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U. S. Department of Energy
Los Alamos Area Office, MS A316
Environmental Restoration Program
Los Alamos, New Mexico 87544
505-667-7203/FAX 505-665-4504

NOV 1997

Date: November 14, 1997
Refer to: EM/ER:97-477

Mr. Benito Garcia
NMED-HRMB
P.O. Box 26110
Santa Fe, NM 87502

SUBJECT: RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION AND ADDITIONAL WORK FOR THE RFI REPORT FOR TA-33, PRSs 33-004(d, g-i), 33-005(a-c), 33-007(c), 33-010(e-f), 33-011(a, e), 33-012(a) and 33-015 (FORMER OU 1122)

Dear Mr. Garcia:

The Environmental Restoration Project received your letter dated September 11, 1997, in which you approved a request for extension for supplemental information and additional work on the Resource Conservation and Recovery Act Facility Investigation Report for Technical Area 33, Potential Release Sites 33-004(d, g-i), 33-005(a-c), 33-007(c), 33-010(e-f), 33-011(a, e), 33-012(a) and 33-015. In your letter, you indicated that a response should be received from the Los Alamos National Laboratory no later than November 15, 1997. Enclosed please find our response to your request.

Should you have any questions, please contact Roy Michelotti at (505) 665-7444 or Joe Mose at (505) 667-5808.

Sincerely,

Julie A. Canepa, Program Manager
LANL/ER Project

Sincerely,

Theodore J. Taylor, Program Manager
DOE/LAAO

4775

JC/TT/gmn

Enclosure: Response to Request for Supplemental Information for RFI Report for TA-33

Cy (w/enc.):
D. Griswold, AL-ERD, MS A906
J. Harry, EES-5, MS M992
R. Michelotti, CST-7, MS E525
J. Mose, LAAO, MS A316
D. Neleigh, EPA, R.6, 6PD-N
C. Rodriguez, CIO/ER, MS M769
T. Taylor, LAAO, MS A316
J. White, ESH-19, MS K490
S. Dinwiddie, NMED-HRMB
M. Leavitt, NMED-GWQB
J. Parker, NMED-HRMB
G. Saums, NMED-SWQB
S. Yanicak, NMED-AIP, MS J993
RPF, MS M707

Information Only (w/o encs)
T. Baca, EM, MS J591
T. Glatzmaier, DDEES/ER, MS M992
T. Longo, DOE-HQ, EM-453
D. McInroy, EM/ER, MS M992
J. Plum, LAAO, MS A316
S. Rae, ESH-18, MS K497
G. Rael, AL-ERD, MS A906
J. Vozella, LAAO, MS A316
EM/ER File (CT# C327), MS M992
EM/ER File, MS M992

RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION REGARDING "RCRA FACILITY INVESTIGATION REPORT TA-33, PRSS 33-002(A—E), MATERIAL DISPOSAL AREA K"

GENERAL COMMENTS

1. LANL shall provide a summary of all analytical data regardless of non-detectable concentrations.

Response: As per an October 22, 1997, telephone agreement between Tracy Glatzmaier of LANL and John Kieling of NMED, summaries of 1993 analytical data are provided for all PRSs discussed in the September 1995 MDA K RFI Report.

The data are provided on floppy disk in Excel 4 format as Addendum 1 to this response. Two copies of each PRS file are provided. One copy is locked as a read-only archival file. The other copy is provided an in unlocked file for the convenience of NMED when inspecting the data. The data include sample ID, request number, analytical suite, analytical result and qualifier (if any), and units.

2. For each inactive septic tank, LANL shall remove or, at a minimum, backfill the tank with a solid, non-porous material (such as flow-crete). However, any action other than removal of the tank and associated lines may not be considered as a final disposition appropriate for no further action.

Response: There is only one septic tank at MDA K. The tank has been cleaned and plugged (see item 4 below). NMED has been informed of this work (Attachment A).

3. In order to address Water Quality Control Commission concerns, LANL shall, at a minimum, plug outfall piping at the origin and remove all associated piping.

Response: Both inflow and outflow pipes were removed at the tank and the pipe orifices at the tank were plugged during the cleaning described in response to item 4 below.

SPECIFIC COMMENTS

4. **33-002(a):** The administrative Authority recommends that LANL perform an interim action to remove the contents of the septic tank.

RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION REGARDING "RCRA FACILITY INVESTIGATION REPORT TA-33, PRSS 33-002(A—E), MATERIAL DISPOSAL AREA K"

GENERAL COMMENTS

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The data are provided on floppy disk in Excel 4 format as Addendum 1 to this response. Two copies of each PRS file are provided. One copy is locked as a read-only archival file. The other copy is provided an in unlocked file for the convenience of NMED when inspecting the data. The data include sample ID, request number, analytical suite, analytical result and qualifier (if any), and units.

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Response: There is only one septic tank at MDA K. The tank has been cleaned and plugged (see item 4 below). NMED has been informed of this work (Attachment A).

3. In order to address Water Quality Control Commission concerns, LANL shall, at a minimum, plug outfall piping at the origin and remove all associated piping.

Response: Both inflow and outflow pipes were removed at the tank and the pipe orifices at the tank were plugged during the cleaning described in response to item 4 below.

SPECIFIC COMMENTS

4. **33-002(a):** The administrative Authority recommends that LANL perform an interim action to remove the contents of the septic tank.

Response: The septic tank at MDA K [PRS 33-002(a)] was deactivated and cleaned in September-October 1997 as an institutional interim measure. The tank was sampled prior to removal of contents. All contents were pumped out, and the tank was steam cleaned several times. The inlet and outlet pipes were removed and their orifices plugged at the tank. At this writing, the tank is awaiting final disposition. A report will be sent to NMED at the conclusion of the work, as proposed by e-mail from Roy Michelotti (CST-7) to John Kieling (NMED) (Attachment A). All data and the fate of the tank will be provided in the NFA report for PRS 33-002(a).

5. **33-002(b):** LANL shall submit a schedule for the Phase II field work.

Response: Phase II fieldwork for bounding the extent of tritium below the sump and for checking for contamination by inorganic chemicals, VOCs, and SVOCs was completed in FY 96. The Phase II report for PRS 33-002(b) was submitted to NMED in September 1997 with a recommendation for NFA. A copy of the 33-002(b) section of that report is provided as Attachment B to this response.

6. **33-002(c):** LANL shall submit a schedule for the Phase II field work.

Response: Phase II fieldwork for bounding the extent of tritium below the sump and for checking for contamination by inorganic chemicals, VOCs, SVOCs, and plutonium was completed in FY 96. The Phase II report for PRS 33-002(c) was submitted to NMED in September 1997 with a recommendation for NFA. A copy of the 33-002(c) section of that report is provided as Attachment C to this response.

7. **33-002(d):** Contaminants are present at this PRS above UTL. Therefore, LANL must conduct additional sampling at depth for this PRS. LANL must submit a Phase II SAP.

Response: Because a borehole was drilled at PRS 33-002(d) in 1993, LANL believes that additional subsurface sampling is not needed at this PRS. As part of the 1993 investigation of a subsurface tritium plume at MDA K, Borehole 33-1230 was located in the 33-002(d) drainage. In the MDA K RFI Report, this borehole was discussed under PRS 33-002(a) because PRS 33-002(d) is located within the boundaries of PRS 33-002(a) and because Borehole 33-1230 was part of a broader investigation at MDA K. Borehole 33-1230 was specifically located in the PRS 33-002(d) drainage to address contamination that may have come from the outfall and to determine if the outfall may have been the source of the tritium plume.

Borehole 33-1230 is located approximately 25 ft downslope from sample point AAA1942. Analyses of the cores for inorganics, radionuclides, SVOCs, and VOCs (except the surface sample) were performed at 10-ft intervals in the upper 30 feet of the borehole and at 30-ft intervals thereafter to a total depth of 230 ft. Details of the core drilling are presented on pages 18 and 26 of the MDA K RFI Report. Cadmium (3.6 mg/kg), chromium (57 mg/kg), lead (48 mg/kg), and uranium (8.09 mg/kg) were found at the surface. Uranium (5.16 mg/kg) was found at 30 ft and antimony (23 mg/kg) was found at 217 ft but not in any samples above. Trace levels of plutonium were found at 10 ft. (A plutonium spill occurred at Main Site in 1960, resulting in plutonium activities above LANL background UTLs at Main Site.) LANL feels that, while these concentrations are above UTLs, contamination is well below SALs, not widespread, and is bounded by the borehole and surface sampling.

LANL sincerely believes that Borehole 33-1230 sufficiently addresses the question of subsurface contamination at PRS 33-002(d) and requests that NMED reconsider the need for a SAP. If, after reviewing the arguments presented above, NMED still believes that a SAP is necessary, LANL requests a more specific statement of NMED concerns.

8. **Appendix C Ecotoxicological Screening Assessment:** LANL shall revise the text to indicate that the ecotoxicological screening at TA-33 follows the approach agreed upon by the New Mexico Environment Department, Environmental Protection Agency, and the Department of Energy.

Response: Field Unit 3 withdraws Appendix C. TA-33 will be included in the LANL Environmental Restoration Project's sitewide Ecotoxicological Screening Assessment when the methodology is agreed upon by all parties.

ATTACHMENT A

E-mail communication from Roy Michelotti (CST-7) to John Kieling (NMED) concerning the septic tank at PRS 33-002(a).

John Kieling
HRMB/NMED
fax 827-1544

Dear John,

Per a discussion I had with Dave McInroy and Pat Shanley, we agreed to this expeditious and informal communique as a follow up to our 9/19/97 phone conversation. This note is to further advise you of work being performed in two PRSs at TA-33. We are conducting BMPs at two septic system PRSs, 33-002(a) and 33-004(a). The contents of the tanks will be removed from both units, and the tanks will be decontaminated. Waste disposal decisions will be based on the results of waste characterization data.

PRS 33-002(a) is the unit which overflowed earlier this summer, and NMED sampled the contents. This unit has been taken out of service by the operating group. ER is sealing the inlet and outlet pipes, a decision on the final disposition of the tank is pending

PRS 33-004(a) is an active unit which is suspected to have been leaking. LANL ER is working with the facility management organization to inspect the tank and piping for leaks. If we discover stained soil during this inspection we will remove it, characterize it, and dispose it properly. Based on previous RFI data we do not expect to encounter any soil with contamination above human-health risk-based criteria.

We will provide you with an informal summary report when this activity is completed. This will include waste volumes and waste disposal decisions. All information pertaining to these actions will be included in final decision reports on these units.

If you have any questions please contact me directly at 665-7444.

Sincerely,
Roy

cy:
Dave McInroy
Joe Mose
Pat Shanley

ATTACHMENT B

PRS 33-002(b) Section of the TA-33 September 1997 Phase II report.

RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION

REGARDING THE TA-33 RFI REPORT OF JANUARY 1995

GENERAL COMMENTS

1. LANL shall provide a summary of all analytical data regardless of non-detectable concentrations.

Response: As per an October 22, 1997, telephone agreement between Tracy Glatzmaier of LANL and John Kieling of NMED, summaries of 1993 analytical data are provided for all PRSs that were included in the January 1995 RFI Report.

The data are provided on floppy disk in Excel™ 4 format as Addendum 1 to this response. Two copies of each PRS file are provided. One copy is locked as a read-only archival file. The other file is provided as an unlocked file for the convenience of the NMED when reviewing the data. The data include sample ID, request number, analytical suite, analytical result and qualifier (if any), and units.

Additional sampling and analysis has occurred at PRSs 33-007(c) since the 1993 sampling campaign was completed. Analytical data for PRSs 33-004(g), 33-010(f), 33-011(e), and 33-012(a) will be resubmitted with the reports for these PRSs in which each PRS is recommended for NFA.

2. LANL may submit a Class 3 permit modification for the 33-010(e) under the Document of Understanding No Further Action Criterion 5.

Response: LANL will submit a Class 3 permit modification request for no further action at PRS 33-010(e).

SPECIFIC COMMENTS

1. **33-004(i) Outfall:** LANL must include lead within the screening risk assessment for 33-017 since it is attributable to the vehicle maintenance area.

Response: A baseline risk assessment for lead at PRS 33-017 was included in Appendix D, Section 3.0, of the RFI Report submitted by Field Unit 3 in September 1995. The exposure unit of approximately 0.15 acres (500 m^2) included the vehicle maintenance area, the two 33-004(i) outfalls and drainages, and storage area PRS 33-012(a). Lead concentrations from all samples within the exposure unit were used in the risk calculations regardless of the PRS to which they were assigned. Results of this risk assessment indicate an acceptable risk for lead exposure under EPA guidelines. Because the concentrations of lead on the east side of shop TA-33-39 were higher than one would expect from leaded gasoline emissions, it is reasonable to presume that lead came from the shop,

which contained lead melting apparatus. Therefore, lead contamination was attributed to PRS 33-004(i) which contains the two outfalls from TA-33-39.

For the convenience of NMED when reviewing this risk assessment, Appendix D, Section 3.0 of the September 1995 RFI Report is included as Attachment A to this response.

2. **33-005(a-c) Septic System, Industrial Drain Line and Leach field associated with TA-33-21:** LANL did not respond to the information requested in the notice of deficiency dated April 22, 1995 regarding blank contamination. LANL must report all laboratory contamination in the RFI Report Tables and identify them with a qualifier ("B").

Response: Blank contamination was not applied as a qualifier in 1993 data. Other qualifiers for analytical results for these PRSs are included in Excel tables provided as Addendum 1 to this response. These results are extracted from the ER Project FIMAD database and include qualifiers assigned as a result of data validation. Because data validation is an independent function not subject to modification in FIMAD by field unit personnel, LANL cannot comply with this request to include a "B" qualifier.

LANL presumes that NMED's concern lies in the EPA practice of allowing five times the blank contamination concentration to be subtracted from the analyte concentration in the field samples. This correction is a function of the decision makers. Neither the analytical laboratory or the data qualifiers correct any sample data for blank contamination. [Personal communication on November 13, 1997 between Dorothy Hoard (EM/ER) and Peggy Gautier (validation section leader, CST-3) and between Chris Leibman (organic analysis section leader, CST-12)]. Results listed in the Excel tables provided in this response are the actual concentrations of analyte in the samples. They have not been corrected for blank contamination. Please note that blank contamination of a sample would result in a high bias.

Blank sample data are not provided in the Excel tables included in Addendum 1. Quality control analyses, which includes the analysis of blanks, are a function of the analytical request number (the analytical batch) rather than the PRS or the field sample.

3. **33-004(d) Septic System:** LANL must conduct additional sampling at depth for this PRS. LANL must submit a Phase II SAP.

Response: LANL recognizes that there is no agreement between DOE/LANL and NMED on adequate bounding of vertical extent of contamination at PRSs slated for characterization by the ER Project. However, for the reasons described below, LANL believes that characterization of hazardous constituents at depth adequately bounds contamination at PRS 33-004(d). Because LANL's written justification of the adequacy of the approved sampling

was not accepted by NMED, further detail is provided below in an effort to fully describe and justify LANL's recommendation of NFA.

- At this PRS, LANL completed three boreholes that were sampled at depths of 5 ft and 7-8 ft for a total of six subsurface samples. (Note that two samples at depth—AAA2131 and AAA2129—were resampled for volatiles because VOC analyses were not performed on the original samples.) These boreholes were located at sites where leakage from the septic system was deemed most likely : adjacent to the tank and near the line of the drainpipe. Thus, LANL believes that subsurface samples were taken at locations where high levels of contamination were likely if the septic system had significantly contaminated the subsurface environment near the tank.

- The subsurface samples all contained constituents at levels well below SALs. Constituents found above background UTLs in these samples include uranium, cyanide, and acetone. Cyanide values range from non-detects to 22.5 mg/kg (at 5 ft) in some subsurface samples. However, this level is orders of magnitude below the SAL for cyanide (1 600 mg/kg). Acetone levels range from 0.047 to 0.066 mg/kg, more than six orders of magnitude below the SAL of 8 000 mg/kg. LANL believes that subsurface contamination by cyanide and acetone is bounded beneath the septic tank and drainline. Not only are subsurface concentrations of constituents well below SALs, but the deeper samples show lower or comparable levels when compared to the shallower samples. For example, the highest level cyanide sample, AAA2133 (22.5 mg/kg at 5 ft), is bounded at depth by sample AAA2134 and by down-drainage samples in which cyanide was not detected.

- Subsurface uranium concentrations, which range from 2.8 to 4.7 mg/kg, are slightly greater than both the lab-wide background UTLs for soils that was in use in 1995 (2.82 mg/kg) and that in use now (1.87 mg/kg). (Sample logs indicate the subsurface drainline is in fill material; therefore, soil UTLs are appropriate.) However, none of these values are above the site-specific TA-33 UTL (4.84 mg/kg) that was calculated in 1995. Please see Section 3.2.2 of the January 1995 RFI Report for derivation of the TA-33 site-specific background. Note that Area 6 is located on a basaltic cinder cone and is not typical of the LANL site-wide tuff backgrounds. Uranium in these samples may not be anthropogenic; it may represent higher local background values due to the higher uranium (7.12 mg/kg) from subunits of the Tshirege (Units 2 and 3) Formation that outcrop to the west. Uranium values are well below both the natural uranium SAL that was in use in 1995 (95 mg/kg) and that currently in use (29 mg/kg).

- LANL acknowledges that the sediment samples taken within the downgradient drainage are not bounded at depth. Because this drainage is near bedrock levels, no samples at depths greater than 6 in. were collected in the drainage. However, the levels of constituents in this drainage are at very low levels. Samples AAA2138 through AAA2144 contain uranium at levels that range from 1.1 to 3.6 mg/kg (current LANL background UTL = 1.87 mg/kg; current SAL = 29 mg/kg). As noted above, such uranium levels may represent local background

concentrations of uranium because they are below the TA-33 site-specific uranium UTL that was calculated in 1995.

One sample (AAA2140) contained non-carcinogenic PAHs at levels from 0.49 to 0.62 mg/kg (current SALs: fluoranthene = 2 600 mg/kg; phenanthrene = no SAL; pyrene = 19 000 mg/kg). This sample was located down drainage from a pile of asphalt deposited at the head of the drainage and from a creosote-treated telephone pole, which are likely sources for these PAHs.

Because of these extremely low levels of constituents and because a head of standing water for driving constituent migration to depth would not have existed for long periods of time in this drainage, LANL believes that the likelihood of finding additional high levels of constituents at depths greater than 6 in. within the drainage is small.

In summary, LANL believes that Phase I sampling (1) determined the nature of releases at PRS 33-004(d) and (2) bounded the low levels of hazardous constituents in both the vertical and surface-downgradient directions. LANL believes that additional sampling at this PRS would not significantly increase the technical defensibility of the decision to request NFA for this PRS. LANL asks that NMED reconsider its request for a Phase II SAP at this PRS. If, after reviewing the arguments presented above, NMED still believes that a SAP is necessary, LANL requests both a more specific rationale for sampling and recommendations on sample depths considered adequate for NMED decision-making at this PRS.

4. **33-004(g) Septic System:** LANL must conduct additional sampling that includes analyses for SVOCs and sampling at depth for this PRS. LANL must submit a Phase II SAP.

Response: A sampling and analysis plan for PRS 33-004(g) is submitted as Attachment B to this response.

5. **33-004(h) Warehouse Outfall:** LANL must conduct additional sampling at depth for this PRS. LANL must submit a Phase II SAP.

Response: Phase I investigation of this PRS revealed negligible amounts of surface contamination. Because of a grade of approximately 10%, there is never standing water in this drainage to provide a hydrologic head that could drive contaminants into the tuff. In addition, because there is no evidence of a pathway or release from TA-33-20, LANL requests that NMED reconsider the need for additional sampling.

PRS 33-004(h) is the unlocated outfall from two floor drains in TA-33-20, a warehouse without a water supply (Santa Fe Engineering 1992. See Attachment C). Undocumented evidence (a July 22, 1993 conversation among Roy Michelotti (CST-7), Dorothy Hoard (EM/ER) and Paul Vidrine (FSS-6), LANL project engineer for a TA-33 utilities upgrade) indicated that the outfall pipe was most likely routed to the Main Site septic tank in the 1950s or 1960s. The drainage into which the outfall may have emptied carries a large volume of surface runoff water from

the Main Site pavements. In places, this drainage is scoured to tuff, and where sediments are present they are very shallow. At the east edge of the pavement, the overall slope is about 10% and increases to the east.

