Department of Energy
Albuquerque Operations Office
Los Alamos Area Office
Los Alamos, New Mexico 87544

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CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Benito Garcia, Chief
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
2044 Galisteo St., Bldg. A
P. O. Box 26110
Santa Fe, New Mexico 87505

Dear Mr. Garcia:

SUBJECT: LOS ALAMOS NATIONAL LABORATORY'S RESPONSE TO "REQUEST FOR SUPPLEMENTARY INFORMATION ON TA-14 OB/OD UNITS, EPA I.D. NO. NM0890010515"

The purpose of this letter is to provide the New Mexico Environment Department, Hazardous and Radioactive Materials Bureau with two copies of the above captioned response. Please note that a WordPerfect 5.2 disc accompanies one of the copies.

If you have any questions on this matter please contact me at (505) 665-5042.

Sincerely,

H. L. "Jody" Plum
U.S. Department of Energy
Los Alamos Area Office
Environment and Projects Section

cc w/o attachments:

Stuart Dinwiddie, Program Manager
RCRA Permits Management Program
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
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3874

TC

ATTACHMENT A

REQUEST FOR SUPPLEMENTARY INFORMATION:

NOVEMBER 26, 1997

The New Mexico Environment Department (**NMED**) Hazardous and Radioactive Materials Bureau (**HRMB**) has completed review of Los Alamos National Laboratory's (**LANL's**) response to the June 10, 1997 notice of deficiency (**NOD**) on technical adequacy of OB/OD Permit application for TA-14. After reviewing the subject response to the NOD, HRMB has determined that LANL must address the following issues satisfactorily before the application can be declared technically adequate, and a draft permit developed.

NOTE: Quotes in bold print below, are taken directly from the Revised Part B Permit Application text submitted by LANL, dated October 1997:

A. *Sampling and Analysis Plan (SAP) as required by 20 NMAC 4.1.500 incorporating 40 CFR 264.278.*

LANL must provide a stand alone Sampling and Analysis Plan for the post-detonation soil at TA-14. The SAP must include:

1. *a topographic map showing the proposed soil sample locations.*

2. *the proposed vadose zone soil monitoring program, as well as sample collection, sample preservation and shipment, sampling and analysis procedures, and chain of custody control;*

3. *a description of the sampling methods that will be used to obtain discrete representative samples of post-detonation soil to be analyzed. List the parameters that will be analyzed for in each reactive and non-reactive hazardous waste, the rationale for the selection of these parameters and the test methods which will be used for these parameters;*

4. *the parameters selected and the EPA approved or equivalent acceptable analytical methods for each parameter;*

5. *a description of the background values for each proposed monitoring parameter or constituent; and*

6. *a description of the proposed sampling, analysis and statistical comparison procedures to be used in analytical data interpretation.*

Response: A stand alone SAP is being submitted with LANL's response to this Request for Supplementary Information (RSI) (see tab labeled TA-14 OD SAP).

B. *List of Waste Explosives to be Treated at the OB and OD Units:*

Provide a list of waste explosives that will be detonated at TA-14, and a separate list for waste that will be burned at TA-14. This request was not addressed by LANL in response to item #G(2) of the NOD. The subject lists are needed to be consistent with HRMB's requirement, which other facilities have provided to HRMB in recent OB/OD permit applications.

Response: A list of waste explosives that may be detonated at the TA-14 OD unit is presented in Table A-1 of Appendix A of this RSI response. Table A-2 of Appendix A presents a list of waste explosives that may be burned at the TA-14 OB unit.

C. *Ground Water Detection Monitoring Wells:*

1. *Page 4-10, second paragraph, last sentence: ("**Therefore withdrawal rates are not applicable to any of the OB/OD units at LANL**".)*

   Although no production wells are located within 3,500 feet of any of the OB/OD units, HRMB feels that the capture radius of production well PM-5 described in the Hydrogeologic Work Plan of December 1996 may influence and capture groundwater flow in the area of TA-14. LANL must therefore provide an estimate of the capture zone around the production well PM-5.

   Response: The capture zone around PM-5 is principally determined by the extent of the cone of depression surrounding the pumped well. Each cone differs in size and shape depending upon the aquifer characteristics, pumping rate, length of pumping period, slope of the water table, and recharge within the zone of influence of the well. Because some of the aquifer characteristics (e.g., storage coefficient) and the slope of the water table between PM-5 and TA-14 are not well known, a detailed evaluation of the radius of influence of PM-5 has not been performed. Instead, for this scoping analysis, the radius of influence is approximated using simplifying steady-state assumptions and empirical formulations of the governing groundwater flow equations. Recognizing there is uncertainty in the radius of influence approximations, a variety of calculations have been performed to bracket the likely magnitude of the influence (see calculations in Appendix B of this RSI response). (The radius of influence is defined here as the radius of a circle beyond which pumping of a well has no significant effect on the original groundwater level or piezometric surface.)

   The following table summarizes the results of the various estimates of the radius of influence of PM-5 pumping. The PM-5 radius of influence is calculated to range from approximately 200 to 2,000 feet, given uniform homogeneous aquifer conditions. With the TA-14 OB/OD units located approximately 13,500 feet from production well PM-5, it is highly unlikely that any measurable pumping effects from PM-5 will be seen at TA-14.

Estimated Radius of Influence Distance from Production Well PM-5 to the Limit of the Cone of Depression

Method of Calculation[1]	Distance
Thiem steady-state equation for unconfined aquifers (Bouwer 1978)	210 feet
Empirical formula (Bear 1979)	430 feet
Empirical formula (Bear 1979)	2,000 feet
Empirical formula (Departments of the Army, the Navy, and the Air Force 1971)	735 feet

[1]The aquifer characteristic data used in these calculations are taken from PM-5 pump test results reported in Purtymun (1984).

2. *"Section 4.6.1.2 Monitoring and Reporting"*

Provide a topographic map illustrating the location of all wells within a 3 mile radius of TA-14. LANL should code the current and proposed alluvial, intermediate, regional, and Tschicoma-Tshirege perched wells and also illustrate which wells are routinely monitored. Present a monitoring schedule.

Response: Two topographic maps (Maps 6A and 6B) illustrating the locations of wells within an approximate 3-mile radius of TA-14 are provided in Appendix C of this RSI response. Map 6A illustrates the locations of <u>all</u> types of wells within a 3-mile radius (e.g., test wells, moisture access holes, observation wells, monitoring wells, exploratory holes, RFI boreholes, seismic hazard boreholes, core and test wells, special study sites, water balance wells, and water supply wells; as well as proposed alluvial wells, borehole entry points, and regional wells. Existing "wells" on this map are represented with a black cross; proposed "wells" are represented with a solid green circle. To ensure greater legibility, the locations of pertinent wells (i.e., alluvial and regional wells proposed in LANL's "Hydrogeologic Workplan" [LANL, 1996a], environmental surveillance groundwater monitoring wells, and water supply wells) have been extracted from Map 6A and placed on Map 6B. This map also shows the locations of alluvial monitoring wells at TA-16 (just southwest of TA-14). Additionally, it shows the locations of mesatop wells at TA-16 that are completed in the Tshirege member of the Bandelier Tuff; these wells are dry. Existing wells on this map are indicated with a black cross; proposed wells are indicated with a solid green circle. A table listing the existing routinely monitored wells shown on Map 6B and the monitoring schedule for these wells is included in Table D-1 of Appendix D of this RSI response. These maps are provided for informational purposes only. Their incorporation into the permit would be inappropriate due to the potential dynamic nature of proposed well locations.

The anticipated installation sequence for the regional wells proposed in LANL's "Hydrogeologic Workplan" is presented in Table 4-2 of that plan (a copy of this table is

provided in Appendix E of this RSI response). As LANL's understanding of the hydrogeologic setting and contaminant distributions improves over time, additions, deletions, or location changes of some proposed regional wells may occur. A schedule for monitoring any proposed regional wells deemed necessary will be discussed with NMED after installation and initial characterization are completed.

There is no final schedule for installation of the alluvial wells proposed in the "Hydrogeologic Workplan". The wells were proposed in the "Hydrogeologic Workplan" for potential characterization purposes (e.g., to identify the presence of alluvial water, measure alluvial parameters that control infiltration and contaminant migration, analyze the alluvial water quality, provide background water quality characteristics, evaluate possible migration of contaminants, and/or measure saturated thickness). The number of proposed wells may increase or decrease, and the locations of the proposed wells may change, depending on characterization needs. Schedules for installation of these proposed wells will be developed when the RFI Work Plans for various canyons investigations are prepared; monitoring schedules will then be determined and discussed with NMED only after installation and initial characterization are completed, and a determination is made that repetitive monitoring is necessary.

3. *Section 4.6.1.2, first paragraph, third sentence:*

("Routine samples are analyzed for toxic constituents, basic water quality, and resource depletion".)

Provide all the data for the "routine samples" and define the word "routine". How often are the water samples analyzed? Explain whether all the wells are sampled, and for which constituents. List all constituents for which the samples are analyzed.

Response: Routinely monitored (i.e., quarterly, annually, or triennially) existing alluvial zone wells within a 3-mile radius of TA-14 include MCO-4/4B, MCO-4A, MCO-5, MCO-6, MCO-6A, MCO-6B, MCO-7, MCO-7A, MCO-7.5(A), and MCO-8 in Mortandad Canyon; WCO-1 in Water Canyon, CDBO-5, CDBO-6, and CDBO-7 in Cañada del Buey; and LAO-0.7, LAO-1, and LAO-C in Los Alamos Canyon (see Table D-1 in Appendix D of this RSI response). Wells MCO-4A, MCO-6A, WCO-1, CDBO-5, and CDBO-7 are dry. Wells MCO-4/4B, MCO-5, MCO-6, MCO-7, MCO-7.5(A), CDBO-6, LAO-0.7, LAO-1, and LAO-C are monitored and sampled annually for radiochemistry (Cs-137, H-3, Pu-238, Pu-239/240, total U, Am-241, Sr-90, gross alpha, gross beta, and gross gamma); metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, V, and Zn); and general inorganics (SiO2, Ca, Mg, K, Na, CO3, HCO3, PO4, SO4, NO3, CN, TDS, total hardness, TSS, pH, and electrical conductance). They are monitored and sampled triennially for organics (volatiles, semivolatiles, PCBs, HE, and TICs).

Data collected in 1995 are presented in LANL's "Environmental Surveillance at Los Alamos during 1995," Tables 5-16 through 5-20 (LANL, 1996b). Data collected during 1996 are presented in "Environmental Surveillance and Compliance at Los Alamos during 1996," Tables 5-22 through 5-24 and Tables 5-27 and 5-28 (LANL, 1997a). These documents are provided regularly to NMED.

In 1995, EPA requested additional quarterly sampling events for Wells MCO-4/4B, MCO-4A, MCO-6, MCO-6A, MCO-6B, MCO-7, MCO-7A, and WCO-1. Again, Wells MCO-4A, MCO-6A, and WCO-1 were dry. Wells MCO-4/4B, MCO-6, MCO-6B, MCO-7, and MCO-7A were monitored and sampled quarterly in 1995. These samples were analyzed for radiochemistry (Cs-137, H-3, Pu-238, Pu-240, total U, Am-241, Sr-90, gross alpha, gross beta, and gross gamma, and if necessary, Ra-226); metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, Tl, V, and Zn); general inorganics (SiO2, Ca, Mg, K, Na, CO3, HCO3, PO4, SO4, NO3, CN, TDS, total hardness, TSS, pH, and electrical conductance); and organics (volatiles, semivolatiles, the 129 priority pollutants, herbicides, pesticides, PCBs, oils, and solvents). Some of the data from the 1995 quarterly monitoring effort are presented in Tables 5-36 through 5-40 of "Environmental Surveillance at Los Alamos during 1995." All of the 1995 quarterly monitoring data have been compiled in "1995 Analytical Results from Perched Zone Monitoring Wells" (LANL, in prep.), which will be submitted to NMED in early 1998.

