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Date: January 26, 1995
Refer to: EM/ER:95-J015

FEB 3 - 1995

Mr. William Honker
Hazardous Waste Management Division
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1445 Ross Ave, Suite 1200
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Dear Mr. Honker:

SUBJECT: SUBMITTAL OF THE RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION (RFI) REPORT FOR POTENTIAL RELEASE SITES (PRSs) IN TECHNICAL AREA (TA) 33

Enclosed is Los Alamos National Laboratory's RFI Report concerning PRSs, 33-004(d,g,h,i), 33-005(a,b,c), 33-007(c), 33-0109(e,f), 33-011(a,e), 33-012(a), and 33-015. This RFI Report is due to your office on January 31, 1995.

This RFI report documents field work performed at TA-33 during 1993, as detailed in the RFI Work Plan for Operable Unit (OU) 1122 (LA-UR-92-925). This work plan was approved July 15, 1993, by EPA. A documented quality review of the enclose report has been performed in accordance with procedure LANL-ER-AP-01.3.

Please contact Brad Martin at (505) 667-6080, or Paul Treat at (505) 667-5808 if you have any questions.

Sincerely,

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Document Title:

Submittal of the Resource Conservation and Recovery Act Facility Investigation (RFI) Report for Potential Release Sites in Technical Area 33

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Field Unit 3

Operable Unit 1122

Technical Area 33

RFI Report for PRSs

33-004(d)	33-010(e)
33-004(g)	33-010(f)
33-004(h)	33-011(e)
33-004(i)	33-012(a)
33-005(a)	33-015
33-005(b)	33-007(c)
33-005(c)	33-011(a)

Environmental Restoration Project

Los Alamos National Laboratory

January 31, 1995

A Department of Energy

Environmental Cleanup Project

1122

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Executive Summary

The Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1122 (TA-33 and TA-70) (LANL 1992, 0784), was approved by the Environmental Protection Agency (EPA) Region 6 in July 1993 (EPA 1993, 02-090). Sampling and analysis were performed at 25 potential release sites (PRSs) in OU 1122 from May through November 1993. Subsequent sampling was performed at one SWMU in 1994. This RFI report documents results of sampling and analysis for 14 PRSs. The remaining 11 PRSs require sampling and analysis or expedited cleanup plans and will be addressed in future reports.

The primary objective of these Phase I investigations was to perform reconnaissance sampling as specified in the RFI Work Plan for OU 1122. Sampling and analysis plans were designed to determine if contamination had been released from PRSs. As detailed in Subsection 3.1 of the work plan, the technical approach is to compare analytical results to background and to screening action levels (SALs) developed in accordance with EPA methods for a residential scenario. Any contaminant concentrations found above SALs trigger the calculation of a preliminary risk assessment. If a PRS fails the risk assessment, it requires a further evaluation.

In this RFI report, 12 PRS proposals for no further action (NFA) are based on sampling results below SALs, in most cases at background or detection limits. In two cases lead was detected above or near its SAL. In these cases a risk assessment indicated a risk acceptable to the most sensitive population. Results of sampling and analysis are presented for two additional PRSs, one requiring further action and one expected to be proposed for NFA based on a non-residential scenario. The proposed non-residential NFA is contingent upon results of a public participation pilot effort by the LANL Environmental Restoration Project.

Table ES-1 lists PRSs discussed in this RFI report recommended for NFA. The table identifies PRSs included in the 1990 Hazardous and Solid Waste Act Amendments (HSWA) Module, those included in the 1993 permit modification (HSWA-PM), and one PRS relisted in the 1993 permit modification from a SWMU to an area of concern (AOC).

TABLE ES-1

PRSs AT TA-33 RECOMMENDED FOR NFA

SUBSECTION	PRS NUMBER	LOCATION	DESCRIPTION	PERMIT
4.1	33-004(d)	Area 6	Septic system	HSWA[a]
4.2	33-004(g)	Area 6	TA-33-16 outfall	HSWA-PM[b]
4.3	33-004(h)	Main Site	TA-33-20 outfall	HSWA-PM
4.4	33-004(i)	Main Site	TA-33-39 outfalls	HSWA-PM
4.5	33-005(a,b,c)	Main Site	Site of TA-33-21	HSWA-PM
4.6	33-010(e)	Area 6	Surface disposal	AOC[c]
4.7	33-010(f)	Main Site	Surface disposal	HSWA-PM
4.8	33-011(e)	Main Site	Drum storage area	HSWA-PM
4.9	33-012(a)	Main Site	TA-33-39 drum storage	HSWA
4.10	33-015	Main Site	Incinerator	HSWA-PM

[a] Hazardous and Solid Waste Amendments (HSWA)
[b] Hazardous and Solid Waste Amendments permit modification of 1993
[c] Area of concern permit modification of 1993. Note that this PRS was previously listed as a SWMU and the SWMU nomenclature is continued in this RFI report

Two PRSs included in this RFI report contain contamination above SALs. Table ES-2 includes a listing of the contaminants found in these PRSs. During trenching in the SWMU 33-007(c) catcher boxes in 1994, uranium metal chunks were discovered. In addition, inorganics near SALs were detected. A Phase II investigation may be proposed at this site. However, the design of the plan is contingent upon receipt of data from 1994 trenching. At SWMU 33-011(a), contamination above residential SALs consists of polynuclear aromatic hydrocarbons (PAHs) characteristic of combustion products (forest fires, coal burning), asphalt, creosote, diesel fuel, etc. TA-33 is an Environmental Restoration (ER) Project pilot site for public involvement. It is proposed to involve the public in decisions for non-residential exposure scenarios at SWMU 33-011(a).

TABLE ES-2

PRSs REQUIRING FURTHER EVALUATION

SUBSECTION	PRS NUMBER	LOCATION	DESCRIPTION	CONTAMINANTS	PERMIT
4.11	33-007(c)	Area 6	Firing area	Uranium, inorganics	HSWA
4.12	33-011(a)	Main Site	Storage area	SVOCs[a]	HSWA

[a] Semivolatile organic compounds

The following list is a summary of each PRS addressed in this report. All samples were analyzed as specified in the RFI Work Plan for OU 1122 unless otherwise noted (LANL 1992, 0784). Deviations from the work plan are listed in Table ES-3. Sampling as specified in the RFI work plan could not be conducted at two PRSs because the expected components were not present.

TABLE ES-3

RFI WORK PLAN SAMPLING NOT CONDUCTED

PRS NUMBER	REASONS FOR DEVIATION FROM RFI WORK PLAN
33-004(d)	Liquid and sludge not present in septic tank
33-005(a,b, c)	Soil too shallow for specified number of subsurface samples

- **SWMU 33-004(d), Septic tank at Area 6.** A total of 19 samples, both surface and subsurface, were collected for laboratory analysis. Four boreholes were drilled along the line of the single drainpipe. Additional samples were taken in a drainage leading from the tank. Because the tank was dry and contained no sludge, no samples were taken from within the tank. Low levels of acetone were detected in four samples. Trace levels of cyanide were found in several drain line samples. Trace levels of the PAHs fluoranthene, phenanthrene, and pyrene were found in one drainage sample. Metals and uranium were found at or very slightly above LANL background.

- **SWMU 33-004(g), Outfall from gun building TA-33-16.** Five surface samples were collected as follows: one at the outfall, three in the related drainage, and one directly below a nearby culvert. At the outfall, silver, barium, lead, and zinc were found well above LANL background but far below their respective SALs. Metals and uranium were found at or slightly above LANL background in other samples.

- **SWMU 33-004(h), Outfall from warehouse TA-33-20.** Five surface samples were collected at the site of the outfall and in the related drainage. Trace levels of tritium, silver, nickel, zinc, pesticides, fluoranthene, phenanthrene, and pyrene were found in various drainage samples. All concentrations were far below SALs.

- **SWMU 33-004(i), Outfalls from shop TA-33-39.** Three surface samples were collected below each of the two outfalls. Five of the six samples had lead above background; one sample had lead above SAL. All had

trace levels of semivolatile organic compounds (SVOCs) characteristic of asphalt. A risk assessment performed for the lead distribution indicated that there is no hazard from lead to the most sensitive population. No other contaminants were found above background except zinc, uranium, and chromium, which were slightly above LANL background.

- **SWMUs 33-005(a,b,c), Site of laboratory TA-33-21.** A total of 22 samples, both surface and subsurface, were collected over the area of the SWMUs and down the drainages. The number of subsurface samples collected was fewer than specified in the work plan due to the very shallow soil; however, one subsurface sample was drilled into tuff at each sampling point. Most samples contained SVOCs, including PAHs. One sample contained PAHs well above SAL. These contaminants are characteristic of overlapping SWMU 33-011(a) and are addressed under that PRS. Metals, uranium and plutonium-239 were found at, or slightly above, background.

- **SWMU 33-010(e), Surface disposal.** A total of 15 surface samples were collected on the slope and in the adjacent drainage that are relevant for this SWMU. A single sample from the drainage contained low-level PAHs. Uranium and nickel were found slightly above LANL background. No other constituents were found above LANL background.

- **SWMU 33-010(f), Surface disposal.** A total of five surface samples were collected relevant to this SWMU. Trace levels of pesticides were found in one sample. Trace levels of tritium were found in all samples. No other constituents were found above LANL background.

- **SWMU 33-011(e), Drum storage.** Three surface samples were collected at random locations over this small SWMU in addition to radiation screening specified in the work

plan. No constituents were found above LANL background, except traces of aniline and uranium.

- **SWMU 33-012(a), Drum storage.** Four samples were collected under asphalt. All contained trace levels of semivolatile organic compounds characteristic of asphalt. Low levels of uranium, zinc, lead, polychlorinated biphenyls (PCBs), and pesticide were found in some samples relevant to the SWMUs, all well below SALs. No other constituents were found above LANL background.

- **SWMU 33-015, Incinerator.** Two surface samples were collected at the base of the incinerator. These contained silver, cadmium, lead, zinc, and uranium that were well above background but below SALs. A consideration of multiple constituents detected at the SWMU, coupled with a risk assessment for lead, suggest that NFA is justifiable. No other constituents were found above LANL background in these two samples. Associated TA-33 grid samples had zinc, tritium, SVOCs and uranium above LANL background.

- **SWMU 33-007(c), Firing site.** A total of 22 surface samples were collected for the firing site at Area 6. Two samples contained metals near SALs. One sample contained uranium near the SAL for natural uranium. During 1994 trenching in the catcher boxes, uranium metal chunks were found. Many metals and uranium were found above LANL background in many samples. Low levels of SVOCs [D(2,4-) and butylbenzene] were found in two samples. The area has been roped off pending receipt of sampling results.

- **SWMU 33-011(a), Storage.** A total of 26 surface and subsurface samples, including samples assigned to SWMUs 33-005(a,b,c), were taken in this storage area. SVOCs were found in most samples. At one sampling point the total low-SAL PAHs exceeded the SAL

normalized by the toxic equivalency factor (see Subsection 4.12.3). NFA will be proposed contingent upon a public participation pilot study at TA-33. Other constituents were at or near LANL background.

1.0 INTRODUCTION

This Resource Recovery and Conservation Act (RCRA) Facility Investigation (RFI) Report discusses results of sampling and analysis at Technical Area 33 (TA-33) of the Los Alamos National Laboratory (LANL). The work was performed during 1993 in accordance with the TA-33 RFI Work Plan (LANL 1992, 0784). Most potential release sites (PRSs) discussed in this report are recommended for no further action (NFA) based on comparison of analytical data with background and screening action levels (SALs). Two PRSs are recommended for NFA based on results of a preliminary risk assessment. One PRS is presented as a progress report pending receipt of additional analytical results. One PRS may be recommended for NFA in a non-residential scenario following consultation with members of the public.

1.1 Facility Background

TA-33 is located at the southeastern section of the Laboratory (Fig. 1-1). TA-33 is divided into five discontinuous areas (Fig. 1-2). Area 6, South Site, and East Site were firing sites. Main Site is the location of offices, shops, and a warehouse. National Radio Astronomy Observatory (NRAO) Site was a storage area that now holds a radiotelescope. TA-33 was used between 1947 and 1972 as a development site for initiators. The Main Site buildings have been in continuous use since 1952. The firing sites are inactive except for occasional short-term experiments.

This RFI report discusses PRSs at Main Site and Area 6. Experiments were performed on surface firing pads at Area 6 beginning in 1948. The firing site was equipped with guns of various sizes that fired non-exploding test projectiles into catcher boxes and the walls of an excavated cinder cone. Natural uranium and inorganics such as beryllium, cadmium, and lead were used in many experiments. Testing at Area 6 ceased in approximately 1954. Antennas for atmospheric research were later located at the site. Area 6 is now inactive.

Main Site was developed in 1952 for offices, a warehouse, and shops. Activities of the initiator group ended in 1972. A tritium facility was operated at TA-33 from 1955 until 1990. Later operations were confined to office and storage activities for geology group ESS-1 until 1989 when an electronics development group, NIS-6, occupied the buildings.

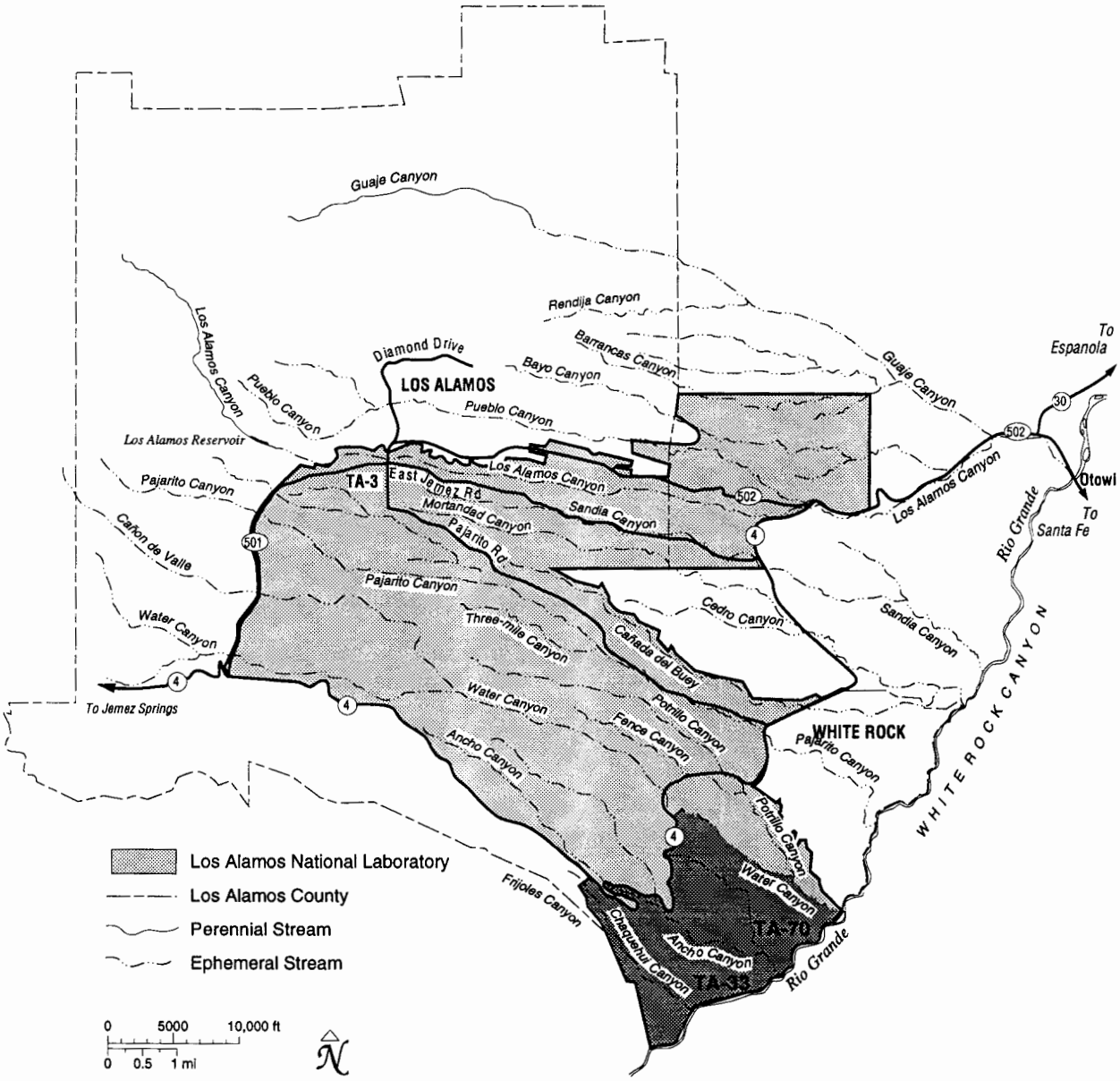


Fig. 1-1. Location of TA-33.

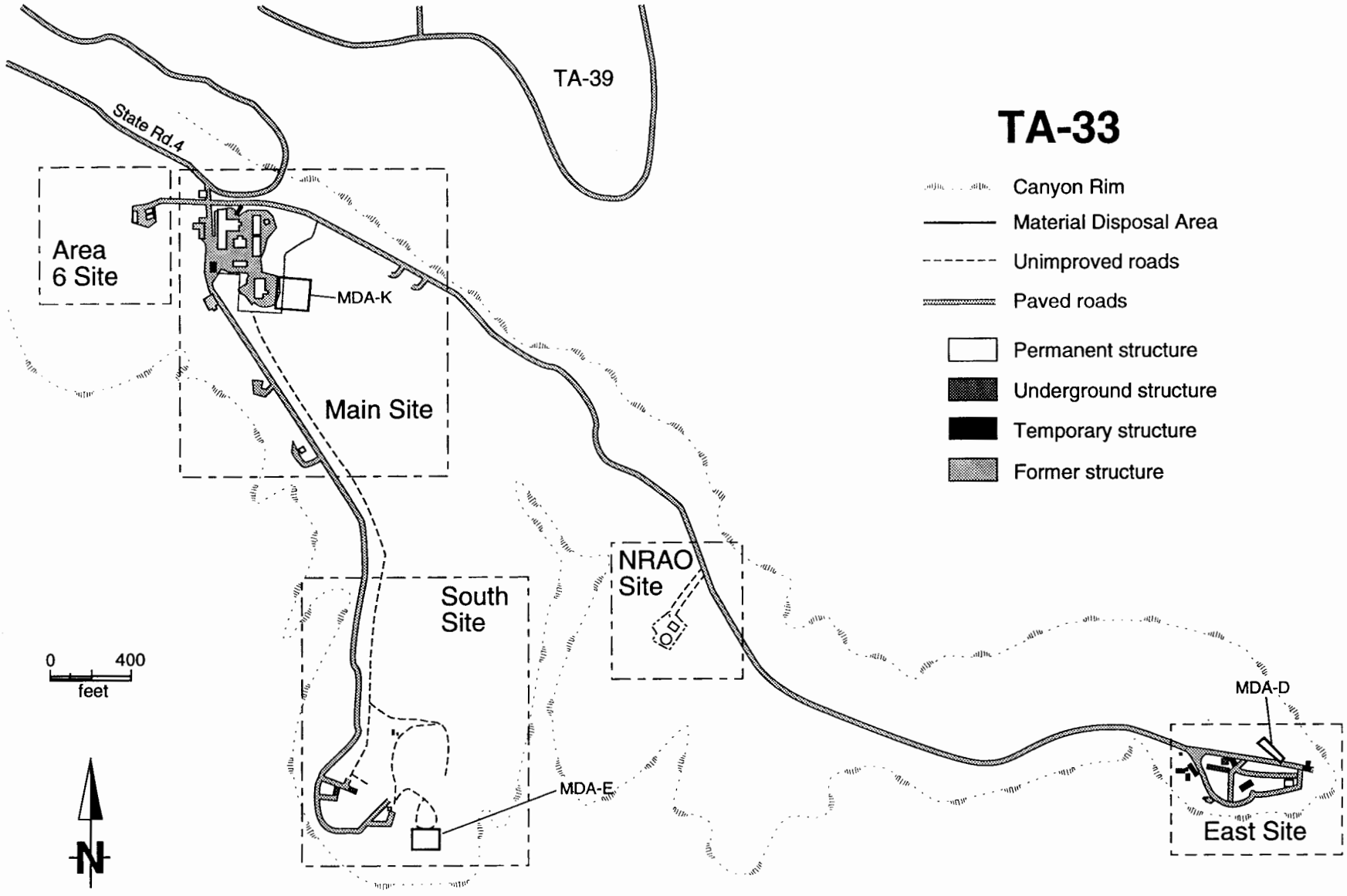


Fig. 1-2. The five sites at TA-33.