The existing data provide no indication of a significant release to this drainage from the warehouse, in which beryllium and uranium were stored in dry form. The surface samples described in this report showed nickel (40 mg/kg; SAL = 1 500 mg/kg) and zinc (110 mg/kg; SAL = 23 000 mg/kg) above background, residual pesticides at levels slightly above the quantitation limit, and noncarcinogenic polyaromatic hydrocarbons at less than 0.5 mg/kg. The main drainage below this site continues to be investigated due to potential releases from other PRSs.

Attachment C is the report of the inspection of TA-33-20 by Santa Fe Engineering, Inc., as part of a LANL-wide investigation of wastewater streams.

LANL believes that PRS 33-004(h) itself has been adequately characterized. LANL requests that NMED reconsider its request for a Phase II SAP at this PRS. If, after reviewing the arguments presented above, NMED still believes that a SAP is necessary, LANL requests a more specific statement of NMED's concerns.

6. **33-010(f) Surface Disposal:** Since the piles are located on the slopes of a tributary, LANL must collect samples in the drainage and analyze them for inorganics, semivolatile organic compounds, pesticides and PCBs. LANL must submit a sampling and analysis plan (SAP) for this PRS.

Response: A sampling and analysis plan for PRS 33-010(f) is submitted as Attachment D to this response.

7. **33-011(e) Drum Storage Area:** LANL must at a minimum use aerial photographs, other suitable historical information, interviews, etc. to determine the location of the drums. In addition, LANL must also resample the drum storage area for inorganics, SVOCs, and volatile organic compounds. LANL must submit a SAP to address these concerns.

Response: LANL believes that this area was misidentified as a drum storage area by the authors of the SWMU Report. Recent (November 1997) informal communication with a member of the operating group (EES-1) at the time of the ER reconnaissance and identification of SWMUs (1986—1987) indicates that bunker TA-33-22 was used for storage and for thin-section preparation of geological samples. Drums containing kerosene, cutting oil, and isopropanol were stored on the pavement near the door to the bunker. Waste from the thin-section operation, which consisted of rags used for wiping cutting oil and kerosene, was taken to a dumpster located at Main Site. The thin-section preparation work was moved to Main Site after a few months because bunker TA-33-22 has no water supply and is not heated.

Because LANL cannot account for the period between 1972 and 1986, a sampling and analysis plan for PRS 33-011(e) is submitted as Attachment E to this response. Aerial photographs from 1984, 1986, and 1987 are also provided. These photographs also show PRS 33-011(a), a drum storage area that is also northwest of TA-33-22 and may be the intended area in the SWMU Report. PRS 33-011(a) was sampled intensively in 1993.

8. **33-012(a) Drum Storage:** The polychlorinated biphenyl (PCB) action levels presented for this PRS does not represent the Environmental Protection Agency's position on PCB action levels. Depending on the site specific considerations, the regional Administrator may determine that a different action/cleanup level is more protective than those presented. Environmental Protection Agency (EPA) Region 6 has a policy of requiring cleanup of PCBs in any drainage areas or areas leading to surface water of 1 part per million in soil. Official notification of identified PCBs should be made to the Toxic Substance Control Act (TSCA) personnel. [See EPA Comments on Draft LANL Guidance, Cleanup of Polychlorinated Biphenyls dated May 8, 1995, and EPA letter dated September 20, 1995, PCB Spill Cleanup Policy.]

Response: LANL recommends rescinding our request for NFA at this PRS pending further investigation and possible cleanup of PCBs.

The TA-33 RFI Report of January 1995 was written in accordance with guidance available at the time of submission. Since that time, the action level for PCB cleanup has been reduced by an order of magnitude to 1 mg/kg in locations that may contribute runoff to a watercourse. LANL is aware of EPA and NMED concerns for PCBs in areas potentially impacting surface water. As a best management practice, straw bales are in place in the drainage below 33-012(a) and several other PRSs that contribute runoff to this drainage. A voluntary corrective action is proposed in this drainage, as described below.

The ER Project has instituted a practice to provide copies to TSCA EPA Region 6 of all ER documents that identify PCB contamination.

After the submittal of the January 1995 RFI Report, additional investigations were performed both at the 33-012(a) area, which is embedded in PRS 33-017, and within the adjacent drainage area. Sampling and analysis plans for this work were submitted in the September 1995 RFI Report for TA-33. The results are summarized here.

Summary of subsequent sampling: An additional three fixed-laboratory samples were collected in 1996 in the asphalt storage area that constitutes the source area for 33-012(a). Three more laboratory samples were collected on the slope below, which overlaps the vehicle maintenance area of PRS 33-017, and another laboratory sample was collected in the main drainage. An additional half dozen screening samples in the area screened negative for PCBs using a field immunoassay kit and were not submitted for laboratory analysis; one of these was from the

asphalted storage area of PRS 33-012(a). Of the seven laboratory samples collected at the storage area (including the four in the January 1995 report), PCBs were detected above 1 mg/kg in only one—AAA2032—for which the result (2.3 mg/kg of Aroclor 1254) is included in Table 4-11 of the January 1995 report. Results for the other six samples were below 0.3 ppm. AAA2032 was collected beneath asphalt. The figure in Attachment F shows PCB sampling points and the relationship of PRSs in this area.

Investigations and remedial actions in the nearby drainage are continuing. Aroclor 1254 [the type that appears to be associated with PRS 33-012(a)] was detected at 2.4 mg/kg in one of the slope samples below PRS 33-012(a) within PRS 33-017 vehicle maintenance area, and below 1 mg/kg in one sample from the main drainage. Aroclor 1260 (associated with the Main Site transformer PRS C-33-001 several hundred feet away) was measured at levels up to 5.5 mg/kg in the sediments of the main drainage channel. As a best management practice, straw bales are in place in the drainage and are inspected at least annually.

9. **33-015 Incinerator:** LANL must revise the screening assessment for this PRS based on recent regulatory guidance [Risk Assessment Guidance for Superfund Volume 1, Human Health Evaluation Manual (Part A) pp. 8-12, 8-13. OSWER 9285.7-01A, December 1989].

Response: The conclusions presented in this January 1995 RFI Report detail a screening assessment conducted in accordance with the process outlined in Appendix J of the 1993 version of the IWP. This was the best and most recent guidance available to the report writers at that time. The screening assessment process performed in this report is essentially the same as is conducted today under recent regulatory guidance. The recent regulatory guidance used in the development of the LANL screening process is based primarily on the Proposed Subpart S RCRA Corrective Action regulation, and EPA's Soil Screening Guidance Document itself (EPA Soil Screening Guidance Fact Sheet, Users Guide, and Technical Background Document, 1996).

The multiple constituenct evaluation in the January 1995 RFI Report was based on an MCE for individual samples. Current LANL guidance directs that MCEs be based on the highest concentration of each contaminant in the entire sampling set for each PRS. For the convenience of NMED, LANL has redone the MCE using current SALs and LANL background UTLs (Table 9-1). Phenanthrene (detected at 0.37 mg/kg) is not included in the MCE because it has no SAL.

TABLE 9-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-015

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Cadmium	33-1094	AAA2039	8.9	380	0.03
Lead	33-1093	AAA2038	350	400	.88
Silver	33-1093	AAA2038	19	380	0.05
Zinc	33-1093	AAA2038	740	23 000	0.03
Fluoranthene	33-1109	AAA2056	0.41	2 600	0.0002
Pyrene	33-1109	AAA2056	0.36	1 900	0.0002
				Total	**1**

Lead is by far the leading contributor to the MCE result. At the time of the January 1995 report, LANL was instructed to presume that TA-33 may be released from laboratory control. Current guidance indicates that the technical area will remain under institutional control. Therefore, from a human health risk assessment standpoint, an industrial scenario with a cleanup level of 1 000 mg/kg for lead is appropriate. The maximum concentration for lead (350 mg/kg) is well below this threshold. LANL presumes that the lead and silver contamination derive from paint on the incinerator. If TA-33 is released to public, the incinerator will be removed under decontamination and decommissioning protocol.

10. **33-007(c) Firing Area:**

a. LANL shall conduct a Phase II investigation to determine the nature and extent of contamination above background and UTLs.

Response: LANL believes that no further investigations are necessary. Surface sampling in the area potentially affected by firing site activities at 33-007(c) has been extensive. Thirty-one surface samples from 22 locations covering approximately 3.5 acres around this firing site are discussed in the January 1995 RFI Report. These samples reveal no widespread contamination.

Above-background levels of antimony, cadmium, chromium, lead, nickel, and zinc were found at one location, near the barricade that separates the excavated part of the cinder cone from the main section of Area 6. A revised MCE for noncarcinogenic effects (using the maximum contaminant concentration over the entire data set) indicates that these contaminants do not present a hazard to human health (Table 10-1). Chromium, a carcinogen,

is not included in the MCE. Uranium was found above SAL; however, extensive sampling indicates that high levels of uranium are not widespread at Area 6. The range of uranium concentrations (3—5.5 mg/kg) above UTL, other than at this one location near the barricade, are little above background UTL (1.87 mg/kg).

TABLE 10-1
MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-007(c)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Antimony	33-1211	AAA2164	2.6	31	0.08
Cadmium	33-1211	AAA2038	4.4	200	.02
Lead	33-1211	AAA2038	150	400	0.4
Nickel	33-1211	AAA2039	850	6 500	0.1
Zinc	33-1211	AAA2056	220	23 000	0.01
				Total	**0.6**

Across the entire PRS, only nickel (21—67 mg/kg) appeared to be widespread in the area when compared with LANL background, as shown in Table 4-14 of the January 1995 report. However, the background samples of the basaltic cinder cone material that underlies Area 6 show that nickel concentrations in this substrate are unusually high (see Figure 3-2 and the discussion in Section 3.2.2.1 of the January 1995 report). By comparison with these data, the impact of Area 6 activities on nickel concentrations is minimal, and in any case well below screening action levels.

Except for the barricade sample mentioned above, lead (36—80 mg/kg), zinc (75—130 mg/kg), and beryllium (2.3—2.4 mg/kg) are detected only sporadically and at concentrations far below screening action levels (Table 4-14 of the January 1995 RFI Report). LANL believes that the extent of surface contamination has been adequately characterized by the Area 6—wide sampling of the 1993 campaign.

Because extensive sampling has not shown widespread contamination and no surface ponding areas have been identified at Area 6 that could drive contaminants into the subsurface, LANL believes that no further investigations at 33-007(c) are needed. If, after reviewing the arguments presented above, NMED still believes that a SAP is necessary, LANL requests a more specific statement of NMED's concerns.

b. The AA recommends that LANL perform an interim action to remove the uranium chunks at this PRS.

Response: LANL appreciates NMED's interest in the radioactive component of this PRS. Please be advised that LANL conducted a pilot project in 1996 consisting of a voluntary corrective action to remove uranium from the catcher boxes at PRS 33-007(c). Methodology included separation of contaminated soil from clean soil using the commercial Segmented Gate System™ of ThermoNutech™. A report of the cleanup has been written and submitted to DOE. A draft of that report is included as Attachment G to this response. The final report awaits assessment for ecotoxicological and other applicable regulations at TA-33.

11. **33-011(a) Storage Area:** LANL must revise the screening risk assessment to include PAHs. The PAH levels are not comparable to the urban values presented in "Background Levels of Polycyclic Aromatic Hydrocarbon (PAH) and Selected Metals in New England Urban Soils" [EPA letter to Mr. Taylor dated may 19, 1995: Evaluation of Interim Guidance for Evaluating Polycyclic Aromatic Hydrocarbons in Soil].

Response: LANL acknowledges that the Bradley approach to screening for PAHs is no longer acceptable to EPA and has been withdrawn from use by the ER Project. However, LANL does not feel that this screening assessment need be revised for this PRS because the authors conservatively proceeded to the next step and presented a human health risk evaluation for PAHs. Decisions for this PRS are based on the preliminary risk calculations. Results from the risk evaluation indicate acceptable levels of risk under residential and recreational scenarios.

LANL recommends no further action for human health effects at PRS 33-011(a) under Criterion 5. The area has been used extensively as a parking lot and as a storage area for drilling equipment for many years. Contaminants found during the 1993 sampling campaign consist of constituents associated with these uses and concentrations are not out of line with similar areas at LANL.

ATTACHMENT A

Appendix D, Section 3.0 of the September 1995 TA-33 RFI Report.

Risk calculations for lead at PRS 33-017.

Reference: Environmental Restoration Project, September 29, 1995. "RFI Report for TA-33, PRSs 33-003(a), 33-004(a), 33-007(c), 33-009, 33-011(d), 33-013, 33-016, 33-017 and Revised Sampling Plans for PRSs 33-003(b), 33-004(k), 33-008(a), 33-008(b), C-33-001, C-33-002," Los Alamos National Laboratory Report LA-UR-95-3625, Los Alamos, New Mexico. **Environmental Restoration Project 1995, 1265)**

0

3.0 RISK CALCULATION FOR LEAD AT SWMU 33-017 VEHICLE MAINTENANCE AREA

Preliminary risk assessment results for the area east of TA-33-39 were discussed in Subsection 4.8.3.3 of this RFI report. This subsection discusses the calculations leading to these results. Analytical results for lead used in the calculations are given in Table D-1.

TABLE D-1

LEAD VALUES IN EXPOSURE UNIT EAST OF TA-33-39

PRS[a]	SITE ID	SAMPLE ID	LEAD (mg/kg)
33-004(i), north	33-1055	AAA1975	10
	33-1056	AAA1976	79
	33-1057	AAA1977	73
33-004(i), south	33-1058	AAA1978	800
	33-1059	AAA1979	71
	33-1060	AAA1980	210
33-012(a)	33-1086	AAA2031	104
	33-1087	AAA2032	118
	33-1088	AAA2033	53
	33-1089	AAA2034	9
33-017, vehicle maintenance area	33-1102	AAA2049	64
	33-1103	AAA2050	90
	33-1104	AAA2051	170
33-017, top of main drainage	33-1105	AAA2052	46
	33-1106	AAA2053	98
	33-1107	AAA2054	200

[a] PCB = Polychlorinated biphenyls.

3.1 Calculations for Lead at the SWMU 33-017 Exposure Unit

The calculation of the mean and upper confidence bound for lead contamination in the exposure unit east of TA-33-39 followed the method for minimum variance unbiased (MVU) estimation for lognormal populations described by Gilbert (1987, 0506), pp. 165-166. The data in Table D-1 are seen to be approximately lognormally distributed in the probability plot of Fig. D-1. (This is a probability plot, that is, the observed values have been sorted and plotted on a logarithmic scale against order statistics from the standard normal distribution. Data from a log-normal distribution should fall approximately along a straight line in such a plot. The departures from a straight line that occur at the low end in Fig. D-1 inflate the estimate of the variance and the estimates of the mean, see Equation 1 below, and especially of the upper confidence interval.)

The MVU estimate of the mean is

$$\hat{\mu} = [\exp(\bar{y})]\Psi_n\left(\frac{s_y^2}{2}\right) \qquad (1)$$

where is the sample mean of the logged data, is the sample variance, n is the sample size, and is a function tabled in Gilbert's book (although for our calculations we programmed this function using the series expansion given on p. 165 of that book and verified our program by comparing its results with Gilbert's Table A9.) An unbiased estimator of the variance of is given by

$$s^2(\hat{\mu}) = \exp(2\bar{y})\left\{\left[\Psi_n\left(\frac{s_y^2}{2}\right)\right]^2 - \Psi_n\left(\frac{s_y^2(n-2)}{n-1}\right)\right\} \qquad (2)$$

and thus a 95% upper confidence interval for the mean is computed finally as

$$\hat{\mu} + t_{n-1,0.95}s(\hat{\mu}) \qquad (3)$$

assuming approximate normality of the estimate (an application of the Central Limit Theorem of probability theory) with the usual number of degrees of freedom.

Risks were estimated using the EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model, Version 0.99d (EPA 1994, 1178). This model considers exposure to lead from several pathways and correlates total exposure to a blood lead level, which is the standard descriptor of lead exposure. The IEUBK model applies to young children from birth to seven years because children are more sensitive to lead toxicity than adults. According to EPA, an acceptable risk for lead exposure is less than 5% of the population expected to have blood lead levels of greater than 10 µg/dL. Results of the modeling effort for TA-33 reveal that 1.66% of a hypothetical population of children exposed to 416.3 mg/kg of lead would exceed the standard value of 10 µg/dL, indicating that adverse health effects from lead exposure are unlikely at this site.

ATTACHMENT B

Sampling and Analysis Plan for PRS 33-004(g).

SAMPLING AND ANALYSIS PLAN
SUPPLEMENTAL SAMPLING AT PRS 33-004(g)

1.0 PROBLEM DEFINITION

PRS 33-004(g), an outfall at TA-33 Area 6, was sampled in May 1993. The Phase I results and discussion are included in the January 1995 RFI Report for TA-33 (LANL 1995, 1212). Samples were collected at the end of the outfall pipe, in the drainage channel below, and at the downgradient end of a culvert draining into the same channel a few feet from the outfall. All were surface samples except the first, for which the end of the pipe had to be excavated so that the sample could be collected immediately below it. This was the only sample in which significant levels of contamination were observed (barium, lead, silver and zinc). This work plan will provide additional samples at depth in order to bound the extent of contamination at this location.

1.1 Site Description

TA-33, located at the southeastern section of the Laboratory, is divided into five discontinuous areas. Area 6, South Site, and East Site were firing sites. PRS 33-004(g) was the outfall from building TA-33-16 at Area 6. A drainline of vitrified clay pipe exits the northwest corner of the building and daylights at the rim of the leveled area above a channel leading to a tributary of Chaquehui Canyon. The outfall discharged at the rim of a steep-sided canyon about 70 ft deep.

The soil is a mixture of clay, small basalt cinders, and tuff pebbles with organic matter from a thick growth of chamisa. The soil is 3—4 ft deep, deposited as a result of leveling the site for construction. Because Area 6 is built upon a large cinder cone, it is unlikely that tuff bedrock underlies the outfall. West of the outfall, soils become thin and intermix with tuff outcrops. The area receives sheet runoff from nearby asphalt paving. West of the outfall area is a steep 40-ft drop into the adjacent tributary of Chaquehui Canyon. This part of the channel consists of tuff blocks and boulders with little soil. A short culvert under an unimproved road also empties into this channel a few yards west of the outfall. The culvert drains much of the Area 6 pavement.

At present, all runoff at this site is from rain or snow. TA-33-16 no longer has a water supply.

1.2 Historical Data

TA-33-16 was used as a gun building for initiator tests at Area 6 between 1948 and 1955. Photo developing may have been performed in the building or in a small trailer parked next to the drainage. In 1956, TA-33-16 was used for experiments in laminating materials containing barium, titanium, lead, and zinc. The building was later used for a library and storage. It has been empty since 1991.

Potential contaminants expected from the archival investigation were inorganics, VOCs, SVOCs, high explosives, and uranium. In the 1993 sampling campaign, five samples were collected: one immediately below the outfall, three more in sediment traps about 100 ft apart in the drainage, and one at the outfall of the nearby culvert. All samples were analyzed for SVOCs, uranium, gamma emitters, inorganics, and explosives. Results indicated that radionuclides were within background ranges for all samples. No explosives were reported above detection levels. Other analytes were either within Laboratory background ranges or below detection levels in all samples except sample AAA2145, the sample at the SWMU 33-004(g) outfall. In this sample, elevated levels of silver, barium, lead, and zinc were observed, consistent with archival information about the laminating experiments and photo developing in TA-33-16. Table 1.1-2 lists the contaminants in comparison to current (November 1997) Laboratory background UTLs and SALs. PCBs were also reported as TICs in sample AAA2145. PCBs were not considered to be a potential contaminant associated with PRS 33-004(g). However, they are one of the primary contaminants associated with overlapping PRS 33-009. Further investigation and possible cleanup of PRS 33-009 has been proposed.

TABLE 1.1-2

INORGANIC CHEMICALS DETECTED IN SAMPLE AAA2145

SAMPLE ID	SILVER (mg/kg)	BARIUM (mg/kg)	LEAD (mg/kg)	ZINC (mg/kg)
SAL[a]	380	5 300	400	23 000
LANL UTL[b]	Not Calculated	315	23.3	50.8
AAA2145	16.7	1 320	244	285

a. EPA Region 9 1996 SALs
b. 0.95, 95% LANL UTLs

2.0 SAMPLING AND ANALYSIS DESIGN

2.1 Survey Activities

Sample locations will be recorded using global positioning system technology. No other survey activities are anticipated.