Routinely monitored (i.e., annually or triennially) existing intermediate and regional groundwater monitoring wells within a 3-mile radius of TA-14 include TW-2A, DT-5A, DT-9, DT-10, TW-2, TW-4, TW-8, PM-2, PM-4, and PM-5 (see Table D-1 in Appendix D of this RSI response). Wells TW-2A, DT-5A, DT-9, DT-10, TW-2, TW-4, and TW-8 are monitored and sampled annually for radiochemistry and general inorganics; they are sampled triennially for metals and organics. Wells PM-2, PM-4, and PM-5 are monitored and sampled annually for radiochemistry, general inorganics, and metals; they are sampled triennially for organics. Data collected in 1995 are presented in LANL's "Environmental Surveillance at Los Alamos during 1995," Tables 5-16 through 5-20 (LANL, 1996b). Data collected during 1996 are presented in "Environmental Surveillance and Compliance at Los Alamos during 1996," Tables 5-22 through 5-24 and Tables 5-27 and 5-28 (LANL, 1997a). These documents are provided regularly to NMED.

In late 1997, monitoring wells were installed on the mesa at TA-16 and in Cañon de Valle just north of TA-16. The mesatop wells include 16-2661, 16-2662, 16-2663, 16-2664, 16-2665, and 16-2666; the alluvial wells include 16-2655, 16-2656, 16-2657, 16-2658, 16-2659, and 16-2660 (see Table D-1 in Appendix D of this RSI response). Wells 16-2661, 16-2662, 16-2663, 16-2664, 16-2665, and 16-2666 are dry. The recently installed wells will be monitored quarterly and sampled (if not dry and sufficient water is present) for high explosives, total metals, cyanide, and anions. Samples were collected for volatile organic compound (VOC) and semivolatile organic compound (SVOC) analyses during the initial sample collection effort; the data obtained will be evaluated to determine if additional quarterly sampling for VOCs and SVOCs is indicated. Quarterly monitoring data will be presented in the RFI reports for potential release sites 16-021© and 16-003(k).

Groundwater resource monitoring is conducted to document conditions of the water supply wells and the main aquifer. This information is documented in annual reports, which provide detailed records of pumping and water-level measurements. The most recent report is "Water Supply at Los Alamos during 1996" (McLin et al., 1997); these annual reports are provided regularly to NMED.

4. *Page 4-11, paragraphs 2-4 and page 4-12, first paragraph:*

Since the shallow groundwater systems (alluvial and springs) are most likely to be impacted by the OB/OD activities at TA-14, LANL must install alluvial wells A-45, A-46, A-47, and A-48 as part of the detection monitoring requirement of the proposed OB/OD permit.

Response: The text on pages 4-11 and 4-12 of the OB/OD Part B permit application, Revision 1.0 (LANL, 1997b), references LANL's "Hydrogeologic Workplan," which only proposed construction and subsequent sampling of alluvial wells in Cañon de Valle and in Water Canyon. As discussed previously in the response to Comment C.2, these wells were proposed for potential characterization purposes; the number of proposed wells may increase or decrease, and the locations of the proposed wells may change. The wells, if needed for characterization, will be installed as part of the Cañon de Valle work plan; the schedule for installation will be determined during annual discussions with NMED on the "Hydrogeologic Workplan" scope and schedule. Pursuant to NMED's request, the "Hydrogeologic Workplan" was developed as a comprehensive, facility-wide approach rather than a unit by unit program. As such, a requirement to perform unit-specific detection monitoring is inconsistent with NMED's initial direction and the "Hydrogeologic Workplan" as drafted. Any subsequent monitoring that is deemed necessary will be performed following implementation of the "Hydrogeologic Workplan."

The "Baseline Human Health and Ecological Risk Assessment for Technical Area 14" conducted in response to the June 10, 1997, Notice of Deficiency indicated that the current level of surface water and cumulative surface soil contamination does not pose a potential significant risk to human health and that overall ecological risks are expected to be low (see Appendix D of the OB/OD Part B permit application, Revision 1.0, LANL, 1997b). Because over 40 years of OB/OD activities at TA-14 have not resulted in the surface media (i.e., soil, sediments, and/or surface water) posing a significant risk to human health and the environment, it is highly unlikely that the shallow groundwater systems in the vicinity of TA-14 have been impacted by these activities.

EPA has stated that a Subpart F groundwater monitoring program should be established for Subpart X units only if a potential exists to impact groundwater. Otherwise, compliance with requirements that address releases threatening human health and the environment must occur (*52 FR 46858 and 46859*). Because the results of the risk assessment do not indicate a potential for groundwater contamination as a result of OB/OD activities, it is suggested that there is no basis for installation of these proposed alluvial wells at this time.

5. *Page 4-12, second paragraph, the last 2 sentences: ("**Well R-28 will be located downgradient of well R-27. It will also be used to provide water quality information for any intermediate perched zones and the regional aquifer.**")*

The intermediate zone groundwater systems are proposed in the Hydrogeologic Work Plan (of December 1996) to be sampled as they are encountered in drilling to the regional

aquifer. However, HRMB suggests that LANL should first drill and monitor the alluvial wells described under item #4 above, and not drill to the regional aquifer, until such a time when the concentrations of hazardous constituents in the vadose zone water samples from the alluvial wells indicate a potential to impact the regional aquifer.

Response: LANL agrees with NMED's approach to characterization of alluvial groundwater systems. LANL also agrees that drilling to the regional aquifer not be conducted until a potential to impact the regional aquifer is indicated. See response to Comment C.4 above.

6. *Page 4-13, line 17: ("**However, the Hydrogeologic Work Plan described above will provide information on water quality in this area.**")*

   Provide a schedule for well installation/completion at TA-14, and what "information on water quality in this area" will be provided to HRMB. This information should also include the frequency at which the water quality information will be provided and in what format it will be submitted to HRMB.

   Response: The anticipated installation/completion sequence for the regional wells proposed in the "Hydrogeologic Workplan" is presented in Table 4-2 of that plan. A determination on the type of regional water quality information that will be provided to HRMB, the frequency at which the information will be provided, and the format for submittal to HRMB will be made during annual negotiations on the "Hydrogeologic Workplan" scope and schedule. As stated in the response to Comment C.2, the schedule for installation of the proposed alluvial wells will be included in the canyons work plans for the major canyon systems of the area. If it is determined, during preparation of the Cañon de Valle work plan, that any or all of proposed alluvial wells A-45, A-46, A-47, and A-48 are needed for characterization purposes, a schedule for well installation/completion will be developed. The list of analytes will be developed in the appropriate work plans and will initially include metals, radionuclides, VOCs, SVOCs, and HE. Water quality data will include pH, turbidity, temperature, and total dissolved solids. Sampling frequencies will be outlined in the appropriate work plans. Alluvial water quality information will be provided to HRMB as part of canyons investigations reports.

D. *Topographic Map as required by 20 NMAC 4.1.900 incorporating 40 CFR §270.14(b)(19). Resubmit Figures (i.e., Maps) 10-1 through 10-4, showing the location of the OB/OD units and the arroyos around TA-14. This will make it easier for third party review.*

Response: Figure 10-1 has been revised to show the following: the location of the OB unit (SWMU No. 14-005) at TA-14; the location of the OD unit [SWMU No. 14-001(c)] at TA-14; and the locations of the drainages around the units at TA-14. This figure is included in Appendix F of this RSI response.

Figures 10-2, 10-3, and 10-4 show the SWMU locations near the OD units at TAs 15, 36, and 39, respectively. Per a telephone conversation with John Young on December 19, 1997, these figures will be similarly revised, when appropriate.

References

Bear, J., 1979, *Hydraulics of Groundwater*, McGraw-Hill, New York, 569 p.

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Departments of the Army, the Navy, and the Air Force, 1971, "Dewatering and Groundwater Control for Deep Excavations," TM 5-818-5, NAVFAC P-418, AFM 88-5 Chap. 6, April 1971.

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Los Alamos National Laboratory (LANL), 1997a, "Environmental Surveillance and Compliance at Los Alamos during 1996," LA-13343-ENV, September 1997.

Los Alamos National Laboratory (LANL), 1997b, "Part B Permit Application—Open Burning/Open Detonation Units at Technical Areas 14, 15, 36, and 39," Revision 1.0, October 1997.

Los Alamos National Laboratory (LANL), 1996a, "Hydrogeologic Workplan," Draft Revision 1.0, December 6, 1996.

Los Alamos National Laboratory (LANL), 1996b, "Environmental Surveillance at Los Alamos during 1995," LA-13210-ENV, October 1996.

McLin, S., W.D. Purtymun, M.N. Maes, P.A. Longmire, 1997, "Water Supply at Los Alamos during 1996," Los Alamos National Laboratory report, LA-13371-PR, December 1997.

Purtymun, W.D., 1984, "Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Ground Water Supplies," Los Alamos National Laboratory report, LA-9957-MS, January 1984.

POST-DETONATION SOIL SAMPLING AND ANALYSIS PLAN FOR THE OPEN DETONATION UNIT AT TECHNICAL AREA 14

February 1998

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
CFR	Code of Federal Regulations
CST-9	Chemical Science and Technology Division's Inorganic Trace Analysis Group
DOT	U.S. Department of Transportation
DX-2	Dynamic Experimentation Division's High Explosives Science and Technology Group
EPA	U.S. Environmental Protection Agency
ESH-19	Environment Safety and Health Division's Hazardous and Solid Waste Group
HE	high explosives
LANL	Los Alamos National Laboratory
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OD	open detonation
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SW-846	"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"
TA	technical area
VOC	volatile organic compound

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) describes the procedures for collecting representative post-detonation soil samples at the Los Alamos National Laboratory (LANL) Technical Area (TA) 14 open detonation (OD) thermal treatment unit. The post-detonation soil samples will be collected as part of the proposed TA-14 OD Soil Monitoring Program to ensure that any hazardous wastes or residues present in the soil following treatment do not pose a significant risk to human health or the environment.

The TA-14 OD Soil Monitoring Program requires one soil sampling effort the first year of the program. Analytical data collected from this sampling effort will then be used as additional input to the baseline risk assessment already conducted for the site (see Appendix D of the OD Part B Permit Application, Revision 1.0 [LANL, 1997a]). This baseline risk assessment concludes that, after 40 years of operations at TA-14, the current level of contaminants for both surface soil and surface water does not pose a potential significant risk to human health. In addition, the overall ecological risks at the site are expected to be low. The soil sampling/risk assessment approach meets the monitoring and analysis requirements of 20 NMAC 4.1.500 incorporating 40 CFR 264.602 and will ensure protection of human health and the environment. After the samples have been analyzed and the additional risk assessment is conducted, LANL proposes to address with the New Mexico Environment Department (NMED) a reasonable schedule for potential additional activities using the risk assessment approach for the Soil Monitoring Program.

For post-detonation soil sampling, 6 discrete (noncomposited), representative soil samples will be collected from the OD treatment unit area during a single sampling effort the first year of the proposed Soil Monitoring Program. One sample will be collected from approximately the center of the OD area and 4 equally spaced samples will be collected along a circle with a radius of approximately 100 feet from the center of the OD area (for a total of 5 samples) (see Figure 1-1). A duplicate soil sample will be collected from 1 of the 5 locations, for a total of 6 soil samples for the OD area.