1.2 RFI Phase I Work Plan Overview

The RFI Work Plan for Operable Unit (OU) 1122 was submitted to the Environmental Protection Agency (EPA) Region 6 in May 1992 and was approved, with minor modifications, by EPA in July 1993 (LANL 1992, 0784). The technical approach in the plan uses phased sampling to ensure that any environmental impacts associated with Laboratory activities are investigated in compliance with the LANL Hazardous and Solid Waste Amendments (HSWA) Module VIII of the LANL RCRA Facility Permit (EPA 1990, 0306).

As specified in the work plan, Phase I reconnaissance sampling was designed to determine if a release occurred. Sampling plans were developed to estimate the maximum concentrations of contaminants, if present. Plans for several PRSs were designed so that sufficient data, if needed, would be collected to perform preliminary risk assessments.

1.2.1 RFI Objectives

Because little was known of contamination levels at TA-33, the objective of most RFI Phase I sampling plans was to ascertain if contamination is present and which contaminants are present at hazardous levels. As appropriate, samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), radionuclides, inorganics (metals), cyanide, pesticides, herbicides, polychlorinated biphenyls (PCBs), and high explosives. Based on the analytical results for each PRS, options for subsequent actions include:

- Expedited cleanup (EC)
- Phase II study to provide data for baseline risk assessment, which may lead to EC or a corrective measures study (CMS)
- NFA and request for removal of the PRS from the HSWA Permit.

In the RFI work plan, field activities were developed to facilitate sampling decisions. Field activities included the following:

- Accurate land and geophysical surveys and channel mapping
- Radiation surveys of Main Site and Area 6
- Surface sampling to identify:
    1) areas of elevated contamination associated with PRSs
    2) transport of contaminants along stream channels
    3) average contaminant concentrations around gun-firing areas
    4) average concentrations and trends with distance from a potential source
    5) spatial variability and predictability of contaminant concentrations
- Subsurface sampling to identify:
    1) possible vapor phase plumes from sumps and septic tanks
    2) residual contamination at the remediated site of a plutonium release
    3) contaminated soil and solid material in catcher boxes and berms

RFI sampling plans for each PRS were designed to allow preliminary risk assessments if analyses indicated that contamination is present above SALs. Conceptual exposure models were developed for current activities, construction, and recreational scenarios as described in Subsection 3.1.2 of the RFI Work Plan for OU 1122 (LANL 1992, 0768). For risk assessments described in this RFI report, the more conservative residential scenario was used. For SWMU 33-011(a), risks calculated for several scenarios are described.

1993," unpublished report, Los Alamos National Laboratory, Los Alamos, New Mexico. **(Longmire et al. 1993, 0958)**

2.0 ENVIRONMENTAL SETTING

2.1 Climate

Weather at TA-33 is similar to that of the Laboratory as described in Subsection 2.5.3 of the Installation Work Plan (IWP) (LANL 1993, 1017). TA-33 is at the lower elevations of the Laboratory; summers are hotter and winter snow cover is of shorter duration than at the majority of the Laboratory. Summer rains are no less severe than at other areas of the Laboratory and runoff rates are high.

2.2 Geology

White Rock Canyon of the Rio Grande, 1 000 ft deep, is the southeastern boundary of TA-33. Bandelier National Monument is adjacent to the southern and western boundaries of TA-33. Ancho and Chaquehui Canyons bound the principal operational areas at TA-33. The terrain is generally level at Main Site and Area 6, the subjects of this RFI report. Canyon sides are moderately sloping, with the exception of the west side of Area 6, where a tributary of Chaquehui Canyon becomes fairly steep-sided. Detailed descriptions of terrain are provided with each SWMU description.

TA-33 extends to the Rio Grande in White Rock Canyon, with numerous geologic units exposed along the canyon walls (Reneau et al. 1994, 02-092). The geology is described in Subsection 2.5 of the RFI Work Plan for OU 1122 , and in detail in the Reneau report. Exposed bedrock at the developed, mesa-top areas of TA-33 consists of Unit 3 of the Tshirege member of the Bandelier Tuff with outcrops of Unit 2 at South and East Sites. Parts of the Area 6 firing site are built on an exposed basaltic cinder cone that predates the formation of the tuff units. Soils range from sandy loam to fine clay. Pumice pebbles are deposited on the surface. Drainage catchments collect sand, pumice pebbles, and sediments. Soils are generally shallow, with bedrock exposed at many areas on the mesas. Shallow hand-auger drilling during the 1993 sampling campaign indicated that most soils ranged from 2 to 5 ft deep. The deepest soil sampled was 15 ft deep at the Main Site septic tank.

2.3 Hydrology

Ephemeral surface-water flow occurs in the major canyons during the spring snowmelt and summer thunderstorm seasons. Groundwater is expected to be at a considerable depth below the mesa tops. Deep drilling conducted at Main Site (elevation 6 530 ft) in the autumn of 1993 reached a depth of 315 ft (elevation 6 215 ft) without encountering water. The depth to groundwater in the vicinity of Main Site is therefore constrained between 315 and 830 ft (corresponding to the elevation of Ancho Spring, 5 700 ft). There is no information available on the existence of alluvial aquifers in Ancho or Chaquehui Canyons. There are no data available concerning water transport through fissures and fractures of bedrock at TA-33.

3.0 DATA ASSESSMENT AND ANALYSIS APPROACH

This subsection assesses the quality of analytical data collected during the 1993 sampling campaign at TA-33. It also derives background concentrations of inorganics and radionuclides for TA-33 and compares the results with Laboratory background values derived from LANL framework studies.

3.1 Summary of Quality Assurance/Quality Control Activities

This subsection summarizes the assessment obtained by statistical analysis of all data collected during the 1993 sampling campaign. That effort included field samples and associated quality assurance (QA) and quality control (QC) samples for 25 PRSs. Fourteen of these 25 PRSs are addressed in this RFI report. This assessment is also relevant to 11 PRSs that will be addressed in future reports. The overall quality of these data for the 25 PRSs and their usefulness for the proposed evaluations are discussed in the following subsections. Additional remarks are included in tables associated with the evaluation of individual PRSs in Subsection 4 of this report and following RFI reports, as appropriate.

Samples were submitted from the field to the LANL CST-9 Sample Coordination Facility (SCF) over the course of the sampling campaign. At the SCF, samples were batched with appropriate QA/QC samples and distributed to analytical laboratories. Each batch was assigned a request number and a report number. A batch could contain from one to more than 20 field samples. Samples were analyzed and results reported and verified by request/report batch. Report numbers given in the following text are available for review in the LANL Facility for Information Management, Analysis and Display (FIMAD) databases.

Laboratory QA samples of various types are added to each analytical batch of samples by the SCF. In addition, internal procedures of each analytical laboratory require measurement of a certain number of QC samples. These results may be evaluated by the SCF but are not discussed here. Depending on the type of analysis to be performed, the QC may include blanks, blinds, blank spikes/blank spike duplicates, and matrix spikes and matrix spike duplicates prepared using sample material provided by the samplers. For organics analyses, the recovery of surrogates is also reported.

Results for blank QC samples are flagged out of control by the SCF data reviewers whenever a reported measurement is above the detection level. Blind QC samples are flagged warning or out of control based on a formula that compares the difference between the measured and known values with a nominally expected variability of the measurement process. As the true values are not provided to the field unit, it is not possible to determine whether the blind QC samples are systematically out of control on the high or low side, but evaluation of patterns by the field unit may lead to a request for further evaluation by the SCF. For blanks and matrix spikes, both the true value and the measured value are usually reported.

3.1.1 Holding Times

One sample failed to meet holding time for SVOCs and the results were unusable. In evaluating the overall data from the affected PRS, SWMU 33-004(d), it was concluded that this loss did not affect the decision for an NFA recommendation.

3.1.2 Inorganic Analyses

As shown in Table 3-1, about one-third of the inorganic analyses were performed by a commercial laboratory. The remaining inorganic analyses were performed by the LANL CST-9 analytical group. No systematic differences were noted between the laboratories.

TABLE 3-1

INORGANIC ANALYSIS

ANALYSIS	NUMBER OF ANALYSES		METHOD
	CST-9	Laboratory 12	
Inorganic suite	188	90	SW 846/6010, ICPES[1], ETVAA[2]
Mercury	15	29	SW 846/6010, CVAA[3]
Cyanide	13	11	SW 846/6010, ACOLR[4]

[1] Inductively coupled plasma emission spectroscopy
[2] Electrothermal Vapor Atomic Absorption
[3] Cold vapor atomic absorption
[4] Automatic color analysis

Blank QC samples: Barium and zinc were detected in QC blanks included with report 20107. Barium was also detected in QC blanks with report 20359. Arsenic was reported in a QC blank with report 20487. Of these, only arsenic is of possible concern, but this report included only samples from SWMUs 33-002(a,b,c,d) to be discussed in a later RFI report, and there is no indication of above background arsenic in any of these samples. Thus, the handful of results out of control for blank QC samples does not indicate any areas of concern for the purposes of this report.

Blind QC samples for inorganics: Cyanide blind QC samples are usually out of control (4 times out of 6) or in warning status (outside of 2-sigma limits; 1 time out of 6). There are not enough splits or laboratory replicates available for an independent assessment of the variability of this measurement. Cyanide measurements were made only for samples from SWMU 33-004(d), and used only to indicate that the appropriate area had been sampled. No observation was close to SAL, a level of concern from a health-based point of view. For the purposes of this report, therefore, the cyanide measurement process appears to be adequate.

Inorganics are out of control in 5 to 16% of the measured blind QC samples, most of which were water QC samples sent by the sample receiving facility. All of the out of control observations come from these water QC samples, for which the project cannot provide any independent assessment of the precision estimate used. No systematic patterns, with respect to either batches or analytes, were observed. Overall, this rate of out of control observations does not appear to compromise data quality.

Matrix spikes: Inorganic matrix spike recovery appears adequate in most cases. No systematic problems appear in a review of the data, although recovery of arsenic, selenium, and antimony tends to be out of control on the low side. There are a handful of outliers: high arsenic recovery in a matrix spike of sample AAA6866 (report 23109); high lead recoveries in matrix spikes of sample AAA1931 and sample AAA2232 (report 20590); low antimony recovery in a matrix spike of sample AAA1995 (report 20678); and low arsenic recoveries in matrix spikes of sample AAA2087 (report 19997) and sample AAA2232 (report 20590). Other recoveries are between 63%

and 120%. Overall, the matrix spike results indicate that the analytical processes were in satisfactory control.

3.1.3 Organic Analyses

As shown in Table 3-2, organic analyses were done by four different laboratories. No systematic differences were noted among these laboratories, with one exception. LANL's CST-9 does not report tentatively identified compounds (TICs). Patterns of presence/absence of non-target organic constituents cannot be reliably determined from these data.

TABLE 3-2

ORGANIC ANALYSES

ANALYTE SUITE	NUMBER OF ANALYSES				METHOD
	CST-9	No. 3	No. 6	No. 13	
Volatiles	53	none	none	none	SW-846, 8260, GCMS[1]
Semivolatiles	97	none	56	94	SW-846, GCMS
HE	none	none	34	16	SW-846, HPLC[2]
PCBs	6	4	14	none	SW-846, GCEC[3]
Pesticides	none	21	8	13	SW-846, GCEC
Herbicides	none	29	15	14	SW-846, HPLC

[1] Gas chromatography-mass spectrometry
[2] High-pressure liquid chromatography
[3] Gas chromatography-electron capture

Surrogate recovery: Surrogates are organic compounds added in known quantity to each sample before analysis. Surrogate recovery is an indication of the accuracy of an analysis. Semivolatile surrogate recovery was reportedly zero for sample AAA2204, a field duplicate of sample AAA2041, sludge from the tank at SWMU 33-016. However, the sludge contained a number of organic compounds, and the reported results for sample AAA2204 closely resemble those for sample AAA2041, so this appears to have been a reporting error.

Semivolatile surrogate recovery was very high (over 250% for all surrogates) for sample AAA1991 from SWMU 33-005(b). Moderately high semivolatile surrogate recoveries (in the range of 130% to 167%) were also noted for grid

sample AAA2100. Particularly high surrogate recoveries for *p*-terphenyl-d14 were common. In particular, sample AAA1944 from SWMU 33-002(d), had recoveries of 359 to 388% of this one surrogate, while others were normal. The laboratory summary for this report (14606) notes that internal standard responses for sample AAA1944 were outside of EPA control limits. As a result, the sample was reanalyzed to confirm matrix effects. Two of three volatile surrogate recoveries for sample AAA1949, the sludge sample from SWMU 33-004(a), exceeded 150%.

Overall, surrogate recoveries were in acceptable ranges, with median recovery between 68 and 112%. The effect of exceptions on decisions is insignificant, but noted in the individual PRS discussions.

Blank QC samples: The following organics were detected in blank QC samples: hexanone, acetone, butanone, tetrachloroethane, di-n-butyl phthalate, dichlorobenzene (1,2), dibromo-3-chloropropane, and trichloropropane. As none of these contaminants were detected at hazardous levels at TA-33, their presence in blanks has no impact on the usefulness of the data.

Blind QC samples: The following organics were indicated as being out of control in 20% or more of the blind QC samples measured: Dinoseb (77%), Endosulfan I (67%), Endosulfan II (58%), aniline (58%), hexanone (35%), dichlorobenzene (23%), and mixed Aroclors™ (once in five QC samples). None of these compounds are of significant concern in the field samples. Acenaphthene, a compound of some concern, was indicated out of control for two reports (19190 and 21900). Report 19190 includes 27 samples from the Main Site grid and drainages, and report 21900 includes no samples from any PRS. Thus, these reports do not include samples from areas where organic contamination is a major concern. Overall, blind organic QC samples do not indicate problems that could render the data unusable for the purposes of this report.

Matrix spikes: Only one sample, AAA6871 from SWMU 33-004(d), was treated with volatile spikes. Recoveries were in the range of 42% to 88% for five spiked compounds. The relative difference between matrix spike and the matrix spike duplicate was between 2% and 10.5%. These results suggest that volatile recovery is typically low, but volatiles are readily

detectable. However, no measurements on field samples suggest any problems with volatile organics at the PRSs discussed in this report: volatiles at SWMU 33-004(d) were detected in the range 0.045 to 0.066 mg/kg; SALs range from 3.2 to 8 000 mg/kg. Trace levels (0.066 and 0.13 mg/kg) of acetone were detected at SWMU 33-011(a); the SAL is 8 000 mg/kg.

Pyrene and acenapththene are used as matrix spikes. Because these compounds are present in several of the samples selected for spiking, spike recoveries for these compounds are sometimes extremely high. This problem occurs with matrix spikes of sample AAA2051, a sample from the vehicle maintenance area, and sample AAA1976 from SWMU 33-004(i). Considerable variability was associated with these matrix spike/matrix spike duplicate pairs as well. Large recoveries of pyrene from the matrix spike of sample AAA1944 are also reported (together with a large difference between the matrix spike and the matrix spike duplicate). There are no organics reported above detection level for sample AAA1944 from SWMU 33-002(d). As noted earlier, the laboratory reported significant matrix effects for this sample that may have made it impossible to obtain reliable measurements. With these exceptions, plus slightly elevated spike recoveries of 4-nitrophenol in matrix spikes of sample AAA1931, spike recoveries are in the range of 48% to 141%, more often below 100% than above. Also, except as noted above, the relative difference between a matrix spike and matrix spike duplicate did not exceed 17.4%. Overall, the matrix spike and matrix spike duplicate results indicate that the analytical processes were in satisfactory control.

3.1.4 Radiochemical Analyses

As shown in Table 3-3, the bulk of the radionuclide measurements for these samples were performed by a commercial analytical laboratory. A small number were performed by LANL's CST-9. A third commercial laboratory performed a few analyses. No systematic differences were noted among the laboratories.

Blind QC samples for radionuclides: Tritium blind QC samples are flagged out of control fully 75% of the time (15 measurements out of 20). This high out of control rate is probably due to an unrealistic assessment of the precision achievable by the sample preparation and measurement

TABLE 3-3

RADIONUCLIDES

ANALYTE	NUMBER OF ANALYSES			METHOD
	CST-9	No. 3	No. 12	
Uranium (total)	1	6	251	ICPES[1], ICPMS[2], KPA[3]
Plutonium-238, -239	1	6	142	Alpha spectroscopy
Tritium	2	6	154	Liquid scintillation
Cesium-137	2	6	154	Gamma spectroscopy

[1] Inductively coupled plasma emission spectroscopy
[2] Inductively coupled plasma mass spectrometry
[3] Kinetic phosphorescence analysis

process, as discussed in Subsection 3.1.5.3. The results were accepted as reported by the analytical laboratory, but much greater uncertainty was assigned to them.

Cesium-137 blind QC samples are flagged out of control 35% of the time (11 times out of 31), and in warning status another 3 times. There is no indication that an unrealistic estimate of precision is being used here, as in the case of tritium; the median reported error is close to two sigma as estimated from splits and collocated samples at TA-33. However, cesium-137 is not of significant concern at TA-33.

Uranium blind QC samples are out of control in only two cases out of 29. Other radionuclides are always reported in control.

3.1.5 Field Quality Assessment Samples

Quality control in the field is assured primarily by following standard operating procedures (SOPs). Field procedures discussed below conformed to the SOPs of the Environmental Restoration (ER) Project and the Quality Assurance Project Plan in the RFI Work Plan for OU 1122 (LANL 1992, 0748). In addition, LANL-ER-SOP 1.05, R0, Field Quality Control Samples, specified procedures that were used in collecting QA/QC samples. Field procedures are described in detail in the Summary of 1993 Survey and Sampling Activities at TA-33 (Main Site and Area 6) (ICF-Kaiser 1994, 02-095).

As one part of the field quality control program, a number of field quality assessment samples were collected.

- Field Blanks. Two water field blanks were included, but the remaining field blanks for this sampling campaign consisted of 17 samples of uncharacterized, homogenized soil from an off-site location, about a mile west of TA-33 near the entrance to Bandelier National Monument. Samples of this material were periodically prepared using the same procedures used for collecting field samples. These samples serve not only to evaluate cross-contamination that might have been introduced during the sampling process, but also to provide limited local background information.

- Rinsates. Seven rinsate samples were collected for the purpose of evaluating decontamination of field equipment.

- Splits. Thirty-two samples were split in the field after collection. By comparing results for these duplicates or triplicates of samples, the replicability of the sample handling, preparation, and measurement process can be assessed.

- Collocated samples. In addition, 16 collocated samples were collected, each within 1 ft of another sample or, in the case of subsurface samples, from an adjacent segment of the core. Results for these pairs reflect not only the variability of the sample handling, preparation, and measurement processes, but also the inherent heterogeneity of the sampled material. Collocated samples permit assessment of the replicability (repeatability) of the sampling and measurement processes.

3.1.5.1 Field Blanks

One of the soil field blanks, sample AAA2188, appeared to be contaminated with silver (7 mg/kg), cadmium (6.6 mg/kg), and chromium (46 mg/kg). These observations are all well above background values. Sample AAA2188 was analyzed for the standard inorganics suite together with approximately 20 other samples included in report 21424. This report includes sample AAA2035, a sample from SWMU 33-013 with high levels of silver (10 mg/kg), cadmium (620 mg/kg), and chromium (670 mg/kg). Also included in this report is grid sample AAA2099 with silver at 4.6 mg/kg, cadmium at 5.2 mg/kg, and chromium at 35 mg/kg. (Grid samples are discussed in Subsection 3.2.2.) Other samples in this batch appear to be unaffected. However, the inorganics results for samples AAA2099 and AAA2188 are considered unusable, because this unusual pattern must be the result of cross contamination or a measurement process out of control. Other evidence from an associated quality control blank suggests a laboratory rather than a field problem, as described below. The inorganics results for sample AAA2035 are suspect, but possibly real. SWMU 33-013 is a former storage site behind TA-33-86 (the former tritium facility). Two other samples from this site showed only background-level inorganics. Phase II investigations are planned for this area to see if the high observations can be replicated and to determine the extent of contamination.

QC samples associated with report 21424 shed light on the high levels of silver, cadmium, and chromium in a field blank and a grid sample discussed above. The spurious observations could result from cross contamination either in the field or in the laboratory, or from an out-of-control laboratory process. All three samples were collected on May 12, but according to the field logs, sample AAA2035, with high levels of silver, cadmium, and chromium, was collected several hours after the other two. This rules out cross-contamination due to the field sample collection process. One of three blind QC samples included with these samples was out of control on the high side in cadmium, chromium, and zinc, and low in nickel. Sample AAA2035 had low zinc (14 mg/kg), but sample AAA2099 at 110 mg/kg was at the top of the range for zinc on the grid, and sample AAA2188 was an outlier at 140 mg/kg. High nickel (100 mg/kg) was reported in sample AAA2035 but not in other samples in this batch. Thus, there appears to be a laboratory problem

with this group of samples. Inorganics for all other samples in this batch are within local background ranges (Subsection 3.2.2.1).