2.2 Sampling and Analysis

One borehole will be drilled at the outfall at the location of 1993 sample AAA2145 (Fig. 2.2-1). One surface sample (that is, a sample immediately beneath the end of the outfall pipe) will be collected and analyzed for PCBs (which were reported as tentatively identified compounds in AAA2145). Additional samples will be collected at 2 ft and at 5 ft or at the soil/tuff interface, whichever is shallower. However, a soil/tuff interface is not expected within five feet of the surface in this area because of the presence of the extensive basaltic cinder cone and fill material.

One field duplicate (split sample) will be collected at the 2-ft depth.

TABLE 2.2-1
SAMPLES AND ANALYSES FOR PRS 33-004(g)

DEPTH (in)	MEDIUM	NUMBER OF SAMPLES	ANALYTICAL SUITES
0-6[a]	Soil	1	VOCs, PCBs
18-30	Soil or soil/tuff	1+duplicate	Inorganics, VOCs, PCBs
48-60	Soil or soil/tuff	1	Inorganics, VOCs, PCBs

[a] Depth is to be measured from the bottom edge of the outfall pipe, which may have to be reexcavated to obtain this "surface" sample

All samples will be analyzed for inorganics, VOCs, and PCBs. Concentration ranges, precision, and bias of analytical techniques specified under the current LANL ER statement of work will be adequate to meet the critical ranges of interest at this PRS. In addition, contract laboratories will provide standard quality control measurements: surrogates, blanks, check standards, matrix spikes, etc., as specified by the analytical procedures requested, and will supply complete analytical data packages supporting the reported results, as specified in the current LANL ER statement of work for contract laboratories.

3.0 SAMPLING PLAN IMPLEMENTATION

Details of field implementation will be described in a TA-33 field implementation plan. All work will be conducted using LANL ER Project standard operating procedures (SOPs).

3.1 Field Methods

Sample location AAA2145 will not be resurveyed.

All samples will be collected using the applicable LANL-ER SOPs for the collection, preservation, identification, storage, transport, and documentation of environmental samples, as described in the ER Project quality assurance project plan (QAPP) (LANL 1996, 1292). Decontamination of sampling equipment will be performed in accordance with LANL-ER-SOP-01.08, R0: "Field Decontamination of Drilling and Sampling Equipment." Wash water and other wastes generated during the sampling operation will be managed and disposed of in accordance with LANL-ER-AP-05.3: "Management of ER Program Wastes."

3.2 Sampling

Appropriate health and safety precautions will be undertaken under the site-specific health and safety plan for TA-33 in accordance with 29 CFR 1910.120, the LANL radiological control manual, and the LANL generic health and safety plan.

Sampling Techniques Surface samples will be collected using a spade and scoop method according to LANL-ER-SOP-06.09. Subsurface sediment samples will be collected with the hand auger and thin-walled tube sampler method according to LANL-ER-SOP-06.10. Borehole samples will be collected using drilling techniques according to LANL-ER-SOP-04.01, R0.

3.3 Laboratory Analyses

All soil, sediment, and tuff samples submitted for laboratory analyses will be analyzed using routine laboratory contract methods under the current statement of work. Inorganic analyses will be performed by EPA SW-846 method 6010 or equivalent. VOC analyses will be by EPA SW-846 method 8260 or equivalent. Laboratory samples will be analyzed for PCBs by EPA method 8080A (EPA 1990, 11-240).

3.4 Sample Handling, Packaging, and Shipping

Samples will be handled, packaged, and shipped in accordance with the latest revisions of the applicable LANL ER Program SOPs: LANL-ER-SOP-01.01, "General Instructions for Field Investigations;" LANL-ER-SOP-01.02, "Sample Containers and Preservation;" LANL-ER-SOP-01.03, "Handling, Packaging, and Shipping of Samples;" LANL-ER-SOP-01.04, "Sample Control and Field Documentation;" and LANL-ER-SOP-01.05, "Field Quality Control Samples." Samples will be submitted to off-site contract analytical laboratories through the ER sample management office (SMO) under the current statement of work.

3.5 Waste Management

Waste management and minimization will conform to LANL policies EM/ER:95-PCT-025, "Management of Investigation Derived Waste" and EM/ER:96-PCT-002, "Management of Samples Returned from Analytical Laboratories."

3.6 Schedule

All sampling will be completed by September 30, 1999, unless otherwise agreed upon by LANL and NMED. The RFI Report will be completed as scheduled by the ER Project. A detailed schedule will be provided in the field implementation plan (see Section 5.1).

4.0 DATA ASSESSMENT

4.1 Verification

Data packages will be checked for completeness and reported deficiencies by routine data verification and validation procedures (Environmental Restoration Project 1995, 1292). Focused validation will be performed only if routine validation indicates possible problems with analytes of concern.

4.2 Transmittal of Results

Field data will be collected and documented in field notebooks and field sample collection logs. Additionally, required field data will be provided in electronic form and uploaded to FIMAD within two weeks of the completion of fieldwork.

Analytical results will be returned to the SMO from off-site contract analytical laboratories. Complete data packets, adequate to support focused validation if necessary, will be provided. Data will be uploaded into the FIMAD database by the SMO (Environmental Restoration Project 1996, 1292).

5.0 ADMINISTRATION

5.1 Task Organization

Task organization, training, records, and oversight will be detailed in the field implementation plan, which will be made available for review by the project manager at least one week prior to the scheduled readiness review for this activity.

Records Copies of field logs and other field information will be supplied, together with information captured in the field database. Field information will include a detailed description of the subsurface material at the selected sampling location.

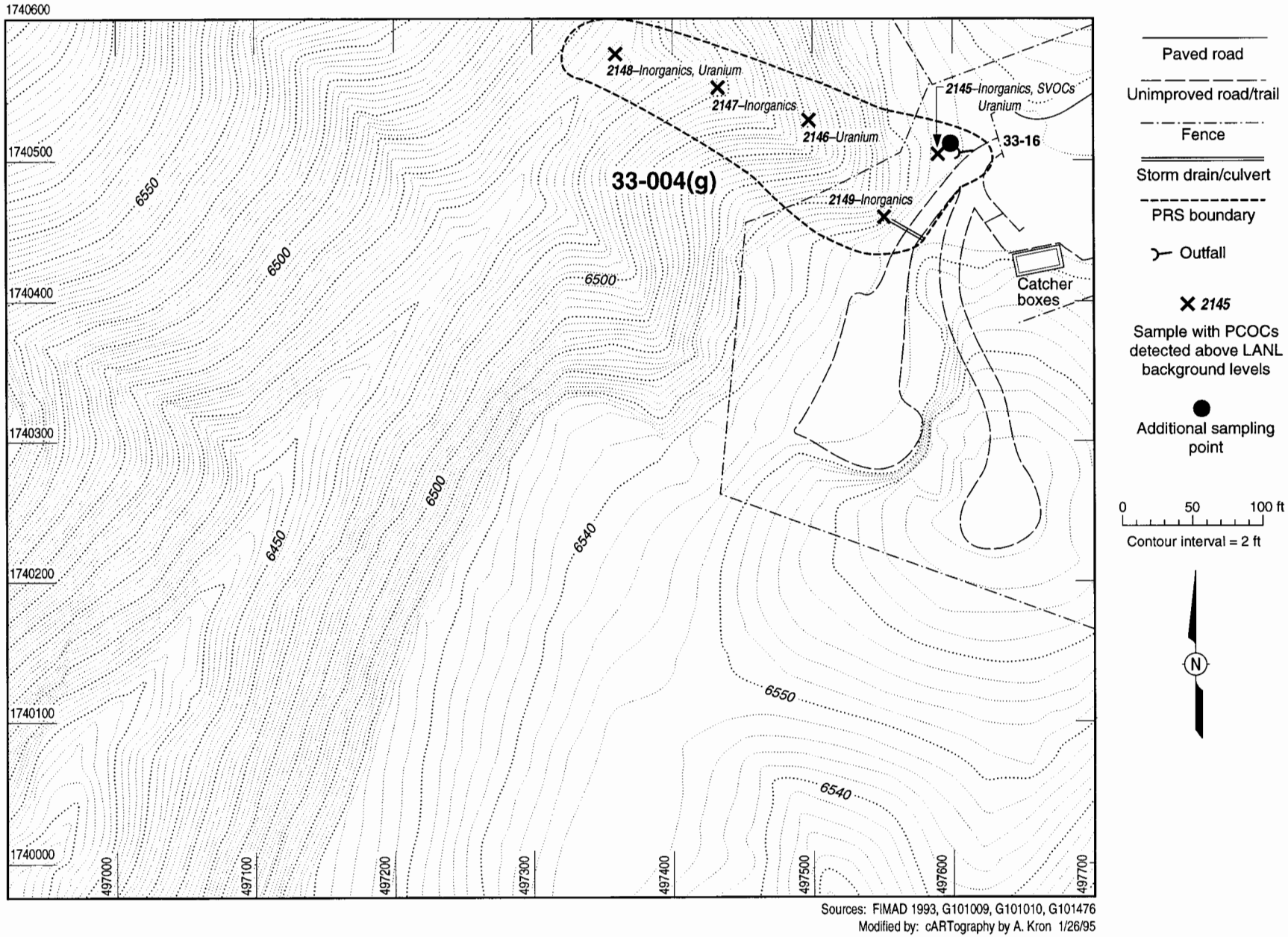
Reports A field summary report prepared following the field activities will be submitted to the ER records processing facility.

REFERENCES

Environmental Restoration Project, January 31, 1995. RFI Report for Potential Release Sites at TA-33 (located in former Operable Unit 1122), Field Unit 3, Los Alamos National Laboratory Report No. LA-UR-95-882, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1212)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory Report No. LA-UR-96-441, Los Alamos, New Mexico. **(LANL 1996, 1292)**



Sources: FIMAD 1993, G101009, G101010, G101476
Modified by: cARTography by A. Kron 1/26/95

Fig. 2.2-1. Area 6: PRSs 33-004(g).

ATTACHMENT C

Santa Fe Engineering report for TA-33-20.

Reference: LANL (Los Alamos National Laboratory), January 1992. "Wastewater Stream Characterization for TA-33, 39, 49, and 69," prepared for the Los Alamos National Laboratory, Los Alamos, New Mexico under subcontract 9-XG8-2874P-1 by Santa Fe Engineering, Santa Fe, New Mexico. **(LANL 1992, 02-096)**

WASTEWATER STREAM CHARACTERIZATION FOR TA-33, 39, 49 AND 69

ENVIRONMENTAL STUDY

prepared for:
THE LOS ALAMOS NATIONAL LABORATORY
Los Alamos, New Mexico

under subcontract 9-XG8-2874P-1

by:
Santa Fe Engineering, Ltd.
P.O. Box 1764
Santa Fe, New Mexico 87504
(505) 988-7438

January, 1992

UPDATED PER EM-8 COMMENTS SEPTEMBER 1993

equipment drains (six) and an air compressor. The air compressor discharge should be containerized. The mechanical equipment drains (boiler (3), water heater (1), backflow preventer (1) and expansion tank (1)) should be repiped to discharge to daylight and should be included in a general Laboratory Notice of Intent (NOI) to discharge. No permitting is recommended. No EPA Forms were completed.

6.0 RECOMMENDATIONS FOR BUILDING 33-20

Table 3 is a list of the drains to the building outfall and Figure 3 is a schematic of the piping. This building has two floor drains that are supposed to go to daylight to the canyon east of the building. The outfall pipe could not be located. The building has no source of water for the drains. Plugging of the floor drains is recommended. No permitting is recommended and no EPA Forms were completed.

7.0 RECOMMENDATIONS FOR BUILDING 33-23

Table 4 is a list of the drains to the building outfall and Figure 4 is a schematic of the piping. The sink that flows to this outfall does not presently have any water supply. Schon Levy of the Geology and Geochemistry Group (EES-1) would like to be able to use the sink for hand washing. For this purpose, the existing outlet to daylight from the settling tank should be plugged and the tank included on the schedule for the vacuum truck that cleans out the septic tanks. No permitting is recommended and no EPA Forms were completed. It should be noted that there is a septic system holding tank (LA-124/33-206) located immediately adjacent to this building. This tank was installed to service a mobile home trailer that has been removed. This tank does not service building 33-23 and should be decommissioned and the state permit eliminated.

TABLE 1: TA 33-1 DRAIN SUMMARY

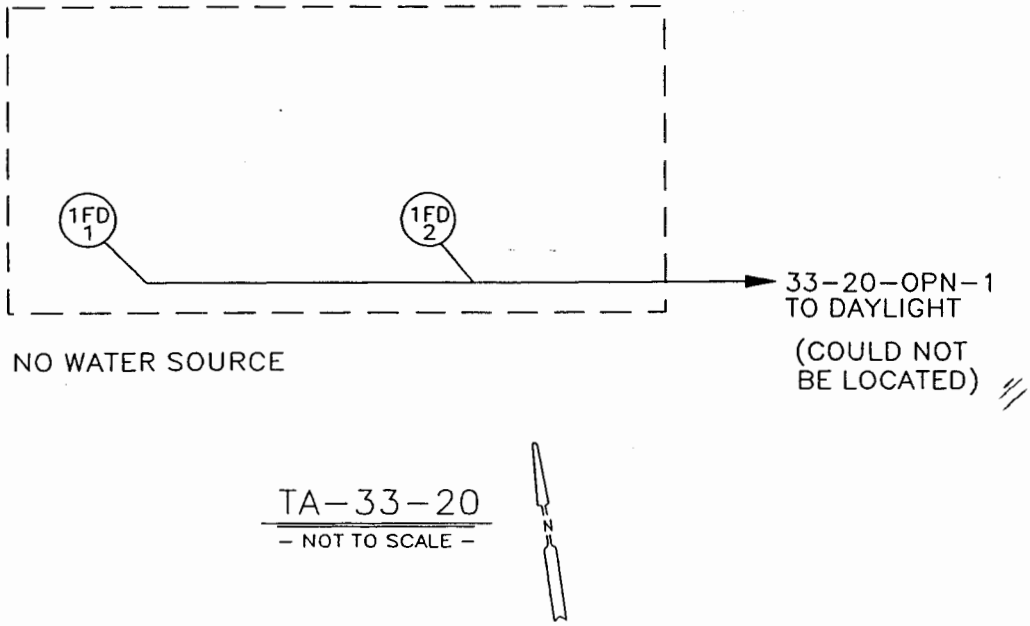
OUTFALL NUMBER	ID NUMBER	ROOM ACTIVITY	ROOM NUMBER	STATUS OR RECOMMENDATIONS	EPA FORM PREPARED
33-1-OPN-1 SEPTIC TANK LA-36	1LV1	REST ROOM		PLUG	no
	1TL1	REST ROOM		PLUG	
33-1-OPN-2	N/A	WATER HEATER		ELIMINATE	no
33-1-OPN-3	N/A	STEAM CONDENSATE		ELIMINATE	no

TABLE 2: TA 33-19 DRAIN SUMMARY

OUTFALL NUMBER	ID NUMBER	ROOM ACTIVITY	ROOM NUMBER	STATUS OR RECOMMENDATIONS	EPA FORM PREPARED
33-19-OPN-1 SEPTIC TANK LA-32	1ED1	LAB	4	NO CHANGE	no
	1FD1	CORRIDOR	N/A	NO CHANGE	
	1FD2	LAB	2	NO CHANGE	
	1FD3	LADIES REST ROOM	8	NO CHANGE	
	1FD4	MEN'S REST ROOM	9	NO CHANGE	
	1FD5	EQUIPMENT ROOM	10	MODIFY	
	1LV1	LADIES REST ROOM	8	NO CHANGE	
	1LV2	MEN'S REST ROOM	9	NO CHANGE	
	1LV3	MEN'S REST ROOM	9	NO CHANGE	
	1SD1	LAB/OFFICE	4	NO CHANGE	
	1SD2	JANITOR'S CLOSET		NO CHANGE	
	1SD3	LAB	3	REMOVED	
	1SD4	CORRIDOR		REMOVED	
	1SD5	LAB/OFFICE	5	NO CHANGE	
	1SH1	LOCKER ROOM	7	NO CHANGE	
	1SH2	LOCKER ROOM	7	NO CHANGE	
	1SH3	LADIES REST ROOM	8	NO CHANGE	
	1TL1	LADIES REST ROOM	8	NO CHANGE	
	1TL2	MEN'S REST ROOM	9	NO CHANGE	
	1TL3	MEN'S REST ROOM	9	NO CHANGE	
	1UR1	MEN'S REST ROOM	9	NO CHANGE	
	1WF1	CORRIDOR	N/A	NO CHANGE	
	RD1	ROOF	N/A	SEPARATE	
	RD2	ROOF	N/A	SEPARATE	
	RD3	ROOF	N/A	SEPARATE	
	RD4	ROOF	N/A	SEPARATE	

TABLE 3: TA 33-20 DRAIN SUMMARY

OUTFALL NUMBER	ID NUMBER	ROOM ACTIVITY	ROOM NUMBER	STATUS OR RECOMMENDATIONS	EPA FORM PREPARED
33-20-OPN-1 DAYLIGHT	1FD1	WAREHOUSE		PLUG	no
	1FD2	WAREHOUSE		PLUG	



TA-33-20

– NOT TO SCALE –

SYMBOL LEGEND	
FD	FLOOR DRAIN

NOTE:

SCHEMATIC BASED ON DRAWINGS C-11538, C-11588 & R-3023 AND SITE VISIT

SANTA FE ENGINEERING, LTD.

TA-33-20
DRAIN SCHEMATIC

DRAWN	G.S.
DESIGN	S.C.D.
CHECKED	S.C.D.
DATE	6-21-93

SUBMITTED | RECOMMENDED | APPROVED

Los Alamos — Los Alamos National Laboratory, Los Alamos, New Mexico 87545

SHEET | OF

CLASSIFICATION | REVIEWER | DATE

REQUESTING DIVISION	LAB JOB NO.	DRAWING NO.	REV
REQUESTING GROUP EM-8	11056-26	FIGURE 3	

ATTACHMENT D

Sampling and Analysis Plan for PRS 33-010(f).

SAMPLING AND ANALYSIS PLAN
SUPPLEMENTAL SAMPLING AT PRS 33-010(f)

1.0 PROBLEM DEFINITION

PRS 33-010(f), a small surface disposal area at TA-33 Main Site, was sampled in May, 1993. The Phase I results and discussion are included in the January 1995 RFI Report for TA-33 (LANL 1995, 1212). Samples were collected from beneath the piles of discarded material at the site. Although no contamination was found in these samples, this supplemental sampling plan will provide additional samples from the small drainage leading away from the area.

1.1 Site Description

TA-33, located at the southeastern section of the Laboratory, is divided into five discontinuous areas. Area 6, South Site, and East Site were firing sites. Main Site is the location of offices, shops, and a warehouse. PRS 33-010(f) is located at the southeast corner of Main Site, approximately 100 ft southeast of MDA K and 350 ft southeast of the decommissioned tritium facility, TA-33-86.

PRS 33-010(f) is located approximately 100 ft southeast of MDA K and 350 ft southeast of the decommissioned tritium facility, TA-33-86. The PRS consists of two small piles: one about 15 ft square, the other about 10 ft wide and 20 ft long. One pile consists of pieces of concrete, the concrete and metal pipe remains of a culvert, piles of tuff, and piles of cured asphalt. The other pile contains rusty metal rebar, rusty metal strapping bands, rusty metal cans, and other debris. The piles are located about 50 ft apart on the slope of a small tributary to the main drainage leading east from Main Site.

The soil consists of pumaceous pebbles mixed with clay. Though the soil depth is unknown, nearby bedrock drainages indicate soil/tuff interfaces at 1—5 ft may be expected. The area is sparsely wooded with piñon and juniper trees and covered with scattered grasses. All runoff is from rain or snow; there are no water sources or standing water.

1.2 Historical Data

PRS 33-010(f) surface disposal area appears to be a dumping area for items not associated with experimental activities at TA-33. Nothing is known of the origins of the debris piles. One of the debris piles appears to be the result of culvert replacement, but the former location of the culvert is not known. The other pile contains empty tin cans and metal strapping bands. No labels remain on the cans to indicate the contents. Potential contaminants included inorganics, radionuclides, herbicides, and pesticides.