Vadose zone sampling and monitoring is not anticipated at the TA-14 OD unit. Previous hydrogeologic studies at LANL ("Hydrogeologic Assessment of Technical Area 54, Areas G and L" [LANL, 1987]) have shown that the combination of very low moisture content in the Bandelier Tuff, the empirical determination that moisture from precipitation does not infiltrate below a depth of 10 to 22 feet, and very low calculated flux rates all indicate that aqueous transport of contaminants through the tuff is not a viable mechanism for

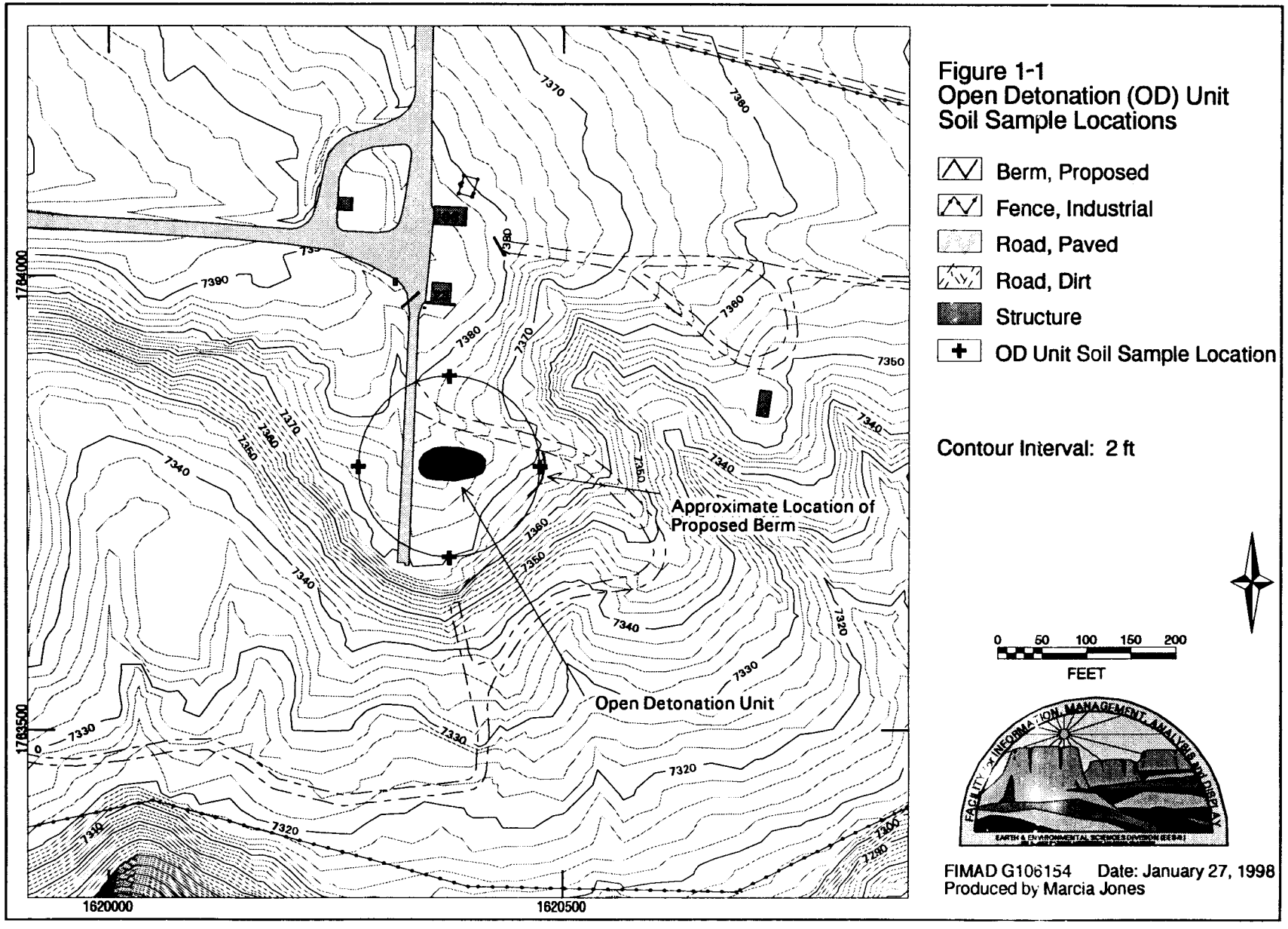

Figure 1-1
Open Detonation (OD) Unit
Soil Sample Locations

contaminant migration from mesa tops. In addition, the "RFI Work Plan for Operable Unit 1085" (LANL, 1994), which includes TA-14, does not consider the vadose zone to be a major exposure pathway for contaminant transport; the major pathways discussed therein include surface water runoff and soil/sediments in surrounding drainages. Furthermore, the risk assessment conducted for the TA-14 OB/OD units (see Appendix D of the OB/OD Part B Permit Application, Revision 1.0 [LANL, 1997a]) concludes that after 40 years of operations at TA-14, the current level of contaminants for both surface soil and surface water does not pose a threat to human health. Therefore, rather than conducting vadose zone sampling for the OD unit at TA-14, LANL proposes to first address surface systems (surface water, soil, and sediments) and use resulting surface systems analytical data in conjunction with existing data in an iterative manner and to conduct additional risk assessments to evaluate additional data needs, if any, and thus optimize characterization and monitoring activities. Vadose zone sampling would then be conducted only if the results of the additional risk assessments indicate a need. If surface sampling data indicate that Resource Conservation and Recovery Act (RCRA) contaminants resulting from OD treatment are present and the risk assessment indicates a threat to human health or the environment, vadose zone sampling may then be conducted using the methods described in this SAP.

2.0 QUALITY ASSURANCE

The overall objective of quality assurance (QA) is to ensure precision, accuracy, representativeness, comparability, and completeness of measurements. All of these QA parameters are essential components of the proposed TA-14 OD Soil Monitoring Program. Field duplicate and quality control (QC) samples will be collected, as appropriate, to evaluate the quantitative QA parameters of precision and accuracy.

Records management is also an essential QA component of the proposed Soil Monitoring Program. All field and laboratory records generated by the sampling and analysis activities will be maintained to document that these activities were conducted in accordance with this SAP.

2.1 Field Duplicate and QC Samples

Field duplicate and QC samples are collected in the field to verify reproducibility of analytical data, and to determine whether extraneous contaminants may have been introduced as a result of sampling or handling procedures. QC samples are also used as part of the analytical laboratory's QA/QC program. Field duplicate and QC samples are described below.

- *Duplicate Samples* - Duplicate samples are collected to monitor sample variability, determine total random error, and verify reproducibility of the analytical data. These collocated samples will be collected simultaneously from the same soil source under identical sampling conditions. Duplicates will be collected at a frequency of 1 per 20 samples per matrix. They will be labeled with a sequential number similar to the soil samples, and designated as duplicate samples in the field logbook.

- *Trip Blank* - Trip blanks are required only when samples are collected for volatile organic compound (VOC) analysis and at a frequency of 1 per VOC shipment cooler. Trip blanks accompany personnel during the sampling effort and accompany collected samples to the laboratory. The trip blank is used to assess any contamination attributable to field handling and shipping procedures. Sampling personnel will label the trip blank with a sequential number similar to the soil samples and designate it as a trip blank in the field logbook.

- *Equipment Rinsate Blank* - Equipment rinsate blanks monitor sampling device decontamination effectiveness and potential for sample cross-contamination that may result from inadequate cleaning procedures. These samples are collected by pouring deionized water over the equipment surface that contacts the sample (after it has been decontaminated) and collecting the rinsate in a sample container. Equipment rinsate blanks will be labeled with sequential numbers similar to soil samples and designated as equipment rinsate blanks in the field logbook. Sample frequency is 1 per 20 field samples.

- *Field Blank* - Field blanks are collected to monitor sampling procedures and ambient conditions at the site, and to evaluate the cleanliness of the precleaned sample bottles. Deionized water is poured into sample containers in the immediate area where the field sample is collected and then preserved, as necessary. Field blanks are collected at a frequency of 1 per 20 field samples per matrix. The

field blank must be labeled with a sequential number similar to the soil samples and designated as a field blank in the field logbook.

2.2 Records Management

Sampling personnel will complete and maintain records to document sampling and analysis activities. These records also demonstrate proper implementation of this plan and ensure that the analytical results can be traced back to the soil that was sampled. Records pertinent to the proposed Soil Monitoring Program include all field and laboratory records generated by the activities performed in accordance with this plan and are listed below.

- Request for Analysis Log.
- "Presampling Questionnaire and Site-Specific Safety Plan."
- Field logbook.
- Chain-of-Custody Record.
- Shipping papers for samples.
- Analytical results reports.
- Discrepancy and corrective action reports.
- Sampling equipment maintenance and calibration forms.
- Written requests and approvals for any temporary modifications to sample collection procedures.

Sampling personnel must make all entries on all records with indelible blue or black ink. All entries should be legible and succinct. Sampling personnel must ensure that the records are identifiable, retrievable, and protected against damage, deterioration, and loss. Access to records must be controlled. Personnel making changes to any record should do so by drawing a single line through the original information, writing the correct information adjacent to the original information, and initialing and dating the change.

2.2.1 Request for Analysis Log

Sampling personnel will use the Request for Analysis Log to track individual sampling efforts and will maintain completed logs. Information provided on the Request for Analysis Log includes the requestor name and group, the requested sample date, the date sampling personnel contacted the requestor to complete the "Presampling Questionnaire and Site-Specific Safety Plan," sample collection date, remarks, results receipt date, and sampler's initials.

2.2.2 Presampling Questionnaire and Site-Specific Safety Plan

Sampling personnel preparing for the initial sampling effort must ensure that a "Presampling Questionnaire and Site-Specific Safety Plan" is prepared and completed. Information required on the Presampling

Questionnaire includes the material to be sampled, the site, and the work area; special hazards of concern; personal protective equipment (PPE) to be worn; emergency evacuation routes and safety equipment locations; and important telephone numbers. Before sampling is conducted, all personnel involved with the sampling effort must sign the form, certifying that they have reviewed the information. The "Presampling Questionnaire and Site-Specific Safety Plan" is described in detail in the "ESH-19 Sampling Plan" (LANL, 1995).

2.2.3 Field Logbook

The field logbook is a bound notebook containing all information pertinent to the sampling operation. The field logbook remains in the custody of sampling personnel at all times. During sampling activities, personnel document the following information in the field logbook:

- Sampling date and time.
- Cost code, program code, and cost account.
- Project name and location.
- Collector's name(s).
- Possible sample hazards.
- Personnel involved.
- Weather conditions.
- Unique sample number(s).
- Sample type(s) and volume(s).
- Analysis requested.
- Remarks (see below).
  - Field observations and measurements
  - Deviations from or anomalies in the sampling procedures
  - Lot number and expiration date of preservatives (if applicable)
  - Preservation method used (if applicable)
  - Sample characteristics (category, matrix, homogenous/heterogeneous, solid/liquid)
  - Sample container(s) and sampling equipment
  - Sample point location(s)
  - Sampling strategy
  - Sample identification (e.g., duplicate, field blank)
  - Other pertinent information.

Sample numbers include the year the sample was taken and the sampler's initials followed by a sequential number that distinguishes individual samples. Sampling personnel record only a single sampling effort per page in the field logbook, and draw a diagonal line through any blank space(s) at the bottom of a page.

2.2.4 Chain-of-Custody Record

Whenever sampling personnel relinquish custody of a sample(s) (e.g., to analytical personnel), the person relinquishing the sample must complete the required information on a Chain-of-Custody Record. This record allows the sample to be tracked throughout the analytical process, assuring control over tracking of the sample and its corresponding analytical results. This tracking is a vital aspect of QA. Sampling personnel maintain a copy of the signed Chain-of-Custody Record.

The Chain-of-Custody Record includes the following information:

- Project name.
- Names of sampling personnel.
- Date and time of sample shipment/transfer.
- Sample type(s) (composite, grab).
- Sampling site (station) location(s).
- Unique sample number for each sample being transferred.
- Number of containers.
- Requested analyses.
- Sample label number.
- Signature of person relinquishing the sample(s).
- Date and time the sample(s) is relinquished.
- Signature of person receiving the sample(s).
- Any additional remarks.

2.2.5 Shipping Papers

Samples to be collected as part of the proposed TA-14 OD Soil Monitoring Program and then transported to an analytical laboratory are exempt from regulation as hazardous waste [40 CFR 261.4(d)]. In such cases, these samples are also exempt from U.S. Department of Transportation (DOT) regulations. Sampling personnel will fill out a transportation form prior to transportation or shipment of samples. The form will document the following:

- name and address of analytical laboratory.
- name and phone number of personnel shipping the samples.
- name of transportation company.
- type of media (e.g., soil, liquid).
- number of sample containers.
- total volume of samples.