The only organics positively identified in field blanks were bis(2-ethylhexyl)phthalate (at 0.36 mg/kg in sample AAA2240) and di-n-butylphthalate (at 3.2 mg/kg in sample AAA2248 and 3.6 mg/kg in sample AAA2249). Organic compounds were tentatively identified in 10 of the 17 field blanks. These were the field blanks that were sent to external laboratories for semivolatile analysis. The LANL organics laboratory does not report tentatively identified compounds (TICs). The largest number of such compounds is associated with field blank sample AAA2245, which was analyzed together with most of the samples from SWMU 33-004(a) (report 20113), including exceptionally contaminated sludge sample AAA1949. Large numbers of TICs are likewise associated with several other samples in this report. Thus, the possibility of some cross contamination is indicated, but not strongly, because no organics were positively identified in sample AAA2245. It is more likely that the TICs represent background levels of organic constituents, as discussed in Subsection 3.2.2.3.

3.1.5.2 Rinsate Samples

Rinsate samples were collected to assess procedures for decontaminating equipment. Rinsate samples were collected only for reusable equipment (auger, drill bits, and coliwasa samplers) at the rate of 1 rinsate per 20 samples for a total of 7 samples. Surface sampling equipment was not reused during the sampling campaign.

The only organic compound reported in any rinsate blank was 4-hydroxy-4-methyl-2-pentanone, tentatively identified at 11 µg/L in sample AAA2198. The same compound was tentatively identified at 14 mg/kg in sample AAA2063 from the SWMU 33-017 drainage to the east of Main Site that was included in the same batch. This was a surface sample that was not collected with an auger. Its presence in the rinsate blank does not indicate a problem with the decontamination procedure.

Some inorganics (barium, nickel, lead, selenium, and zinc) and radionuclides (plutonium and uranium) were reported in the remaining rinsate blanks. Generally, these reported values are barely above detection level and the

associated uncertainty estimate is unrealistically small. The following are possible exceptions:

- Plutonium-238 at 0.035 pCi/L in sample AAA2208, a rinsate sample from the coliwasa tube used to collect samples AAA1915 and AAA1916 from the MDA K septic tank [SWMU 33-002(a)] and AAA2040 and AAA2041 from the SWMU 33-016 sump. The plutonium-238 results from the septic tank were lower than those from the rinsate sample. The field samples from the sump were not analyzed for plutonium, which was not expected at SWMU 33-016.

- Barium at 4.3 µg/L in sample AAA2241, a rinsate sample from the auger used to collect samples AAA1924-1948. This rinsate sample was measured twice and the second time the reported value was below the detection limit of 2 µg/L.

- Lead at 4.5 µg/L and zinc at 170 µg/L in sample AAA6870, a rinsate sample from the pick used to break through asphalt at SWMU 33-011(d) prior to collecting samples AAA6863, 6864, 6866, 6867, and 6868. Asphalt may result in material sticking to the pick. Two samples from SWMU 33-011(d), a pavement sample and a soil sample from beneath the asphalt, had high lead and zinc concentrations. It is possible that decontamination of the pick was incomplete.

With the possible exception of the last rinsate sample, these results indicate no significant problem with the decontamination procedures used at TA-33.

3.1.5.3 Field Splits, Collocated Samples, and Laboratory Replicates

The sampling and analysis results include 16 pairs of collocated samples, 42 independent pairs of split samples from 32 locations, and 45 samples for which the laboratory measurements were replicated for some analytes. These results provide rough estimates of replicability to be compared to the reported laboratory uncertainty for most of the radionuclides and inorganics.

Table 3-4 compares the estimates of replicability based on results from TA-33 QA samples (columns 1, 2, and 3) with the uncertainty reported by analytical laboratories (column 4). The numbers in Table 3-4 should not be considered as more than indicator tables. They are estimates of the average replicability; the difference between individual pairs of collocated samples, splits, or laboratory replicates can be significantly larger.

TABLE 3-4

ESTIMATES OF COEFFICIENTS OF VARIATION OF MEASUREMENTS OF RADIONUCLIDES AND INORGANICS IN SOIL SAMPLES

ANALYTE	BETWEEN COLLOCATED SAMPLES	BETWEEN SPLITS OF ONE SAMPLE	BETWEEN LABORATORY REPLICATES	TYPICAL REPORTED UNCERTAINTY
Cesium-137	13%	13%	5%	30%
Tritium	30%	30%	**	1%
Plutonium-238	65%	25%	20%	65%
Plutonium-239	50%	22%	3%	30%
Uranium	3%	1%	**	20%
Arsenic	4%	4%	2%	20%
Barium	3%	<1%	<0.1%	10%
Beryllium	7%	1%	1%	10%
Cadmium	7%	4%	**	20%
Chromium	7%	2%	<1%	10%
Nickel	29%	11%	8%	13%
Lead	9%	5%	<1%	20%
Zinc	6%	1%	<1%	10%

**Insufficient data

The most significant discrepancy between replicability observed based on field duplicates (either splits or laboratory samples) and reported laboratory uncertainty occurs for tritium, measured in pCi/mL. Reported laboratory uncertainty in this case severely underestimates the replicability of the measurement process. For other radionuclides, except uranium, the reported uncertainty appears to represent approximately two sigma. In the case of uranium our data suggest the measurement process is much better than the reported uncertainties would suggest. (The numbers in the middle three columns should be interpreted as one sigma, or one relative standard

deviation.) In general, except for nickel, the reported uncertainties for inorganics also appear, based on these data, to be generous estimates of two sigma.

Overall, on the basis of the TA-33 collocated/replicated sample data, the precision of the total sampling and measurement process appears to be satisfactory for the intended data uses.

3.2 Statistical Analyses–Background Results

This subsection determines TA-33-specific background ranges of inorganics and radionuclides and compares them to the Laboratory-wide background ranges derived from the Environmental Restoration Project Laboratory-wide background studies (Longmire et al. in preparation, 1142).

3.2.1 Statistical Methodology

Field quality assessment samples, discussed in Subsection 3.1.5, provide indicators of bias arising from field and replicability of observations. In particular, estimates of replicability of observations are compared with reported uncertainties in the analytical results.

Background data sets provide ranges for naturally occurring elements and widespread man-made radionuclides to be expected in uncontaminated areas at TA-33. Local background data can be compared with Laboratory-wide background. In addition to the ranges of the observations (the minimum and maximum observations, excluding outliers, in available data sets), the data are used to compute upper tolerance limits (UTLs). UTLs are upper confidence bounds for an upper tail percentile of the distribution. The (99%,0.95) UTLs are statistics such that we are 95% confident that not more than 1% of the distribution exceeds these values. Calculation of this statistic is based on normal theory: it is a linear combination of the sample mean and the sample standard deviation. The mean and standard deviation of the logarithms may be used if the underlying distribution is more nearly lognormal than normal. While the use of UTLs is frequently recommended for hot spot tests, estimates of such limits are extremely sensitive to outliers and nonnormality. For the results presented below, robust estimates of the mean and standard deviation were used to minimize the effects of outliers and nonnormality.

Finally, preliminary risk assessments are based on upper confidence limits (UCL) for the arithmetic mean concentration of contaminants over an appropriate exposure unit. For lognormally distributed data, a method for evaluating this UCL is available.

3.2.2 Regional and Local Background Distributions for Inorganics and Radionuclides

Both local and Laboratory-wide background data are discussed below. This allows the reader to consider either local or Laboratory-wide data in evaluating whether a release has occurred. In this report analytical data is compared to Lab-wide data to determine if a release has occurred. However, in some cases, particularly for uranium and nickel, consideration of local-background data helps explain apparent values over background. Background data for comparison with measurements from potential release sites at TA-33 are available from five sources:

1) The Main Site grid. The TA-33 Phase 1 investigation included measurements at 51 locations selected from a grid covering Main Site and extending several hundred feet beyond the perimeter of Main Site. These grid points were located in areas believed to be unaffected by any releases other than possible airborne releases from the Main Site stacks. The results from these samples, and their utility as local background, are discussed below in more detail. In particular, outliers that do not appear to be typical of the general grid are noted. Fig. 3-1 shows the location of the grid samples. Table 3-5 is a listing of results for all inorganics and radionuclides and any organics detected.

2) Soil field blanks. Seventeen samples were made up of material collected from a site about one mile to the west of the entrance to TA-33, an undisturbed area of the mesa top across State Road 4 from the entrance to Bandelier National Monument. The primary purpose of these samples was for use as field blanks discussed in Subsection 3.1.5.1, but these analyses also provide

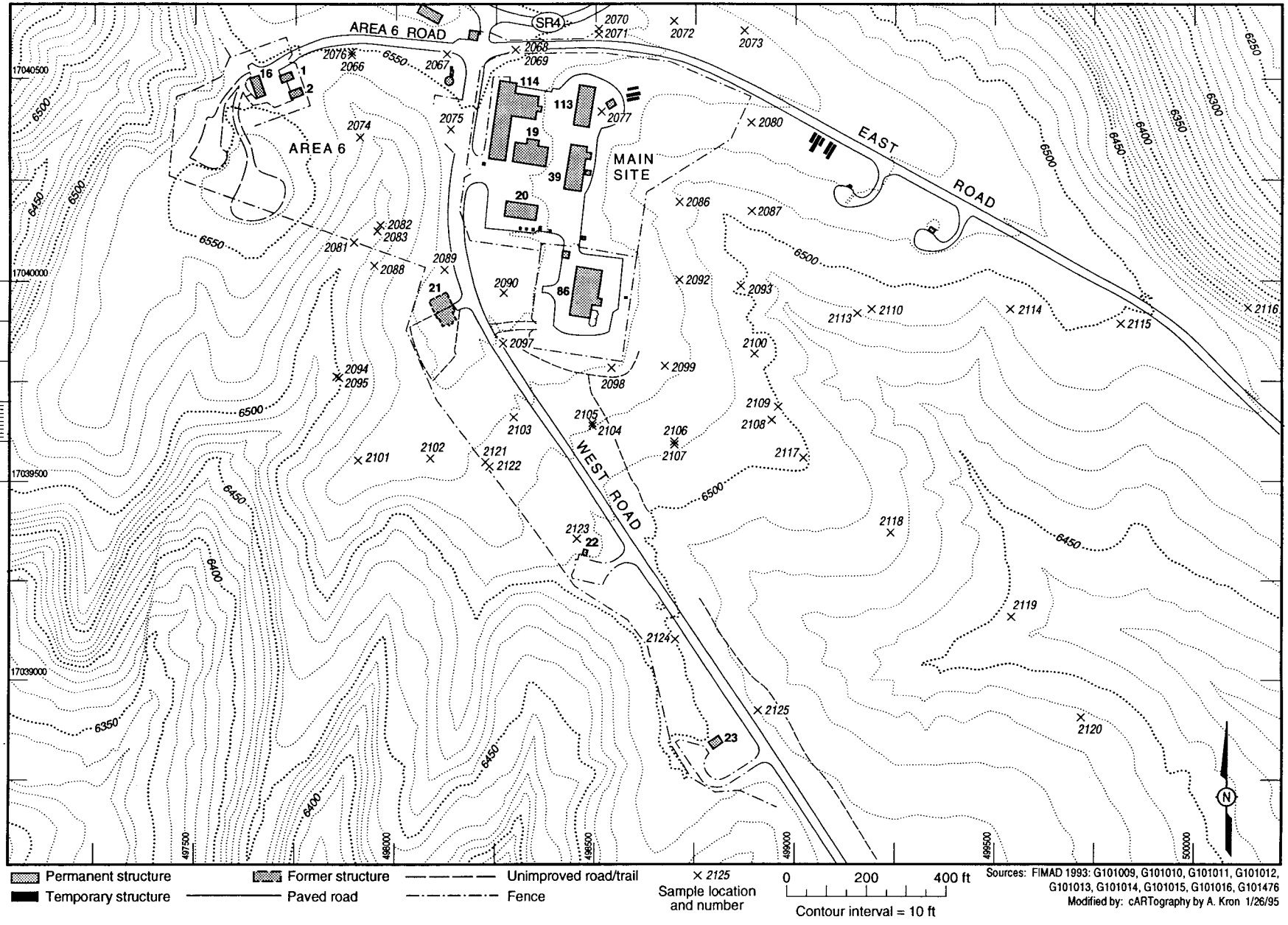


Fig. 3-1. Locations of grid samples.

TABLE 3-5

SWMU 33-017 GRID SAMPLES

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH IN.	END DEPTH IN.	ANALYSES PERFORMED							
											ORGANICS				
								INORGANICS	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2066	33-1119	33-017		soil	0	6	X	X		X			X	X
2	AAA2067	33-1120	33-017		soil	0	6	X	X		X	X		X	X
3	AAA2068	33-1121	33-017		soil	0	6	X	X		X			X	X
4	AAA2069	33-1122	33-017	collocated	soil	0	6	X	X		X	X		X	X
5	AAA2070	33-1123	33-017		soil	0	6	X	X		X			X	X
6	AAA2071	33-1124	33-017	neighbor	soil	0	6	X	X		X			X	X
7	AAA2072	33-1125	33-017		soil	0	6	X	X		X				
8	AAA2073	33-1126	33-017		soil	0	6	X	X		X				
9	AAA2231	33-1126	33-017	duplicate	soil	0	6	X	X		X				
10	AAA2074	33-1127	33-017		soil	0	6	X	X		X			X	X
11	AAA2075	33-1128	33-017		soil	0	6	X	X		X				
12	AAA2076	33-1129	33-017	collocated	soil	0	6	X	X		X				
13	AAA2077	33-1130	33-017		soil	0	6	X	X		X	X		X	X
14	AAA2080	33-1133	33-017		soil	0	6	X	X		X				
15	AAA2218	33-1133	33-017	duplicate	soil	0	6	X	X		X				
16	AAA2219	33-1133	33-017	duplicate	soil	0	6	X	X		X				
17	AAA2081	33-1134	33-017		soil	0	6	X	X		X				
18	AAA2082	33-1135	33-017		soil	0	6	X	X		X				
19	AAA2083	33-1136	33-017	neighbor	soil	0	6	X	X		X				
20	AAA2086	33-1139	33-017		soil	0	6	X	X		X				
21	AAA2087	33-1140	33-017		soil	0	6	X	X		X				
22	AAA2088	33-1141	33-017		soil	0	6	X	X		X				
23	AAA2089	33-1142	33-017		soil	0	6	X	X		X				
24	AAA2221	33-1142	33-017	duplicate	soil	0	6	X	X		X				
25	AAA2222	33-1142	33-017	duplicate	soil	0	6	X	X		X				
26	AAA2090	33-1143	33-017		soil	0	6	X	X		X				
27	AAA2092	33-1145	33-017		soil	0	6	X	X		X				
28	AAA2093	33-1146	33-017		soil	0	6	X	X						

TABLE 3-5 (cont.)

SWMU 33-017 GRID SAMPLES

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH IN.	END DEPTH IN.	ANALYSES PERFORMED							
								INORGANICS	RAD	VOCs	ORGANICS SVOCs	PCBs	HE	PEST	HERB
29	AAA2094	33-1147	33-017		soil	0	6	X	X		X				
30	AAA2095	33-1148	33-017	neighbor	soil	0	6	X	X		X				
31	AAA2097	33-1150	33-017		soil	0	6	X	X		X				X
32	AAA2098	33-1151	33-017		soil	0	6	X	X		X				
33	AAA2099	33-1152	33-017		soil	0	6	X	X		X				X
34	AAA2100	33-1153	33-017		soil	0	6	X	X		X				X
35	AAA2101	33-1154	33-017		soil	0	6	X	X		X				
36	AAA2103	33-1156	33-017		soil	0	6	X	X		X				
37	AAA2104	33-1157	33-017		soil	0	6	X	X		X				
38	AAA2105	33-1157	33-017	collocated	soil	0	6	X	X		X				
39	AAA2106	33-1159	33-017		soil	0	6	X	X		X				
40	AAA2107	33-1160	33-017	neighbor	soil	0	6	X	X		X				
41	AAA2108	33-1161	33-017		soil	0	6	X	X		X				
42	AAA2109	33-1162	33-017		soil	0	6	X	X		X				
43	AAA2110	33-1163	33-017		soil	0	6	X	X		X				
44	AAA2113	33-1166	33-017		soil	0	6	X	X		X				
45	AAA2114	33-1167	33-017		soil	0	6	X	X		X				
46	AAA2115	33-1168	33-017		soil	0	6	X	X		X				
47	AAA2116	33-1169	33-017		soil	0	6	X	X		X				
48	AAA2117	33-1170	33-017		soil	0	6	X	X		X				
49	AAA2118	33-1171	33-017		soil	0	6	X	X		X				
50	AAA2119	33-1172	33-017		soil	0	6	X	X		X				
51	AAA2120	33-1173	33-017		soil	0	6	X	X		X				
52	AAA2121	33-1174	33-017		soil	0	6	X	X		X				
53	AAA2122	33-1175	33-017	neighbor	soil	0	6	X	X		X				
54	AAA2123	33-1176	33-017		soil	0	6	X	X		X				
55	AAA2124	33-1177	33-017		soil	0	6	X	X		X				
56	AAA2125	33-1178	33-017		soil	0	6	X	X		X				

TABLE 3-5 (cont.)

SWMU 33-017 GRID SAMPLES

		RADIONUCLIDES					INORGANICS										
#	SAMPLE ID	U mg/kg	238Pu pCi/g	239Pu pCi/g	137Cs pCi/g	3H pCi/g	Ag mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Pb mg/kg	Sb mg/kg	Se mg/kg	Zn mg/kg
1	AAA2066	2.6	0.004	0.011	1.2	0.2	<1	3	73	0.67	<0.4	7.3	6	11	<0.06	0.5	42
2	AAA2067	2.1	0.004	0.017	<0.85	0.1	<1	13.8	76.2	0.41	1.5	10	8.5	902	<11.2	<0.6	217
3	AAA2068	1.8	0.001	0.003	<0.53	0.2	<1	1.6	93	0.45	<0.4	9	8	10	0.07	0.3	49
	AAA2068R	NA	NA	NA	<0.46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	AAA2069	2.4	0.004	0.027	<0.43	1.4	<1	2.2	75	0.76	<0.4	5.5	4	13	<0.04	0.3	28
5	AAA2070	2.3	0.004	0.017	1.46	1.0	<1	1	66	0.56	<0.4	7	7	17	0.07	<0.2	49
6	AAA2071	2.5	0.002	0.017	1.25	1.2	<1	1.2	54	0.4	<0.4	5.4	5	12	<0.025	<0.2	38
	AAA2071R	NA	NA	NA	NA	NA	NA	NA	54	0.4	<0.4	5.4	4	13	NA	NA	40
7	AAA2072	2.1	0.006	0.044	0.83	2.1	<1	1.4	74	0.6	<0.4	5.5	10	20	<0.04	0.3	34
	AAA2072R	NA	0.005	0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	AAA2073	2.6	0.005	0.042	1.61	0.4	<1	3.5	78	0.73	<0.4	10	7	18	<0.06	0.5	41
	AAA2073R	NA	0.006	0.037	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9	AAA2231	2.2	0.004	0.04	1.57	2.0	<1	3.6	85	0.78	<0.4	11	7	21	<0.06	0.4	43
	AAA2231R	NA	NA	NA	NA	NA	NA	3.3	NA	NA	NA	NA	NA	NA	<0.06	0.5	NA
10	AAA2074	3.8	0.003	0.01	<0.84	0.2	<1	2.8	150	0.59	<0.4	13	8	11	0.07	0.6	33
11	AAA2075	41.6	0.005	0.008	<0.37	0.1	<1	2.8	240	0.64	<0.4	13	69	24	<0.06	0.5	38
12	AAA2076	2.8	0.004	0.014	<0.69	0.2	<1	3.2	75	0.67	<0.4	7.8	7	10	<0.06	0.4	42
13	AAA2077	2.9	0.002	0.007	<0.91	1.1	<1	1.44	45	0.43	<0.4	6.8	460	28	<0.1	<0.2	41
	AAA2077R	3.1	NA	NA	<0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14	AAA2080	2.3	0.001	0.013	0.78 1	2.0	<1	1.8	69	0.95	<0.4	6.3	<2	14	<0.06	<0.2	34
15	AAA2218	2.4	0.004	0.009	<0.65 1	2.5	<1	1.5	61	0.89	<0.4	5.7	<2	15	<0.06	<0.2	29
16	AAA2219	2	0.003	0.016	0.77 3	6.2	<1	1.65	65	0.87	<0.4	5.7	<2	15	<0.06	<0.2	30
17	AAA2081	3.1	0.002	0.02	<0.76	0.4	<1	2.9	260	1.1	<0.4	19	32	16	<0.06	0.5	57
18	AAA2082	2.1	0.001	0.025	1.33	0.6	<1	2.7	65	0.56	<0.4	7	4	90	<0.06	<0.2	76
19	AAA2083	2	0.003	0.033	1.03	1.7	<1	2.4	67	0.71	<0.4	5.6	5	53	<0.06	<0.2	47
	AAA2083R	NA	NA	NA	0.84	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
20	AAA2086	4.1	0.004	0.013	<0.80 8	27.0	<1	1.4	72	0.39	<0.4	4.8	<2	12	<0.06	0.25	17
21	AAA2087	2.5	0.003	0.009	<0.9	2.0	<1	2.5	100	1.1	<0.4	7.4	<2	23	0.19	0.5	34
	AAA2087R	NA	NA	NA	NA	NA	NA	2.3	NA	NA	NA	NA	NA	21	0.13	0.6	NA
22	AAA2088	2.1	0.004	0.016	0.97	0.3	<1	3.1	86	0.84	<0.4	8.4	5	15	<0.06	0.5	42
23	AAA2089	3	0.005	0.174	1.01	0.8	<1	3.6	120	1	<0.4	10	7	21	<0.06	0.4	45
24	AAA2221	2.6	0.004	0.096	<0.6	1.2	<1	3.6	120	0.94	<0.4	9.6	7	16	<0.06	0.6	44
25	AAA2222	3	0.003	0.082	<0.56	0.7	<1	4	130	0.98	<0.4	10	5.7	15	<0.06	0.6	47
	AAA2222R	NA	0.003	0.091	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
26	AAA2090	2.1	0.006	0.044	1.66	2.5	<1	2.9	140	1.1	<0.4	11	<2	13	0.14	0.6	38
27	AAA2092	2.2	0.004	0.016	1.16 4	43.6	2.3	2	84	0.67	0.7	11	<2	21	<0.06	0.6	39
28	AAA2093	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29	AAA2094	2.1	0.003	0.042	1.41	0.4	<1	2.4	62	0.61	<0.4	5.7	5	12	<0.06	<0.2	41
30	AAA2095	1.9	0.003	0.018	<0.48	0.2	<1	1.7	31	0.33	<0.4	5.5	3	7	<0.06	<0.2	36
31	AAA2097	1.9	0.003	0.014	<0.89	4.4	<1	1.8	50	0.34	0.5	5.4	<2	61	0.05	0.3	50

TABLE 3-5 (cont.)