During the 1993 sampling campaign, SWMU 33-010(f) was included in the general grid-based radiation survey called for in the RFI Work Plan for OU 1122. As specified in the work plan, one sample was collected at random within each pile, one in duplicate, one in triplicate, for a total of five sets of results. Because there were no visible indications of soil staining, sampling locations were chosen at random from each pile. Samples were analyzed for inorganics, gamma emitters, and tritium. (Also, as part of the TA-33 strategy to analyze a subset of samples for pesticides and herbicides, one pair was analyzed for these suites.) Trace levels (0.0024—0.011 mg/kg) of pesticides were found in one sample. Low levels (1.4—1.8 pCi/g) of tritium were found in all samples, far below the soil SAL of 820 pCi/g. No other analytes were found above LANL background 0.95, 95% UTLs.

2.0 SAMPLING AND ANALYSIS DESIGN

2.1 Survey Activities

Sample locations will be recorded using global positioning system technology. No other survey activities are anticipated.

2.2 Sampling and Analysis

One sample location will be identified in the drainage at a sediment trap below but within 100 feet of the lower debris pile (Fig. 2.2-1). A surface sample will be collected at 0—6 in. One subsurface sample will be collected at 5 ft or at soil/tuff interface, whichever is shallower.

Both samples will be analyzed for inorganic constituents and uranium. No herbicides or pesticides will be analyzed for because sampling in 1993 determined that both were used in the customary manner.

TABLE 2.2-1
SAMPLES AND ANALYSES FOR PRS 33-010(f)

DEPTH (in)	MEDIUM	NUMBER OF SAMPLES	ANALYTICAL SUITES
0-6	Soil	1	Inorganics, total uranium
48-60	Soil or soil/tuff	1	Inorganics, total uranium

Concentration ranges, precision, and bias of analytical techniques specified under the current LANL ER statement of work will be adequate for the ranges of interest at this PRS. In addition, contract laboratories will provide standard quality control measurements: surrogates, blanks, check standards, matrix spikes, etc., as

specified by the analytical procedures requested and will supply complete analytical data packages supporting the reported results, as specified in the current LANL ER statement of work for contract laboratories.

3.0 SAMPLING PLAN IMPLEMENTATION

Details of field implementation will be described in a TA-33 field implementation plan. All work will be conducted using LANL ER Project standard operating procedures (SOPs).

3.1 Field Methods

Land Surveys: Following sample collection, the sample point will be staked, documented, and surveyed using global positioning system technology. These data will be recorded on the base map. The surveying will be performed by licensed professionals working to minimum standards for land surveying in New Mexico with oversight by the field team leader.

All samples will be collected using the applicable LANL-ER SOPs for the collection, preservation, identification, storage, transport, and documentation of environmental samples, as described in the ER Project quality assurance project plan (QAPP) (LANL 1996, 1292). Decontamination of sampling equipment will be performed in accordance with LANL-ER-SOP-01.08, R0: "Field Decontamination of Drilling and Sampling Equipment." Wash water and other wastes generated during the sampling operation will be managed and disposed of in accordance with LANL-ER-AP-05.3: "Management of ER Program Wastes."

3.2 Sampling

Appropriate health and safety precautions will be undertaken under the site-specific health and safety plan for TA-33 in accordance with 29 CFR 1910.120, the LANL radiological control manual, and the LANL generic health and safety plan.

Sampling Techniques Surface samples will be collected using a spade and scoop method according to LANL-ER-SOP-06.09. Subsurface sediment samples will be collected with the hand auger and thin-walled tube sampler methods according to LANL-ER-SOP-06.10. Borehole samples will be collected using drilling techniques according to LANL-ER-SOP-04.01, R0.

3.3 Laboratory Analyses

All soil, sediment, and tuff samples submitted for laboratory analyses will be analyzed using routine laboratory contract methods under the current statement of work. Inorganic analyses will be performed by EPA SW-846 method 6010 or equivalent. Uranium will be analyzed by inductively-coupled plasma mass spectrometry (ICP-MS) using a total uranium digestion.

3.4 Sample Handling, Packaging, and Shipping

Samples will be handled, packaged, and shipped in accordance with the latest revisions of the applicable LANL ER Program SOPs: LANL-ER-SOP-01.01, "General Instructions for Field Investigations;" LANL-ER-SOP-01.02, "Sample Containers and Preservation;" LANL-ER-SOP-01.03, "Handling, Packaging, and Shipping of Samples;" LANL-ER-SOP-01.04, "Sample Control and Field Documentation;" and LANL-ER-SOP-01.05, "Field Quality Control Samples." Samples will be submitted to off-site contract analytical laboratories through the ER sample management office (SMO) under the current statement of work.

3.5 Waste Management

Waste management and minimization will conform to LANL policies EM/ER:95-PCT-025, "Management of Investigation Derived Waste" and EM/ER:96-PCT-002, "Management of Samples Returned from Analytical Laboratories."

3.6 Schedule

All sampling will be completed by September 30, 1999. The RFI report will be completed as scheduled by the ER Project. A detailed schedule will be provided in the field implementation plan (see Section 5.1).

4.0 DATA ASSESSMENT

4.1 Verification

Data packages will be checked for completeness and reported deficiencies by routine data verification and validation procedures (Environmental Restoration Project 1995, 1292). Focused validation will be performed only if routine validation indicates possible problems with analytes of concern.

4.2 Transmittal of Results

Field data will be collected and documented in field notebooks and field sample collection logs. Additionally, required field data will be provided in electronic form and uploaded to FIMAD within two weeks of the completion of fieldwork.

Analytical results will be returned to the SMO from off-site contract analytical laboratories. Complete data packets, adequate to support focused validation if necessary, will be provided. Data will be uploaded into the FIMAD database by the SMO (Environmental Restoration Project 1996, 1292).

5.0 ADMINISTRATION

5.1 Task Organization

Task organization, training, records, and oversight will be detailed in the field implementation plan, which will be made available for review by the project manager at least one week prior to the scheduled readiness review for this activity.

Records Copies of field logs and other field information will be supplied, together with information captured in the field database. Field information will include a detailed description of the subsurface material at the selected sampling location.

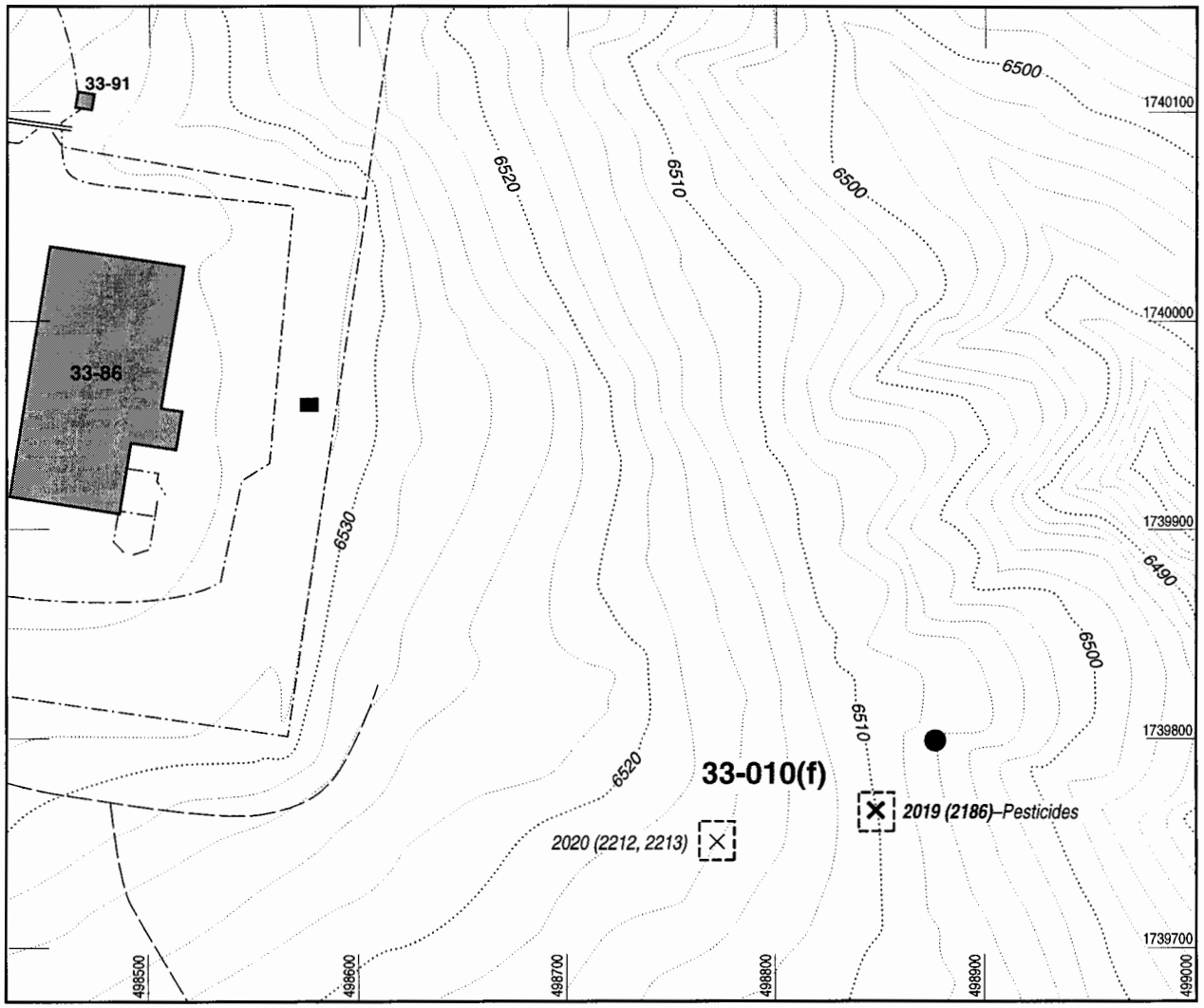
Reports A field summary report prepared following the field activities will be submitted to the ER records processing facility.

REFERENCES

Environmental Restoration Project, January 31, 1995. RFI Report for Potential Release Sites at TA-33 (located in former Operable Unit 1122), Field Unit 3, Los Alamos National Laboratory Report No. LA-UR-95-882, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1212)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory Report No. LA-UR-96-441, Los Alamos, New Mexico. **(LANL 1996, 1292)**



Sources: FIMAD 1993, G101016 & G101476
Modified by: cARTography by A. Kron 1/19/95

Permanent structure
Temporary structure
Paved road
Unimproved road/trail
Fence
Storm drain/culvert
PRS boundary
× 2020 Sample location and number—no elevated levels found
× 2019 Sample with PCOCs detected above LANL background levels
(2212, 2213) Duplicate samples are shown in parentheses
● Additional sampling point

0 50 100 ft
Contour interval = 2 ft

N

Fig. 2.2-1. Main Site: PRS 33-010(f).

ATTACHMENT E

Sampling and Analysis Plan for PRS 33-011(e).

SAMPLING AND ANALYSIS PLAN
SUPPLEMENTAL SAMPLING AT PRS 33-011(e)

1.0 PROBLEM DEFINITION

PRS 33-011(e), a former drum storage area near TA-33 Main Site, was sampled in May 1993. The Phase I results and discussion are included in the January 1995 RFI Report for TA-33 (LANL 1995, 1212). Based on information available at the time, samples were analyzed only for uranium and gamma emitters. Due to regulator concerns, further sampling and analysis for additional potential chemicals is proposed.

1.1 Site Description

TA-33, located at the southeastern section of the Laboratory, is divided into five discontinuous areas: Main Site, Area 6, South Site, East Site, and the site of a radio telescope. PRS 33-011(e) is located on the level mesa in the piñon-juniper habitat south of Main Site, along the road leading to South Site.

PRS 33-011(e) is located northwest of bunkered magazine TA-33-22. No trace remains of the former storage location, nor are drums visible on any aerial photograph of the area. Except for the parking lot in front of the bunker, the area is unpaved with a sparse grass cover. It is level with a very slight slope to the southwest into a tributary of Chaquehui Canyon. All runoff is from rain or snow; there are no water sources or standing water. Soil is sandy and rocky. Depths are unknown but nearby bedrock outcrops indicate soil/tuff interface may be within 3 ft. Tuff bedrock outcrops nearby on the canyon rim.

1.2 Historical Data

TA-33-22 was built and used as a storage facility for high explosives until the operating group left in 1972. In 1986-1987, bunker TA-33-22 was used for preparation of thin-section geological samples by EES-1 geologists. This operation was moved to Main Site within a year because the bunker has no heat or water. Drums containing kerosene, cutting oil, and isopropanol were stored on pavement near the door of the bunker. The drums contain original reagents; no waste was stored in drums at this site. LANL cannot find documentation on use of the site for other periods.

The LANL SWMU Report identified SWMU 33-011(e) as located northwest of TA-33-22, commenting that, "The DOE Environmental Survey observed and sampled an area where materials stored in drums have contaminated the soil." However, the report cited as the DOE Environmental Survey provided a map identifying the location of a nearby drum storage area, PRS 33-011(a), which was extensively sampled in 1993. (See Photographs 1, 2, and 3 for the relative positions of these areas.) This evidence cast some doubt on drum storage in the unpaved area adjacent to bunker TA-33-22.

The SWMU Report further states that in 1987, "Soil sampling near building TA-33-22 has detected uranium and gamma emitters above natural activity." (LANL 1990, 0145). The map provided in the SWMU Report indicated the location of SWMU 33-011(e) as being immediately northwest of TA-33-22. This area was analyzed for these radionuclides in 1993 by the ER Project. Prior to sampling in 1993, a grid-based radiation survey was conducted at PRS 33-011(e). This presampling radiation survey showed no levels above background. Because there were no screening or surface indications to bias sampling, two surface soil samples and a duplicate were taken at random locations within a 20 x 100 ft area. In addition, sample AAA2123 from the large-scale SWMU 33-017 sampling grid is located approximately 20 ft north of the site.

All samples were analyzed for uranium and gamma emitters. (Also, as part of the TA-33 strategy to analyze a subset of samples for pesticides and herbicides, two were analyzed for herbicides and one for pesticides.) The grid sample was also analyzed for inorganics, tritium, plutonium, and SVOCs. Uranium was found at background levels (2.2—2.8 mg/kg) in all samples, as were gamma emitters. Aniline was found at 0.4 mg/kg in the grid sample (SAL = 19 mg/kg).

2.0 SAMPLING AND ANALYSIS DESIGN

2.1 Survey Activities

Sample locations will be recorded using global positioning system technology. No other survey activities are anticipated.

2.2 Sampling and Analysis

A minimum of two samples will be located within the PRS. Because there are no visible or other indications of the exact location of former drums, sample locations will be selected at random within the area , using EPA-approved randomization methods (Fig. 2.2-1). The area near the bunker door, where the EES-1 drums are known to have been stored, will be examined as a possible sampling point. No samples will be taken on or under asphalt because SVOCs are a common component of asphalt.

Samples and analyses are summarized in Table 2.2-1. Two surface soil samples will be collected at 0—6 in. Exposed soil under the samples will be collected and field-screened for total petroleum hydrocarbons (TPH). If screening results are positive, an additional laboratory sample will be taken at 2 ft or at the soil/tuff interface (whichever is shallower) and screening will continue with the possibility of a third sample from a depth of up to 4 ft or the soil/tuff interface. If field-screening results are positive below a sample collected at 4 ft or at the soil/tuff interface, sampling will stop and the site will be evaluated for cleanup.

One field duplicate sample will be collected, collocated with one of the two surface samples. A field trip blank will be included with the VOC samples.

TABLE 2.2-1
SAMPLES AND ANALYSES FOR PRS 33-011(e)

DEPTH (in)	MEDIUM	NUMBER OF SAMPLES	ANALYTICAL SUITES
0-6	Soil	2+collocated QA	SVOCs, VOCs
12-24	Soil or soil/tuff	0—2	SVOCs, VOCs
36-48	Soil or soil/tuff	0—2	SVOCs, VOCs
NA	Distilled water	1	VOCs

All laboratory samples will be analyzed for VOCs and SVOCs. Concentration ranges, precision, and bias of analytical techniques specified under the LANL ER statement of work current will be adequate for the ranges of interest at this PRS. In addition, contract laboratories will provide standard quality control measurements: surrogates, blanks, check standards, matrix spikes, etc., as specified by the analytical procedures requested, and will supply complete analytical data packages supporting the reported results, as specified in the LANL ER statement of work for contract laboratories then current.

3.0 SAMPLING PLAN IMPLEMENTATION

Details of field implementation will be described in a TA-33 field implementation plan. All work will be conducted using LANL ER Project standard operating procedures (SOPs).

3.1 Field Methods

3.1 Field Methods

Land Surveys Following sample collection, the sample points will be staked, documented, and surveyed using global positioning system technology. These data will be recorded on the base map. The surveying will be performed by licensed professionals working to minimum standards for land surveying in New Mexico with oversight by the field team leader.

All samples will be collected using the applicable LANL ER SOPs for the collection, preservation, identification, storage, transport, and documentation of environmental samples, as described in the ER Project quality assurance project plan (QAPP) (LANL 1996, 1292). Field screening for TPH will follow LANL-ER-SOP 10.05, R0 "Field Analysis of Total Hydrocarbons Using the Hanby Method." Decontamination of sampling equipment will be performed in accordance with LANL-ER-SOP-01.08, R0: "Field Decontamination of Drilling and Sampling

Equipment." Wash water and other wastes generated during the sampling operation will be managed and disposed of in accordance with LANL-ER-AP-05.3: "Management of ER Program Wastes."

3.2 Sampling

Prior to sampling, all sample locations will be field-screened for radioactivity and VOCs to identify gross concentrations of contaminants. Appropriate health and safety precautions will be undertaken under the site-specific health and safety plan for TA-33 in accordance with 29 CFR 1910.120, the LANL radiological control manual, and the LANL generic health and safety plan.

Sampling Techniques Surface samples will be collected using a spade and scoop method according to LANL-ER-SOP-06.09. Subsurface sediment samples will be collected with the hand auger and thin-walled tube sampler method according to LANL-ER-SOP-06.10. Borehole samples will be collected using drilling techniques according to LANL-ER-SOP-04.01, R0.

3.3 Laboratory Analyses

All soil, sediment, and tuff samples submitted for laboratory analyses will be analyzed using routine laboratory contract methods under the current statement of work. Analyses will be performed by EPA SW-846 method 8260 for VOCs and 8270 for SVOCs or equivalent.

3.4 Sample Handling, Packaging, and Shipping

Samples will be handled, packaged, and shipped in accordance with the latest revisions of the applicable LANL ER Program SOPs: LANL-ER-SOP-01.01, "General Instructions for Field Investigations;" LANL-ER-SOP-01.02, "Sample Containers and Preservation;" LANL-ER-SOP-01.03, "Handling, Packaging, and Shipping of Samples;" LANL-ER-SOP-01.04, "Sample Control and Field Documentation;" and LANL-ER-SOP-01.05, "Field Quality Control Samples." Samples will be submitted to off-site contract analytical laboratories through the ER sample management office (SMO) under the current statement of work.

3.5 Waste Management

Waste management and minimization will conform to LANL policies EM/ER:95-PCT-025, "Management of Investigation Derived Waste" and EM/ER:96-PCT-002, "Management of Samples Returned from Analytical Laboratories."

3.6 Schedule

All sampling will be completed by September 30, 1999. The RFI report will be completed as scheduled by the ER Project. A detailed schedule will be provided in the field implementation plan (see Section 5.1).

4.0 DATA ASSESSMENT

4.1 Verification

Data packages will be checked for completeness and reported deficiencies by routine data verification and validation procedures (Environmental Restoration Project 1995, 1292). Focused validation will be performed only if routine validation indicates possible problems with analytes of concern.

4.2 Transmittal of Results

Field data will be collected and documented in field notebooks and field sample collection logs. Additionally, required field data will be provided in electronic form and uploaded to FIMAD within two weeks of the completion of fieldwork.

Analytical results will be returned to the SMO from off-site contract analytical laboratories. Complete data packets, adequate to support focused validation if necessary, will be provided. Data will be uploaded into the FIMAD database by the SMO (Environmental Restoration Project 1996, 1292).

5.0 ADMINISTRATION

5.1 Task Organization

Task organization, training, records, and oversight will be detailed in the field implementation plan, which will be made available for review by the project manager at least one week prior to the scheduled readiness review for this activity.