2.2.6 Analytical Results Reports

Analytical personnel will generate a report of the analytical results for each sample submitted by sampling personnel. The following information must be included in each report:

- Analytical request number.
- Unique sample number (provided by sample collector).
- Unique sample number assigned by the analytical laboratory (if applicable).
- Date the sample was received by analytical personnel.
- Date of analysis.
- Name of the analyst (or initials).
- Analytical parameters requested.
- Analytical results for each parameter.
- Analytical methods used for each parameter.
- Data from QC samples (e.g., replicates, matrix spikes, and surrogates) introduced by the analytical laboratory into the sample analysis stream.

Sampling personnel may compare the analytical reports to the field logbook to identify cross contamination, blank contamination, or other discrepancies. Sampling personnel may then make appropriate entries on the Request for Analysis Log (see Section 2.2.1)

2.2.7 Discrepancy and Corrective Action Reports

If sampling personnel note significant deficiencies or discrepancies while collecting samples or reviewing the analytical results, a report will be prepared describing the deficiencies or discrepancies and the action required for correction. The report should also describe how the deficiency or discrepancy was identified, person(s) responsible for correcting the discrepancy, and a recommended schedule for and type of corrective action necessary.

3.0 SAMPLING PROCEDURES

This section describes activities that sampling personnel should perform before, during, and after a sampling effort conducted as part of the proposed TA-14 OD Soil Monitoring Program. The instructions in this section provide general information about sample collection, preservation, packaging, and shipping. Following these instructions will ensure that the collected samples are representative, thus providing scientifically valid and legally defensible analytical data.

3.1 Presampling Activities

Field preparation includes organizing sample container(s), sample label(s), and documentation in an orderly, systematic manner that will promote consistency and traceability of all data. Sampling personnel should perform the following activities before each sampling effort.

- Identify the sampling team.
- Consult analytical personnel for guidance on sample containers, preservatives, and holding times.
- Complete a "Presampling Questionnaire and Site-Specific Safety Plan" for the initial sampling effort (see the "ESH-19 Sampling Plan").
- Review and discuss specific plans, safety issues and considerations, procedures, and QA/QC concerns applicable to the sampling effort.
- Assemble sample containers, labels, integrity seals, and Chain-of-Custody Records.
- Prepare equipment and supplies.

Immediately preceding the sampling effort, sampling personnel and any site personnel involved in sampling operations must attend a safety briefing, during which they review the "Presampling Questionnaire and Site-Specific Safety Plan." Sampling personnel must wear PPE noted on the "Presampling Questionnaire and Site-Specific Safety Plan."

3.2 Sampling Activities

Sampling personnel will collect, label, preserve (as appropriate), package, store, and transport the samples to enable holding times to be met. Throughout this process, sampling personnel will document chain-of-custody for the samples using the Chain-of-Custody Record. Sampling personnel will record all pertinent information (e.g., date, time, site, sample location) in a field logbook.

The spade and scoop method will be used by LANL personnel collecting surface soil samples. Samples will be collected from the locations shown on Figure 1-1. Sample containers will be labeled with the date, time, exact sampling location, and the name of the individual collecting the sample. For each sampling effort, a duplicate soil sample will be collected from one of the sample locations and analyzed to assess QC. The duplicate soil sample will be collected and handled in the same manner as the soil samples. In addition, a field blank will be collected for each sampling effort. Following the collection of each sample, used disposable sampling equipment will be containerized and stored appropriately, pending receipt of analytical results. Equipment rinsate blanks will be collected only if vadose zone sampling is conducted.

Following each sampling effort, LANL personnel will transport the field and QC samples to LANL's High Explosives Science and Technology Group (DX-2) for high explosives (HE) analysis, and to LANL's Inorganic Trace Analysis Group (CST-9) for metals analysis or, if necessary, will arrange for transport to and analysis at a LANL-approved off-site analytical laboratory. Samples will be transported to the respective analytical laboratories in a timely manner to ensure that sample holding times specified in the U.S. Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (*SW-846*) (EPA, 1986) are met. In addition, samples will be preserved, as appropriate, as specified in *SW-846*. At the time of sample collection, sampling personnel will complete Chain-of-Custody Records and will place integrity tape on all sample containers to ensure that sample custody is maintained and sample integrity is not compromised. Sample collection personnel will maintain physical custody of the samples until the samples are relinquished to analytical laboratory personnel or to the shipping representative. Upon receiving the soil samples, the laboratory technician or shipping representative will assume custody of the samples, noting the date, time, and name of the person relinquishing custody. All samples will be analyzed using *SW-846* methods or similar NMED-approved methods for the parameters described in Section 4.0 of this SAP. Step-by-step sampling procedures for collecting surface and subsurface soil samples are provided in the following sections.

3.2.1 Sampling Surface Soil Using Spade and Scoop Method

Surface and near surface soil samples will be collected using a nonfriction-type spade, scoop, or trowel. Preservation will be achieved by cooling the samples to 4 degrees Celsius (°C). Sampling will be performed as follows:

- Review health and safety concerns.
- Don PPE.
- Clear any surface debris (e.g., twigs, rocks) from the area to be sampled.

- Using a precleaned, disposable scoop or trowel, carefully collect a sample from the 0-3 inch depth with the scoop or trowel.
- Remove the sample container cap. Take extreme care to avoid contaminating the containers and caps.
- Transfer the sample into an appropriate sample container.
- Cap the sample container.
- Attach the integrity seal and the completed self-adhesive sample label.
- Refrigerate the sample in an insulated cooler.
- Record pertinent information in the field logbook.
- Complete the sample analysis request log and Chain-of-Custody Record.
- Collect a duplicate sample following the steps outlined above.
- Prepare the field QA/QC samples (see Section 2.1 of this plan).
- Place spade and scoop in an approved waste container.
- Doff PPE and place in an approved waste container.

3.2.2 Sampling Subsurface Soil with Hand Auger and Thin-Walled Sampler

Subsurface (i.e., vadose zone) sampling will be conducted only if the results of future risk assessments indicate the need. Subsurface soil samples may be collected with a hand auger and thin-walled sampler, which can be used in a wide variety of soil conditions. This system can be used to sample to a depth of 6 feet. The presence of rock layers and collapse of any borehole precludes sampling at depths greater than 6 feet. Preservation of soil samples will be achieved by cooling the samples to 4°C. Sampling will be performed as follows:

- Review health and safety concerns.
- Don PPE.
- Clear any surface debris (e.g., twigs, rocks) from the area to be sampled.
- Begin drilling, periodically removing accumulated soils.
- After reaching desired depth, slowly and carefully remove the auger from the boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring, transfer it into

a sample container, and cap the sample container.

- Remove auger tip from drill rods and replace with a precleaned, decontaminated, thin-walled corer. Install the proper cutting tip.
- Carefully lower the corer down the borehole, being careful not to scrape soil from the sides of the borehole that will fall into the bottom of the borehole. Gradually force the corer into the soil. Avoid hammering the drill rods to facilitate coring because the vibrations may cause the boring walls to collapse.
- Remove the tube sampler and unscrew the drill rods.
- Remove the cutting tip and remove the core from the sampling device.
- Discard the top inch (approximately) of the core which contains any material collected by the tube sampler before it penetrated the layer to be sampled.
- Remove the sample container cap. Take extreme care to avoid contaminating the containers and caps.
- Place the remaining core in a sample container.
- Cap the sample container.
- Attach the integrity seal and the completed self-adhesive sample label.
- Refrigerate the sample in an insulated cooler.
- Record information in the field logbook.
- Complete the sample analysis request log and Chain-of-Custody Record.
- Collect a duplicate sample following the steps outlined above.
- Prepare the field QA/QC samples (see Section 2.1 of this plan).
- Clean and decontaminate the sampler after each use and between sampling locations.
- Place decontamination rinsate and waste in appropriate containers.
- Doff PPE and place in an approved waste container.

3.3 Post-Sampling Activities

Sampling personnel will verify that all sample containers have been correctly identified and that the labels indicate the sample number, preservatives (if any), date, and time. In addition, sampling personnel will check label information against information recorded in the field logbook. Custody of filled sample containers (with

integrity seal affixed) must be maintained by sampling personnel by keeping the containers (or the cooler[s]) in their possession, within view, locked or sealed to prevent tampering, or in an area under lock and key with controlled access. Sampling personnel will also prepare samples for transport to analytical facilities (see Section 2.2.5). Finally, sampling personnel must ensure that used, containerized sampling equipment and PPE are transported to and stored in an approved waste storage area.

4.0 ANALYTICAL DESIGN, PARAMETERS, AND METHODS

This section describes the analytical parameters, the rationale for parameter selection, and the analytical methods to be used for the samples collected as part of the proposed TA-14 OD Soil Monitoring Program. Also included in this section is information on the background values of the constituents of concern, statistical comparison procedures that may be used to evaluate the data obtained, and how the risk assessment approach will be used for the Soil Monitoring Program.

4.1 Parameters, Test Methods, and Rationale

Analytical parameters, rationale for parameter selection, and EPA *SW-846* test methods for soil samples collected as part of the proposed TA-14 OD Soil Monitoring Program are presented in Table 4-1.

Table 4-1
Selected Parameters, Rationale, and Test Methods

General Chemical Class	Parameter	EPA Hazardous Waste No.	Rationale for Parameter Selection	*SW-846* Test Method[a]
Explosives	HMX[b]	D003	Determine the presence of HE waste residues	8330
	RDX[c]	D003	Determine the presence of HE waste residues	8330
	1,3,5-TNB[d]	D003	Determine the presence of HE waste residues	8330
	1,3-DNB[e]	D003	Determine the presence of HE waste residues	8330
	Tetryl[f]	D003	Determine the presence of HE waste residues	8330
	NB[g]	D003	Determine the presence of HE waste residues	8330
	2,4,6-TNT[h]	D003	Determine the presence of HE waste residues	8330
	4-Am-DNT[i]	D003	Determine the presence of HE waste residues	8330
	2-Am-DNT[j]	D003	Determine the presence of HE waste residues	8330
	2,4-DNT[k]	D003	Determine the presence of HE waste residues	8330
	2,6-DNT	D003	Determine the presence of HE waste residues	8330

Table 4-1 (Continued)

Selected Parameters, Rationale, and Test Methods

General Chemical Class	Parameter	EPA Hazardous Waste No.	Rationale for Parameter Selection	*SW-846* Test Method[a]
	2-NT[l]	D003	Determine the presence of HE waste residues	8330
	3-NT	D003	Determine the presence of HE waste residues	8330
	4-NT	D003	Determine the presence of HE waste residues	8330
Metals	Barium	D005	Determine the presence of barium metal associated with the HE-contaminated waste treated at the OD unit	7081
	Chromium	D007	Determine the presence of chromium metal which may originate from detonator caps used in OD waste treatment process	7191

a U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.
b Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
c Hexahydro-1,3,5-trinitro-1,3,5-triazine
d TNB = trinitrobenzene
e DNB = dinitrobenzene
f Methyl-2,4,6-trinitrophenylnitramine
g NB = nitrobenzene
h TNT = trinitrotoluene
i 4-Amino-2,6-dinitrotoluene
j 2-Amino-4,6-dinitrotoluene
k DNT = dinitrotoluene
l NT = nitrotoluene

4.2 Determination of Background Values

Because HE is not naturally occurring, background values will likely be below instrument detection limits. The background concentrations of the metals proposed for monitoring (barium [from the HE] and chromium [from the detonator caps]) were estimated using data collected as part of LANL's Environmental Surveillance Program; these existing data include a number of on-site (i.e., within LANL boundaries) and off-site perimeter (i.e., within approximately 5 kilometers of LANL boundaries) sample locations. The values given in Table 4-2 represent the average concentrations of samples collected at the 22 on-site and off-site perimeter locations during 1996. Background data will be used to calculate a background mean and variance, per the guidance in Appendix IV of 20 NMAC 4.1, Subpart V, incorporating 40 CFR 264.

Table 4-2

Average Background Concentrations for Selected Metals[a]

Element	Average Background Concentration (parts per million)
Barium	95
Chromium	6.9

[a] Source: *Environmental Surveillance and Compliance at Los Alamos During 1996*, 1997, Los Alamos National Laboratory.

4.3 Statistical Comparison Procedures and Additional Risk Assessments

Statistical analysis of analytical data may be performed using Cochran's Approximation to the Behrens-Fisher Students' t-test in Appendix IV of 20 NMAC 4.1, Subpart V, incorporating 40 CFR 264. This method of statistical analysis may be performed by LANL to identify statistically significant differences between the monitoring data and background data.