SWMU 33-017 GRID SAMPLES

		RADIONUCLIDES								INORGANICS							
#	SAMPLE ID	U mg/kg	238Pu pCi/g	239Pu pCi/g	137Cs pCi/g	3H pCi/g	Ag mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Pb mg/kg	Sb mg/kg	Se mg/kg	Zn mg/kg
32	AAA2098	2.6	0.003	0.01	<0.98	1.0	<1	2	110	1.1	<0.4	8	7	16	0.06	0.5	41
33	AAA2099	2.6	0.006	0.021	<1.91	5.3	4.6	2.4	52	0.48	5.2	35	<2	13	0.24	0.4	110
34	AAA2100	2.1	0.004	0.015	<0.75	4.2	<1	2.4	36	0.31	<0.4	6.1	<2	13	0.1	0.7	46
35	AAA2101	3.3	0.005	0.12	2.61	0.5	<1	3	76	0.57	<0.4	7.2	5	20	<0.06	0.3	54
36	AAA2103	2.2	0.006	0.01	0.92	0.9	<1.4	1.5	83.7	0.59	2.7	18	13.5	10.2	<11.2	<0.6	55.9
37	AAA2104	2.2	0.003	0.033	<1.3	4.0	<1	2.6	130	0.87	<0.4	7.3	<2	14	0.08	0.7	35
38	AAA2105	3.7	0.004	0.019	<1.05	1.8	<1	1.6	210	1.2	<0.4	14	3	60	0.09	0.5	47
	AAA2105R	NA	0.002	0.014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
39	AAA2106	2.5	0.002	0.012	<0.85	0.5	<1	3.3	57	0.47	<0.4	3.7	<2	15	0.1	1	16
40	AAA2107	2.3	0.002	0.022	<0.65	0.4	<1	3.5	150	1.1	0.53	10	<2	15	0.1	0.9	42
41	AAA2108	2	0.005	0.023	<0.72	0.9	<1	2.2	100	0.98	<0.4	8.3	<2	24	0.07	0.7	42
	AAA2108R	NA	0.003	0.023	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
42	AAA2109	2.8	0.004	0.06	2.19	2.0	<1	2.5	88	0.74	<0.4	4.9	4.7	18	<0.08	<0.2	27
43	AAA2110	3.4	0.002	0.022	1.63	1.1	<1	2.36	100	0.78	<0.4	5	5.8	10	<0.08	0.24	22
44	AAA2113	4.1	0.004	0.034	<0.92	10.4	1	1.7	100	0.5	1	5.4	6	21	<0.04	0.3	29
	AAA2113R	NA	NA	NA	NA	NA	1	NA	93	0.47	0.6	4.8	9	18	NA	NA	26
45	AAA2114	2.5	0.004	0.03	1.49	0.6	<1	2.4	89	1.3	<0.4	5	3.6	8	<0.04	0.5	29
46	AAA2115	2.6	0.004	0.038	<0.64	0.5	<1	2.72	93	0.86	<0.4	5.9	5	16	<0.02	0.27	35
47	AAA2116	NA	0.002	0.031	<0.8	NA	<1	1.6	61	0.62	<0.4	3.4	4.2	11	<0.04	<0.2	25
48	AAA2117	2.9	0.004	0.024	1.14	0.6	<1	2.97	98	1	0.7	10	7.8	18	<0.02	0.29	40
	AAA2117R	NA	NA	NA	NA	NA	NA	3.5	NA	NA	NA	NA	NA	NA	<0.02	0.25	NA
49	AAA2118	2.1	0.004	0.034	1.54	0.1	<1	2.3	74	0.66	0.5	4.7	6	14	<0.04	0.3	30
50	AAA2119	3.3	0.003	0.034	<0.76	0.3	<1	2.96	71	0.71	<0.4	4.6	3	12	<0.08	<0.2	30
51	AAA2120	3.4	0.003	0.041	1.49	0.2	<1	2.7	88	0.69	<0.4	6.6	6	14	<0.08	<0.2	36
	AAA2120R	NA	NA	NA	NA	NA	<1	NA	89	0.61	<0.4	5.9	6	14	NA	NA	33
52	AAA2121	2.2	0.002	0.012	<0.55	0.1	<1	3.44	89	0.98	<0.4	7.1	8	12	<0.06	1.39	35
53	AAA2122	2.6	0.003	0.074	1.68	0.3	<1	2.86	76	0.64	<0.4	4.5	6	16	<0.06	<0.2	23
54	AAA2123	4.2	0.003	0.032	<0.95	0.4	<1	2.26	63	0.39	<0.4	3.5	3	11	<0.02	0.34	22
55	AAA2124	2.1	0.004	0.028	1.19	0.7	<1	2.49	110	0.56	<0.4	5.5	5	13	<0.02	<0.2	27
56	AAA2125	2.4	0.008	0.01	<0.67	0.2	<1.4	1.2	126	0.83	1	7.2	11.4	8	<11.2	<0.6	46.1
	SALs	*95*	*27*	*24*	*4*	*820*	*400*	*14*	*5 600*	*4*	*80*	*400*	*1 600*	*500*	*32*	*400*	*24 000*
	EQL	*1.4*	*0.01*	*0.01*	*1*	*.3 pCi/ml**	*2*	*2*	*40*	*1*	*1*	*10*	*8*	*0.2*	*12*	*1*	*4*

TABLE 3-5 (cont.)

SWMU 33-017 GRID SAMPLES

#	ORGANICS DETECTED SAMPLE ID	SVOCS	RESULT	SAL	UNITS
3	AAA2068	Pyrene	0.49	2400	mg/kg
4	AAA2069	D [2,4-]	1.89	nc	mg/kg
	AAA2069	Diethylphthalate	30	64000	mg/kg
	AAA2069	Dinoseb	0.692	nc	mg/kg
5	AAA2070	BHC [beta-]	0.0023	4	mg/kg
	AAA2070	Endrin	0.0023	nc	mg/kg
	AAA2070	Pyrene	0.38	2400	mg/kg
6	AAA2071	DDE [p,p'-]	0.0014	nc	mg/kg
	AAA2071	Dieldrin	0.00083	nc	mg/kg
	AAA2071	Endrin	0.0027	nc	mg/kg
11	AAA2075	Di-n-butyl phthalate	0.5	8000	mg/kg
13	AAA2077	Anthracene	0.36	24000	mg/kg
	AAA2077	Benzo[a]anthracene	1.3	0.64	mg/kg
	AAA2077	Benzo[a]pyrene	1.4	0.1	mg/kg
	AAA2077	Benzo[b]fluoranthene	1.8	0.7	mg/kg
	AAA2077	Benzo[g,h,i]perylene	0.66	44	mg/kg
	AAA2077	Benzo[k]fluoranthene	1.1	1.5	mg/kg
	AAA2077	Chrysene	1.6	22	mg/kg
	AAA2077	Fluoranthene	2.5	3200	mg/kg
	AAA2077	Indeno[1,2,3-cd]pyrene	0.82	0.41	mg/kg
	AAA2077	Phenanthrene	1.5	nc	mg/kg
	AAA2077	Pyrene	2.6	2400	mg/kg

#	ORGANICS DETECTED SAMPLE ID	SVOCS	RESULT	SAL	UNITS
31	AAA2097	Acenaphthene	0.69	4800	mg/kg
	AAA2097	Anthracene	0.95	###	mg/kg
	AAA2097	Benzo[a]anthracene	2.1	0.64	mg/kg
	AAA2097	Benzo[b]fluoranthene	3.8	0.7	mg/kg
	AAA2097	Benzo[k]fluoranthene	1.9	1.5	mg/kg
	AAA2097	Bis(2-ethylhexyl)phthalate	1.9	50	mg/kg
	AAA2097	Chrysene	2.4	22	mg/kg
	AAA2097	Dibenzofuran	0.44	nc	mg/kg
	AAA2097	Fluoranthene	2.8	3200	mg/kg
	AAA2097	Fluorene	0.58	3200	mg/kg
	AAA2097	Naphthalene	0.93	3200	mg/kg
	AAA2097	Phenanthrene	2.8	nc	mg/kg
	AAA2097	Pyrene	3.3	2400	mg/kg
32	AAA2098	Fluoranthene	0.61	3200	mg/kg
	AAA2098	Phenanthrene	0.39	nc	mg/kg
	AAA2098	Pyrene	0.53	2400	mg/kg
43	AAA2110	Bis(2-ethylhexyl)phthalate	3.2	50	mg/kg
54	AAA2123	Aniline	0.41	nc	mg/kg
24	AAA2221	Pyrene	0.69	2400	mg/kg
25	AAA2222	Pyrene	0.44	2400	mg/kg

Data Qualifications

QA/QC results for inorganics indicate that arsenic recovery was low in the blind samples but the duplicate matrix spike and nonblind samples were acceptable. Recoveries were low for chromium, zinc, nickel, beryllium and lead, increasing the uncertainty of the reported results. Many samples contained high levels of unspecified organic compounds, causing a matrix effect in SVOC results. Due to the excess of organic constituents in one batch of samples, non-target peaks (i.e. TICs) were not reported for these samples. Surrogate recovery was high in many samples, low in many others. The net effect of these interferences is to increase uncertainty.

For pesticides, Endosulfan I and II were low in the blind samples, showing that actual concentrations could be lower than indicated. The pesticide blank was acceptable. QA data indicates that total uranium and isotopic plutonium QA/QC results were acceptable. For tritium QA/QC results were acceptable with the following exceptions: Three blind samples were high and three blind samples were low. One batch that had high levels of tritium was believed to have a cross contaminant. QA results indicate that the gamma emitter cesium-137 (not a PCOC) may be higher or lower than reported for two groups of samples.
SWMU 33-017 contained a large number of samples submitted to analytical laboratories in many batches. QA/QC results varied over these many batches. Overall, however, QA/QC data do not compromise the decisions affecting each sample or the aggregate of samples.

indications of local background. Because the samples are subsamples of a large homogenized sample, they do not reflect the natural heterogeneity of the area; the measured values are generally confined to a relatively small range.

3) Framework studies data. About 80 samples were collected for the ER Project's Framework Studies Program (Longmire et al. in preparation, 1142) and analyzed for inorganics by two methods. The data used here for comparison with TA-33 data come from 58 samples from LANL *A*, *B*, and *C* soil horizons that were analyzed using EPA's SW 846 methods: inductively coupled plasma emission spectroscopy (ICPES), inductively coupled plasma mass spectrometry (ICPMS), or atomic absorption. Samples were extracted using nitric acid. As expected, given the natural differences among the sites from which these data are collected, the framework studies data frequently show much greater variability than is found within TA-33. This data set includes total uranium measurements by ICPMS, the method used for most of the TA-33 samples.

4) Cinder cone background samples. Much of Area 6 lies on a basaltic cinder cone, a geologically unusual substratum unlike the aeolian and tuff-derived surface soils elsewhere in TA-33 or the Laboratory. In particular, the soils derived from this material are deep red in color, indicating the presence of high quantities of iron. Laboratory framework studies data indicate that concentrations of many trace elements (arsenic, beryllium, and chromium among others) are highly correlated with iron. Therefore, eight additional samples were collected from the remote areas of the cinder cone to the west and south of Area 6 in locations that should not have been affected by TA-33 activities.

5) Environmental surveillance data. Approximately 100 soil samples collected between 1974 and 1990 at seven perimeter locations for environmental monitoring purposes provide background information on the isotopes cesium-137, plutonium-238, plutonium-239, and total uranium. The methods for cesium-137 and total uranium may not be comparable to the methods used for TA-33 samples. In particular, the uranium surveillance observations were made using delayed neutron activation, a method requiring no sample preparation, unlike ICPMS. Cesium-137 is measured by gamma spectrometry, but the detection limits reported at TA-33 are an order of magnitude above those reported in the surveillance data (0.5 to 1 pCi/g compared with 0.05 to 0.1 pCi/g in surveillance data), possibly indicating shorter count times.

An evaluation of the background data provides both expected ranges for uncontaminated areas and an indication of the adequacy of the measurement process for detecting releases of materials that are part of the natural environment.

3.2.2.1 Inorganic Background Data

Side-by-side box plots of the data distributions for inorganics are presented in which the central box contains the middle half of the observations, with a white bar indicating the median value and the extending lines indicate the range of the remaining data (Figs. 3-2, 3-3, 3-4). Individual outliers are shown by separate horizontal lines above the corresponding boxes. Four distributions are shown for each element: the distribution observed in the Main Site grid samples (*grid* in the tables), the distribution observed in the 17 field blanks (*fb*), the distribution for the eight cinder cone background samples (*cone*), and the distribution for framework studies or environmental surveillance soil samples (*lab*).

Four minor elements (barium, nickel, lead, and zinc) occur naturally at levels of tens or hundred of milligrams per kilogram (mg/kg). There are few non-detects reported in the data sets. The measurement process is more than adequate to determine if a release has occurred.

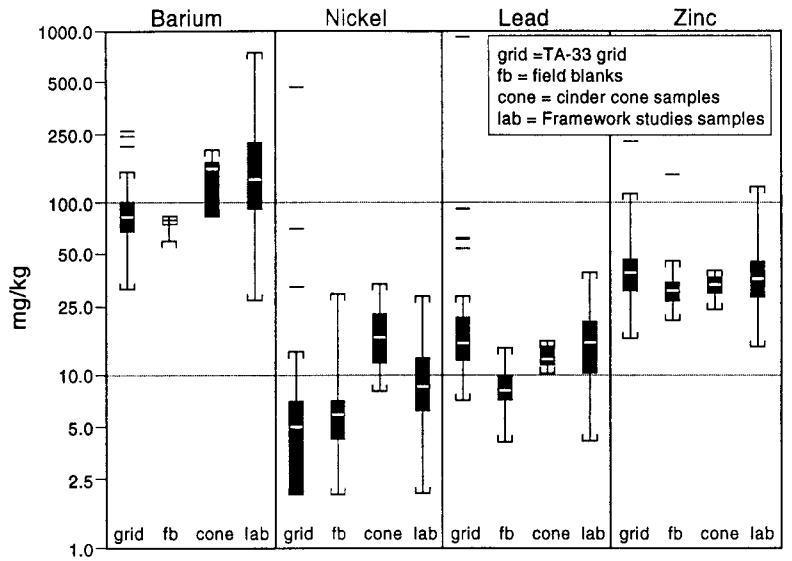


Fig. 3-2. Boxplots of minor elements.

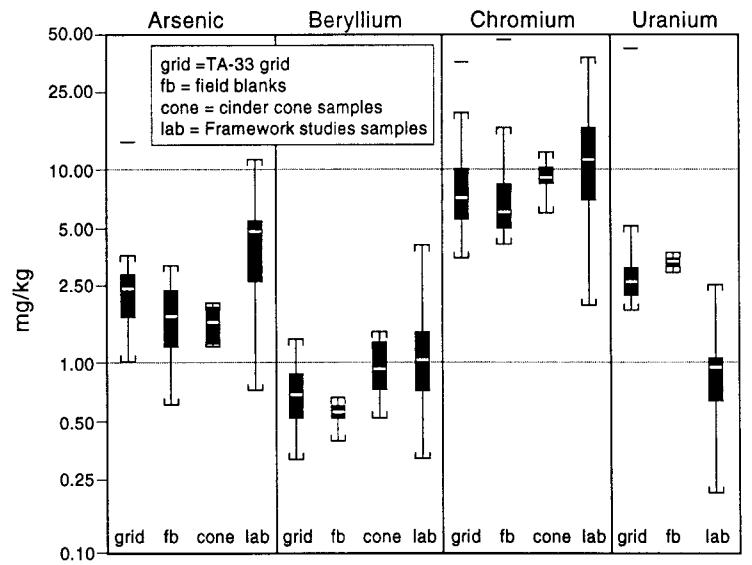


Fig. 3-3. Boxplots of trace elements.

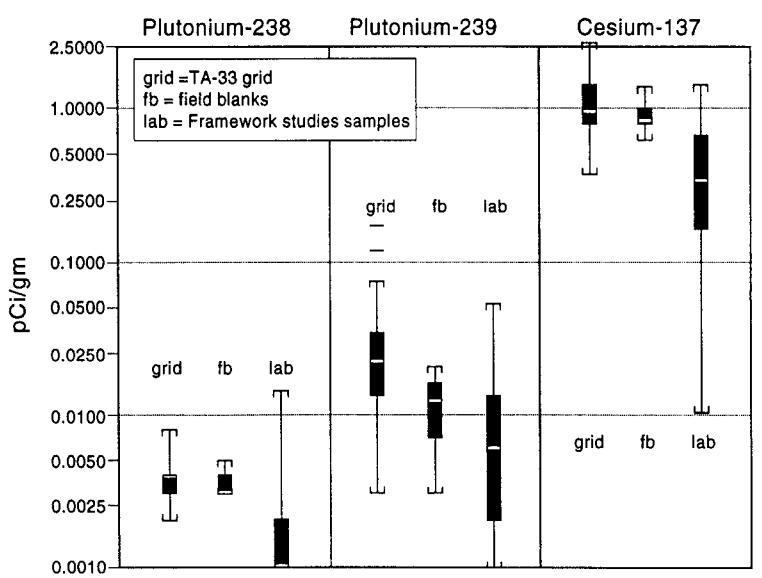


Fig. 3-4. Boxplots of radionuclides.

Barium The grid distribution for barium is significantly below the lab-wide distribution (Fig. 3-2). Only a handful of the grid observations exceed the median of the framework studies observations (135 mg/kg), and two observations (260 mg/kg for sample AAA2081 and 240 mg/kg for sample AAA2075) look like outliers relative to the remaining grid samples, although they are well within the laboratory background distribution. The field blanks span a narrow range comparable to the center of the grid distribution.

The cinder cone samples are on the average higher than the grid samples or the field blanks, spanning a range comparable to the middle of the framework studies data, with a maximum of 201 mg/kg. Sample AAA2081 is described as including "red lava cinder" and sample AAA2075 as containing "some cinders." It is possible that the high barium observation in sample AAA2081 in fact reflects derivation from cinder cone material. However, sample AAA2075 is higher in nickel than other cinder cone samples and is clearly contaminated with uranium, as discussed below.