Records Copies of field logs and other field information will be supplied, together with information captured in the field database. Field information will include TPH screening results and a map of the area finally identified as most likely to have contained the drums used by EES-1.

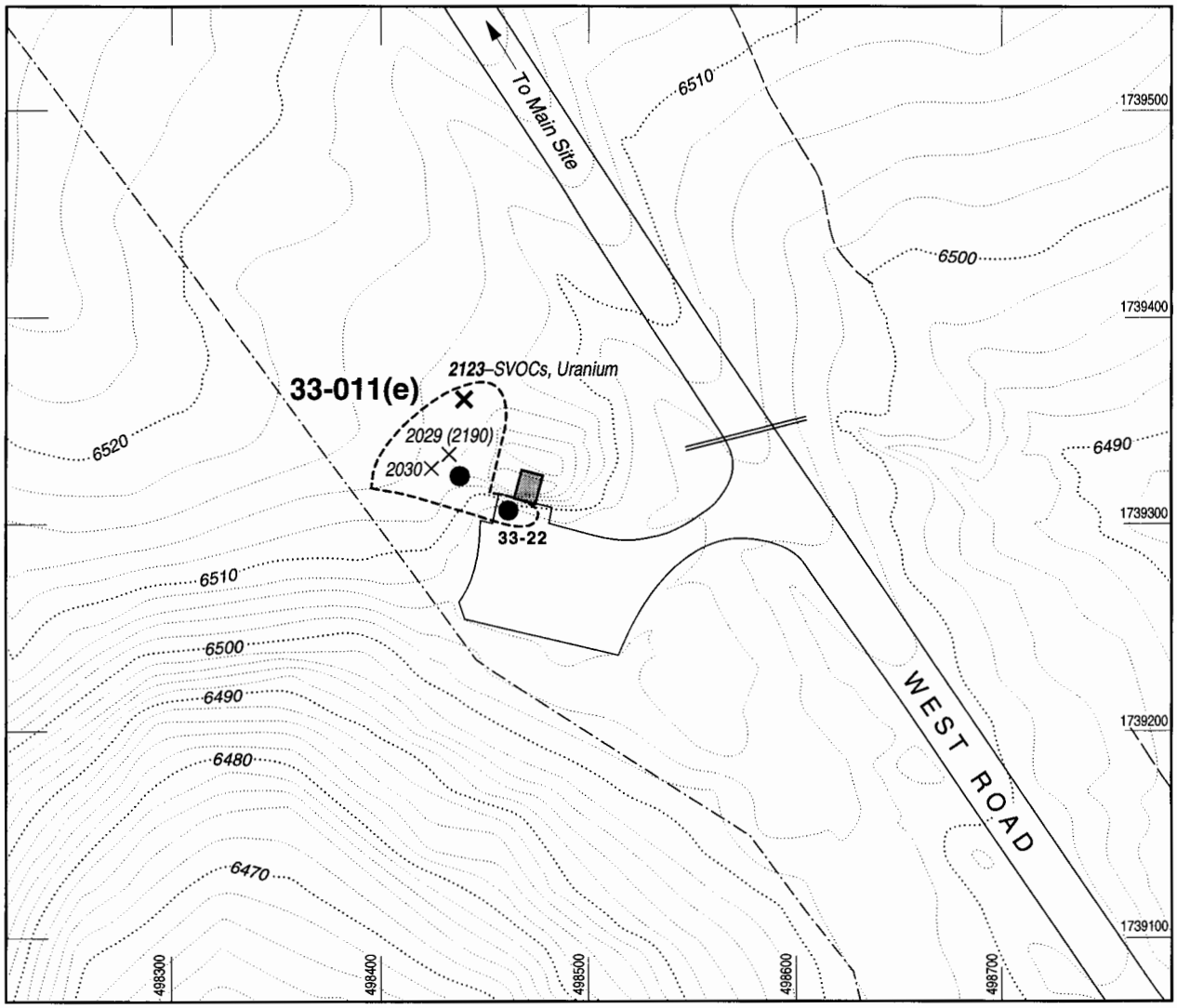
Reports A field summary report prepared following the field activities will be submitted to the ER records processing facility.

REFERENCES

Environmental Restoration Project, January 31, 1995. RFI Report for Potential Release Sites at TA-33 (located in former Operable Unit 1122), Field Unit 3, Los Alamos National Laboratory Report No. LA-UR-95-882, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1212)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory Report No. LA-UR-96-441, Los Alamos, New Mexico. **(LANL 1996, 1292)**



Sources: FIMAD 1993, G101011 & G101476
Modified by: cARTography by A. Kron 1/26/95

Permanent structure
Paved road
Unimproved road/trail
Fence
Storm drain/culvert
PRS boundary
× *2030* Sample location and number—no elevated levels found
✕ ***2123*** Sample with PCOCs detected above LANL background levels
(2190) Duplicate samples are shown in parentheses
● Conceptual sample location. Actual locations will be selected by EPA-approved randomization techniques.

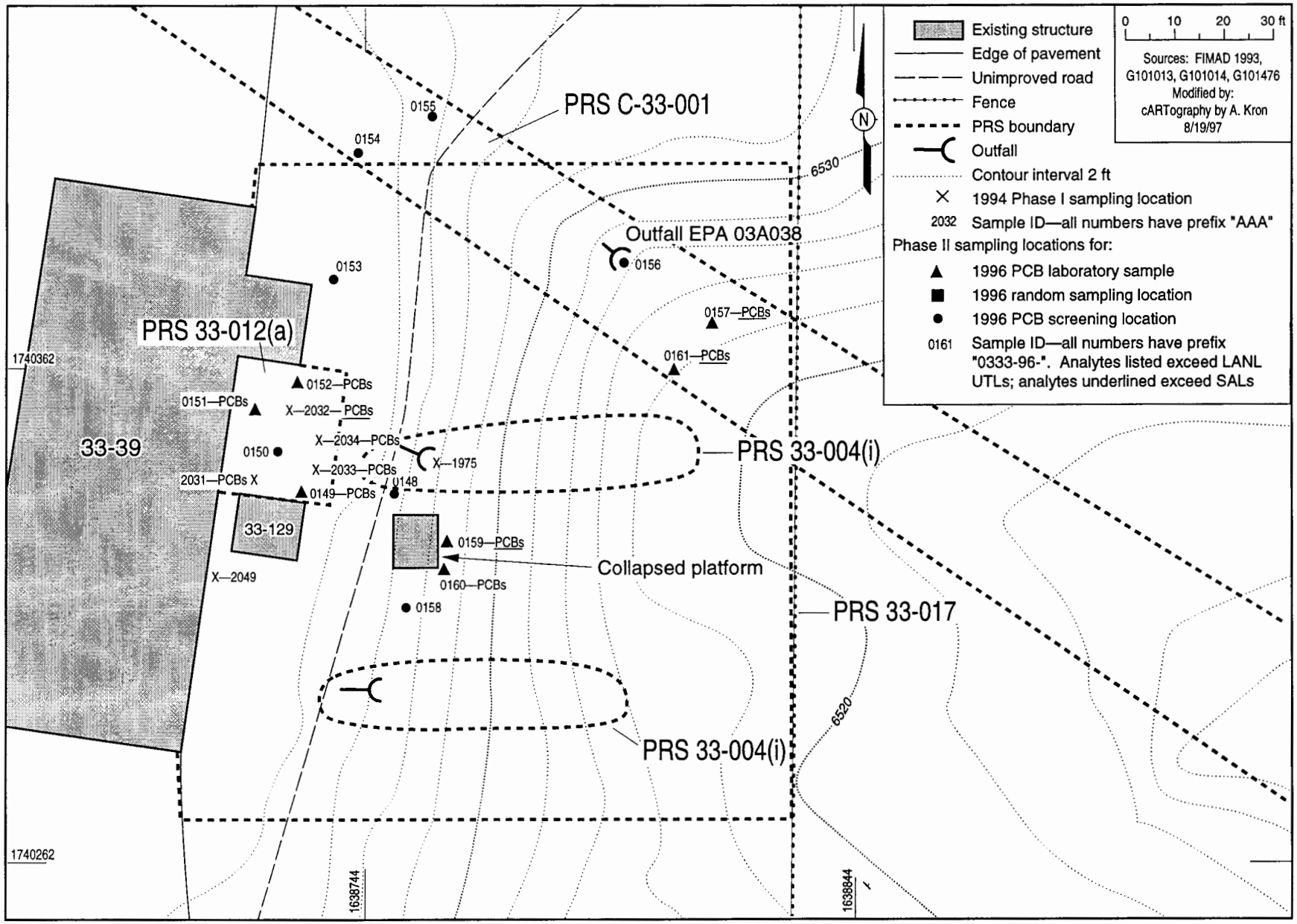
0 50 100 ft
Contour interval = 2 ft

N

Fig. 2.2-1. Main Site: PRS 33-011(e).

ATTACHMENT F

PCB Sampling points at PRSs 33-017, showing embedded PRSs 33-012(a) and 33-004(i) and runoff area from PRS C-33-001.



Attachment F. PRS 33-017 and embedded PRSs showing PCB sampling locations.

ATTACHMENT G

Voluntary Corrective Action Report for cleanup of catcher boxes at PRS 33-007(c) [DRAFT].

DRAFT

Voluntary Corrective Action Report for a Solid Waste Management Unit at TA-33

33-007(c)

Field Unit 3

Environmental Restoration Project

October 1996

A Department of Energy
Environmental Cleanup Program

DRAFT

Los Alamos
NATIONAL LABORATORY

LA-UR-96-3198

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1.0 INTRODUCTION

Solid waste management unit (SWMU) 33-007(c) is located at Area 6 of Technical Area (TA) 33. During Phase I investigation of the SWMU, uranium was detected above screening action levels (SALs) and retained as a chemical of potential concern (COPC). SWMU 33-007(c) is identified in the Los Alamos National Laboratory's (LANL's) Hazardous Waste Facility Permit, Module VIII, as requiring a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). An accelerated cleanup was proposed in the TA-33 September 1995 RFI report (Environmental Restoration Project 1995, 1265). Although uranium is not a RCRA, concern, this VCA report is provided for completion of the SWMU.

In 1996 a pilot project was initiated to determine the effectiveness of two methods to remove uranium from soil. Initial results suggested that the pilot project methods were effective. Therefore, a plan was developed to collect confirmatory samples, calculate cleanup levels, and investigate the SWMU as a voluntary corrective action (VCA), (Environmental Restoration Project 1996, 02-117).

Because results of confirmatory sampling, discussed in Section 3.3 of this VCA report, indicate that uranium concentrations have been reduced to acceptable levels, SWMU 33-007(c) is proposed for no further action (NFA) under Criterion 5 of the document of understanding between LANL, the New Mexico Environment Department (NMED), and the Environmental Protection Agency (EPA) (New Mexico Environment Department et al. 1995,1328). A Class III permit modification will be requested to remove this site from the HSWA Module of the Laboratory's RCRA operating permit.

2.0 SITE CHARACTERIZATION PRIOR TO CLEANUP ACTIVITY

2.1 History

Between 1947 and 1972 TA-33 was used to develop initiators, a component of nuclear weapons. Area 6 at TA-33 was a small firing site where gun-type studies were performed between 1949 and 1955. No high explosives were detonated. SWMU 33-007(c) encompasses firing activities at Area 6. Following abandonment as a firing site, the site was used for occasional experiments and office facilities. Additional historical information on Area 6 is included in the RFI Work Plan for Operable Unit 1122 (LANL 1992, 0784).

2.2 Description

SWMU 33-007(c) consists of three firing pads and a pair of catcher boxes at Area 6. One concrete firing pad lies immediately west of TA-33-16. The area surrounding the building is level and paved. Three 6-ft-square catcher boxes were approximately 20 ft south of the building and firing pad. Removal of the catcher boxes and surrounding soil revealed that a concrete pad was located under the boxes.

2.3 Previous Investigation

RFI Phase I sampling was performed at Area 6 during the 1993 and 1994 sampling campaigns at TA-33. Sections 2.4–2.7 of this VCA report summarize results from those campaigns.

2.4 Field Investigation

The 1993 and 1994 field investigations are discussed in the January and September 1995 RFI reports for TA-33 (LANL 1995, 1212; Environmental Restoration Project 1995, 1265). All samples collected were analyzed for inorganics, high explosives, uranium, and gamma emitters. A subset of samples was analyzed for pesticides, herbicides, and polychlorinated biphenyls. During the TA-33 sampling campaign in 1994, trenches were dug into catcher boxes located in the SWMU. Eight samples were collected and analyzed for uranium and inorganics.

2.5 Evaluation of Inorganic Chemicals and Radionuclides

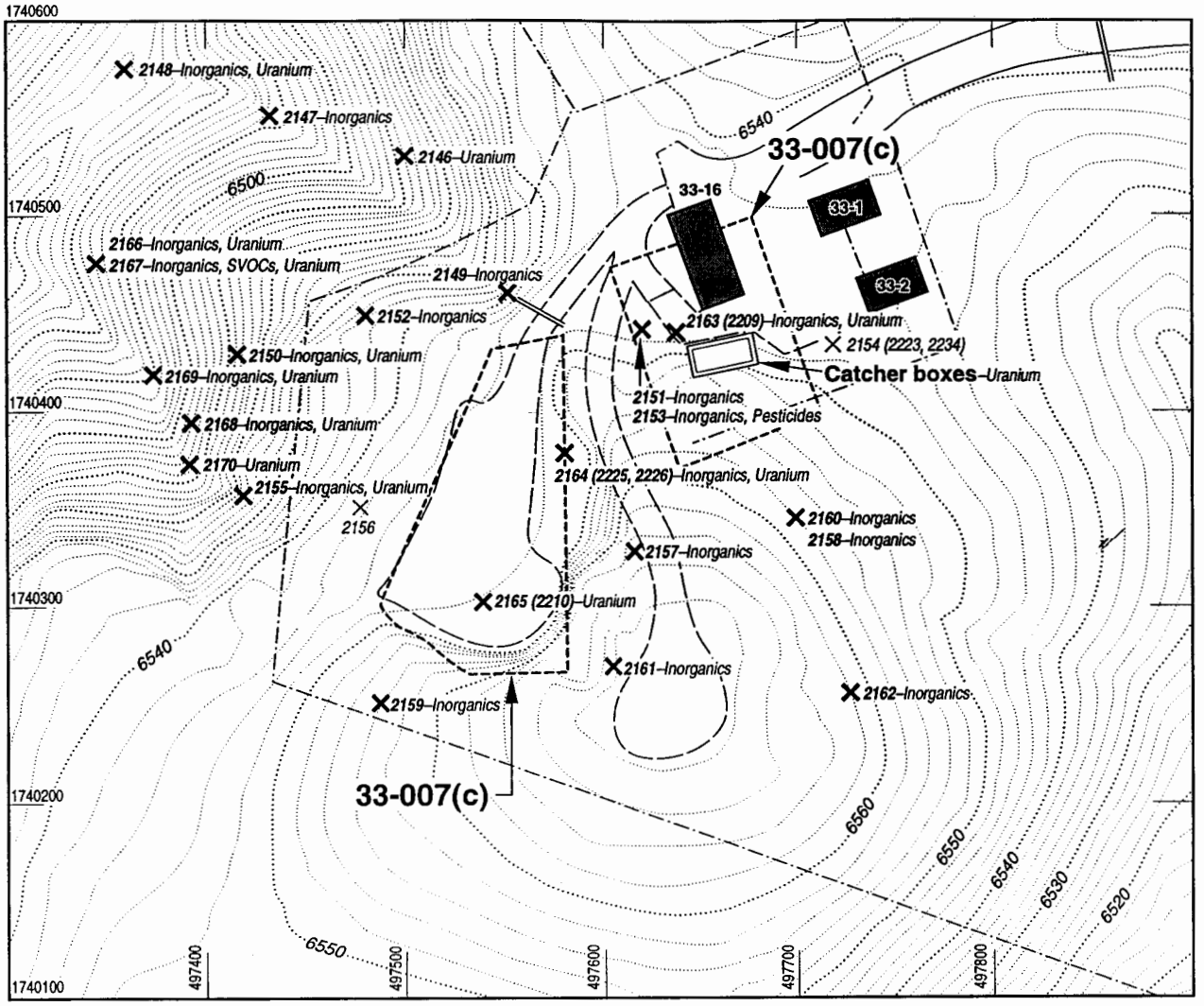
Inorganic chemicals. Analyses from the 1993 sampling campaign indicated that arsenic and beryllium were above background in two samples. Lead, nickel, and zinc were detected in many samples above background but below SALs. Sample AAA2164 and its two field splits contained elevated levels of cadmium, chromium, nickel, lead, antimony, and zinc. Table 2.5-1 lists inorganic contaminants found above background upper tolerance limits (UTLs) and Fig. 2.2-1 shows sample locations from the 1993 sampling campaign (LANL 1995, 1212).

TABLE 2.5-1

INORGANICS DETECTED ABOVE BACKGROUND UTLs IN THE 1993 SAMPLING CAMPAIGN

SAMPLE ID	ARSENIC (mg/kg)	BARIUM (mg/kg)	BERYLLIUM (mg/kg)	CADMIUM (mg/kg)	CHROMIUM (mg/kg)	NICKEL (mg/kg)	LEAD (mg/kg)	ANTIMONY (mg/kg)	ZINC (mg/kg)
SAL	Background	5 300	Background	38	210	1 500	400	31	23 000
LANL UTL	7.82	315	1.95	2.7	19.3	15.2	23.3	1	50.8
AAA2150	2.7	240	0.81	<0.4	6.3	*44*[a]	13	<0.07	*67*
AAA2151	1.9	100	0.35	<0.4	4.6	8	*80*	0.25	47
AAA2152	5.0	*330*	1.2	<0.4	12	*60*	15	<0.07	*57*
AAA2153	2.6	110	0.51	<0.4	5.9	14	*57*	<0.07	44
AAA2154	3.4	150	0.86	<0.4	9	*25*	17	0.22	*56*
AAA2223	2.7	130	0.75	0.5	10	*21*	13	<0.1	*64*
AAA2224	3.2	150	0.9	0.5	11	*22*	14	0.27	*70*
AAA2155	3.0	250	0.65	0.9	8.5	*67*	*39*	0.13	*75*
AAA2156	1.5	74	0.75	<0.4	6.2	5	*36*	<0.07	38
AAA2157	*10.9*	*370*	*2.3*	<0.4	30	*41*	21	<0.1	*61*
AAA2158	5.5	290	1.2	0.5	14	*39*	20	<0.07	46
AAA2159	4.7	*320*	1.4	<0.4	27	*50*	19	<0.07	46
AAA2160	5.0	280	1.4	<0.4	17	*38*	16	<0.07	50
AAA2161	*11.2*	*700*	*2.4*	0.4	25	*53*	16	0.105	*60*
AAA2162	3.5	310	1.5	<0.4	15	*47*	14	0.13	47
AAA2163	4.9	210	1	0.5	18	*33*	21	0.15	50
AAA2209	5.2	230	1.2	<0.4	13	*32*	*26*	<0.1	*51*
AAA2164	4.0	230	1.3	*4.4*	*52*	*850*	*150*	*2.6*	*210*
AAA2225	4.6	260	1.3	*3.8*	*62*	*530*	*130*	0.34	*220*
AAA2226	3.6	200	1.1	*3.6*	*54*	*440*	*120*	2.2	*190*
AAA2165	1.6	100	0.23	<0.4	6.3	8	*24*	0.15	26
AAA2210	1.8	200	0.34	0.5	7.7	11	*33*	<0.1	41
AAA2146	1.2	133	0.9	<0.8	6.8	11	12	<11.2	46.8
AAA2147	1.0	204	0.76	1.8	10.3	*46*	14	<11.2	*108*
AAA2148	4.0	210	0.93	<0.4	8	*38*	14	<0.07	*51*
AAA2149	1.1	291	0.74	1.5	7.4	*52*	16	<11.2	*78.5*
AAA2166	2.4	220	0.84	<0.4	7	*46*	13	<0.1	39
AAA2167	1.7	160	0.52	<0.4	4.4	*32*	10	<0.04	27
AAA2168	2.5	220	0.74	1.1	6.6	*45*	*38*	0.15	*130*
AAA2169	1.3	130	0.63	<0.4	4.3	*34*	7	<0.04	30
AAA2081	2.9	260	1.1	<0.4	19	*32*	16	<0.06	*57*

[a] Italicized results are above LANL background UTLs



Sources: FIMAD 1993, G101009, G101010, G101476
Modified by: cARTography by A. Kron 1/26/95

Permanent structure
Paved road
Unimproved road/trail
Fence
Storm drain/culvert
PRS boundary

X 2154 Sample location and number—no elevated levels found
X 2164 Sample with PCOCs detected above LANL background levels
(2223, 2234) Duplicate samples are shown in parentheses

0 50 100 ft

Contour interval = 2 ft

N

Fig. 2.5-1. SWMU 33-007(c) showing 1993 sampling locations.