Sampling and analysis data will be used to perform an additional risk assessment, which will determine if any hazardous wastes or resides present in the soil pose a significant risk to human health or the environment. LANL will then address with NMED a reasonable schedule for potential additional activities using the risk assessment approach for the Soil Monitoring Program.

5.0 REFERENCES

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Appendix A

Waste Explosives Detonated and Burned at Technical Area 14

Table A-1

Waste Explosives That May Be Detonated at the TA-14 OD Unit

Explosives	Other Names, Compositions, or Reference
AN	Ammonium nitrate
DATB	Diaminotrinitrobenzene
DINGU	Dinitroglycoluril
DINA	Di(nitroethyl) nitramine, Dioxyethyl dinitrate
EDNA	Ethylenedinitramine. Halite
HMX	Cyclotetramethylenetetranitramine, Octogen
LAX-112	Bis-diaminotetrazine N-oxide
NQ	Nitroguanidine, Picrite
NTO	1,2,4-Nitro-tiazole-5-one
PETN	Pentaerythritoltetranitrate
Picric Acid	1,3,5-Trinitrophenol Note: Picric acid forms impact-sensitive compounds with metal ions.
RDX	Cyclo-1,3,5-trimethylene-2,4,6-trinitramine; Hexogen, Cyclonite
TATB	1,3,5-Triamino-2,4,6-trinitrobenzene
Tetryl	2,4,5-Trinitrophenylmethylnitramine
HNS	Hexanitrostilbene
TNT	2,4,6-Trinitrotoluene; Trotyl
FEFO	1,1'[Methylene bis(oxy)]bis[2-fluoro-2,2-dinitroethane]
NM	Nitromethane
ANFO	Ammonium nitrate/fuel oil
Boracitol	60 wt% Boric acid/40 wt% TNT
Baratol	76 wt% Barium nitrate/24 wt% TNT
Calcitol	40 wt% TNT/55-60 wt% $CaCO_3$/0-2 wt% Talc/1-2 wt% Microballoons, X-0533
CH-6	97.5 wt% RDX/1.5 wt% Calcium stearate/0.5 wt% Polyisobutylene/ 0.5 wt% Graphite
Comp. A	91 wt% RDX/9 wt% Beeswax
Comp. A-2	91 wt% RDX/9 wt% Synthetic wax
Comp. A-3	9085, 91 wt% RDX/9 wt% Beeswax
Comp. A-4	97 wt% RDX/3 wt% Beeswax
Comp. A-5	98.5 wt% RDX/1.5 wt% Beeswax
Comp. B	64 wt% RDX/36 wt% TNT, Comp B, Hexolite, Hexotol

Table A-1 (continued)

Waste Explosives That May Be Detonated at the TA-14 OD Unit

Explosives	Other Names, Compositions, or Reference
Comp. B-3	60 wt% RDX/40 wt% TNT
Comp. C-3	9080, 88 wt% RDX/12 wt% Wax
Comp. C-4	9081, 91 wt% RDX/2.1 wt% Polyisobutylene/1.6 wt% Motor oil/5.3 wt% Di(2-ethylhexyl) sebacate
Cyclotol 75/25	75 wt% RDX/25 wt% TNT
Cyclotol 70/30	70 wt% RDX/30 wt% TNT
Detasheet C	63 wt% PETN/8 wt% NC/29 wt% Elastomeric binder
Detasheet D	75 wt% PETN/25 wt% Elastomeric binder Note: This material is usually red, but it is an explosive, not an inert material.
EDC-8	76.0 wt% PETN/24.0 wt% RTV Silicone
EDC-28	94 wt% RDX/6 wt% FPC 461
EDC-32	85 wt% HMX/15 wt% Viton A
EDC-37	91 wt% HMX/1 wt% Nitrocellulose/8 wt% K-10 Liquid
EDC-38	94.5 wt% HMX/3.5 wt% K-10 Liquid/2 wt% Polyurethane
HBX-1	40 wt% RDX/38 wt% TNT/17 wt% Al/4.5 wt% Wax/0.5 wt% $CaCl_2$
LX-04	85.5 wt% HMX/15.0 wt% Viton A
LX-07	90 wt% HMX/10 wt% Viton A
LX-10	95.0 wt% HMX/5.0 wt% Viton A
LX-14	95.5 wt% HMX/4.5 wt% Estane 5702-F1 (X-0282)
MDF	Mild Detonating Fuse
Nonel	RDX-Lined Metal Tubing
Octogen	94.5 wt% HMX/4.5 wt% Wax/1 wt% Graphite
Octol	75 wt% HMX/25 wt% TNT
PBX 9001	90 wt% RDX/8.5 wt% Polystyrene/1.5 wt% Dioctyl phthalate
PBX 9007	90 wt% RDX/9.1 wt% Polystyrene/0.5 wt% Dioctyl phthalate/0.4 wt% Resin
PBX 9010	90 wt% RDX/10 wt% Kel-F 3700 Elastomer
PBX 9011	90 wt% HMX/10 wt% Estane-5703 F-1
PBX 9205	92 wt% RDX/6 wt% Polystyrene/2 wt% Dioctyl phthalate
PBX 9206	92 wt% HMX/8 wt% Kel-F 3700 Elastomer
PBX 9404	94 wt% HMX/3 wt% NC/3 wt% Tris(b-chloroethyl) phosphate Note: PBX-9404 is unusually sensitive to certain types of impact, in particular, skidding.

Table A-1 (continued)

Waste Explosives That May Be Detonated at the TA-14 OD Unit

Explosives	Other Names, Compositions, or Reference
PBX 9401	94.2 wt% RDX/3.6 wt% Polystyrene/2.2 wt% Trioctyl phosphate
PBX 9405	93.7 wt% HMX/3.15 wt% Nitrocelulose/3.15 wt% Tricloroethyl phosphate
PBX 9407	94 wt% RDX/6 wt% Exon-461
PBX 9501	95 wt% HMX/2.5 wt% Estane/2.5 wt% BDNPA or BDNPF, X-0242
PBX 9502	95 wt% TATB/5 wt% Kel-F 800, X-0290
PBX 9503	80 wt% TATB, superfine/15 wt% HMX/5 wt% Kel-F 800, X-0351
PBXN-5	See LX-10
PBXN-9	92 wt% HMX, 2 wt% Hycar 4454 (Hytemp 4454), 6 wt% Dioctyl Adipate (DOA)
PBXN-110	88 wt% HMX/5.4 wt% Polybutadiene/5 wt% Isodecyl pelargonate
PBXW-113	See PBX N110
Primacord	Assorted PETN & RDX Loaded Commercial Detonating Fuse
Pentolite	50 wt% PETN/50 wt% TNT
Tritonal	80 wt% TNT/20 wt% Aluminum powder
X-0208	See XTX-8004
X-0233	5-40 wt% HMX; 40-95 wt% Tungsten, 0-10 wt% Polystyrene, 0-5 wt% Plasticizer
X-0242	See PBX 9501
X-0282	See LX-14
X-0290	See PBX 9502
X-0309	75% TNT, 19% Aluminum powder, 5% D-2 Wax, 1% Acetylene black (carbon)
X-0351	See PBX 9503
X-0407	69.8 wt% TATB/25.0 wt% PETN/0.2 wt% Dye/5 wt% Kel-F 800
X-0533	See Calcitol
X-0534	50 wt% TNT/16-24 wt% $CaCO_3$/25-33 wt% Talc/1-2 wt% Microballoons
XTX-8003	80 wt% PETN/20 wt% Sylgard 182
XTX-8004	80 wt% RDX/20 wt% Sylgard 182, Formerly X-0208
Black powder	Standard commercial and military grades only; 74 wt% Potassium nitrate/15.6 wt% Charcoal/10.4 wt% Sulfur
Benite	Black powder based mixture

Table A-1 (continued)

Waste Explosives That May Be Detonated at the TA-14 OD Unit

Explosives	Other Names, Compositions, or Reference
Commercial sporting	Any commercially available smokeless gun propellant for sport use is approved.
HARP-1,-2	HARP propellants are Al/AP/HMX composites.
HELP-1,-2	HELP propellants are NC/NG/HMX composites.
Smokeless Powder Single, Double, or Triple Base	Standard military grades. Military research explosives are specifically not included.
VTP 25540	HMX based High Energy Propellant
Liquid Gun Propellant LGP 1846	DX-11 SOP:15-11-4.20, "LGP 1846, TA-36-3"
3E-1 Detonator	3 E-1 SWP
Al-ANFO	Ammonium nitrate/Fuel oil/Aluminum powder
BDNPA	Bis(dinitropropyl) acetal
BDNPF	Bis(dinitropropyl) formal
BTX	5,7-Dinitro-1-picrylbenzotriazole (transportation only)
DNPA	2,2-Dinitropropyl acrylate polymer
DNT	Dinitrotoluene
HBX-1	40 wt% RDX/38 wt% TNT/17 wt% Al/5 wt% Wax/0.5 wt% $CaCl_2$
Methane/Oxygen	Explosive mixtures of methane and oxygen gases
NC	Nitrocellulose
PYX	2,6-Bis(picrylamino)-3,5-dinitropyridine
STRATABLAST C	Storage and transportation only
TAGN	Triaminoguanadine nitrate
TAL-1005E	Storage and transportation only
TNS	Trinitrostilbene
TNT/NC	80 wt% TNT/20 wt% NC
TPM	Tripicryl malamine
DAAF	Diaminoazoxyfurazan (residuals only)
BATTZ	Bisaminotetrazolyltetrazine (residuals only)
TNAZ	Trinitroazetidine (residuals only)

Sources: DX-4: SOP 3, "General Safety," Attachment 1, HE Routinely Used at DX Division Firing Areas, July 1996; DX personnel.

Note: Additional types of explosives may be developed and used and the wastes subsequently detonated at the OD unit.

Table A-2

Waste Explosives That May Be Burned at the TA-14 OB Unit

Explosives	Other Names, Compositions, or Reference
AN	Ammonium nitrate
DATB	Diaminotrinitrobenzene
DINGU	Dinitroglycoluril
DINA	Di(nitroethyl) nitramine, Dioxyethyl dinitrate
EDNA	Ethylenedinitramine, Halite
HMX	Cyclotetramethylenetetranitramine, Octogen
LAX-112	B[illegible]-diaminotetrazine N-oxide
NQ	Nitroguanidine, Picrite
NTO	1,2,4-Nitro-tiazole-5-one
PETN	Pentaerythritoltetranitrate
Picric Acid	1,3,5-Trinitrophenol Note: Picric acid forms impact-sensitive compounds with metal ions.
RDX	Cyclo-1,3,5-trimethylene-2,4,6-trinitramine; Hexogen, Cyclonite
TATB	1,3,5-Triamino-2,4,6-trinitrobenzene
Tetryl	2,4,5-Trinitrophenylmethylnitramine
HNS	Hexanitrostilbene
TNT	2,4,6-Trinitrotoluene; Trotyl
FEFO	1,1'[Methylene bis(oxy)]bis[2-fluoro-2,2-dinitroethane]
NM	Nitromethane
ANFO	Ammonium nitrate/fuel oil
Boracitol	60 wt% Boric acid/40 wt% TNT
Baratol	76 wt% Barium nitrate/24 wt% TNT
Calcitol	40 wt% TNT/55-60 wt% $CaCO_3$/0-2 wt% Talc/1-2 wt% Microballoons, X-0533
CH-6	97.5 wt% RDX/1.5 wt% Calcium stearate/0.5 wt% Polyisobutylene/ 0.5 wt% Graphite
Comp. A	91 wt% RDX/9 wt% Beeswax
Comp. A-2	91 wt% RDX/9 wt% Synthetic wax
Comp. A-3	9085, 91 wt% RDX/9 wt% Beeswax
Comp. A-4	97 wt% RDX/3 wt% Beeswax
Comp. A-5	98.5 wt% RDX/1.5 wt% Beeswax
Comp. B	64 wt% RDX/36 wt% TNT, Comp B, Hexolite, Hexotol