Almost all of the samples that are above background are associated with the Area 6 firing site, SWMU 33-007(c), or adjacent SWMUs 33-009 and 33-004(g). The highest observed value, 1 320 mg/kg, is less than one-quarter of the SAL of 5 600 mg/kg.

Nickel As with barium, the grid distribution of nickel is low by comparison with the framework studies data (Fig. 3-2). Three observations on the grid exceed the framework studies maximum of 28 mg/kg: sample AAA2077 at 460 mg/kg, sample AAA2075 at 69 mg/kg, and sample AAA2081 at 32 mg/kg. The field blanks span a wide range, up to 29 mg/kg. The cinder cone samples are significantly higher than any other set, spanning a range equivalent to the upper half of the framework studies data with a maximum of 32.9 mg/kg. As noted above, sample AAA2081 appears to contain cinder cone material.

Again, the bulk of observations above background for nickel at TA-33 are associated with SWMU 33-007(c) and adjacent areas, and the largest (850 mg/kg) is still only slightly more than half of the SAL for soil, 1 600 mg/kg. The large number of nickel values slightly above LANL background at the SWMUs at Area 6 may be due to derivation of the local soils from high-nickel cinder cone material.

Lead The grid data for lead indicate a local distribution that is comparable to the framework studies data; the median for both is 15 mg/kg (Fig. 3-2). The grid maximum excluding outliers is only 28 mg/kg compared to 38 mg/kg in the framework studies data. Five grid-sample outliers exceed these values: sample AAA2067 at 902 mg/kg, collocated samples AAA2082 at 90 mg/kg and AAA2083 at 53 mg/kg, AAA2097 at 61 mg/kg, and AAA2105 at 60 mg/kg. The field blanks are low by comparison with the grid samples (4 to 14 mg/kg), while the background samples from the cinder cone span the range 10 to 15 mg/kg.

Contamination above background is widespread at TA-33 PRSs. An area of consistently high values is found to the east of TA-33-39. (See discussion of SWMU 33-004(i), Subsection 4.4) However, only two observations, including the outlier on the grid and one SWMU 33-004(i) sample, exceed a health-based SAL of 400 mg/kg.

Zinc The distribution of zinc observations on the grid is comparable to the Laboratory-wide distribution (16 to 110 mg/kg with a median of 38 mg/kg on the grid, compared to 14 to 120 mg/kg with a median of 35 mg/kg in the framework studies data) (Fig. 3-2). There is one outlier on the grid, sample AAA2067 at 217 mg/kg. Sample AAA2099 at 110 mg/kg also is relatively high compared to the remainder of the grid data. Field blanks and cinder cone samples are also comparable, with small ranges of 20 to 44 and 23 to 39 mg/kg, respectively.

Contamination above background is fairly widespread at TA-33 PRSs, with a number of high values to the east of TA-33-39.

However, the largest observations are less than 10% of the SAL for zinc.

Four trace elements (arsenic, beryllium, chromium, and uranium) occur in local soils. While the analytical process is closer to its practical quantitation level for these elements at background concentrations, there are still relatively few non-detects reported, and the measurements are adequate for calculating statistical background values.

Arsenic Arsenic measurements on grid samples are significantly lower than the range reported in framework studies samples, with a median value of 2.4 mg/kg and a maximum of 3.6 mg/kg, compared to the framework studies median of 4.7 mg/kg and maximum of 11.2 mg/kg (Fig. 3-3). The field blanks and cinder cone samples are, in turn, significantly lower than the grid samples. There is one grid outlier, sample AAA2067 of 13.8 mg/kg.

There are a number of observations of arsenic between 3.6 and 13.8 mg/kg at TA-33 PRSs. The majority of these are associated with SWMU 33-007(c). Only the grid observation at sample AAA2067 exceeds the framework studies maximum of 11.2 mg/kg.

Beryllium Beryllium on the grid is also lower than for framework studies samples, with a median value of 0.67 mg/kg and a maximum of 1.3 mg/kg, compared to the framework studies median of 1 mg/kg and maximum of 4 mg/kg (Fig. 3-3). The field blanks span a narrow range of 0.38 to 0.64 mg/kg, while the cinder cone samples are significantly higher than the grid samples, with a median of 0.9 mg/kg and maximum of 1.4 mg/kg. There are no outliers.

A handful of other TA-33 samples, most associated with SWMU 33-007(c), have observations above background. Only one, associated with SWMU 33-013 and with a number of other

analytes well above background, exceeds the framework studies maximum with a value of 7.8 mg/kg.

Chromium Chromium on the grid is lower than in framework studies samples, with a median value of 7 mg/kg and a maximum of 19 mg/kg, compared to the framework studies median of 11 mg/kg and maximum of 37 mg/kg (Fig. 3-3). Field blanks were between 4 and 16 mg/kg, except for sample AAA2188 which is considered invalid (see Subsection 3.1.5.1). The cinder cone samples were somewhat higher (5.8 to 11.9 mg/kg), but still below the framework studies distribution. There was one outlier on the grid, sample AAA2099 at 35 mg/kg, also considered invalid.

About a dozen other TA-33 samples, half of them associated with SWMU 33-007(c), have chromium at 20 mg/kg or higher. Only one, associated with SWMU 33-013, exceeds the SAL of 400 mg/kg. All of the others are less than 100 mg/kg.

Uranium With a median observation of 2.5 mg/kg and a maximum of 5 mg/kg (apart from an outlier at sample AAA2075 of 41.6 mg/kg), uranium on the grid is significantly higher than reported by the framework studies program (median 0.9 mg/kg, maximum 2.4 mg/kg)(Fig. 3-3). The field blanks are also high, spanning a range of 2.8 to 3.6 mg/kg. Total uranium was not measured for the cinder cone samples.

Except for the outlier, the TA-33 grid data are entirely comparable to the surveillance background data, measured by delayed neutron activation.

There are a handful of uranium measurements above 5 mg/kg in addition to the grid outlier at TA-33. The largest values, and the only ones that approach a dose-based action limit of 95 mg/kg (for natural uranium), are associated with a sample from SWMU 33-007(c) and its two field duplicates (at 72 to 90 mg/kg). The remaining measurements are between 5.1 and 10.2 mg/kg.

A large number of TA-33 samples are slightly higher than Lab background (99%, 0.95) UTLs. This may be due to the slightly higher uranium in background soils at TA-33. The Bandelier Tuff itself is higher in uranium in the lower subunits of the Tshirege Member of the Bandelier Tuff, which outcrops at the eastern edge of the Laboratory.

Four other inorganics included in the target analyte suite for TA-33 are generally reported below detection levels. (Because of insufficient data, no box plots are plotted) These are silver, cadmium, antimony, and selenium. Mercury was also measured for 11 grid samples. The analytical process may not be adequate to determine if environmental releases of these constituents have occurred above background, but it is entirely adequate for comparison of data to health-risk-based levels.

Silver Silver was reported at or below detection level for all but two grid samples: sample AAA2099 at 4.6 mg/kg and sample AAA2092 at 2.3 mg/kg. The former is considered invalid (Subsection 3.1.5.1). The detection level is about 1 mg/kg for most samples. One of the field blanks (sample AAA2188) was returned with a reported measurement of 7 mg/kg, but this is considered invalid. Another field blank was reported at 1.1 mg/kg, but this is barely above the detection level and associated with a large relative uncertainty. All of the cinder cone samples were below a reported detection level of about 0.35 mg/kg.

Silver was detected in about a dozen PRS samples, half of them in the drainages to the east of Main Site. The highest measured value, 46 mg/kg, is only 11.5% of the SAL of 400 mg/kg.

Cadmium About 20% of the grid results for cadmium exceed a detection level of 0.4 mg/kg, compared with 12% of the framework studies results (for which the reported detection limit was generally higher). All of the positive grid results were in the LANL background range, except for sample AAA2099 at 5.2 mg/kg. One of the field blanks (sample AAA2188) was reported at 6.6 mg/kg. Results for both sample AAA2099 and sample

AAA2188 are considered invalid (Subsection 3.1.5.1). Other field blanks were below detection level or within the framework studies background results (none was greater than 1.2 mg/kg). The cinder cone samples were all above detection level, in the range of 0.84 to 1.1 mg/kg.

Nine PRS samples had cadmium concentrations above 2.7 mg/kg. Eight of these samples were less than 9 mg/kg, less than 11.25% of the SAL at 80 mg/kg. One sample from SWMU 33-013 exceeded the SAL.

Antimony Most antimony measurements from the grid were below detection levels in the range of 0.05 mg/kg. Positive values ranged from 0.05 to 0.27 mg/kg. There are no framework studies data collected by a comparable method, but neutron activation results are in the range of 0.2 to slightly more than 1 mg/kg. The field blanks were either below detection level or in the range of 0.025 to 0.1 mg/kg. The cinder cone samples were below detection level or in the range 0.1 to 0.16 mg/kg.

Overall, about 20 TA-33 samples exceeded 0.16 mg/kg, including three from the grid. The highest observations, above 2 mg/kg, came from a pair of field duplicates from SWMU 33-007(c). Eighteen were less than 0.5 mg/kg. None was within an order of magnitude of the SAL at 32 mg/kg.

Selenium Grid data for selenium ranged from below detection levels of 0.2 to 0.6 mg/kg to 1.39 mg/kg, with a median value of 0.3 mg/kg. Similar results were obtained from the framework studies samples (median 0.3 mg/kg, maximum 1.7 mg/kg.) The field blanks were barely above detection level (maximum 0.5 mg/kg), and the cinder cone samples were uniformly below detection level.

The only TA-33 sample above 1.4 mg/kg came from SWMU 33-007(c) and was reported at 1.5 mg/kg. No observation is within two orders of magnitude of the SAL of 400 mg/kg.

Mercury All grid and field blank measurements of mercury were less than detection levels of 0.02 to 0.1 mg/kg. The only positive measurements of mercury come from SWMUs 33-004(a) and 33-002(b), and none exceed 0.04 mg/kg, far short of the SAL of 24 mg/kg.

Table 3-6 presents a comparison of local background inorganic data with the Laboratory-wide framework studies data (Longmire et al. 1993, 0958). TA-33 grid data and the background results from the cinder cone samples are combined to calculate the local background. Results are compared both with respect to the data ranges (minimum and maximum observations), and with respect to estimated UTLs (Longmire et al. in preparation, 1142). As indicated in the third column of Table 3-6, calculations were performed on the logarithms of the data for several analytes (Subsection 3.2.1).

3.2.2.2 Radionuclide Background Data

This subsection compares grid results for three radionuclides (plutonium-238, plutonium-239, and cesium-137) with field blanks and environmental surveillance data.

Plutonium-238 While grid measurements of plutonium-238 were all within the range of the surveillance data (from below a detection level of 0.001 pCi/g to 0.014 pCi/g), they were in the upper part of this range, having a median of 0.003 pCi/g and a maximum of 0.008 pCi/g (Fig. 3-4). The median surveillance result is below detection levels. The field blanks were similarly elevated, falling between 0.003 and 0.005 pCi/g.

PRS observations above 0.01 pCi/g are associated with samples from MDA K, specifically SWMUs 33-002(b,c,d), SWMU 33-011(d), and one sample from SWMU 33-005(c). The largest of these is 0.328 pCi/g in a sample from SWMU 33-002(b), less than 5% of the dose-based SAL of approximately 20 pCi/g.

Plutonium-239 TA-33 grid measurements are systematically higher than the background surveillance measurements, having a median value of 0.022 pCi/g compared to the background median of 0.006 pCi/g, and maximum 0.174 pCi/g compared

TABLE 3-6

RANGE (EXCLUDING OUTLIERS) AND UPPER TOLERANCE LIMITS (UTLS) FOR INORGANICS IN SOIL SAMPLES

			FRAMEWORK DATA			TA-33 LOCAL BACKGROUND		
ANALYTE[1]	UNITS	LOG[2]	MINIMUM	MAXIMUM	(99%,0.95) UTL	MINIMUM	MAXIMUM	(99%,0.95) UTL
Antimony	mg/kg	NA[3]	<5	<5	NA	<0.02	0.27	NA
Arsenic	mg/kg	N	0.7	11.2	11.6	1	3.6	4.36
Barium	mg/kg	Y	27	730	1140	31	260	268
Beryllium	mg/kg	N	0.31	4	3.31	0.31	1.4	1.51
Cadmium	mg/kg	NA[3]	<0.4	2.7	NA	<0.4	5.2	NA
Chromium	mg/kg	Y	1.9	37	34.2	3.4	19	20.7
Lead	mg/kg	N	<4	38	39.0	7	28	NA[4]
Nickel	mg/kg	N	<2	28	26.7	<2	32	17[5]
Selenium	mg/kg	NA	<0.6	1.7	NA	<0.6	1.39	NA
Uranium	mg/kg	Y	<0.2	2.4	2.82	1.8	5	4.84
Zinc	mg/kg	N	14	120	101	16	217	62.3

[1] Insufficient data to calculate a silver background.

[2] Were calculations performed on logarithms of the data?

[3] These data sets have too many below-detection-level observations to calculate UTLs.

[4] The distribution of lead on the grid was too nonnormal to obtain a reliable UTL. However, the upper tail of the local background data (excluding outliers) is very similar to that of the framework studies data, so the Framework UTL of 39 mg/kg may be used.

[5] Nickel in cinder cone samples is significantly different from nickel in either the background data or on the general grid. For the grid, 17 mg/kg is a reasonable UTL. A more representative UTL for the combined distribution is 33.4 mg/kg, based on log transformed data.

with background maximum of 0.052 pCi/g (Fig. 3-4). The field blank results were between these two distributions (median 0.012 pCi/g, maximum 0.020 pCi/g). The largest grid values come from a single sample and its two field splits, one of which was measured twice in the laboratory (samples AAA2089 at 0.174 pCi/g, AAA2221 at 0.096 pCi/g, and AAA2222 at 0.082 and 0.091 pCi/g). These samples come from sample location 33-1142, about 100 ft north of the former TA-33-21 site. Other observations above the surveillance maximum are provided by samples AAA2101 (0.120 pCi/g) and AAA2122 (0.074 pCi/g),

from sites about 200 ft south of the TA-33-21 site. The remaining observations are less than or equal to 0.6 pCi/g.

The largest observations of plutonium-239 are associated with the MDA K sumps in SWMUs 33-002(b and c), including observations up to 0.95 pCi/g at SWMU 33-002(b). This is less than 5% of the dose-based SAL of about 20 pCi/g.

Cesium-137 Cesium-137 was not identified as a potential contaminant of concern for TA-33. Cesium-137 was measured for TA-33 samples with a detection limit of 0.5 to 1 pCi/g, compared with a detection limit an order of magnitude below this for surveillance data. Thus, the data sets are not entirely comparable. More than 40% of the TA-33 grid results were reported above 1 pCi/g (that is, marginally above the reported detection limit and, in most cases, with measurement errors of 20% to 30%) (Fig. 3-4). Field blanks also appear to be slightly elevated relative to the surveillance data. Less than 5% of the surveillance results were reported above 1 pCi/g, with a maximum value of 1.4 pCi/g. Even allowing for measurement errors, slightly elevated levels of cesium-137 appear to prevail in the TA-33 region. The highest values measured on the grid were 2.61 pCi/g at sample AAA2101, and 2.19 pCi/g at sample AAA2109. However, in the context of a number of other measurements in the range of 1 to 1.7 pCi/g, these do not appear as outliers with respect to the grid.

The grid maximum was exceeded only by one sample, 3.31 $\pm$ 0.41 pCi/g at sample AAA1989 from SWMU 33-005(a). This is still below the dose-based SAL of 4 pCi/g.

Tritium, measured in pCi/mL or nCi/L (equivalent units) is uniformly high on the TA-33 grid, with a median value of 13.7 pCi/mL, higher than the surveillance maximum of 13 pCi/mL. The grid maximum is 872 pCi/mL. By contrast the field blanks, all below 3.6 pCi/mL, are within the surveillance background range. The elevated values on the grid show a spatial pattern highest in the direction of the prevailing daytime winds, that is, northeast of

the former tritium production facility (TA-33-86). The values fall off in all directions with distance from this facility. Fig. 3-5 shows the distribution of grid samples containing tritium and an indication of the tritium concentrations.

When translated into pCi/g using the soil moisture measurements, the highest tritium observation on the grid is about 40 pCi/g, less than 5% of the dose-based SAL of approximately 800 pCi/g. PRS observations above 40 pCi/g are associated with MDA K [SWMUs 33-002(a,b,c,d)] and SWMU 33-013. Five samples, including one pair of field duplicates, exceed the SAL of 800 pCi/g.

Table 3-7 presents a comparison of radionuclide data from the TA-33 grid with the surveillance data from perimeter stations around the Laboratory. Results are compared both with respect to the data ranges (minimum and maximum observations), and with respect to estimated upper tolerance limits.

TABLE 3-7

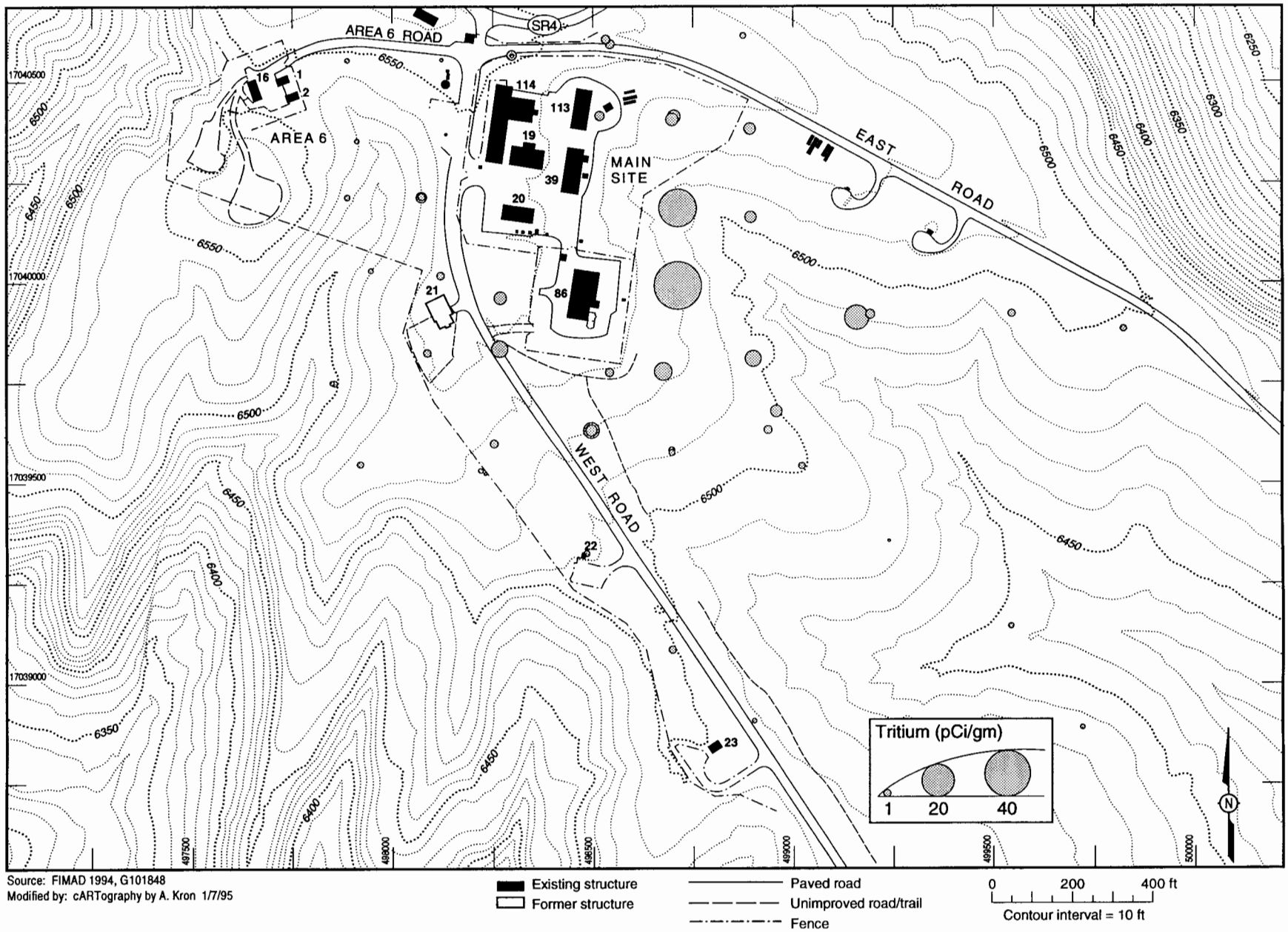
RANGE (EXCLUDING OUTLIERS) AND UPPER TOLERANCE LIMITS FOR RADIONUCLIDES IN SOIL SAMPLES

			SURVEILLANCE DATA			TA-33 GRID DATA		
ANALYTE	UNITS	LOG[1]	MINIMUM	MAXIMUM	(99%,0.95) UTL	MINIMUM	MAXIMUM	(99%,0.95) UTL
Cs-137	pCi/g	N	<0.01	1.4	1.5	<1	2.61	2.75
Tritium	pCi/g	Y	NA[2]	NA	NA	0.08	43.6	23.2
Pu-238	pCi/g	N	<0.001	0.140	NA[3]	0.001	0.008	0.0074
Pu-239	pCi/g	N	<0.001	0.052	0.025	0.003	0.174	0.058

[1] Were calculations performed on logarithms of the data?
[2] Tritium is not available in pCi/g in the surveillance data (only pCi/mL are given). In terms of pCi/mL, about half of the TA-33 grid observations are above the surveillance maximum of 13 pCi/mL.
[3] The distribution of plutonium-238 is too nonnormal to obtain a reliable UTL. Surveillance plutonium-238 data has more undetected plutonium-238 than the TA-33 grid data, but the ranges are comparable.