Catcher box sampling in 1994 indicated that lead, nickel, silver, and zinc were above LANL background levels but below SALs (Environmental Restoration Project 1995, 1265).

Uranium. Sample AAA2164 and its field splits in the cinder cone contained elevated levels of uranium in addition to the inorganics listed above.

During 1994 trenching in the catcher boxes, a pocket of corroded uranium was uncovered. Two soil samples taken near the pocket contained elevated uranium, one in excess of 6 000 mg/kg. Samples collected elsewhere in the catcher box soil contained uranium at background levels.

2.6 Evaluation of Organic Chemicals

Organic analyses are discussed in the January 1995 RFI report (LANL 1995, 1212). PCBs detected in SWMU 33-007(c) samples were assigned to SWMU 33-009, an overlapping canyonside disposal area where a VCA is planned.

2.7 Human Health Assessment

2.7.1 Screening Assessment

Inorganic analyses for 31 samples collected across SWMU 33-007(c) are presented in the January 1995 RFI report for TA-33 (LANL 1995, 1212). Results for inorganics above LANL background UTLs are reproduced from that report in Table 2.5-1 of this VCA report. Results for samples collected in the catcher boxes are presented in the September 1995 RFI report (Environmental Restoration Project 1995, 1265).

Inorganic chemicals. As discussed in the January 1995 RFI report, beryllium and arsenic were found above LANL background (95%, 0.95) UTLs in two samples (AAA2157 and AAA2161) collected at the top of the cinder cone in a relatively undisturbed area above the Area 6 developed sites. Only these two samples contained arsenic and beryllium above the UTLs, but in the remaining samples both elements also tended to be elevated relative to TA-33 background. In general, samples from this area include material derived from an unusual (for LANL) matrix of basaltic cinders, which are high in iron and in elements that tend to be associated with iron in soils. For example, several samples from SWMU 33-007(c) were above LANL background levels for chromium and nickel, elements that are positively correlated with iron in LANL background samples, as discussed in Section 3.2.2.1 of the RFI report (Environmental Restoration Project 1995, 1212). These observations are summarized in Table 2.7-1. Consequently, arsenic and beryllium are judged not to be associated with programmatic activities at Area 6, but rather to represent the high end of natural background concentrations in this area.

TABLE 2.7-1

COMPARISON OF ARSENIC AND BERYLLIUM CONCENTRATIONS WITH LANL BACKGROUND VALUES

STATISTIC	AAA2157	AAA2161
Arsenic concentration (mg/kg)	10.9	11.2
Arsenic LANL (95%,0.95) UTL[a] (mg/kg)	7.82	7.82
Arsenic framework maximum (mg/kg)	11.2	11.2
Beryllium concentration (mg/kg)	2.3	2.4
Beryllium LANL (95%,0.95) UTL (mg/kg)	1.95	1.95
Beryllium framework maximum (mg/kg)	4	4

[a] UTL = Upper tolerance limit.

Another sample (AAA2164 with two field splits), collected from a location in the cinder cone adjacent to one of the gun mounts, contained cadmium, chromium, nickel, lead, antimony, and zinc, as well as uranium, at levels well above both LANL-wide and local background levels. Table 2.7-2 shows the results of a multiple constituent evaluation (MCE) for the elevated inorganic chemicals at the location of sample AAA2164. Lead is excluded from this calculation because its toxicity is based on lead uptake in children (EPA 1994, 1178). Uranium, as a radioactive carcinogen, is handled separately (see below). Because the SALs for cadmium and chromium have been approximately halved since January 1995, the result shown in Table 2.7-2 (1.1) is different than the result shown in Table 4-16 (0.8) of the original RFI report (LANL 1995, 1212).

TABLE 2.7-2

MULTIPLE CONSTITUENT EVALUATION FOR NONCARCINOGENIC EFFECTS OF INORGANICS DETECTED IN SAMPLE AAA2164 AND ITS FIELD SPLITS

ANALYTE	SAMPLE ID	MAXIMUM SOIL CONCENTRATION (mg/kg)	SOIL SAL (mg/kg)	CONCENTRATION NORMALIZED TO SAL
Antimony	AAA2164	2.6	31	0.08
Cadmium	AAA2164	4.4	38	0.1
Chromium	AAA2225	62	210	0.3
Nickel	AAA2164	850	1 500	0.6
Zinc	AAA2225	220	23 000	0.005
TOTAL				**1.1**

The MCE for noncarcinogenic effects slightly exceeds the target value of 1. However the concentrations of these elements in the 1993 data set of contaminants exceeding UTLs (Table 2.5-1 of this VCA report) does not suggest a significant contaminant release. Any area of inorganic contamination at SWMU 33-007(c) is projected to be limited. The potential human health concern that would be evaluated with a recreational exposure scenario at this site is considered low. Risk calculations using the shorter exposure duration and smaller exposure frequency associated with the recreational land use assumed for TA-33 reduce the possibility of realizing adverse health impacts from soil exposure. Therefore, additional evaluation of metals for human health risk will not be pursued at this SWMU and these inorganics will not be carried forward through the screening level process as COPCs.

For inorganics detected in the catcher boxes during the 1994 sampling campaign, an MCE for noncarcinogenic effects indicated that inorganics were not present in catcher box soil at levels of concern. Catcher box inorganics were not carried forward through the screening process as COPCs (Environmental Restoration Project 1995, 1265).

Uranium: The only chemical of concern at SWMU 33-007(c) was uranium, observed at high levels in two samples during the RFI investigation of the catcher boxes (Environmental Restoration Project 1995, 1265), and at levels above both background and SAL in AAA2164 and its field splits (LANL 1995, 1212).

Because uranium results for sample AAA2164 and its field splits (72, 91, and 84 mg/kg) are above SAL (LANL 1995, 1212), they are compared with the cleanup levels discussed in Section 3.1 of this VCA report. A total uranium concentration of 374 mg/kg is necessary to deliver the EPA-allowable maximum dose of 15 mrem per year under a recreational scenario, assuming the isotopic distribution of natural uranium. The maximum concentration of uranium (91 mg/kg) measured at this point is less than 25% of the 374 mg/kg limit. Based on these calculations, the total dose associated with uranium isotopes in sample AAA2164 and its field splits, considered as a source of exposure in the recreational scenario and used to calculate the cleanup levels, is well within EPA limits. Therefore, uranium is not considered a COPC at SWMU 33-007(c) outside of the catcher boxes.

2.7.2 Risk Assessment

No risk assessment was performed for SWMU 33-007(c) because a cleanup was planned.

2.8 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory Environmental Restoration (ER) Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this site will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

2.9 Extent of Contamination

Elevated uranium concentrations of concern were confined to localized spots in the catcher boxes. Total volume of the catcher boxes was approximately 200 yd^3. Subsequent soil separation indicated that 9 yd^3 of that volume were contaminated (Section 4.1 of this VCA report).

2.10 Conclusions and Recommendations

The MCE calculations in Section 2.7 of this VCA report indicate that inorganics are not a concern at SWMU 33-007(c) under a recreational scenario. As a result of the analyses discussed in the original RFI reports and summarized above, uranium was the only COPC identified at SWMU 33-007(c) (LANL 1995, 1212; Environmental Restoration Project 1995, 1265). Uranium was found to be above levels of concern only in the catcher boxes south of TA-33-16, where limited RFI data suggested that it might be confined to small pockets surrounded by uncontaminated soil.

A pilot study was conducted in 1996 to separate uranium-contaminated soil from clean soil. Initial data collected during the cleanup campaign indicated satisfactory separation. A VCA plan was developed to describe the objectives of the pilot study and define the cleanup objectives. A VCA was appropriate at this site because the following criteria were met.

- The contaminant of concern (uranium) was defined, as well as its nature and extent.
- Removal time was less than six months and waste facilities were available.
- Remedy was obvious and final.
- Land-use assumptions were straightforward.
- Cleanup costs were reasonable for the planned action.

As discussed in Section 3.3 of this VCA report, uranium concentrations were reduced below levels of concern during soil separation. Soil returned to the site of the catcher boxes is below cleanup levels.

Only radioactive contamination, subject to DOE regulatory authority, was found at SWMU 33-007(c). For nonradioactive contaminants, five criteria have been agreed upon under which a SWMU may be proposed for NFA (New Mexico Environment Department et al. 1995, 1328). The appropriate criterion for the NFA proposed for SWMU 33-007(c) is Criterion 5: the SWMU has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

Based on the radiological cleanup and NFA Criterion 5, SWMU 33-007(c) is recommended for NFA.

3.0 REMEDIAL ACTIVITIES AND RESULTS OF CONFIRMATORY SAMPLING

Because high concentrations of uranium occurred in distinct pockets and the remaining soil was known to be at background levels, a pilot study was performed to reduce uranium concentrations below levels of concern. The study included mechanically separating clean soil from radioactively contaminated soil. Contaminated soil was leached to remove uranium.

3.1 Cleanup Level Derivation

Derivation of cleanup levels was presented in the VCA plan for SWMU 33-007(c). Modeling calculations using the Residual Radioactive (RESRAD) computer code determined concentrations of residual uranium acceptable to meet regulatory requirements of the proposed EPA dose limit of 15 mrem/yr. RESRAD calculations assumed a recreational scenario exposure for typical recreational time periods for picnickers and trail users. Table 3.1-1 lists several key assumptions used to calculate the maximum total allowed dose.

TABLE 3.1-1

RECREATIONAL SCENARIO RESRAD INPUT PARAMETERS FOR SWMU 33-007(c)

PARAMETER	ASSUMPTIONS
Allowed dose/year	15 mrem
Area of contaminated zone	1 960 yd^3, 9 ft deep
Time spent on site	9 days/year, 3 hr/day
Inhalation rate (recreational)	50.4 yd^3/day of air inhaled
Dust mass loading	0.00045 g/yd3
Soil Ingestion Rate	0.2 g/day (Approximately 0.003 ounces)

In order for the picnicker not to exceed the proposed EPA dose limit (the most conservative case), the total dose from all uranium isotopes in the soil must be reduced below 15 mrem/yr. Single radionuclide soil guidelines were calculated for uranium-234, -235, and -238 assuming the picnicker scenario. A basic radiation dose limit of 15 mrem/year was set for each isotope. Results are shown in Table 3.1-2. These activities are equivalent to a concentration of 374 mg/kg, assuming the isotopic distribution of natural uranium.

TABLE 3.1-2

SINGLE RADIOACTIVE SOIL GUIDELINES CALCULATED BY RESRAD TO PRODUCE A DOSE OF 15 mrem/YR

ISOTOPE	GUIDELINE
Uranium-234	114 pCi/g
Uranium-235	72 pCi/g
Uranium-238	116 pCi/g

To determine if residual uranium at the site meets EPA guidelines, the 0.95 upper confidence bound (UCB) for the mean concentration of each isotope in the clean soil will be calculated. The reasonable maximum dose based on these UCBs will be calculated as

$$15 \sum Ui/U_{gi} ,$$

where U_i is the UCB for the ith isotope and U_{gi} is the guideline for the ith isotope from Table 3.1-1. If this reasonable maximum dose is less than 15 mrem/year, the site will meet EPA guidelines. See Section 3.3 of this RFI report for results of confirmatory sampling.

3.2 Remedial Implementation

A total of 202 yd^3 of soil was processed· Soil separation was performed by the Thermo Nuclean Segmented Gate System™ (SGS) in April/May 1996. Soil from the catcher boxes was delivered to a hopper on the SGS plant where large rocks and other debris were caught by a mesh and rejected. Soil was delivered at a uniform thickness to a conveyor belt that passed under a set of gamma radiation detectors. A series of gates on the conveyor belt diverted contaminated soil to collection bags; clean soil was deposited in separate piles. At the conclusion of the campaign, discarded rocks were hand screened for radioactivity and returned to the catcher box area, together with the clean soil. A description of the SGS is given in Attachment A.

During removal of large pieces in the SGS hopper, 56 experimental projectiles were discovered. These were non-exploding containers for experimental devices. The projectiles were 2.5 in.-diameter cylinders varying from 5 to 22 in. long. Radiography indicated that they were solid metal except for small cavities. The cavities appeared to be empty. Most projectiles appeared to be steel or metal alloys; some were made of uranium. They were removed to locked storage pending investigation to determine proper management and disposal methods.

Bags containing contaminated soil were leached by the LANL-developed containerized vat leaching (CVL) system using a solution of sodium bicarbonate, that preferentially dissolves uranyl hydroxides, the form of uranium present. Uranyl carbonate was collected on resin columns and the carbonate

solution reused. This process is described in the VCA plan. Details of the pilot study are given in Attachment B. The CVL study is continuing. Uranium-contaminated soil separated by the SGS plant has been retained as experimental material.

3.3 Confirmatory Sampling

To determine if the soil and area of the catcher boxes met cleanup goals, a total of 20 confirmatory soil samples were collected (Table 3.3-1). All samples were analyzed for isotopic uranium.

- Eight samples represented the material remaining at the back and bottom of the area of excavation.
- Twelve samples, including two field duplicates, represented the SGS clean pile material that was returned to the excavated area.

The eight samples collected at the back and bottom of the excavation were biased toward locations around and below areas where projectiles were found during excavation (Fig. 3.3-1). All isotopic uranium measurements on these samples were below the (.95,.95) UTLs for background (Table 3.3-1).

TABLE 3.3-1

CONFIRMATORY SAMPLES FROM THE EXCAVATION

SAMPLE ID	REQUEST NUMBER	LOCATION	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
Cleanup level	N/A [a]	N/A	114	72	116
UTL	N/A	N/A	1.94	0.084	1.82
33-96-0181	2136	Bottom of east box, beneath projectile location	0.75	0.05	0.81
33-96-0182	2136	Bottom of west box, beneath projectile location	0.93	0.04	0.93
33-96-0183	2136	Bottom of west box, beneath projectile location	1.02	0.05	1.00
33-96-0184	2136	Bottom of excavation, beneath hot spot	1.83	0.07	1.34
33-96-0185	2136	Back of east box, beneath projectile	0.86	0.04	0.88
33-96-0186	2136	Back of box near excavated projectiles	0.82 (R) [b]	0.04 (R)	0.88 (R)
33-96-0187	2136	Back of box near excavated projectiles	1.13	0.06	1.14
33-96-0188	2136	Back of box near excavated projectiles	1.25	0.07	1.16

[a] N/A = Not applicable.
[b] R = Results are rejected because of sample preparation irregularities.

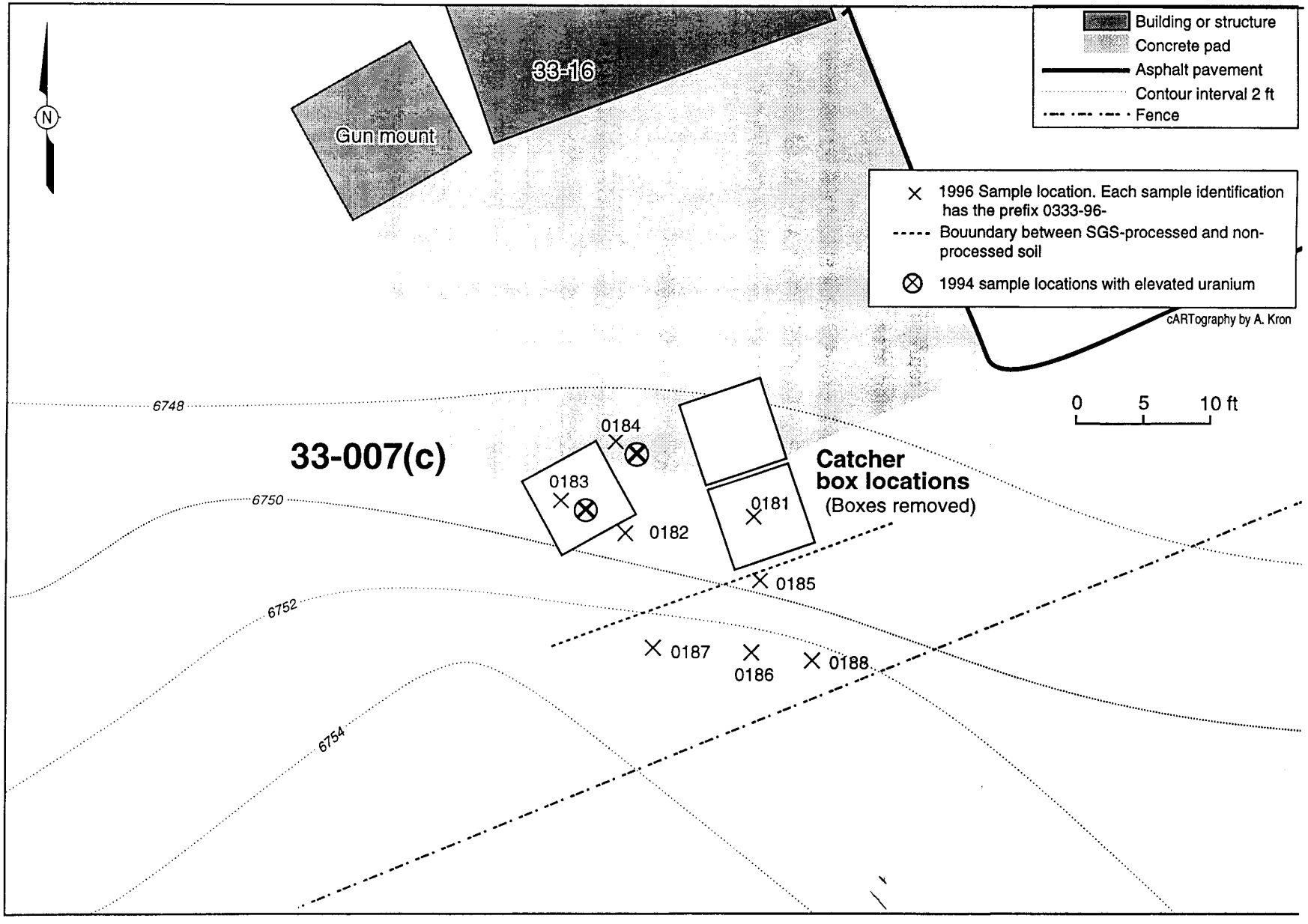


Fig. 3.3-1. Confirmatory sampling locations at SWMU 33-007(c) catcher box location.

Samples collected from the SGS clean pile were distributed across seven processing days. Results were generally above background, and the data indicate considerable heterogeneity in this material (Table 3.3-2). However, the highest isotopic uranium results, obtained for sample 33-96-0170 on day 5, were less than 25% of the cleanup levels.

TABLE 3.3-2

CONFIRMATORY SAMPLES FROM THE SGS CLEAN PILE

SAMPLE ID	REQUEST NUMBER	LOCATION	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
Cleanup level	N/A [a]	N/A	114	72	116
UTL	N/A	N/A	1.94	0.084	1.82
33-96-0166	96-06-199	SGS clean pile, day 1	16.73	0.67	16.57
33-96-0167	96-06-199	SGS clean pile, day 2	3.16	0.10	3.13
33-96-0168	96-06-199	SGS clean pile, day 3	2.47	0.08	2.69
33-96-0169	96-06-199	SGS clean pile, day 4	14.55	0.68	13.94
33-96-0179	96-06-199	Duplicate of 33-96-0169	11.2	0.42	11.1
33-96-0170	96-06-199	SGS clean pile, day 5	26.96	1.14	27.34
33-96-0171	96-06-199	SGS clean pile, day 6	2.01	0.07	1.87
33-96-0172	96-06-199	SGS clean pile, day 7	1.56	0.07	1.53
33-96-0173	96-06-199	SGS clean pile, day 7	1.75	0.07	1.81
33-96-0174	96-06-199	SGS clean pile, after rerun of day 1 clean pile with lower settings	7.3	0.26	7.51
33-96-0180	2136	Duplicate of 33-96-0174	3.3	0.13	3.22
33-96-0175	96-06-199	SGS clean pile, after rerun of day 6 clean pile	16.02	0.06	15.96

[a] N/A = Not applicable.