Table A-2 (continued)

Waste Explosives That May Be Burned at the TA-14 OB Unit

Explosives	Other Names, Compositions, or Reference
Comp. B-3	60 wt% RDX/40 wt% TNT
Comp. C-3	9080, 88 wt% RDX/12 wt% Wax
Comp. C-4	9081, 91 wt% RDX/2.1 wt% Polyisobutylene/1.6 wt% Motor oil/5.3 wt% Di(2-ethylhexyl) sebacate
Cyclotol 75/25	75 wt% RDX/25 wt% TNT
Cyclotol 70/30	70 wt% RDX/30 wt% TNT
Detasheet C	63 wt% PETN/8 wt% NC/29 wt% Elastomeric binder
Detasheet D	75 wt% PETN/25 wt% Elastomeric binder Note: This material is usually red, but it is an explosive, not an inert material.
EDC-8	76.0 wt% PETN/24.0 wt% RTV Silicone
EDC-28	94 wt% RDX/6 wt% FPC 461
EDC-32	85 wt% HMX/15 wt% Viton A
EDC-37	91 wt% HMX/1 wt% Nitrocellulose/8 wt% K-10 Liquid
EDC-38	94.5 wt% HMX/3.5 wt% K-10 Liquid/2 wt% Polyurethane
HBX-1	40 wt% RDX/38 wt% TNT/17 wt% Al/4.5 wt% Wax/0.5 wt% $CaCl_2$
LX-04	85.5 wt% HMX/15.0 wt% Viton A
LX-07	90 wt% HMX/10 wt% Viton A
LX-10	95.0 wt% HMX/5.0 wt% Viton A
LX-14	95.5 wt% HMX/4.5 wt% Estane 5702-F1 (X-0282)
MDF	Mild Detonating Fuse
Nonel	RDX-Lined Metal Tubing
Octogen	94.5 wt% HMX/4.5 wt% Wax/1 wt% Graphite
Octol	75 wt% HMX/25 wt% TNT
PBX 9001	90 wt% RDX/8.5 wt% Polystyrene/1.5 wt% Dioctyl phthalate
PBX 9007	90 wt% RDX/9.1 wt% Polystyrene/0.5 wt% Dioctyl phthalate/0.4 wt% Resin
PBX 9010	90 wt% RDX/10 wt% Kel-F 3700 Elastomer
PBX 9011	90 wt% HMX/10 wt% Estane-5703 F-1
PBX 9205	92 wt% RDX/6 wt% Polystyrene/2 wt% Dioctyl phthalate
PBX 9206	92 wt% HMX/8 wt% Kel-F 3700 Elastomer
PBX 9404	94 wt% HMX/3 wt% NC/3 wt% Tris(b-chloroethyl) phosphate Note: PBX-9404 is unusually sensitive to certain types of impact, in particular, skidding.

Table A-2 (continued)

Waste Explosives That May Be Burned at the TA-14 OB Unit

Explosives	Other Names, Compositions, or Reference
PBX 9401	94.2 wt% RDX/3.6 wt% Polystyrene/2.2 wt% Trioctyl phosphate
PBX 9405	93.7 wt% HMX/3.15 wt% Nitrocelulose/3.15 wt% Tricloroethyl phosphate
PBX 9407	94 wt% RDX/6 wt% Exon-461
PBX 9501	95 wt% HMX/2.5 wt% Estane/2.5 wt% BDNPA or BDNPF, X-0242
PBX 9502	95 wt% TATB/5 wt% Kel-F 800, X-0290
PBX 9503	80 wt% TATB, superfine/15 wt% HMX/5 wt% Kel-F 800, X-0351
PBXN-5	See LX-10
PBXN-9	92 wt% HMX, 2 wt% Hycar 4454 (Hytemp 4454), 6 wt% Dioctyl Adipate (DOA)
PBXN-110	88 wt% HMX/5.4 wt% Polybutadiene/5 wt% Isodecyl pelargonate
PBXW-113	See PBX N110
Primacord	Assorted PETN & RDX Loaded Commercial Detonating Fuse
Pentolite	50 wt% PETN/50 wt% TNT
Tritonal	80 wt% TNT/20 wt% Aluminum powder
X-0208	See XTX-8004
X-0233	5-40 wt% HMX; 40-95 wt% Tungsten, 0-10 wt% Polystyrene, 0-5 wt% Plasticizer
X-0242	See PBX 9501
X-0282	See LX-14
X-0290	See PBX 9502
X-0309	75% TNT, 19% Aluminum powder, 5% D-2 Wax, 1% Acetylene black (carbon)
X-0351	See PBX 9503
X-0407	69.8 wt% TATB/25.0 wt% PETN/0.2 wt% Dye/5 wt% Kel-F 800
X-0533	See Calcitol
X-0534	50 wt% TNT/16-24 wt% $CaCO_3$/25-33 wt% Talc/1-2 wt% Microballoons
XTX-8003	80 wt% PETN/20 wt% Sylgard 182
XTX-8004	80 wt% RDX/20 wt% Sylgard 182, Formerly X-0208
Black powder	Standard commercial and military grades only; 74 wt% Potassium nitrate/15.6 wt% Charcoal/10.4 wt% Sulfur
Benite	Black powder based mixture

Table A-2 (continued)

Waste Explosives That May Be Burned at the TA-14 OB Unit

Explosives	Other Names, Compositions, or Reference
Commercial sporting	Any commercially available smokeless gun propellant for sport use is approved.
HARP-1,-2	HARP propellants are Al/AP/HMX composites.
HELP-1,-2	HELP propellants are NC/NG/HMX composites.
Smokeless Powder Single, Double, or Triple Base	Standard military grades. Military research explosives are specifically not included.
VTP 25540	HMX based High Energy Propellant
Liquid Gun Propellant LGP 1846	DX-11 SOP:15-11-4.20, "LGP 1846, TA-36-3"
3E-1 Detonator	3 E-1 SWP
Al-ANFO	Ammonium nitrate/Fuel oil/Aluminum powder
BDNPA	Bis(dinitropropyl) acetal
BDNPF	Bis(dinitropropyl) formal
BTX	5,7-Dinitro-1-picrylbenzotriazole (transportation only)
DNPA	2,2-Dinitropropyl acrylate polymer
DNT	Dinitrotoluene
HBX-1	40 wt% RDX/38 wt% TNT/17 wt% Al/5 wt% Wax/0.5 wt% $CaCl_2$
Methane/Oxygen	Explosive mixtures of methane and oxygen gases
NC	Nitrocellulose
PYX	2,6-Bis(picrylamino)-3,5-dinitropyridine
STRATABLAST C	Storage and transportation only
TAGN	Triaminoguanadine nitrate
TAL-1005E	Storage and transportation only
TNS	Trinitrostilbene
TNT/NC	80 wt% TNT/20 wt% NC
TPM	Tripicryl melamine
DAAF	Diaminoazoxyfurazan (residuals only)
BATTZ	Bisaminotetrazolyltetrazine (residuals only)
TNAZ	Trinitroazetidine (residuals only)

Sources: DX-4: SOP 3, "General Safety," Attachment 1, HE Routinely Used at DX Division Firing Areas, July 1996; DX personnel.

Note: Additional types of explosives may be developed and used and the wastes subsequently burned at the OB unit.

Appendix B

Estimated Radius of Influence Distance Calculations
(Calculations performed by David Rogers, Ph.D., and Bruce Gallaher, M.S., of LANL's Water Quality and Hydrology Group [ESH-18])

Problem : Estimate Likely Radius of Influence, R, at production well PM-5. Is cone of depression likely to extend beneath TA-14 OB/OD unit?

Knowns :

Distance from PM-5 to OB/OD ≅ 13,475 feet

T = Transmissivity @ PM-5, T = 10,000 gpd/ft
(From Pump Test in Purtymun 1984, LA 9957 MS)

D = Contributing thickness of aquifer = 1632 ft
of louvres. [Assume minimal contribution below and above louvres.]

⇒ Hydraulic Conductivity, K

$$K = \frac{T}{D} = \frac{10{,}000 \text{ gpd/ft}}{1632 \text{ ft}} = 6.13 \text{ gpd/ft}^2$$

Radius of well, r_w

r_w = 8 inches ≅ 0.66 ft use 1 ft.

Pumping rate during pump test, Q

$Q = 1225 \text{ gpm} \simeq 1.764 \times 10^6 \text{ gpd}$

Drawdown in PM-5 during test, s

$\Delta s = 144$ ft.

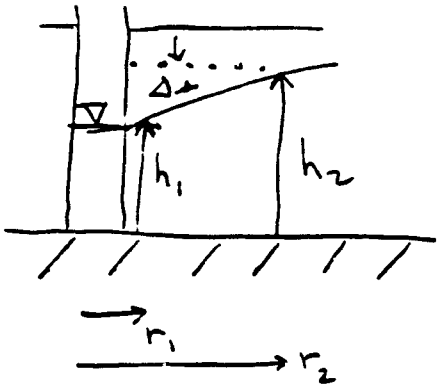
Approach :

Will estimate distance from PM-5 where drawdown in aquifer ≃ 0, using the above well/hydraulic parameters.

Equations to be used :

- Thiem eq. for unconfined aquifers
- 3 empirical eqs. from Baer and Depts. of Army, Navy, Air Force

1) Thiem Equation - Steady State Analysis for Unconfined Aquifers.



Thiem eqn. unconfined $h_1 = 1632$ ft

$h_2 = 1776$ ft

$$Q = \frac{\pi K (h_2^2 - h_1^2)}{\ln(r_2/r_1)} \quad \text{or}$$

$$\ln \frac{r_2}{r_1} = \frac{\pi K}{Q}(h_2^2 - h_1^2)$$

$$r_2 = r_1 \exp\left[\frac{\pi K}{Q}(h_2^2 - h_1^2)\right]$$

$$= 1\text{ ft} \cdot \exp.\left[\frac{\pi (6.13\text{ gpd/ft}^2)}{1.764 \times 10^6\text{ gpd}}(1776^2 - 1632^2)\right]$$

$$= 1 \times \exp.(5.36) = \underline{212\text{ ft.}}$$

2) Baer (1979) p.306 empirical formulas a, b

(a) $R = 3000 s_w K^{1/2}$

s_w = drawdown in meters $= 43.9$ m

$K = H\,C.\ (m/s) \cong 10^{-6}$ m/s

$R \sim 132$ m $= \underline{432\text{ ft}}$

(b) $R = 575 s_w (HK)^{1/2}$

H = sat thickness (m) $\simeq 575$ m

$R \sim 605$ m $= 1986$ ft.