3.2.2.3 Organics in Grid and Background Samples

Because experimental activities at TA-33 could not be completely defined during archival searches, analyses for organic compounds were performed on most samples. The attempt was to determine all hazardous material that



Source: FIMAD 1994, G101848
Modified by: cARTography by A. Kron 1/7/95

Existing structure
Former structure
Paved road
Unimproved road/trail
Fence

0 200 400 ft
Contour interval = 10 ft

Fig. 3-5. Tritium distribution at Main Site.

may have been discarded as waste. Many of the compounds discovered as a result of sampling are common combustion products of urban and industrialized societies, including suspected cancer-causing agents called carcinogenic polynuclear aromatic hydrocarbons (cPAHs). In addition, phthalates were frequently reported in both grid samples and samples attributed to PRSs. Phthalates are used as plasticizers. Often, phthalates are not present in a sample, but are common laboratory contaminants introduced during sample collection and analysis. It cannot be determined if phthalates were used at TA-33 to the extent implied by these analyses. This subsection assesses results from grid samples in an attempt to determine background levels of organic compounds present at TA-33 due to use in an industrial context.

Substantial numbers of organics were reported for sample AAA2077 (which also had nickel at 460 mg/kg) and sample AAA2097 (which also had lead at 61 mg/kg). These include cPAHs identified at a number of SWMUs (e.g., SWMU 33-011(a) and the vehicle maintenance area of SWMU 33-017 behind TA-33-39): benzo[b]fluoranthene, benzo[k)fluoranthene, benzo[a]anthracene, and (in one sample each) benzo[a]pyrene, and indeno[1,2,3-cd]pyrene. Many of these grid-sample organics were at levels above SALs due to the low SALs for many cPAHs. Non-carcinogenic PAHs were fairly widespread: anthracene, pyrene, fluoranthene, chrysene, phenanthrene. Sample AAA2097 also contained dibenzofuran, acenaphthene, fluorene, and naphthalene at levels below 1 mg/kg. Small quantities of pesticides (less than 3 µg/kg) were detected in a collocated pair of samples collected near the entrance to TA-33 (samples AAA2070 and AAA2071), and herbicides were detected in another roadside sample (sample AAA2069) at levels below 2 mg/kg. Phthalates were reported in samples AAA2069, AAA2075, AAA2097, and AAA2110, at levels below 4 mg/kg except for diethylphthalate at 30 mg/kg in sample AAA2069. These organic compounds are found in occasional PRS samples as well, but not at levels of concern.

Between 3 and 20 TICs were reported in each of the 15 grid samples that were analyzed for SVOCs by external laboratories. The majority of these were classified as unknown *organic compounds*, *unknown PAHs*, and *saturated hydrocarbons*. Similar results were observed in the field blanks.

These appear to reflect widespread natural organics or airborne deposition from forest fires or man-made sources.

3.2.2.4 Groundwater Results

This RFI report addresses only PRSs with a surface or shallow subsurface component. No samples were taken that relate directly to groundwater, estimated at 315 to 830 ft below the surface of the mesa as derived in Subsection 2.3. Studies at TA-33 relating to groundwater will be addressed in a future RFI report dealing with MDA K.

3.3 Action Levels

3.3.1 RCRA Risk Based Action Levels

In evaluating the results of the 1993 RFI sampling at TA-33, measured analyte concentrations from field samples are compared directly with background and with media-specific SALs. These SALs have been developed for chemical and radiological constituents to determine the need for further evaluation of contamination in various environmental media (e.g., soil, air, surface water, or groundwater). The SALs are calculated using chemical-specific toxicity values and an EPA-proposed set of assumptions about how an individual might become exposed. A complete discussion of the assumptions used in developing SALs and complete list of SALs can be found in Appendix J of the Installation Work Plan (LANL 1993, 1017).

The SALs provide estimates of environmental concentrations that could affect human health under chronic exposure scenarios. SALs for hazardous constituents are calculated using chemical-specific toxicity values and media-specific exposure parameters provided by EPA (EPA 1992, 1062; EPA 1992, 0833; and EPA 1990, 0432). For radioactive constituents, dose-based SALs have been calculated using the RESRAD computer code (Gilbert et al. 1989, 0754) as prescribed by DOE Order 5400.5. SAL levels are adjusted downward for Phase I decisions when more than one contaminant is present. See the IWP, Appendix J, Subsection 4.0 for treatment of multiple constituents (LANL 1993, 1017). Comparisons only with background are used for a small number of constituents (e.g., arsenic and beryllium in soil) for which the SALs calculated using these very conservative methods are below natural background levels.

3.3.2 Ecological Risk-based Action Levels

Ecological risk assessment is a method of determining effects of hazardous activities on the environment. Several legislative acts provide directives for including ecological risk assessment in estimating the impacts on the environment of a number of practices, including releases of hazardous wastes: The Clean Water Act (CWA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the National Environmental Policy Act (NEPA), the Superfund Amendments Reauthorization Act (SARA), and the Oil Pollution Act (OPA). The requirements are codified in the National Contingency Plan (NCP) under Title 40 of the Code of Federal Regulations (40 CFR 300). The directives were formulated to protect the environment and human health, to ensure compliance with state and federal environmental regulations, and to provide a means of recovering damage to natural resources caused by release of hazardous materials.

As a result of environmental legislation, the EPA developed guidelines for ecological risk assessment (EPA, 1992). The methods for ecological risk assessment are presently being developed by LANL group EES-15. Although LANL is addressing management and possible remediation of hazardous wastes under RCRA and a HSWA permit, the LANL ER Project is also currently developing methods for incorporating ecological assessment into ER projects. This activity is being undertaken in consultation with EPA Region 6 and will result in ER guidance documents for ecological risk assessments. The TA-33 assessment team will consider ecological risk assessment in a manner that is consistent with evolving ER Project and EPA guidance.

3.4 Summary of Risk Screen and Baseline Risk Assessment

There are four principal elements of human risk assessments. The first is development of SALs, which is described in Appendix I of the IWP. The others include assessing the potential for human exposure to contamination; assessing the toxicity of contaminants of concern; and, finally, characterizing the risk to human health. A brief description of each element follows.

3.4.1 Exposure Assessment

Exposure assessment requires identification of appropriate land use scenarios, exposure units, potential human receptors and exposure routes, and estimates of contaminant intake. For risk assessments described herein, it is assumed that all land may be used for future residential sites. For an exposure unit under the residential scenario, it is assumed that each residence will occupy approximately 0.15 acres (500 m^2). The human exposure assumptions are that the residents will be exposed to existing site contaminants for 20 hours/day, 350 days/year, for 30 years. The exposure pathways that are considered under the residential scenario include inhalation of vapors and wind-blown dust; ingestion of contaminated soil, water, and fruits or vegetables grown in contaminated soil; and contaminated soils or water coming into contact with the skin. Attachment 1 to Appendix K of the IWP provides additional detail about the intake assumptions used for each exposure pathway, under each land use scenario (LANL 1993, 1017).

3.4.2 Toxicity Assessment

Toxicity assessment requires identifying appropriate toxicity values for hazardous contaminants. Slope factors, which express the potential of a contaminant to cause cancer, are obtained from EPA's Integrated Risk Information System, EPA's Health Effects Assessment Summary Tables, or Superfund Health Risk Technical Support Center. Reference doses, which express non-carcinogenic toxicity of contaminants, are based on the most sensitive data set available for a given target organ or system (e.g., liver, central nervous system). For exposure to radiation, toxicity is expressed as a dose equivalent or effective dose equivalent, which means the ability of a radionuclide to cause damage to the human body.

3.4.3 Risk to Human Health

Characterizing risk consists of two steps: calculating a quantified estimate of risk (e.g., exposure may result in a one in a million chance of developing cancer), and considering the uncertainties associated with the estimate to place it in perspective. The numerical estimate of risk is calculated using methods found in EPA's Risk Assessment Guidance for Superfund. The uncertainty analysis considers both the uncertainties inherent in the risk assessment process and the uncertainties specific to a particular site.

Appendix K of the IWP presents a detailed description of the risk assessment process adopted by LANL's ER Program (LANL 1993, 1017).

3.5 Development of Conclusions and Recommendations

The RFI work plan was based on a phased effort using reconnaissance sampling. The first phase determines if contamination is present. Conclusions and recommendations in this RFI report are based on the results of Phase I sampling and analysis as specified in the RFI Work Plan for OU 1122 (LANL 1992, 0784). Each sampling point was re-examined as to appropriateness for the decisions being made. Analytical results were compared to Laboratory background and to SALs at each sampling point. At most of the PRSs discussed in this RFI report, no contamination was found above SALs. Most contamination was near background levels. At SWMU 33-015 a multiple constituent analysis indicated a potential human health risk. A preliminary risk assessment for lead, based on a residential scenario, suggested that risks were acceptable to the most sensitive population. At SWMU 33-004(i), lead was detected above SAL in one sample. A preliminary risk assessment was performed based on a residential scenario. The risk was acceptable under EPA standards for the most sensitive population.

The rationale for proposal for NFA at these PRSs is based on the LANL Environmental Restoration Project Criterion 4: "The PRS 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. The determination of acceptable risk and future land use has considered stakeholder involvement" (LANL ER 1994, 02-100).

Two PRSs in this report, SWMUs 33-007(c) and 33-011(a), will receive further assessment. Because neither is expected to go to a Phase II investigation, no sampling and analysis plans have been written.

4.0 SITE SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Twelve PRSs at TA-33 are recommended for NFA based on results of sampling and analysis conducted in 1993. In six PRSs, no concentrations of hazardous constituents were found above levels of concern represented by LANL SALs. Preliminary risk assessments for lead for two PRSs suggested acceptable risk to the most sensitive population. In five PRSs, the elevated constituents are associated with overlapping PRSs scheduled for further investigation. In these cases the contamination was more appropriately addressed in conjunction with the overlapping PRS. Table 4-1 lists the PRSs proposed for NFA in this report.

TABLE 4-1

PRSs PROPOSED FOR NFA

SUBSECTION	PRS	DESCRIPTION	CONCLUSION
4.1	33-004(d)	TA-33-121 septic system	No contamination at hazardous levels
4.2	33-004(g)	TA-33-16 outfall	PCB from SWMU 33-009 detected No other contamination at hazardous levels
4.3	33-004(h)	TA-33-20 outfall	No contamination at hazardous levels
4.4	33-004(i)	TA-33-39 outfall	SVOCs from SWMU 33-017 detected Lead evaluated by risk assessment No other contamination at hazardous levels
4.5	33-005(a,b,c)	Former TA-33-21 area	SVOCs from SWMU 33-011(a) detected No other contamination at hazardous levels
4.6	33-010(e)	Surface disposal, Area 6	No contamination at hazardous levels
4.7	33-010(f)	Surface disposal, Main Site	No contamination at hazardous levels
4.8	33-011(e)	TA-33-22 drum storage	No contamination at hazardous levels
4.9	33-012(a)	TA-33-39 drum storage	No contamination at hazardous levels
4.10	33-015	Incinerator	No contamination at hazardous levels based on multiple constituent analyses and risk assessment for lead

All PRSs in this report were subject to an initial radiation survey prior to sampling as specified in the RFI Work Plan for OU 1122 (LANL 1992, 0784). In addition, each sample was individually screened at the time of collection as required by the OU 1122 site specific health and safety plan. No radiation above background was detected at any PRS described in this subsection (ICF-Kaiser 1994, 02-095); therefore, the radiation survey is rarely mentioned in individual PRS assessments.

Included with each PRS discussed in this RFI report is a summary of field activities. These PRSs had a minor subsurface component; therefore, subsurface sampling details are discussed only in relevant PRSs. Prior to sampling, the field contractor conducted all radiation and geophysical surveys in accordance with the work plan. Details are documented in the field report (ICF-Kaiser 1994, 02-095). Analytical quality assurance/quality control (QA/QC) data, a measure of the reliability of the analytical results upon which the recommendations are based, is included with the sampling and results tables for each PRS.

4.1 SWMU 33-004(d) Area 6 Septic System

SWMU 33-004(d) is discussed in the OU 1122 RFI Work Plan Subsections 3.3.2.2, 4.3.3.1, and 4.3.4 (LANL 1992, 0784). It is proposed for NFA based on sampling data collected in 1993.

4.1.1 Unit Description

4.1.1.1 Description and Historical Information

SWMU 33-004(d) is a septic system which served a toilet and sink in TA-33-1, located at Area 6. The 500-gal., corrugated-iron septic tank, TA-33-121, is located about 50 ft southeast of the building (Fig. 4-1). The system includes a single drain line of vitrified clay sections laid in gravel and terminating about 5 ft below grade.

TA-33-1 is a wooden laboratory building. Between 1948 and 1955 it supported non-explosive initiator tests at Area 6. The building was later used for offices and storage. It has been abandoned since 1991.

Potential contaminants identified from the archival investigation were photoprocessing chemicals, beryllium, natural uranium, and VOCs.

4.1.1.2 Setting

The tank is located in a wooded area east of the fenced Area 6 complex. Juniper trees and sparse grasses cover the site. From Area 6 and the septic tank, the ground level slopes gently east approximately 200 ft to a shallow drainage eroded to bedrock. This drainage also receives runoff from the road leading to Area 6. The channel of the drainage descends south,

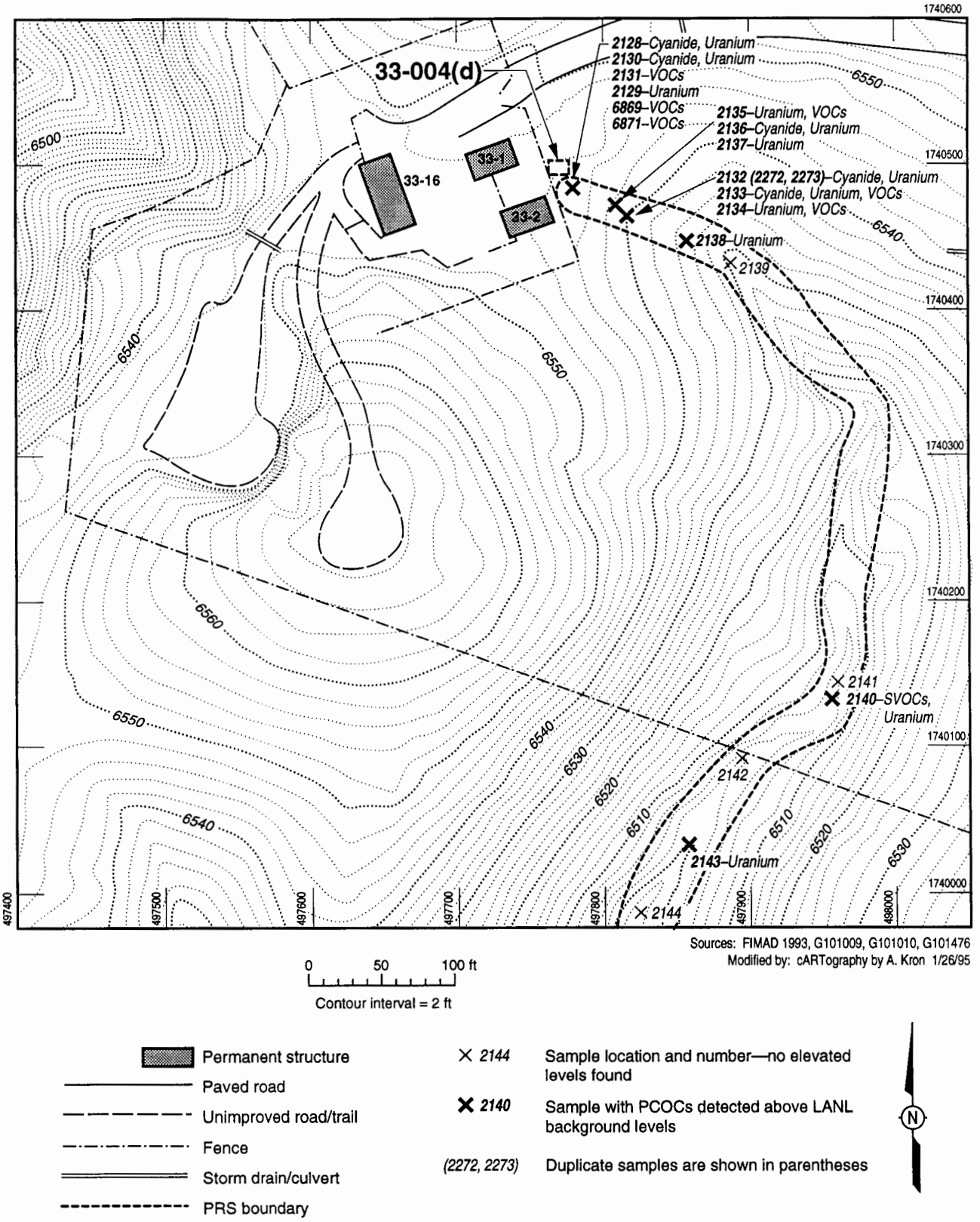


Fig. 4-1. Area 6: PRS 33-004(d).

receiving runoff from SWMUs 33-010(e), 33-005(a,b,c), and 33-011(a) before dropping into Chaquehui Canyon.

Except for rainwater or snowmelt, there is no surface water at Area 6. Surface soils are slightly sandy with numerous pumice pebbles, and are high in organic material from the trees and shrubs. In several areas, non-native gravel is intermixed with the soil. Field logs of subsurface sampling indicate that soils at 5-ft and 8-ft depths become sandy with many pumice pebbles ranging in size to 0.5 in. Clay lenses are intermixed with pulverized tuff. Soils in the drainage are sandy with some clay and many small pebbles. Bedrock is exposed at many areas on the site, including the drainage channel below the septic system.

4.1.2 Field Investigation and Subsurface Characterization

The septic tank was dry and rusty and contained no sludge, so no samples were taken. This is contrary to the work plan for SWMU 33-004(d). As specified in the sampling and analysis field plan for the outfall and drainage, a total of 19 samples, including field duplicates and collocated samples, were collected. One borehole was hand-augered adjacent to the tank and two more boreholes were placed downslope from the tank along the line of the single drainpipe for a total of three surface (plus one duplicate and one sample analyzed in triplicate) and six subsurface samples. See Table 4-2 for depths. The remaining samples were surface samples collected on the slope below the buried outfall and in the drainage (Fig. 4-1).

All samples were analyzed for uranium, gamma emitters, inorganics, cyanide, and SVOCs. Four subsurface samples were analyzed for VOCs. Two resamples were later taken at the borehole nearest the septic tank and analyzed for VOCs only (Table 4-2).