Data from the SGS clean pile can be used to estimate the exposure of a recreational user of the site, assuming (very conservatively) that his total exposure while at the site comes from the material in this pile. For this purpose, results from 10 of the 12 samples shown in Table 3.3-2 are used. The field duplicate results, obtained by splitting homogenized samples, were not considered to be independent measurements. Because the data are skewed to the right, calculations were made using lognormal assumptions following the method described by Gilbert (1987, 0506). Results are shown in Table 3.3-3.

TABLE 3.3-3

STATISTICS FOR MATERIAL IN SGS CLEAN PILE[a]

STATISTIC	URANIUM-234	URANIUM-235	URANIUM-238
Cleanup level (pCi/g)[U_{gi}]	114	72	116
Estimate for mean activity (pCi/g)	9.34	0.302	9.44
95% UCB[a] for mean activity (pCi/g)U_i]	15.8	0.515	15.7
Fraction of PRG [U_i/U_{gi}]	0.136	0.007	0.138
Reasonable maximum dose (mrem/year)	$15 \sum U_i/U_{gi} = 4.2$		

[a] UCB = upper confidence bound.

Based on the calculations shown in Table 3.3-3, the total dose of 4.2 mrem/yr associated with all uranium isotopes in the SGS clean pile material, considered as the source of exposure for the picnicker used to calculate the PRGs, is less than 30% of the EPA dose limit of 15 mrem/yr. Therefore the SGS clean pile material will be left on the site, and SWMU 33-007(c) is recommended for NFA.

4.0 WASTE MANAGEMENT

4.1 Waste Minimization, Recycling, and Waste Avoidance

Three samples were collected to represent material diverted by the SGS for the CVL process. Results are shown in Table 4.1-1. Results for sample 33-96-0189 shown in Table 4.1-1 are from a CVL bag after leaching. All contaminated material diverted from the SGS has been retained as experimental material for further experiments using the CVL process. See Attachment B of this VCA report for a description of the CVL pilot study.

Leached soil that meets the cleanup criteria described in Section 3.1 of this VCA report will be returned to the catcher box site. Material failing the criteria will be disposed at LANL TA-54, Area G, as radioactive waste.

TABLE 4.1-1

CVL CHARACTERIZATION SAMPLES

SAMPLE ID	REQUEST NUMBER	LOCATION	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
33-96-0176	96-06-199	Clean pile after SGS rerun of a "hot" pile (material then leached).	205.82	8.05	210.23
33-96-0177	96-06-199	CVL bag #3 prior to leaching, sample included a piece of oxidized uranium	930	36	943
33-96-0178	96-06-199	CVL bag #3 prior to leaching	73.24	2.74	72.85
33-96-0189	2476	CVL bag #1 after leaching	45.5	2.02	45.7
33-96-0189D	2476	Laboratory duplicate	42.1	1.85	42.9

Chunks of uranium removed from the CVL bags by hand or mechanical screening prior to leaching and uranium uranium-contaminated material generated by leaching will be sent to LANL TA-54, Area G as radioactive waste,.

Projectiles were radiographed to identify uranium-containing and nonradioactive items. They will be segregated and disposed of appropriately.

- Projectiles free of uranium will be sectioned to determine if hazardous metals are present. If no such metals are found, the projectiles will be sent to a contract recycle firm.
- Projectiles containing both hazardous metals and uranium will be disassembled and segregated into hazardous and radioactive components for disposal.
- Projectiles containing hazardous metals will be sent to an approved RCRA facility for disposal.
- Projectiles containing uranium will be disposed of as radioactive waste.

4.2 Comparisons with VCA Plan

Table 4.2-1 compares the estimated actual volumes of generated VCA waste with projected waste volumes estimated in the VCA Plan (Environmental Restoration Project 1996, 02-117). Discrepancies are due to the following:

- Catcher box timbers and associated municipal wastes were not included in the projected waste volume estimate.
- Projectile disassembly is anticipated to successfully separate recyclable industrial waste from hazardous and radioactive components.
- Uranium was found to be a larger component of several projectiles than expected.

Because of continuing experimentation with the CVL system, actual waste volumes are not known at this time. The objective of the CVL pilot is maximum waste reduction.

TABLE 4.2-1

ESTIMATED ACTUAL VOLUMES COMPARED WITH PROJECTED WASTE VOLUMES

SWMU ID	WASTE TYPE	PROJECTED BULK VOLUME	ESTIMATED ACTUAL BULK VOLUME
33-007(c)	Municipal refuse	1 yd^3	4 yd^3
	Radioactive liquid (CVL)	15 gal.	30 gal.[a]
	Radioactive solid (CVL)	15 gal.	15 gal.[a]
	Recyclable metals (projectiles)	0.10 yd^3	0.8 yd^3 [b]
	Radioactive (projectiles)	0.05 yd^3	0.1 yd^3 [b]
	Mixed	0.01 yd^3	0 yd^3 [b]
	Hazardous (projectiles)	0.01 yd^3	<0.1 yd^3 [b]

4.3. Type of Waste and Waste Characterization Methods

Natural uranium, the principal contaminant, was characterized by beta/gamma Geiger counters and fixed laboratory isotopic uranium analysis. Radiography of projectiles was performed in September 1996 by LANL radiography group ESA-MT. Analysis of radiographic data will be used to determine appropriate disposal. Disassembly and further analysis of the metal composition by x-ray fluorescence may be needed.

4.4 DISPOSAL LOCATIONS

Nonhazardous, nonradioactive, nonmetallic waste has been sent to a sanitary landfill. Following disassembly of the projectiles, nonhazardous, nonradioactive waste will be recycled with a commercial recycle company. Radioactive and hazardous waste (if found) will be sent to LANL disposal facilities at LANL TA-54. Mixed waste is not anticipated because of planned disassembly of uranium-containing projectiles, with subsequent segregation into nonhazardous and radioactive waste. Radioactive waste generated by continuing CVL experiments will be disposed after all experimental work is completed.

5.0 REFERENCES

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LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1122," Los Alamos National Laboratory Report LA-UR-92-925, Los Alamos, New Mexico. **(LANL 1992, 0784)**

LANL (Los Alamos National Laboratory), January 1995. "RFI Report for TA-33," Los Alamos National Laboratory Report LA-UR-95-882, Los Alamos, New Mexico. **(LANL 1995, 1212)**

New Mexico Environment Department, US Environmental Protection Agency, Los Alamos National Laboratory, Sandia National Laboratory, November 16, 1995. "Environmental Restoration Document of Understanding," Santa Fe, New Mexico. **(New Mexico Environment Department et al. 1995, 1328)**

APPENDIX A RAW RFI CHARACTERIZATION DATA

1. Screening Data. No screening data were used in decisions at this solid waste management unit.

2. Confirmatory Sampling Data. All confirmatory sampling data are shown in Tables 3.3-1 and 3.3-2. of this voluntary corrective action (VCA) report.

3. Waste Characterization Data. No samples were collected for waste characterization at this SWMU.

Chemicals that are reported by analytical laboratories that are nonhazardous, below Laboratory background levels, or as undetected have not been included in the tables of this VCA report. Nonetheless, these analytes are part of the decision-making process and it is important to note that these chemicals were analyzed for. Analytes included in the inorganic analytical suite for this VCA report are listed below.

Aluminum	Beryllium	Cobalt	Magnesium	Potassium	Thallium
Antimony	Cadmium	Copper	Manganese	Selenium	Vanadium
Arsenic	Calcium	Iron	Mercury	Silver	Zinc
Barium	Chromium	Lead	Nickel	Sodium	

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APPENDIX B QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Validated data are available in Facility for Information, Management, Analysis and Display (FIMAD) or upon request. Table B-1 summarized data validation for confirmatory samples for SWMU 33-007(c).

Samples are submitted to analytical laboratories in batches identified by a request number. Request numbers for each sampling campaign at SWMU 33-010(b) are referenced in Tables 3.3-1, 3.3-1, and 4.4-1 and of this voluntary corrective action (VCA) report. Table B-1 summarizes the results of quality assurance/quality control (QA/QC) data validation for all inorganic and radiological analytical results used to support recommendations in this VCA report.

TABLE B-1

DATA VALIDATION TABLE FOR SWMU 33-007(c) SAMPLES

REQUEST NUMBER	ANALYTICAL SUITE*	COMMENTS
2136	Isotopic uranium	During micro-precipitation, the funnel used for sample 33-96-0186 leaked, leading to an estimated 15-20% loss. Solutions of samples 33-96-0180 and 33-96-0186 were slow in eluting from the column and the resin had to be disturbed to completely elute the sample. This may have effected recovery of the total solution. Because of these problems, results for sample 33-96-0180 is qualified as J- (result is an estimate and suspected to be low) and sample 33-96-0186 is rejected. Trace levels of uranium activity were found in the blank. This activity is attributed to uranium in sand of the blank and was expected by the laboratory. Blank and blank spike control samples were within control limits. With the exception of sample 33-96-0186 and a low bias for sample 33-96-0180, the data are accepted as valid.
2475	Isotopic uranium	No anomalies were noted during sample preparation or analysis. Trace levels of uranium activity were found in the blank. This activity is attributed to uranium in sand of the blank and was expected by the laboratory. Blank and blank spike control samples were within control limits. Data are accepted as valid.
96-06-199	Isotopic uranium	These samples were analyzed by Thermo NUtech™ laboratories and were not submitted through the LANL ER Sample Management Facility

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APPENDIX C BEFORE AND AFTER COST COMPARISON

The pilot project at Solid Waste Management Unit (SWMU) 33-007(c) was undertaken to evaluate the technique for use at similar sites at Technical Area 33 and other sites at Los Alamos National Laboratory. Table C-1 compares projected and estimated actual costs for the pilot project and the voluntary corrective action for SWMU 33-007(c).

TABLE C-1

COST COMPARISON

ACTIVITY	PROJECTED COSTS	ACTUAL COSTS PILOT PROJECT	ACTUAL COSTS VCA PLAN
Planning and field preparation	Not projected	N/A [a]	$13 461
Cleanup	$55 750	$130 930	$2 125
Post-field operations	Not projected	N/A	$31 726
Disposal	$4 856	N/A	$9 766
Develop VCA Report	Not projected	N/A	$8 678
TOTAL	$60 606	$130 930	$65 756

[a] N/A = Not applicable.
[b] Actual costs are not known because waste has not been picked up for disposal.
[c] $77 000 of $107 400 was for activity not estimated in the plan.

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APPENDIX D CONFIRMATORY SAMPLING RESULTS TABLE

All confirmatory results are shown in Tables 3.3-1 and 3.3-2 of this voluntary corrective action report.

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APPENDIX E CERTIFICATION OF COMPLETION

The certification of completion follows this page.

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ATTACHMENT A

THE THERMO NUCLEAN™ SEGMENTED GATE SYSTEM

1.0 INTRODUCTION

This attachment describes a pilot project that utilized procedures to assay and sort uranium-contaminated material from large volumes of soil. Two preliminary assaying procedures, the mower detector and the mockup unit developed by Thermo Nuclean, were used to determine the potential value of soil sorting and the parameters needed for optimal sorting at a given site. The Segmented Gate System (SGS) developed by Thermo Nuclean was used on site to assay and sort uranium-contaminated soil into contaminated and clean components.

2.0 PROJECT OBJECTIVE

The pilot project assessed the capabilities of removing radioactive contamination from large volumes of soil to remediate sites and reduce the volume of radioactive waste. The desired outcome of the pilot project was the remediation of soils at SWMU 33-007(c). Results from this work will be used to assess the cost-effectiveness of this approach for future work at similar sites.

2.1 Technical Capabilities

The effectiveness of the SGS is influenced by soil characteristics such as soil density, radioactive species, radionuclide concentrations, and contaminant distribution and sorting. Preliminary assaying techniques, a mower detector and mockup unit, were used to measure the soil characteristics to determine fine adjustments needed to operate the SGS for optimal results.

- The mower detector system is a shielded detector box on wheels pushed over the ground at estimated speeds replicating conveyer belt speeds of the SGS. Gamma ray detectors count radiation at intervals, replicating those of the SGS. The system looks at soil of thickness between 0.5 and 3 in. The system was used to determine the radioactive distribution and variability and indicated the detector sensitivity for sorting site-specific soils using the SGS.

- The SGS mockup is run in a laboratory where the system replicates the operation of the SGS plant. The SGS mockup uses the same sodium iodide gamma ray scintillators, count geometry, shielding, and count times as the SGS. It has radiation detectors and a conveyer system. The system does not have segmented gates. However, an electronic signal is generated upon detection and a signal could activate a gate if one were present.

  The SGS mockup detector signals are processed by a multichannel analyzer (MCA) that is not present in the SGS plant. The MCA is used to determine radioactive species present in a given soil. The SGS mockup system also has an adjustable speed controller for the conveyer system. This is used to determine the best belt speed to produce increased sensitivity for the SGS.

The SGS method assays and separates uranium and other radioactive contamination from soil matrices. The procedure is capable of separating contamination from large volumes (as much as 100 000 yd3) of soil. Thermo Nuclean has shown that reduction in the volume of contaminated soil is as great as 98%.

The SGS plant includes a hopper, a conveyer system, radiation detectors, and computer controls that remove radioactively contaminated soils moving on a conveyer belt. Contaminated soil is diverted to segmented gates, then to a conveyer belt that separates it from the clean soil. Figure 2.1-1 shows a schematic of the plant.

Processed soil is first directed through a vibrating screen plant that separates larger pieces of rock, metal, or other material from the feed material (the soil that will be directed to the SGS). The feed material is directed to the hopper at the SGS plant.

The hopper holds the feed material and directs it to a motor-driven conveyer belt that moves soil through the plant. Fifteen sodium iodide detectors are mounted over the conveyor belt and are arranged in two overlapping rows of 7 and 8 detectors, respectively. Each detector has an active area measuring 100 x 100 millimeters and is encased in an aluminum housing with a thin end window. The two rows of detectors are offset to prevent radioactive particles from passing undetected between adjacent detectors. Each detector electronically reports to an individual microprocessor board that calculates amounts of radioactivity and determines whether a radioactive particle has been detected. A master control board collects data from each detector microprocessor and determines whether dispersed radioactivity has been detected and selects and actuates the eight diversion chutes of the SGS.

Fig. 2.1-1. Schematic of the Thermo Nuclean Segmented Gate System™.

When radioactive particles or distributed contamination above release criteria are detected, one or more of the eight diversion segmented gates located at the end of the sorter conveyer diverts the contaminated material. Radioactive soil is diverted directly into a special bag or dump truck to be sent to the containerized vat leaching system. The clean soil is diverted and stacked in a pile until it is transported back to its original location.

2.2 Assaying and Sorting Procedures

Procedures for setting up and using the SGS system at SWMU 33-007(c) are presented below. Standard operating procedures developed by Thermo Nuclean and LANL were followed for all operations.

2.3 Mower Detector System

The mower detector was used at SWMU 33-007(c). A plastic cover was temporarily removed from the catcher boxes to conduct this preliminary study. Soil on the upper surface of the pile was excavated with shovels to locate contaminated soil for this study. Direct reading radiation instruments were used to guide the excavation and determine the area of interest.

Clean soil and contaminated soil were studied to determine soil background and other soil characteristics. The soil was shoveled from the pile to a 2 ft x 15 ft plank. The soil on the surface of the plank was leveled to a two-inch thickness. The mower detector was moved along this leveled surface. The detector was first driven directly on the plank, with no soil, to determine environmental and cosmic background. The mower detector was moved along the surface of the plank at estimated speeds to simulate 30 ft/min speed of the SGS conveyer belt. Gamma ray counts were recorded at 0.25-second intervals.

This study helped to define parameters needed to most effectively operate the SGS by making the following determinations:

- the distribution of the contamination,
- the background radiation in the clean soil and at the site,
- the optimal belt speed for increased sensitivity, and
- the best segmented gate setup for optimal sorting.

Because uranium contamination was exposed on the surface, there was no need to further excavate the pile. The mower detector was moved along the surface of the pile as discussed above and the optimal operating conditions were determined. Upon completion of the preliminary study, the plastic cover was replace over the contaminated soil.

2.4 SGS Mockup System

To further define operating parameters for the SGS, the following quantities and types of soil were collected from the site:

- 5 gal. of clean soil,
- 5 gal. of radioactively contaminated soil near the criteria release limit, and
- 10 gal. of bulk (clean and contaminated mixture) soil.

Thermo Nuclean transported the soil to their laboratory as environmental samples in accordance with the Nuclear Regulatory Commission and Department of Transportation guidelines for shipping environmental samples.

This study helped to define the following parameters:

- soil density,
- radioactive species,
- optimal belt speed for increased sensitivity, and
- appropriate segmented gate setup for optimal sorting.

These parameters were used to adjust the SGS plant operations for each site.

2.5 SGS Plant

The SGS plant and the screening plant were set up near building TA-33-16. Heavy plastic matting was placed under the soil processing equipment to prevent potentially contaminated soils from contacting clean ground. Planning and setup of operations are were coordinated with the facility manager at TA-33. An excavation permit was obtained prior to conducting the SGS study.

Thermo Nuclean personnel operated the SGS. ICF Kaiser personnel supervised on-site activities and collected samples for off-site analysis. A trained equipment operator with a commercial driver's license operated a front-end loader and dump truck according to Occupational Safety and Health Administration (OSHA) requirements. Setup and preliminary SGS work took approximately one week and the SGS sorting activities lasted approximately two weeks. Work was interrupted for five days because of a large forest fire in nearby Bandelier National Monument.

The SGS assayed and sorted approximately 200 yd^3 of uranium-contaminated soil. A front-end loader moved soil from the catcher boxes to the screening plant, where larger chunks of material were separated from soil. Screened soil moved by conveyor belt from the screening plant to the hopper at the SGS plant, where the soil was assayed and sorted into contaminated and clean components. The contaminated soil was directed into 1-yd^3 leaching containers. Clean soil was deposited on plastic matting until it was transported back to the original site. This material was transported in the decontaminated front-end loader at the end of the separation process. Large rocks and organic material were tested for radioactivity and returned to the original catcher box site. Extraneous material, such as metal, wood, and plastic, was not returned to the catcher box site. It will be characterized and disposed of appropriately.

Air sampling monitors were set up adjacent to the plant to measure radiation levels from dust emissions. The workers most exposed to dust wore personal air monitors to measure radiation exposure from the dust. The soil was wet down if the site safety officer and radiation control personnel determined that the dust emissions were great enough to create a health and safety problem. A 200-gal. capacity tub with a hose and sprayer provided water for dust control. The soil moisture level was monitored to assure there were no complications when moving the moistened soil along the conveyer belt system of the SGS.

ATTACHMENT B

CONTAINERIZED VAT LEACHING SYSTEM

1.0 INTRODUCTION

The objective of the containerized vat leaching (CVL) project was to demonstrate the technique of leaching uranium from soil. The effectiveness of the CVL is influenced by soil characteristics such as particle size, permeability, and organic content, as well as chemical form and concentration of the radioactive species. These characteristics were determined prior to soil leaching so that adjustments could be made to achieve optimal results.

2.0 CVL SYSTEM

The heap leach procedure involves leaching uranium-contaminated soils with a bicarbonate-carbonate solution that selectively dissolves uranium. Uranium in the oxidized state (U^{6+}) is readily soluble in carbonate solutions, but minerals containing uranium in the reduced state (U^{4+}) are not readily dissolved. The overall reaction for the dissolution of uranium oxide in bicarbonate-carbonate solution to uranyl tricarbonate is as follows:

$$UO_2^{2+} + 2HCO_3^- + CO_3^{2-} \longrightarrow UO_2(CO3)_3^{4-} + 2H^+$$

The CVL process involves using an overhead sprinkler system to spray uranium-contaminated soil with sodium bicarbonate-carbonate solution. This dissolves (leaches) uranium in the form of uranyl carbonate ion. The exact amount of uranium that can be removed depends on the characteristics of the soil and the uranium. The developers of this technology have shown that 75% to 95% of the uranium can be removed.