3) Depts. of the Army, Navy and Air Force (1971) - Empirical Formula

Radius of Influence, R, can be estimated for both artesian and gravity flows by

$$R = c(H - h_w)\sqrt{K}$$

where R, H, h_w are in feet;
K is in 10^{-4} cm/sec = perm
$C = 3$ for flows to well

$K = 6.13$ gpd/ft^2 $= 2.9 \times 10^{-4}$ cm/sec

Total Short term Drawdown $(H - h_w) = 144$ ft
from Rustgmun 1984, LA 9957 MS

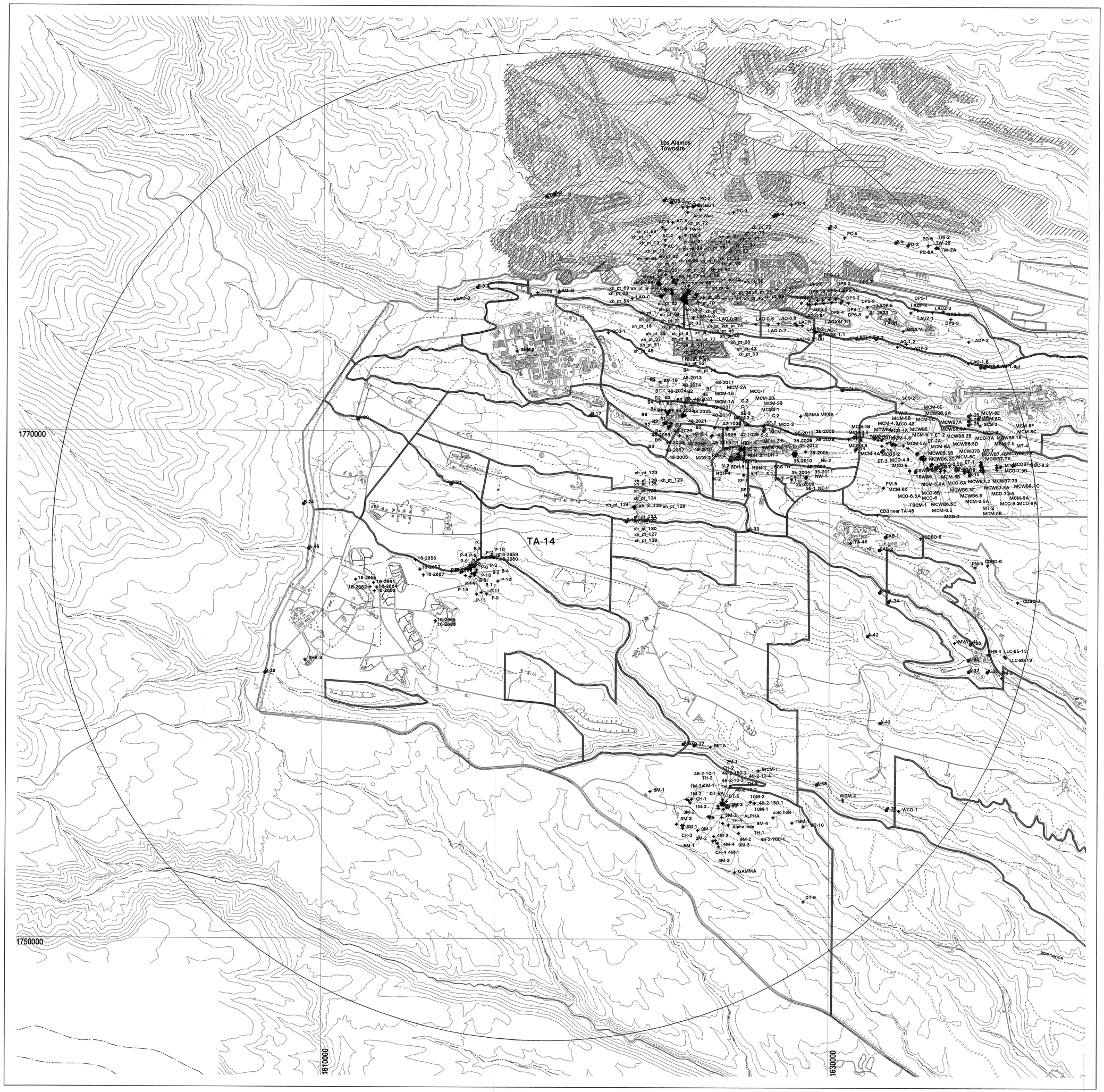
$$\therefore \quad R = 3(144 \text{ ft})\sqrt{2.9}$$
$$= \underline{735 \text{ ft.}}$$

Sustained Long-term drawdown ≤ 100 ft (McLin et al., 197

$$\Rightarrow \quad R = 3(100 \text{ ft})\sqrt{2.9}$$
$$= 510 \text{ ft.}$$

Appendix C

Topographic Maps of Wells Within a Three-Mile Radius of Technical Area 14



LEGEND

- Boundary, Los Alamos National Laboratory
- Boundary, Technical Area (TA)
- Contours, 100 foot
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Stream, Intermittent
- Stream, Perennial
- Building
- Residential Areas
- Existing Wells and Holes
- Proposed Wells and Holes

3874-A

MAP 6A:
All Existing and Proposed Wells and Holes Within an Approximate Three-Mile Radius of Technical Area (TA) 14

FACILITY for INFORMATION, MANAGEMENT, ANALYSIS and DISPLAY
EARTH & ENVIRONMENTAL SCIENCES DIVISION (EES-6)
Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico

Produced by: Marcia Jones
Date: January 28, 1998
FIMAD Plot ID: G106133

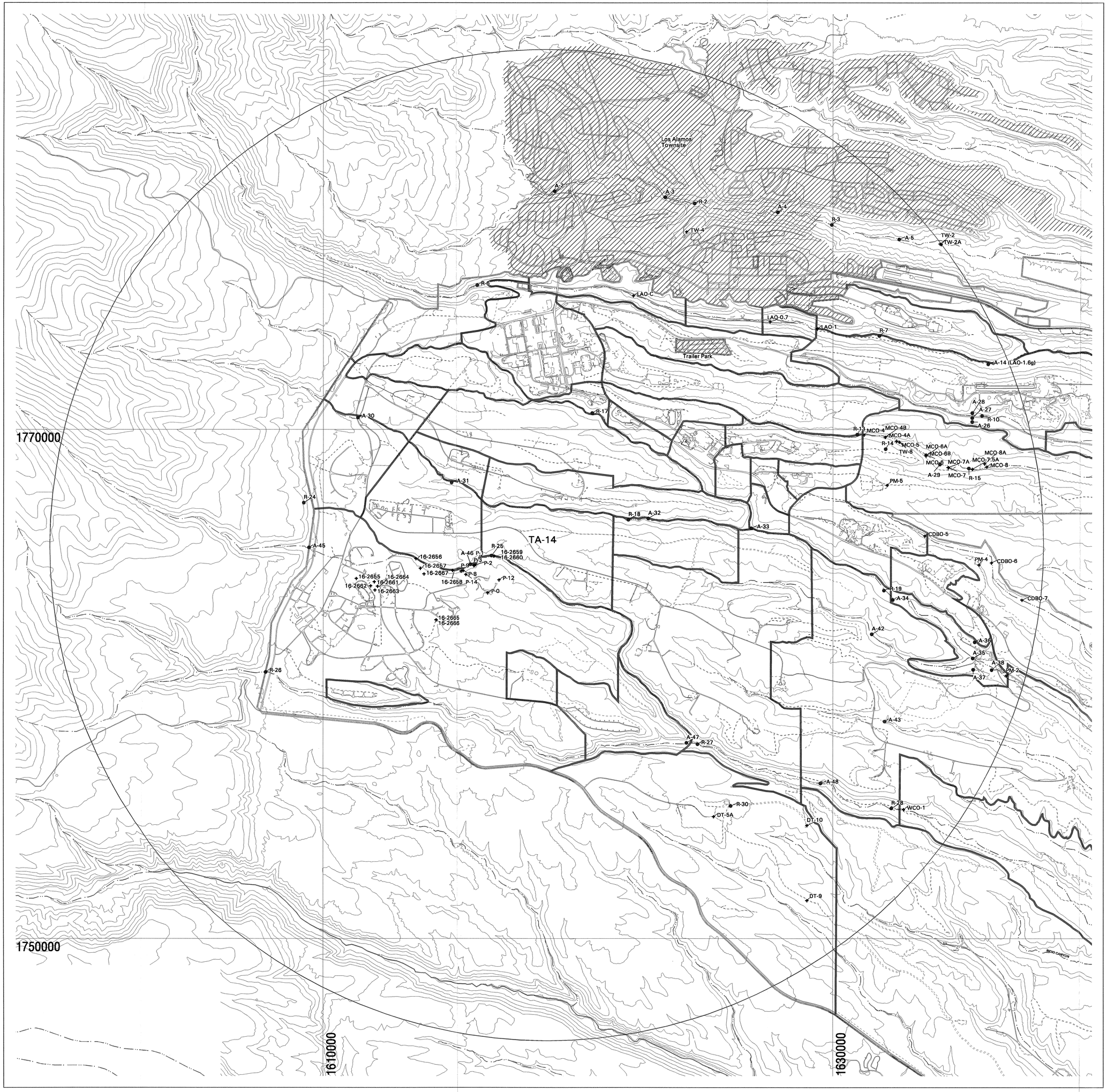
N

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides NM State Plane coordinates in feet.
Grid interval, in feet: 20000

0 457 914 1371 1828
METERS
0 1500 3000 4500 6000
FEET

NOTICE: The information on this map is provisional. Feature locations are dependent on scale and symbology and their accuracy may not have been confirmed. Los Alamos National Laboratory boundary is based on legal description established in 1995. Contour data are from a September 1991 aerial survey. All other data are from various sources and are part of the FIMAD repository.



LEGEND

- Boundary, Los Alamos National Laboratory
- Boundary, Technical Area (TA)
- Contours, 100 foot
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Stream, Intermittent
- Stream, Perennial
- Building
- Residential Areas
- Existing Wells and Holes
- Proposed Wells

3874-B

MAP 6B:
Pertinent Existing and Proposed Wells and Holes Within an Approximate Three-Mile Radius of Technical Area (TA) 14

FACILITY for INFORMATION, MANAGEMENT, ANALYSIS and DISPLAY
EARTH & ENVIRONMENTAL SCIENCES DIVISION (EES-5)
Los Alamos National Laboratory, Los Alamos, New Mexico

Produced by: Marcia Jones
Date: January 28, 1998
FIMAD Plot ID: G106175

N

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides NM State Plane coordinates in feet.
Grid interval, in feet: 20000

0 457 914 1371 1828
METERS
0 1500 3000 4500 6000
FEET

NOTICE: The information on this map is provisional. Feature locations are dependent on scale and symbology and their accuracy may not have been confirmed. Los Alamos National Laboratory boundary is based on legal description established in 1965. Contour data are from a September 1991 aerial survey. All other data are from various sources and are part of the FIMAD repository.

Appendix D

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Table D-1

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Existing Well ID	Well Type	Purpose	Monitoring/Sampling Frequency	Analyses	Notes
MCO-4/-4B	Alluvial	Observation	Annually	Radiochemistry (R), Metals (M), General Inorganics (GI)	Old MCO-4 out of service; MCO-4B installed pursuant to requirements in the HSWA Module.
	---	---	Triennially	Organics (O)	
	---	---	Quarterly for 1995	R, M, GI, O	
MCO-4A	Alluvial	Observation	Quarterly for 1995	R, M, GI, O	HSWA Module. Well is dry.
MCO-5	Alluvial	Observation	Annually	R, M, GI	
	---	---	Triennially	O	
MCO-6	Alluvial	Observation	Annually	R, M, GI	
	---	---	Triennially	O	
	---	---	Quarterly for 1995	R, M, GI, O	
MCO-6A	Alluvial	Observation	Quarterly for 1995	R, M, GI, O	HSWA Module. Well is dry.
MCO-6B	Alluvial	Observation	Quarterly for 1995	R, M, GI, O	HSWA Module.
MCO-7	Alluvial	Observation	Annually	R, M, GI	
	---	---	Triennially	O	
	---	---	Quarterly for 1995	R, M, GI, O	
MCO-7A	Alluvial	Observation	Quarterly for 1995	R, M, GI, O	HSWA Module.
MCO-7.5/-7.5A	Alluvial	Observation	Annually	R, M, GI	MCO-7.5 demolished by falling tree; MCO-7.5A now sampled.
	---	---	Triennially	O	

Table D-1 (Continued)

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Existing Well ID	Well Type	Purpose	Monitoring/Sampling Frequency	Analyses	Notes
MCO-8/-8A	Alluvial	Observation	Annually	M, GI, Module II Organics	MCO-8 damaged beyond repair in 1976. MCO-8A for Module II. Well is usually dry.
WCO-1	Alluvial	Observation	Quarterly for 1995	R, M, GI, O	HSWA Module. Well is dry.
CDBO-5	Alluvial	Observation	Annually	R, M, GI	Well is dry.
	---	---	Triennially	O	
CDBO-6	Alluvial	Observation	Annually	R, M, GI	Volume sometimes insufficient to sample.
	---	---	Triennially	O	
CDBO-7	Alluvial	Observation	Annually	R, M, GI	Well is sometimes dry.
	---	---	Triennially	O	
LAO-0.7	Alluvial	Observation	Annually	R, M, GI	
	---		Triennially	O	
LAO-1	Alluvial	Observation	Annually	R, M, GI	
	---	---	Triennially	O	
LAO-C	Alluvial	Observation	Annually	R, M, GI	
	---	---	Triennially	O	
TW-2A	Intermediate	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	
DT-5A	Regional	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	

Table D-1 (Continued)

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Existing Well ID	Well Type	Purpose	Monitoring/Sampling Frequency	Analyses	Notes
DT-9	Regional	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	
DT-10	Regional	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	
TW-2	Regional	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	
TW-4	Regional	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	
TW-8	Regional	Monitoring	Annually	R, GI	
	---	---	Triennially	M, O	
PM-2	Regional	Water Supply	Annually	R, M, GI	
	---	---	Triennially	O	
PM-4	Regional	Water Supply	Annually	R, M, GI	
	---	---	Triennially	O	
PM-5	Regional	Water Supply	Annually	R, M, GI	
	---	---	Triennially	O	
16-2655	Alluvial	Monitoring	Quarterly	High Explosives (HE), M, Cyanide (CN), Anions (A). Anions include bromine, chlorine, phosphates, sulfates, nitrates, and nitrites.	Volatile organic compounds (VOC) and semivolatile organic compounds (SVOC) to be sampled quarterly only if indicated by initial data.