4.1.3 Potential Release Characterization

See Table 4-2 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Concentrations of uranium and gamma emitters were within local background ranges, although uranium was typically above the framework studies UTL. Inorganics were within background ranges. Low levels of cyanide were detected in six of the augered samples at concentrations ranging from 0.75 to 2.6 mg/kg. A

TABLE 4-2

SWMU 33-004(D) AREA 6 SEPTIC TANK

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH IN.	END DEPTH IN.	ANALYSES PERFORMED							
										ORGANICS					
								INORGANICS	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2128	33-1181	33-004(d)	*borehole*	soil	0	6	X	X		X				
2	AAA2130	33-1181	33-004(d)	duplicate	soil	0	6	X	X		X				
3	AAA2131	33-1181	33-004(d)		soil	60	60	X	X	X	X				
4	AAA2129	33-1181	33-004(d)		soil	75	96	X	X		X				
5	AAA2132	33-1183	33-004(d)	*borehole*	soil	0	6	X	X		X				
6	AAA2272	33-1183	33-004(d)	duplicate	soil	0	6	X	X		X				
7	AAA2273	33-1183	33-004(d)	duplicate	soil	0	6	X	X		X				
8	AAA2133	33-1183	33-004(d)		soil	60	60	X	X	X	X				
9	AAA2134	33-1183	33-004(d)		soil	96	96	X	X	X	X				
10	AAA2135	33-1184	33-004(d)	*borehole*	soil	0	6	X	X	X	X				
11	AAA2136	33-1184	33-004(d)		soil	60	60	X	X		X				
12	AAA2137	33-1184	33-004(d)		soil	84	84	X	X		X				
13	AAA2138	33-1185	33-004(d)	*surface samples*	sediment	0	6	X	X		X				
14	AAA2139	33-1186	33-004(d)		sediment	0	6	X	X		X				
15	AAA2140	33-1187	33-004(d)		sediment	0	6	X	X		X				
16	AAA2141	33-1188	33-004(d)	collocated	sediment	0	6	X	X		X				
17	AAA2142	33-1189	33-004(d)		sediment	0	6	X	X		X				
18	AAA2143	33-1190	33-004(d)		sediment	0	6	X	X		X				
19	AAA2144	33-1191	33-004(d)		sediment	0	6	X	X		X				
20	AAA6869	33-1181	33-004(d)	*borehole resample*	soil	60	60			X					
21	AAA6871	33-1181	33-004(d)		soil	76	76			X					

TABLE 4-2 (Continued)

SWMU 33-004(D) AREA 6 SEPTIC TANK

RESULTS OF ANALYSES

		RADIONUCLIDES (a)					INORGANICS											
#	SAMPLE ID	U mg/kg	238Pu pCi/g	239Pu pCi/g	137Cs pCi/g	3H pCi/g	Ag mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Pb mg/kg	Sb mg/kg	Se mg/kg	Zn mg/kg	CN- mg/kg
1	AAA2128	3.6	NA	NA	<0.8	NA	<1	3.5	110	0.74	<0.4	7.3	8	19	<0.06	<0.2	43	2.57
2	AAA2130	3.8	NA	NA	1.24	NA	<1	3.5	110	0.8	<0.4	6.4	8	15	<0.06	<0.2	39	2
	AAA2130R	NA	NA	NA	NA	NA	<1	NA	110	0.77	<0.4	6.6	8	17	NA	NA	37	NA
3	AAA2131	2.8	NA	NA	<0.83	NA	<1	3.2	56	0.66	<0.4	5.8	7	5	<0.07	<0.2	31	<0.05
4	AAA2129	4.5	NA	NA	<0.86	NA	<1	1.2	44	0.33	<0.4	4.1	8	2	<0.06	<0.2	9	<0.05
5	AAA2132	2.9	NA	NA	0.71	NA	<1	3.0	110	0.74	<0.4	7.9	7	18	<0.06	<0.2	38	1.25
6	AAA2272	3	NA	NA	<0.68	NA	<1	2.6	95	0.55	<0.4	5	6	16	<0.06	0.6	30	1.25
7	AAA2273	3	NA	NA	<0.78	NA	<1	4.4	110	0.57	0.4	6.5	6	20	<0.06	<0.2	34	1.25
8	AAA2133	4.7	NA	NA	<0.47	NA	<1	1.3	49	0.27	<0.4	4.4	2	6	<0.07	<0.2	10	22.5
	AAA2133R	NA	NA	NA	NA	NA	NA	1.3	NA	NA	NA	NA	NA	NA	<0.07	<0.2	NA	NA
9	AAA2134	3.2	NA	NA	<0.65	NA	<1	2.1	34	0.45	<0.4	3.3	3	6	<0.07	<0.2	22	<0.05
10	AAA2135	3.3	NA	NA	<0.84	NA	<1	2.9	120	0.81	<0.4	7.2	6	14	<0.06	<0.2	30	<0.05
11	AAA2136	4.1	NA	NA	<0.45	NA	<1	2.4	120	0.52	<0.4	5.6	6	6	<0.06	<0.2	16	0.75
12	AAA2137	3.5	NA	NA	<0.38	NA	<1	2.9	88	0.73	<0.4	7	7	7	<0.06	<0.2	27	<0.05
13	AAA2138	3	NA	NA	<0.76	NA	<1.4	1.6	124	0.62	<0.8	9.2	6	19	<11.2	<0.6	43	<0.2
14	AAA2139	1.1	NA	NA	<0.65	NA	<1.4	<0.6	40.6	0.32	<0.8	3	<2.8	5	<11.2	<0.6	18	<0.2
15	AAA2140	3.6	NA	NA	<0.52	NA	<1.4	2.5	141	0.94	0.82	9.1	12	26	<11.2	<0.6	52	<0.2
16	AAA2141	2.2	NA	NA	<0.56	NA	<1.4	5.8	61.8	0.22	<0.8	7.4	13	25	<11.2	<0.6	84	<0.2
17	AAA2142	2.1	NA	NA	<0.55	NA	<1.4	<0.6	74.7	0.28	2.3	15.3	18	12	<11.2	<0.6	62	<0.2
18	AAA2143	3.1	NA	NA	<0.77	NA	<1.4	1.0	100	0.64	<0.8	7.4	9	23	<11.2	<0.6	36	<0.2
19	AAA2144	2.5	NA	NA	<0.51	NA	<1.4	1.0	93.9	0.54	1.3	12.5	19	14	<11.2	<0.6	52	<0.2
	SALs (b)	95	27	24	4	820	400	(h)	5 600	(h)	80	400	1 600	400	32	400	24 000	1 600
	EQLs (c)	1.4	0.01	0.01	1	(g)	2	2	40	1	1	2	8	0.6	12	1	4	0.05
	LANL UTLs(d)	2.82	0.01	0.052	1.4	nd	NA	11.6	1140	3.31	2.7	34.2	26.7	39	2.5(f)	1.7(f)	101	nd
	TA-33 UTLs(e)	4.84	0.0074	0.058	2.75	23.2	NA	4.36	268	1.51	2.7(f)	20.7	17	(i)	0.27(f)	1.39(f)	62.3	nd

R =reanalyzed

ORGANICS DETECTED						
#	SAMPLE ID	VOCs	RESULT	SAL	EQL	UNITS
3	AAA2131	Acetone	0.066	8000	0.02	mg/kg
8	AAA2133	Acetone	0.047	8000	0.02	mg/kg
9	AAA2134	Acetone	0.059	8000	0.02	mg/kg
10	AAA2135	Acetone	0.045	8000	0.02	mg/kg
		SVOCs				
15	AAA2140	Fluoranthene	0.49	3200	0.33	mg/kg
	AAA2140	Phenanthrene	0.62	nc	0.33	mg/kg
	AAA2140	Pyrene	0.49	2400	0.33	mg/kg

Data Qualifications

QA/QC data indicate poor surrogate recovery for SVOC analytes in sample AAA2134 (at a depth of 8 feet). Although the SVOC data for this one sample were judged to be unusable, no SVOCs were observed in adjacent samples and these results are not felt to be critical. Low levels of acetone, found in four samples, may indicate laboratory contamination, though no acetone was found in the blanks.

Surrogate recovery for SVOCs for some other samples may have been low by as much as 50%. This increases the uncertainty of the results for low-level AAA2140 SVOCs found in the drainage. QC data also indicate that selenium and antimony results may be high, but neither was detected in any sample. Barium and selenium were detected in one blank, but neither was found above background in any sample. One sample container was dropped in transfer and the sample recovered, but data from this sample do not differ statistically from the overall data, so the transfer does not appear to have invalidated the results.

Despite the increased uncertainty of SVOC results, QA/QC data does not invalidate the NFA recommendation for SWMU 33-004(d).

TABLE 4-2 (Continued)

SWMU 33-004(D) AREA 6 SEPTIC TANK

Footnotes for tables

Notes: Concentrations above LANL background levels are italicized and left justified in the tables. Tritium italicized and left justified if over TA-33 background.
Concentrations above screening action levels (SALs) are bold-faced and left-justified in the tables
NA = not analyzed
nd = not determined
nc = not calculated due to insufficient data
mg/kg = milligrams per kilogram
mg/ml = milligrams per milliliter

a) Standard chemical symbols: Ag = silver, As = arsenic,Ba = barium, Be = beryllium, Cd = cadmium
CN = cyanide, Cr = chromium, Cs = cesium, Hg = mercury, Ni = nickel
Pb = lead, Pu = plutonium, Sb = antimony, Se = selenium, U = uranium, Zn = zinc
^3H = tritium

b) Screening action levels as calculated by the LANL risk assessment team for the 1993 Installation Work Plan (LANL 1993, 1017) with modifications as follows:
Lead SAL reduced to 400 mg/kg
Arsenic and beryllium SALs have been set at LANL background levels.

c) EQL: Estimated quantitation limits as established by the LANL environmental chemistry group (Fisk and Miglio 1993, 02-098)
Results below these values are reported at the discretion of the analytical laboratory.

d) LANL upper tolerance limits (UTLs) for inorganic concentrations (Longmire et al. in preparation, 1142) See Subsection 3.2.2.1. UTLs calculated by FU-3 statistics team.

e) TA-33 upper tolerance limits (UTLs) for inorganic concentrations. See Subsection 3.2.2.1

f) Insufficient data to calculate UTLs. Concentration shown is maximum concentration found.

g) Tritium is reported from the analytical laboratory as pCi/L and percent soil moisture. Results are converted to pCi/g using the following formula:

pCi/g ^3H = pCi/L ^3H x % soil moisture/(100% soil moisture)

h) LANL has no SAL for arsenic and beryllium. Background comparisons are appropriate.

i) Distribution of lead was too nonnormal to calculate a reliable UTL. The LANL UTL is appropriate for background comparison. See Subsection 3.2.2.1.

seventh sample (sample AAA2133, at the depth of the drainpipe) contained 22.5 mg/kg cyanide. Very low levels of acetone (0.045-0.066 mg/kg) were detected in four samples. SVOCs were detected at low levels in drainage sample AAA2140, about 500 ft downslope from the septic tank: phenanthrene (0.62 mg/kg) and pyrene and fluoranthene each at 0.49 mg/kg (Table 4-2). No SVOCs were positively identified in any other sample, including Sample AAA2141, collected from a point 1 ft to the north of Sample AAA2140. TICs were reported for the majority of the samples, and were most numerous in surface samples. The TICs are considered components of the humus of surface soil horizons.

4.1.4 Conclusion and Recommendation

Comparison with SALs and background levels indicates that no inorganics or radionuclides were detected at levels of concern. Inorganics and uranium are within or near their backgrounds. Cyanide concentrations were far below SAL of 1 600 mg/kg. The trace concentrations of organics in subsurface samples are also well below their respective SALs. The SVOCs that appear only in one drainage sample are also well below SALs except for phenanthrene at 0.62 mg/kg, for which no SAL has been calculated. These SVOCs were not found in a collocated sample one foot away. This location in the drainage could have been affected by wood preservatives from a telephone pole approximately 15 ft upslope.

Based on these results NFA is proposed for SWMU 33-004(d) based on current LANL Criterion 4. It is believed that these samples represent zones of maximum soil contamination. Although no samples were taken from the tank due to lack of sludge, samples were chosen near the tank and drain line in locations that would have detected contamination if any had occurred. In addition, samples from the bedrock drainage indicate that no contamination is migrating from the PRS.

4.2 SWMU 33-004(g) Outfall from TA-33-16 at Area 6

SWMU 33-004(g) is discussed in the RFI Work Plan for OU 1122 Subsections 3.3.2.3 and 4.3.3.1 (LANL 1992, 0784). PCBs detected in this area are attributed to overlapping SWMU 33-009, to be discussed in a future RFI

report. SWMU 33-004(g) is proposed for NFA based on results from samples collected in 1993.

4.2.1 Unit Description

4.2.1.1 Description and Historical Information

SWMU 33-004(g) is the outfall from building TA-33-16 at Area 6. A drain line 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 (Fig. 4-2). 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.

Between 1948 and 1955, TA-33-16 was a used as a gun building for initiator tests at Area 6. 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.

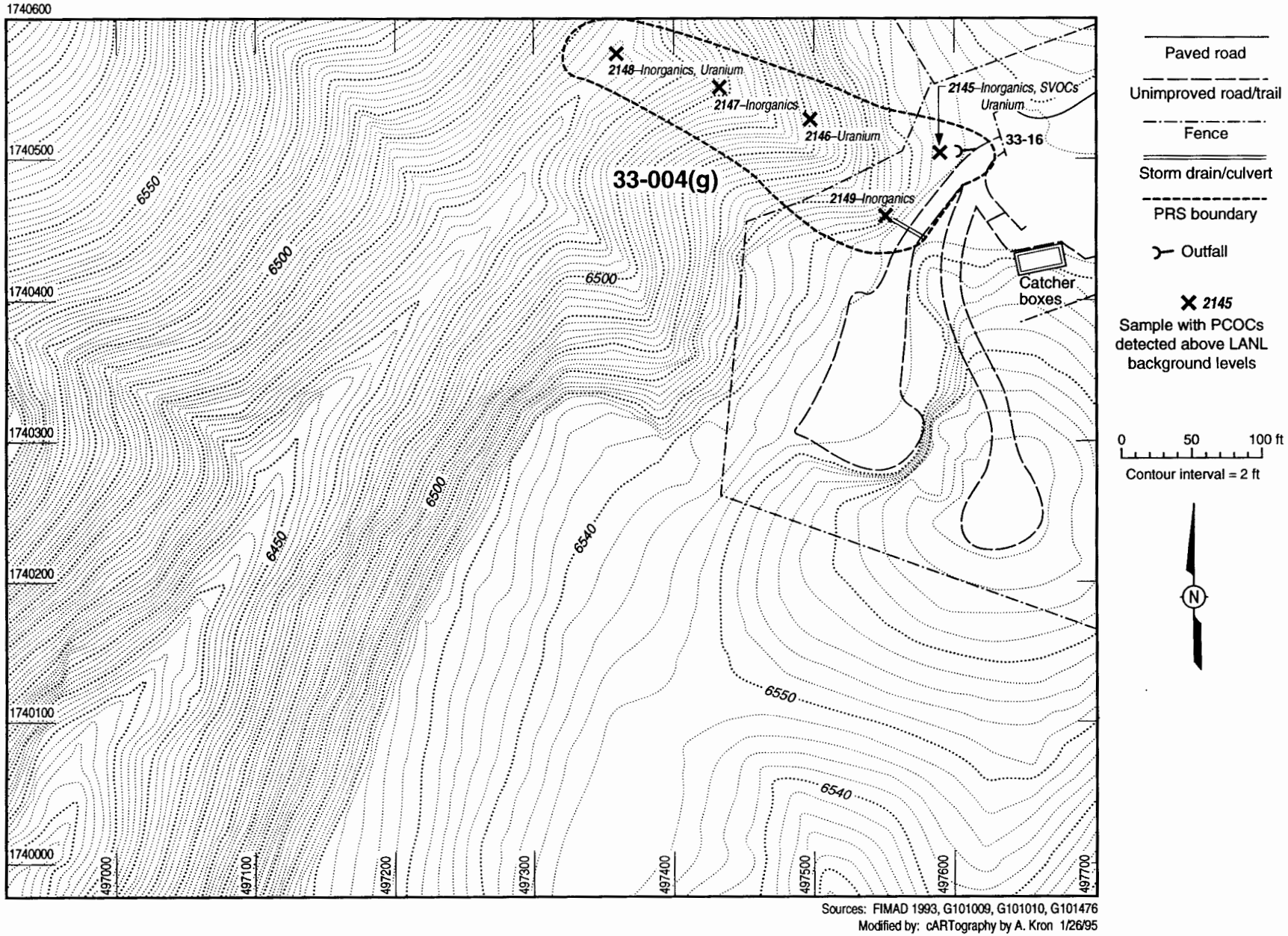
Potential contaminants expected from the archival investigation were inorganics, VOCs, SVOCs, high explosives, and uranium.

4.2.1.2 Setting

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 to 4 ft deep, deposited as a result of leveling the site for construction. West of the outfall, soils become thin and intermixed with tuff outcrops. The area receives sheet runoff from nearby asphalt paving. West of the outfall area is a steep, 40-ft drop, almost cliff-like, into the adjacent tributary of Chaquehui Canyon. This part of the channel consists of tuff blocks and boulders with little soil.

4.2.2 Field Investigation

Four surface samples for SWMU 33-004(g) were specified in the work plan. 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



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

Fig. 4-2. Area 6: PRSs 33-004(g).

of the nearby culvert (Fig. 4-2). All samples were analyzed for SVOCs, uranium, gamma emitters, inorganics, and explosives (Table 4-3).

4.2.3 Potential Release Characterization

See Table 4-3 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Radionuclides were within local background ranges for all samples, although the uranium data are often above the framework studies UTL. No explosives were reported above detection levels. Nickel and zinc were above background in the drainage samples. Other analytes were either within or near 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, significantly 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 4-4 lists the constituents in comparison to Laboratory and TA-33 background UTLs and SALs.

The table also addresses the question of multiple constituent contamination. Combinations of chemicals may pose a risk even though each is present below its individual SAL. A simple evaluation for screening purposes used here calculates the ratio of the observed concentration to the SAL for each inorganic, then calculates the sum of the ratios. If the total multiple constituent ratio (TMCR) is less than one, then the suite is considered below a level of concern. Here the TMCR is 0.922, below the trigger level of one. Multiple constituents are addressed in Subsection 4.0, Appendix J of the LANL Installation Work Plan (LANL 1993, 1017).

Nickel is above LANL and local backgrounds in three samples, but not in the outfall sample or sample AAA2146. The drainage receives material from the basaltic cinder cone that forms a part of Area 6. As noted in Subsection 3.2.2.1, nickel is elevated in cinder cone background samples and in samples associated with SWMU 33-007(c). Since the highest concentration of nickel (52.3 in sample AAA2149) represents only 3.3% of its SAL of 1 600, nickel is not considered a contaminant of concern at SWMU 33-004(g).

TICs were reported for all five samples. Bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was identified in sample AAA2145 at 0.53 mg/kg.

TABLE 4-3

SWMU 33-004(G) OUTFALL AT TA-33-16, AREA 6

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED							
										ORGANICS					
								INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2145	33-1192	33-004(g)	*outfall*	sediment	0	6	X	X		X		X		
2	AAA2146	33-1193	33-004(g)	*runoff*	sediment	0	6	X	X		X		X		
3	AAA2147	33-1194	33-004(g)	*drainage*	sediment	0	6	X	X		X		X		
4	AAA2148	33-1195	33-004(g)		sediment	0	6	X	X		X		X		
5	AAA2149	33-1196	33-004(g)	*culvert*	sediment	0	6	X	X		X		X		

RESULTS OF ANALYSES

#	SAMPLE ID	RADIONUCLIDES (a)					INORGANICS										
		U	238Pu	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
		mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA2145	*3.6*	NA	NA	<1	NA	*16.7*	1.7	*1320*	0.87	2.2	11.8	16.5	*244*	<11.2	<0.6	*285*
2	AAA2146	*3.4*	NA	NA	<0.69	NA	<1.4	1.2	133	0.9	<0.8	6.8	10.7	11.7	<11.2	<0.6	46.8
3	AAA2147	2.6	NA	NA	<0.44	NA	<1.4	1	204	0.76	1.8	10.3	*45.9*	14.2	<11.2	<0.6	*108*
4	AAA2148	*3.4*	NA	NA	<0.67	NA	<1	4.01	210	0.93	<0.4	8	*38*	14	<0.07	1.1	51
5	AAA2149	2.8	NA	NA	<0.67	NA	<1.4	1.1	291	0.74	1.5	7.4	*52.3*	15.6	<11.2	<0.6	78.5
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.0074*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

#	ORGANICS DETECTED					
	SAMPLE ID	SVOC	RESULT	*SAL*	*EQL*	UNITS
1	AAA2145	Bis(2-ethylhexyl)phthalate	0.53	*50*	*0.33*	mg/kg

PCBs in sample AAA2145 attributed to overlapping SWMU 33-009

DATA QUALIFICATIONS

Surrogate recoveries indicate that some SVOC analytes may be as much as 50% low. QC recoveries indicate that uranium may be low by 20% and the gamma emitter CS-137 may be high. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant and may not be present in the sample. It was not present in the laboratory blank.