In situ gamma counters monitor the concentrations of uranium throughout this process. The bicarbonate solution is continually recycled through the soil and the soluble uranium is removed on ion exchange resins. During the leach, samples are taken for uranium analysis. Fig. 2.0-1 is a diagram of the CVL setup.

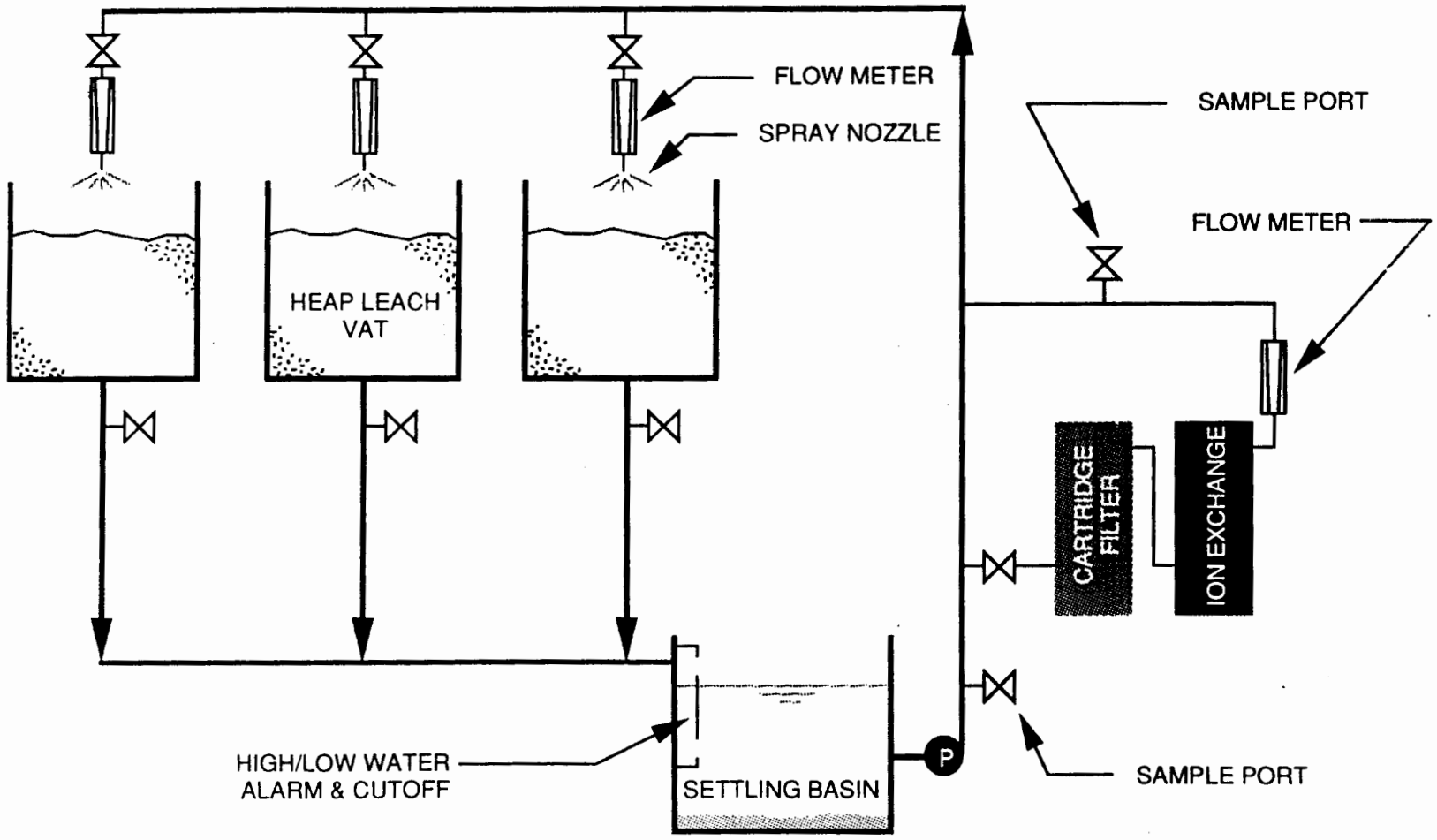

Fig. 2.0-1. Containerized Vat Leaching System flow chart.

3.0 HEAP LEACH PROCEDURES

The CVL was set up adjacent to the catcher boxes and building TA-33-16. The Los Alamos National Laboratory's Environmental Systems and Waste Characterization Group (CST-7) personnel operated CVL. ICF Kaiser personnel supervised on-site activities and collected samples for off-site analysis. Setup of the CVL lasted approximately two weeks and the leaching activities lasted approximately five months.

Prior to conducting the CVL procedure on the contaminated component (derived from the SGS separation), the following analyses were performed on the contaminated soil and were used to adjust the operation of the system:

- particle size fraction,
- organic analysis,
- speciation of radioactive constituents (by x-ray diffraction), and
- concentration of radioactivity (by LANL ER-130 method for gamma spectral analysis).

The contaminated soil was transported by conveyor belt from the SGS plant and placed into 1 yd^3 containers, then carried to the CVL setup for leaching operations. The containers are woven fabric with plastic liners and are tapered to facilitate draining liquid to the bottom of the bag. A solution of carbonate-bicarbonate reagent was sprayed on the containerized soil in a continuous, uniform fashion. The leachate drained into a settling reservoir and sediment-free solution was recycled through the system. The spent rinse may be sent to ion exchange columns where the uranium may be recovered.

The CST-7 report follows this attachment.

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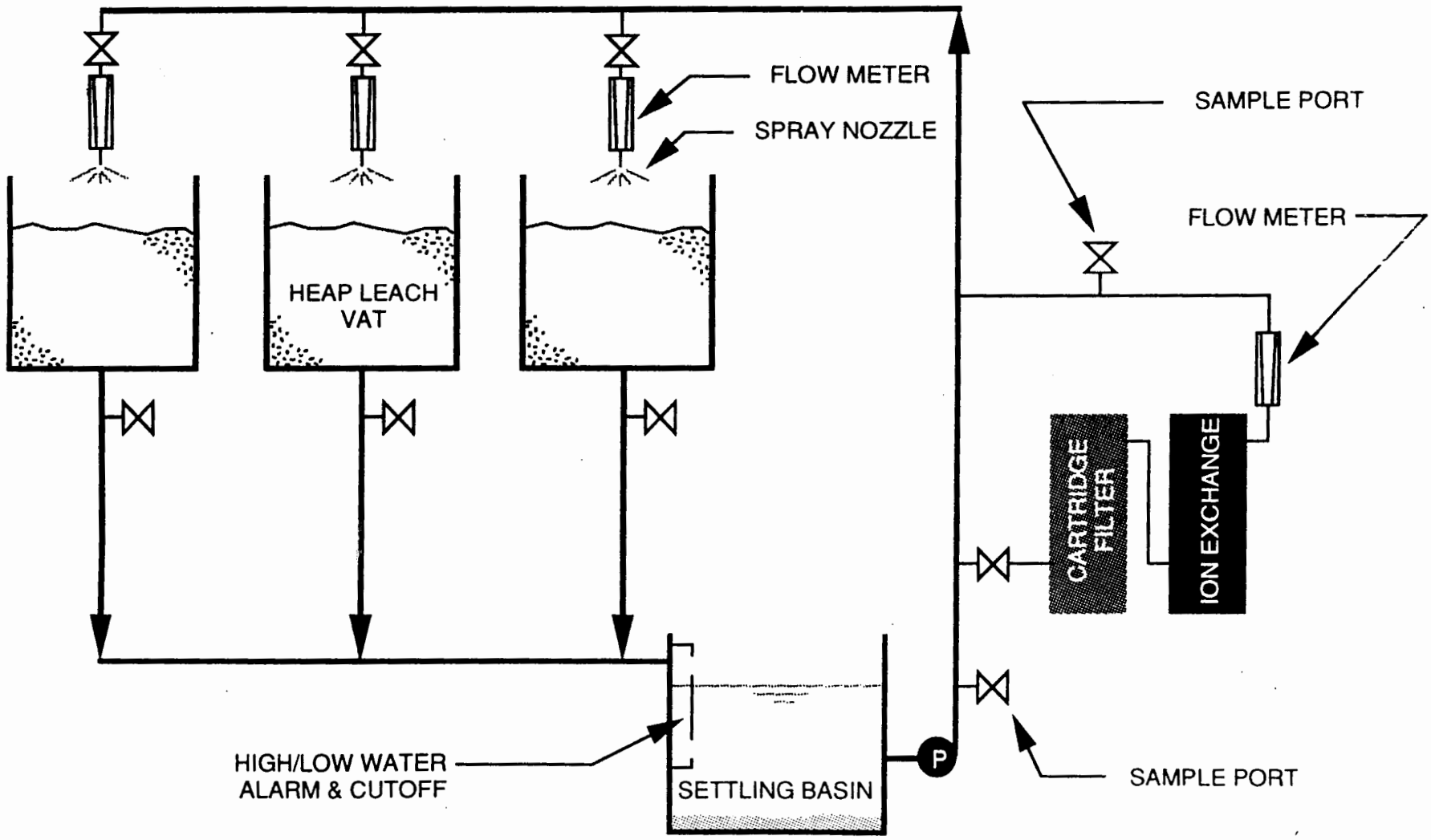
Flow Chart of Containerized Vat Leach (CVL) Process



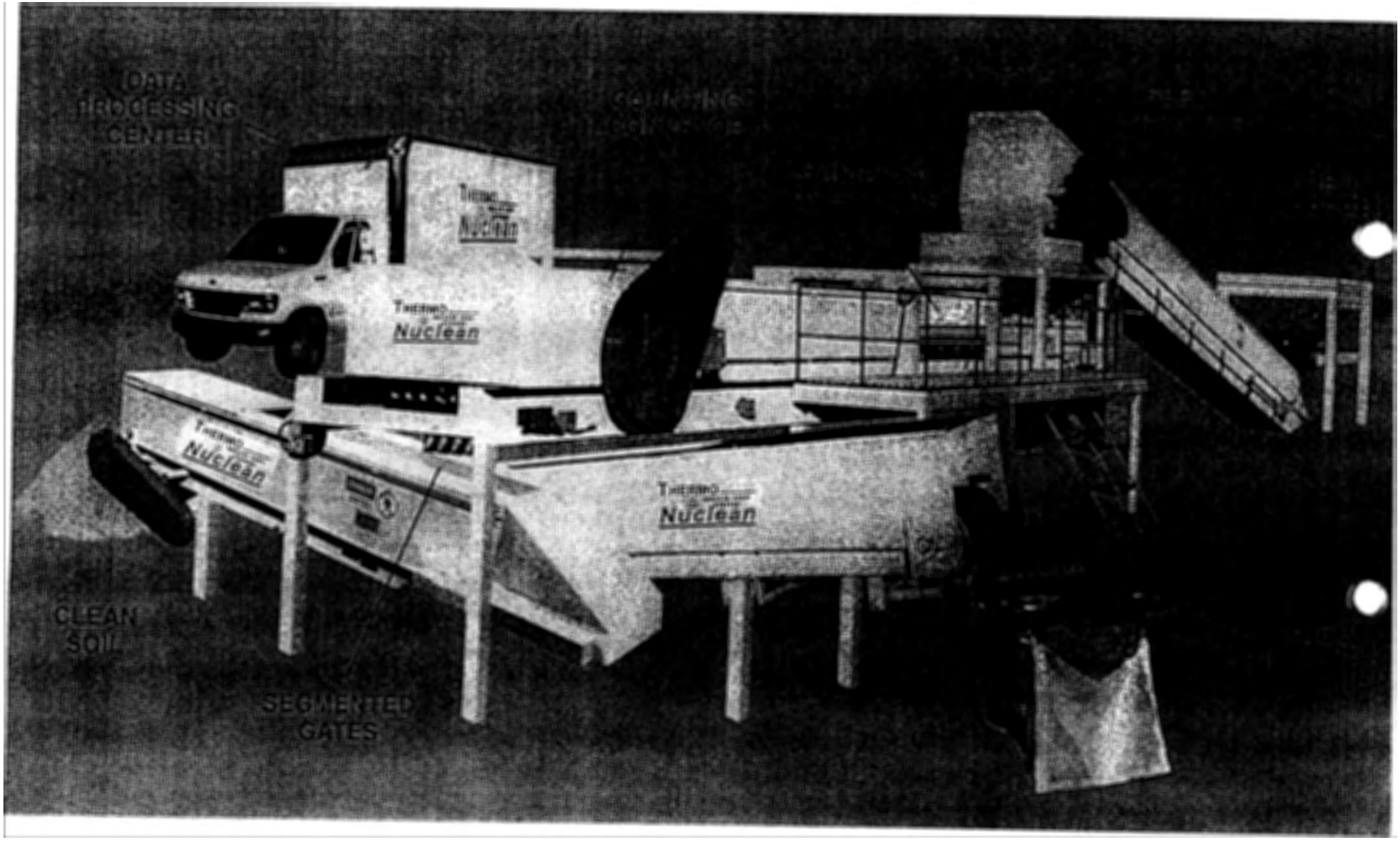

DATA
PROCESSING
CENTER
Nuclean
Nuclean
Nuclean
Nuclean
CLEAN
SOIL
SEGMENTED
GATES

Fig. 1. Bunker TA-33-22, showing the area to the northeast identified as PRS 33-011(e). Photo taken 1987.

Fig. 2. TA-33 Main Site showing location of bunker TA-33-22 and PRS 33-011(e) and PRS 33-011(a). Photo taken 1986.

Fig. 3. TA-33 Main Site showing location of PRSs 33-011(a) and 33-011(e). Photo taken 1984.

ATTACHMENT H

Upper Confidence Limit(UCL) calculations for PAH Risk at PRS 33-011(a).

Calculation of Upper Confidence Limits for PAHs at PRS 33-011(a)

PAH data were collected for 27 samples from 18 locations at PRS 33-011(a). For the risk calculation, one result for each analyte for each location was used; the maximum value observed among all samples from a given location was selected for this purpose. These values are shown in Table 1.

The calculation of the mean and upper confidence limit for PAH contamination based on these data followed the method for minimum variance unbiased (MVU) estimation for lognormal populations described by Gilbert (Gilbert 1987, 0506, pp. 165-166.) Specifically, logarithms of the data in Table 1 were calculated (after replacing "<" values by one-half the reported detection limit). Then the MVU estimate of the mean is given by

$$\hat{\mu} = [\exp(\bar{y})]\Psi_n\left(\frac{s_y^2}{2}\right) \qquad (1)$$

where $\bar{y}$ is the sample mean of the logged data, s_y^2 is the sample variance, n is the sample size (18), and $\Psi_n(t)$ is a function tabled in Gilbert's book (although for our calculations we programmed this function using the series expansion given on p. 165 of that book.) An unbiased estimator of the variance of $\hat{\mu}$ is given by

$$s^2(\hat{\mu}) = \exp(2\bar{y})\left\{\left[\Psi_n\left(\frac{s_y^2}{2}\right)\right]^2 - \Psi_n\left(\frac{s_y^2(n-2)}{n-1}\right)\right\}, \qquad (2)$$

and thus a 95% upper confidence interval for the mean is computed finally as

$$\hat{\mu} + t_{n-1,0.95}s(\hat{\mu}), \qquad (3)$$

assuming approximate normality of the estimator $\hat{\mu}$ (an application of the Central Limit Theorem of probability theory) with the usual number of degrees of freedom. For n=18, the t-statistic in Equation 3 has a value of 1.74. Results are shown in Table 2.

Reference

Gilbert, R. O., 1987. Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York, New York. (Gilbert 1987, 0506)

Table 1. PAHs at PRS 33-011(a)

Analyte	LOCATION ID					
	33-1061	**33-1062**	**33-1063**	**33-1064**	**33-1065**	**33-1066**
Acenaphthene	<0.33	<0.33	0.49	<0.33	12.90	<0.33
Acenaphthylene	<0.33	<0.33	<0.33	<0.33	0.49	<0.33
Anthracene	0.39	<0.33	0.73	<0.33	18.60	<0.33
Benzo(a)anthracene	0.83	<0.33	1.40	<0.33	26.90	<0.33
Benzo(a)pyrene	0.79	<0.33	1.60	<0.33	28.80	0.52
Benzo(b)fluoranthene	0.60	<0.33	1.40	<0.33	28.40	0.69
Benzo(g,h,i)perylene	0.63	<0.33	0.57	<0.33	12.60	<0.33
Benzo(k)fluoranthene	0.57	<0.33	1.60	<0.33	21.40	0.47
Chrysene	0.85	<0.33	1.60	<0.33	29.20	0.54
Dibenz(a,h)anthracene	<0.33	<0.33	<0.33	<0.33	4.70	<0.33
Fluoranthene	1.70	<0.33	2.60	<0.33	54.10	0.99
Fluorene	<0.33	<0.33	0.50	<0.33	15.10	<0.33
Indeno(1,2,3-cd)pyrene	0.54	<0.33	0.60	<0.33	14.30	<0.33
Naphthalene	<0.33	<0.33	0.44	<0.33	26.60	<0.33
Phenanthrene	1.50	<0.33	2.70	<0.33	66.80	0.90
Pyrene	1.90	<0.33	2.90	<0.33	51.00	1.20
	33-1067	**33-1068**	**33-1069**	**33-1070**	**33-1072**	**33-1073**
Acenaphthene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Acenaphthylene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Anthracene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Benzo(a)anthracene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Benzo(a)pyrene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Benzo(b)fluoranthene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Benzo(g,h,i)perylene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Benzo(k)fluoranthene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Chrysene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Dibenz(a,h)anthracene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Fluoranthene	<0.33	<0.34	<0.35	<0.35	<0.36	0.46
Fluorene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Indeno(1,2,3-cd)pyrene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Naphthalene	<0.33	<0.34	<0.35	<0.35	<0.36	<0.36
Phenanthrene	<0.33	<0.34	<0.35	<0.35	<0.36	0.45
Pyrene	<0.33	<0.34	<0.35	<0.35	<0.36	0.46
	33-1076	**33-1077**	**33-1078**	**33-1147**	**33-1148**	**33-1149**
Acenaphthene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Acenaphthylene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Anthracene	0.37	<0.33	<0.33	<0.33	<0.33	<0.33
Benzo(a)anthracene	0.87	<0.33	<0.33	<0.33	<0.33	<0.33
Benzo(a)pyrene	1.10	<0.33	<0.33	<0.33	<0.33	<0.33
Benzo(b)fluoranthene	0.80	<0.33	<0.33	<0.33	<0.33	<0.33
Benzo(g,h,i)perylene	0.45	<0.33	<0.33	<0.33	<0.33	<0.33
Benzo(k)fluoranthene	1.20	<0.33	<0.33	<0.33	<0.33	<0.33
Chrysene	1.10	<0.33	<0.33	<0.33	<0.33	<0.33
Dibenz(a,h)anthracene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Fluoranthene	1.80	0.35	<0.33	<0.33	<0.33	<0.33
Fluorene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Indeno(1,2,3-cd)pyrene	0.56	<0.33	<0.33	<0.33	<0.33	<0.33
Naphthalene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Phenanthrene	1.70	<0.33	<0.33	<0.33	<0.33	<0.33
Pyrene	1.90	0.40	<0.33	<0.33	<0.33	<0.33

Table 2
PAHs at PRS 33-011(a)

Analyte	Mean (Eq. 1)	Standard error (Eq. 2)	95% upper confidence limit for the mean (Eq. 3)
Acenaphthene	0.37	0.10	0.55
Acenaphthylene	0.18	0.01	0.20
Anthracene	0.47	0.14	0.72
Benzo(a)anthracene	0.66	0.24	1.07
Benzo(a)pyrene	0.74	0.27	1.22
Benzo(b)fluoranthene	0.70	0.25	1.14
Benzo(g,h,i)perylene	0.44	0.12	0.66
Benzo(k)fluoranthene	0.67	0.23	1.07
Chrysene	0.75	0.28	1.24
Dibenz(a,h)anthracene	0.27	0.05	0.36
Fluoranthene	1.25	0.54	2.19
Fluorene	0.39	0.11	0.58
Indeno(1,2,3-cd)pyrene	0.46	0.13	0.69
Naphthalene	0.45	0.15	0.71
Phenanthrene	1.27	0.57	2.26
Pyrene	1.31	0.57	2.30

ADDENDUM 1

Analytical Data for PRSs in the January 1995 RFI Report for TA-33.