Table D-1 (Continued)

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Existing Well ID	Well Type	Purpose	Monitoring/Sampling Frequency	Analyses	Notes
16-2656	Alluvial	Monitoring	Quarterly	HE, M, CN, A	VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2657	Alluvial	Monitoring	Quarterly	HE, M, CN, A	VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2658	Alluvial	Monitoring	Quarterly	HE, M, CN, A	VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2659	Alluvial	Monitoring	Quarterly	HE, M, CN, A	VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2660	Alluvial	Monitoring	Quarterly	HE, M, CN, A	VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2661	Completed in Tshirege Member of Bandelier Tuff.	Monitoring	Quarterly	HE, M, CN, A	Well is dry. VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2662	Completed in Tshirege Member of Bandelier Tuff.	Monitoring	Quarterly	HE, M, CN, A	Well is dry. VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2663	Completed in Tshirege Member of Bandelier Tuff.	Monitoring	Quarterly	HE, M, CN, A	Well is dry. VOCs and SVOCs to be sampled quarterly only if indicated by initial data.

Table D-1 (Continued)

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Existing Well ID	Well Type	Purpose	Monitoring/Sampling Frequency	Analyses	Notes
16-2664	Completed in Tshirege Member of Bandelier Tuff.	Monitoring	Quarterly	HE, M, CN, A	Well is dry. VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2665	Completed in Tshirege Member of Bandelier Tuff.	Monitoring	Quarterly	HE, M, CN, A	Well is dry. VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2666	Completed in Tshirege Member of Bandelier Tuff.	Monitoring	Quarterly	HE, M, CN, A	Well is dry. VOCs and SVOCs to be sampled quarterly only if indicated by initial data.
16-2667	Completed in Tshirege Member of Bandelier Tuff.	Moisture Access Hole	Quarterly	Percent moisture	Hole is dry.
P-0	Completed in Tshirege Member of Bandelier Tuff.	Moisture Access Hole	Seven sampling efforts between July 1994 and July 1995	Percent moisture	Hole is dry.
P-1	Completed in Tshirege Member of Bandelier Tuff.	Observation Well			Well is dry.
P-2	Completed in Tshirege Member of Bandelier Tuff.	Observation Well			Well is dry.
P-3	Completed in Tshirege Member of Bandelier Tuff.	Observation Well			Well is dry.

Table D-1 (Continued)

Pertinent Existing Wells Within a Three-Mile Radius of Technical Area 14

Existing Well ID	Well Type	Purpose	Monitoring/Sampling Frequency	Analyses	Notes
P-8	Completed in Tshirege Member of Bandelier Tuff.	Observation Well			Well is dry.
P-9	Completed in Tshirege Member of Bandelier Tuff.	Observation Well			Well is dry.
P-12	Completed in Tshirege Member of Bandelier Tuff.	Moisture Access Hole	Seven sampling efforts between July 1994 and July 1995	Percent moisture	Hole is dry.
P-14	Completed in Tshirege Member of Bandelier Tuff.	Moisture Access Hole	Six sampling efforts between July 1994 and March 1995	Percent moisture	Hole is dry.

Note: See Map 6B in Appendix C of the TA-14 OB/OD RSI response for the locations of these wells.

Appendix E

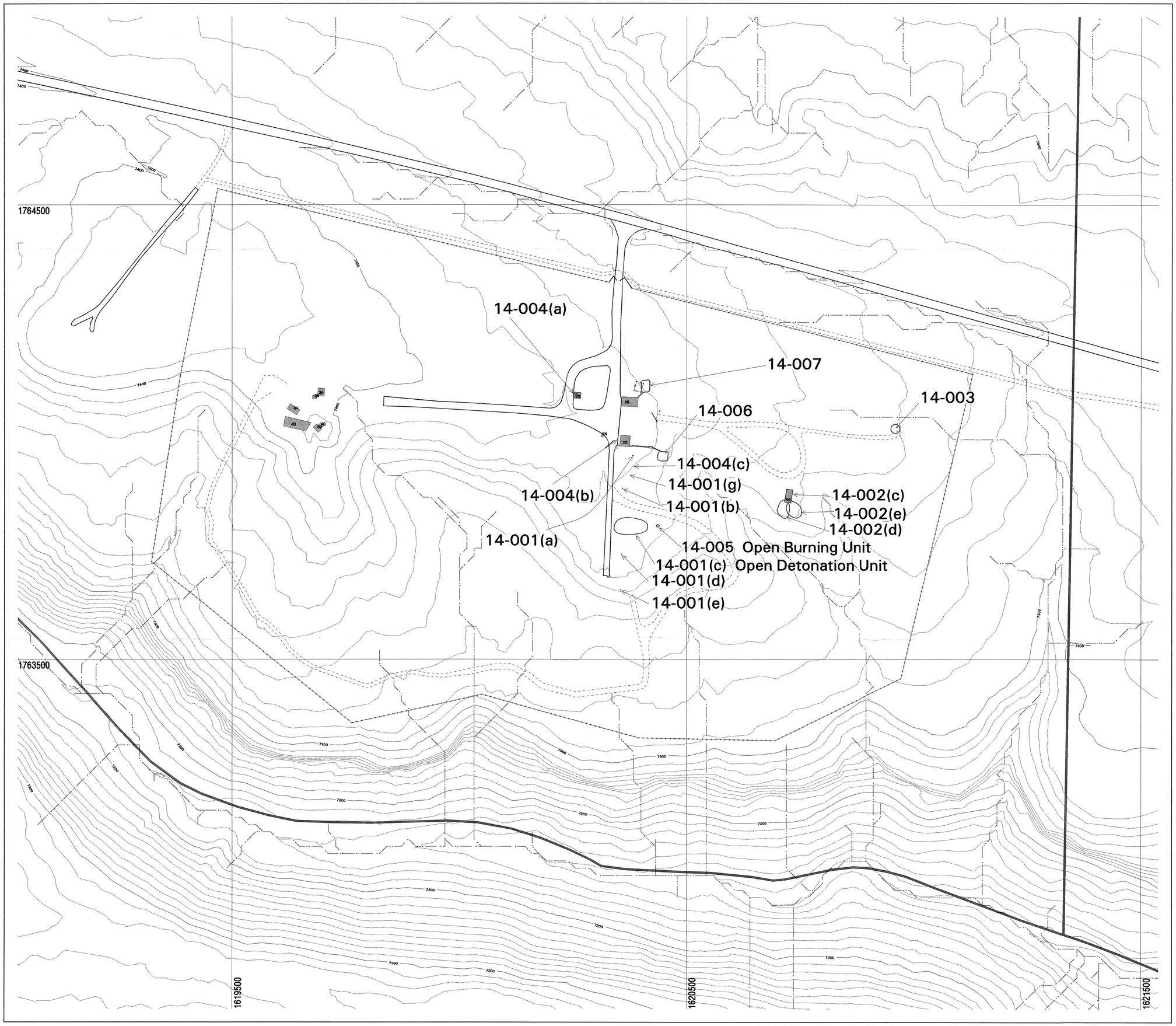
Table 4-2 of LANL's "Hydrogeologic Workplan"

Table 4-2. Installation sequence for proposed wells.

Borehole	Year	Funding Program	Timing Score	Location
R-25	FY99	DP	20	Canon de Valle near MDA P
R-12	FY98	ER	20	Sandia Canyon at eastern boundary of Laboratory
R-5	FY99	DP	19	Pueblo Canyon near water supply well Otowi-1
R-31	FY99	DP	18	Ancho Canyon downgradient of Aggregate 6
R-28	FY99	DP	18	Water Canyon near WCO-1
R-7	FY98	ER	18	Los Alamos Canyon south of TA-21
R-32	FY00	DP	18	Ancho Canyon near Ancho Spring
R-22	FY98	ER	18	Pajarito Canyon at eastern boundary of Laboratory
R-2	FY00	DP	17	Pueblo Canyon near TW-4
R-18	FY99	ER	17	Pajarito Canyon above Two Mile Canyon confluence
R-1	FY00	DP	15	Rendija Canyon north of Los Alamos
R-9	FY99	ER	15	Los Alamos Canyon at eastern boundary of Laboratory
R-3	FY99	ER	15	Pueblo Canyon between TW-2/2A and TW-4
R-15	FY00	ER	15	Mortandad Canyon near sediment traps
R-27	FY00	ER	15	Water Canyon and Canyon de Valle confluence
R-8	FY00	DP	13	Los Alamos Canyon near water supply well Otowi-4
R-10	FY00	ER	13	Sandia Canyon south of TA-21
R-4	FY01	ER	13	Pueblo Canyon between TW-2/2A and LA County sewage treatment plant
R-20	FY01	DP	13	Pajarito Canyon near water supply well PM-2
R-14	FY01	DP	13	Mesa top well between Mortandad Canyon and water supply well PM-5
R-13	FY01	ER	13	Mortandad Canyon downgradient of TA-50 outfall
R-19	FY01	ER	13	Pajarito Canyon upgradient of TA-18
R-17	FY02	ER	13	Two Mile Canyon
R-6	FY01	DP	12	Los Alamos Canyon at western boundary of Laboratory
R-11	FY01	DP	12	Sandia Canyon near water supply well PM-3
R-23	FY02	ER	12	Potrillo Canyon at hydrologic sink
R-29	FY02	DP	11	Water Canyon near eastern boundary of Laboratory
R-24	FY02	DP	11	Mesa top west of TA-16 between Canon de Valle and Pajarito Canyon
R-26	FY02	DP	11	Water Canyon at western boundary of Laboratory
R-16	FY02	DP	11	Canada del Buey on the east side of White Rock
R-21	FY02	ER	11	Mesita del Buey at TA-54, MDA L
R-30	FY02	ER	10	Frijoles Mesa at TA-49

Appendix F

Topographic Map of Solid Waste Management Units and Drainages Around the Open Burning/ Open Detonation Units at Technical Area 14



LEGEND

- Boundary, TA
- Contour, 100 foot
- Contour, 10 foot
- Drainage
- Fence, Industrial
- Road, Dirt
- Road, Paved
- Road/Trail
- Permanent Structure
- SWMU Outline
- SWMU (point location)

3874-C

Figure 10-1:
Solid Waste Management Units (SWMU) in the Vicinity of the Thermal Treatment Units near Technical Area (TA) 14, Building 23

N

State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides NM State Plane coordinates in feet.
Grid interval, in feet: 1000
Feet per inch on map = 100

SCALE 1:1200

0 30 60 90 120

METERS

0 100 200 300 400

FEET

NOTICE: The information on this map is provisional. Feature locations are dependent on scale and symbology and their accuracy may not have been confirmed. Los Alamos National Laboratory boundary is based on legal description established in 1986. Contour data are from a September 1991 aerial survey. All other data are from various sources and are part of the FIMAD repository.

University of California
Los Alamos National Laboratory
Earth and Environmental Sciences Division

FIMAD Facility for Information Management, Analysis, and Display
FIMAD is the electronic data repository for the Environmental Restoration Project at Los Alamos National Laboratory.

Produced by: Marcia Jones
Date: December 22, 1997 FIMAD Plot ID: G106132