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

TABLE 4-4

INORGANICS DETECTED IN SAMPLE AAA2145

ELEMENT	SILVER (mg/kg)	BARIUM (mg/kg)	LEAD (mg/kg)	ZINC (mg/kg)
Concentration	16.7	1 320	244	285
LANL UTL	*not analyzed*	*1 140*	*39.0*	*101*
TA-33 UTL	*not calculated*	*260*	*33.7*	*62.3*
SAL	*400*	*5 600*	*400*	*24 000*
Ratio C/SAL	*0.042*	*0.236*	*0.61*	*0.034*

See Table 4-3. Mixed Aroclors™ (PCBs) were reported as TICs at levels up to 2.5 mg/kg in outfall sample AAA2145.

4.2.4 Conclusion and Recommendation

Although significantly elevated levels of some inorganics were observed in the sample at the outfall at SWMU 33-004(g), these levels are below SALs and the TMCR limit of one. A release did occur, but adequate sampling took place in the drainage to define the extent of that release. This location is the point of entry to the environment from TA-33-16 drainpipe and contains the only contaminants found. No or very low levels of contaminants were found in the channel below the outfall samples, indicating that the low-level inorganic contaminants are not migrating from the site to any significant degree.

PCBs were not considered to be a potential contaminant associated with SWMU 33-004(g). However, they are one of the primary contaminants associated with overlapping SWMU 33-009. The PCB observations in sample AAA2145 will be considered further in connection with SWMU 33-009 in a future RFI report.

NFA is proposed for SWMU 33-004(g) based on LANL Criterion 4. However, actions taken for PCBs at SWMU 33-009 may affect overlapping areas of SWMU 33-004(g).

4.3 SWMU 33-004(h) Outfall from TA-33-20 at Main Site

4.3.1 Unit Description

SWMU 33-004(h) is discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.4 and 4.2.3.2 (LANL 1992, 0784). It is proposed for NFA based on results from samples collected in 1993.

4.3.1.1 Description and Historical Information

SWMU 33-004(h) is described as an outfall from warehouse TA-33-20 located at Main Site (Fig. 4-3). Engineering drawings indicate that a floor drainpipe from the warehouse led eastward to an outfall. However, no outfall was located by LANL environmental restoration personnel, ICF Kaiser sampling team members, or during the 1992 LANL wastewater stream characterization studies (Santa Fe Engineering 1992, 02-096). TA-33-20 is a Quonset-type warehouse. From 1952 until 1972 material for initiator experiments was stored in and around the building. The building was cleaned for subsequent groups. Floor drains were not plugged.

Potential contaminants identified during the archival search were beryllium, uranium (natural and depleted), and possibly other inorganics.

4.3.1.2 Setting

From the edge of the pavement east of warehouse TA-33-20, unpaved ground slopes toward the channel draining Main Site. The soil is less than two feet deep, in places scraped almost to bedrock, with a few weeds and grasses. The area receives sheet runoff from the pavement during rainstorms.

4.3.2 Field Investigation

There was no visual evidence of an outfall in the area identified with SWMU 33-004(h), but a geophysical survey using ground-penetrating radar indicated that a pipe or trench may have existed. The existence of a pipe or trench was not confirmed. Three sampling locations were selected based on these geophysical results. As specified in the work plan, all samples were from the surface. Soils are shallow in this area, with nearby tuff outcrops. Indications lead to the conclusion that the samples are representative of soil around the outfall. A pile of asphalt and gravel was noted within 10 ft of the first of these sampling locations (ICF-Kaiser 1994, 02-095).

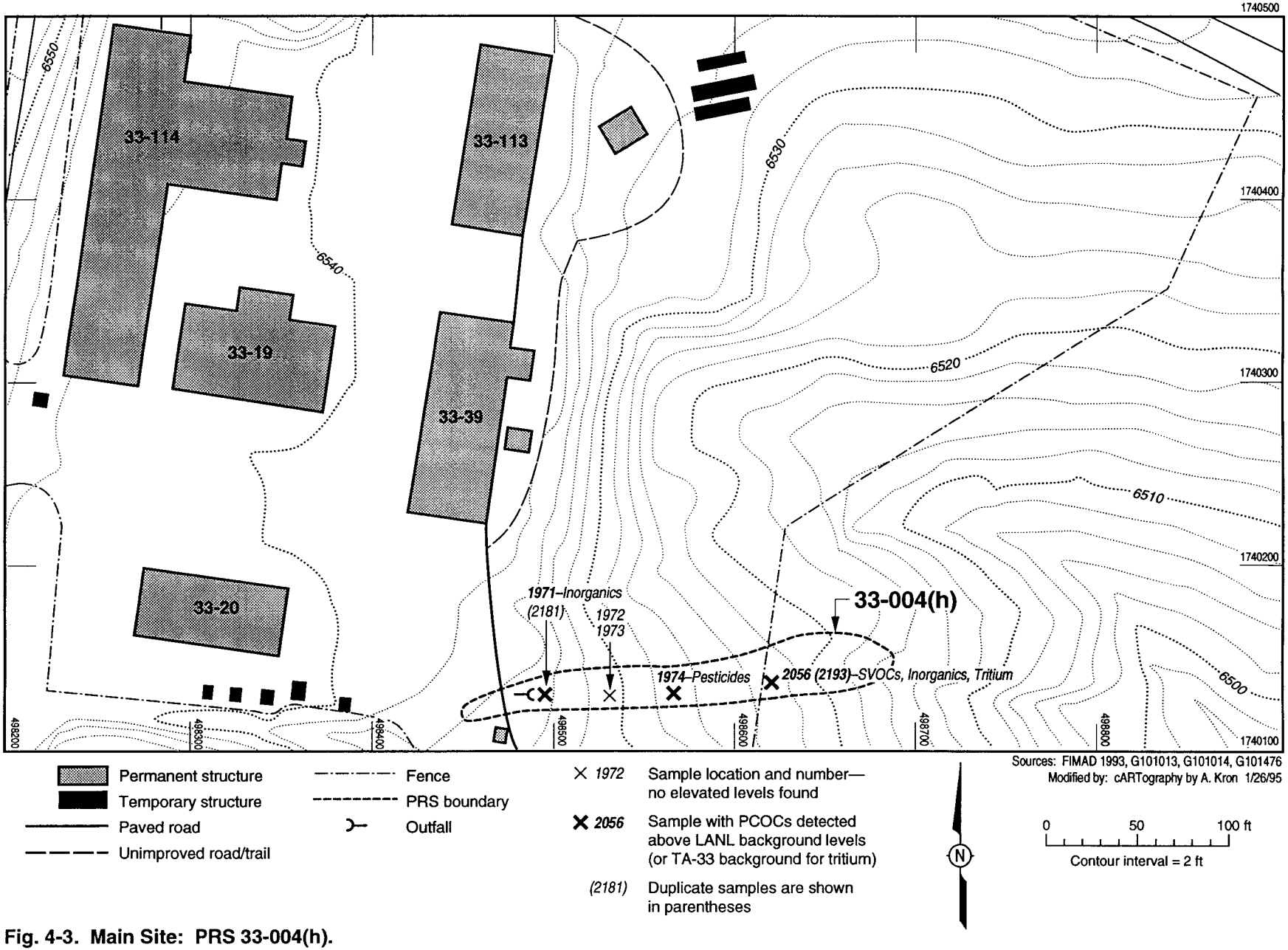


Fig. 4-3. Main Site: PRS 33-004(h).

The RFI Work Plan for OU 1122 specified that three surface samples and one duplicate be collected at SWMU 33-004(h) (LANL 1992, 0784). Five surface samples plus one duplicate were collected at this SWMU as follows: one sample and its duplicate were collected where the geophysical survey suggested the end of a pipe or trench might be located. A pair of collocated samples was collected 35 ft to the east and downgradient from this point. A third sample was collected another 36 ft to the east, in a natural rocky drainage area. In addition, one sample and its duplicate associated with SWMU 33-017 were collected about 60 ft northeast of the third sample in the same channel (Fig. 4-3).

All samples were analyzed for inorganics, uranium, and gamma emitters. Sample AAA1974 was also analyzed for herbicides, pesticides, and PCBs. The SWMU 33-017 channel duplicates were also analyzed for SVOCs, isotopic plutonium, and tritium (Table 4-5).

4.3.3 Potential Release Characterization

See Table 4-5 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Concentrations of most inorganics and radionuclides were within background ranges. Silver was at 1 mg/kg in the channel samples AAA2056 and its duplicate AAA2193. Nickel was above background in the outfall sample AAA1971. Low levels of above-background zinc were in three locations. Minute amounts of pesticides (0.003 mg/kg) were observed in sample AAA1974. Non-carcinogenic PAHs phenanthrene, pyrene, and fluoranthene were identified in one channel sample at levels below 0.5 mg/kg, and TICs were observed in both channel samples. Tritium was measured at about 27 pCi/g in the channel samples (Table 4-5).

4.3.4 Conclusion and Recommendation

Comparison of results with background and SALs indicates that contaminants are not present at concentrations near levels of concern. Above-background levels of tritium and PAHs in the channel samples are ascribed to the general operational releases from the nearby tritium facility, TA-33-86, and from the paved areas of Main Site, not to SWMU 33-004(h). Above-background levels at 1 mg/kg of silver in the drainage sample AAA2056 and

TABLE 4-5

SWMU 33-004(H) OUTFALL FROM WAREHOUSE TA-33-20

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED INORG	RAD	ORGANICS VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA1971	33-1051	33-004h	*surface samples*	sediment	0	6	X	X						
2	AAA2181	33-1051	33-004h	duplicate	sediment	0	6	X	X						
3	AAA1972	33-1052	33-004h		sediment	0	6	X	X						
4	AAA1973	33-1053	33-004h	collocated	sediment	0	6	X	X						
5	AAA1974	33-1054	33-004h		sediment	0	6	X	X			X		X	X
6	AAA2056	33-1109	33-017		sediment	0	6	X	X		X				
7	AAA2193	33-1109	33-017	duplicate	sediment	0	6	X	X		X				

RESULTS OF ANALYSES

#	SAMPLE ID	*RADIONUCLIDES (a)* U mg/kg	238Pu pCi/g	239Pu pCi/g	137Cs pCi/g	3H pCi/g	*INORGANICS* Ag mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Pb mg/kg	Sb mg/kg	Se mg/kg	Zn mg/kg
1	AAA1971	2.2	NA	NA	<0.76	NA	<1	1.91	68	0.77	<0.4	8.3	*40*	30	<0.1	<0.2	*110*
2	AAA2181	2.3	NA	NA	<1.37	NA	<1	1.92	60	0.65	<0.4	5.8	2	16	<0.1	<0.2	85
3	AAA1972	2.3	NA	NA	<0.83	NA	<1	2.85	90	0.84	0.7	7.5	20	3.4	<0.1	<0.2	39
4	AAA1973	2.4	NA	NA	<1.42	NA	<1	2.92	77	0.7	<0.4	7.1	12	11	<0.1	<0.2	55
5	AAA1974	2.5	NA	NA	<1.1	NA	<1	2.07	49	0.44	0.7	5.6	7.3	19	0.04	<0.2	67
5	AAA1974R	NA	NA	NA	0.92	NA	NA	3.02	NA	NA	NA	NA	NA	NA	NA	<0.2	NA
6	AAA2056	2.5	0.003	0.008	<0.64	*27.7*	*1*	2.7	78	0.81	0.8	7.2	11	31	<0.04	<0.2	*110*
7	AAA2193	2.3	0.003	0.011	<0.58	*27.4*	*1*	1.7	74	0.7	1	6.7	12	22	<0.04	<0.2	*110*
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

R=reanalyzed

#	ORGANICS DETECTED SAMPLE ID	PESTICIDES	RESULT	*SAL*	*EQL*	UNITS
5	AAA1974	DDE [p,p'-]	0.0021	*2.1*	*0.001*	mg/kg
5	AAA1974	Endosulfan II	0.0025	*4*	*0.001*	mg/kg
		SVOCs				
6	AAA2056	Fluoranthene	0.41	*32,000*	*0.33*	mg/kg
6	AAA2056	Phenanthrene	0.37	*nc*	*0.33*	mg/kg
6	AAA2056	Pyrene	0.36	*24,000*	*0.33*	mg/kg

DATA QUALIFICATIONS

QA blind results indicate that beryllium, chromium, lead, nickel, and zinc results may be low by as much as 35%. Non-blind results indicate that only beryllium may be low by 50%. Adjustment for these elements does not bring the confidence interval above background. QA data indicate that pesticide and herbicide results may be low by 80%. Two pesticides were found in one sample at minute concentrations. Cs-137 results may be high by 125%. Adjustment of the confidence interval to account for these anomalies does not affect the NFA decision. QC/QC data indcate that all other results are satisfactory.

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p.55).

40 mg/kg nickel in sample AAA1971 may be related to the nearby incinerator, SWMU 33-015, where silver was observed at 10 to 20 mg/kg; see Subsection 4.10 of this RFI report.

Although the outfall was not located, and subsurface samples could not be taken due to the thin soils, the sampling points represent the best estimates of suitable locations for this PRS. Based on sampling results and the near-bedrock conditions at the SWMU, NFA is proposed at SWMU 33-004(h) based on LANL Criterion 4.

4.4 SWMU 33-004(i) Outfalls from Shop TA-33-39 at Main Site

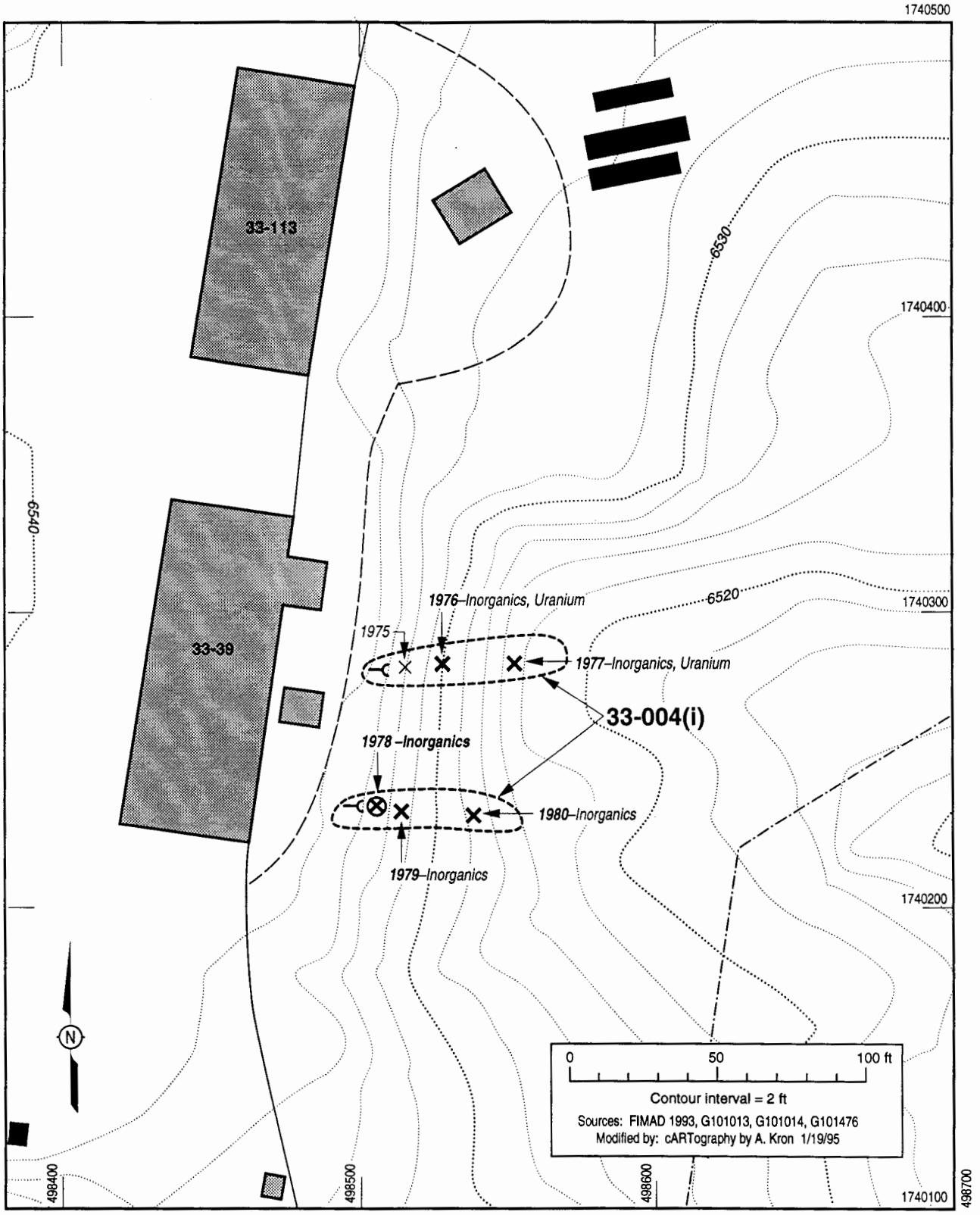
SWMU 33-004(i) is discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.5 and 4.2.3.2 (LANL 1992, 0784). Lead was detected above SAL at one of the outfalls. The SWMU is proposed for NFA based on a preliminary human health risk assessment. SVOCs identified in the samples have been transferred to overlapping SWMU 33-017 to be addressed in a later report.

4.4.1 Unit Description

4.4.1.1 Description and Historical Information

SWMU 33-004(i) consists of the outfalls of two drains from shop TA-33-39 at Main Site (Fig. 4-4). The drain lines do not daylight. The 1992 LANL wastewater stream characterization study (Santa Fe Engineering 1992, 02-096) did not mention floor drains in shop TA-33-39, which indicates that the drains may be plugged. The drains were located about 50 ft apart on the east side of the building by ground-penetrating radar geophysical methods prior to sampling activities in 1993. The drains are constructed of 4-in. vitrified clay pipe. The north outfall is about 30 ft east of the building, the south outfall about 40 ft.

TA-33-39 was a shop completed in 1951. Over the years the shop housed facilities using silver, cadmium, beryllium, uranium, polystyrene, and sand-blasting equipment. It also housed a lead-melting facility. Machine shop operations ceased in 1990. In addition to these inorganics, VOCs were also identified as potential contaminants. Because only surface samples were taken, no samples were analyzed for VOCs.



Permanent structure
Temporary structure
Outfall
Paved road
Unimproved road/trail
Fence
PRS boundary
1975 Sample location and number—no elevated levels
1976 Sample with PCOCs detected above LANL background levels
1978 Sample with PCOCs detected above SALs (for contaminants in bold face)

Fig. 4-4. Main Site: PRS 33-004(i).

4.4.1.2 Setting

The two outfalls are located at the top of the steep slope east of Main Site east of TA-33-39. This slope was formed during leveling of the site for construction. The slope is formed of tuff rubble. No channel has formed at either outfall and there is no sign of outflow from the pipes. The entire bank is covered with a dense thicket of chamisa and in this area shows little sign of erosion. The grade of the slope lessens into a grassy area about 100 ft downslope from the outfalls.

4.4.2 Field Investigation

As specified in the work plan, three surface samples were taken at each outfall: one at each pipe, one in the dense brush about 15 ft below each pipe, and one where the grade of the slope lessens in the grassy area, for a total of six samples (Fig. 4-4). Field notes indicate some sampling points are heavily vegetated (ICF-Kaiser 1994, 02-095). Samples were analyzed for inorganics, SVOCs, uranium, and radionuclides. One sample was analyzed for pesticides, herbicides, and PCBs. (Table 4-6) Although VOCs were identified as potential contaminants, surface samples were never analyzed for VOCs at TA-33.

4.4.3 Potential Release Characterization

See Table 4-6 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Sample AAA1978 taken at the southern outfall adjacent to the pipe contained 800 mg/kg lead. Four other samples contained lead above background but below SAL. Several samples contained zinc above background but at less than 1% of its SAL of 24 000 mg/kg. Sample AAA1976 also contained 60 mg/kg of chromium, above background but below the SAL of 400 mg/kg (Table 4-6). Uranium in two samples was above the framework studies UTL. All samples showed low levels of PAHs. Because several SWMUs overlap in this area, the SVOC contamination is more appropriately attributed to SWMU 33-017, the vehicle maintenance area, to be discussed in a subsequent RFI report.

4.4.4 Conclusion and Recommendation

The measured lead concentration exceeded the SAL of 400 mg/kg at one sampling location. As lead measurements are available at several

TABLE 4-6

SWMU 33-004(L): OUTFALLS FROM TA-33-39

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED INORG	RAD	ORGANICS VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA1975	33-1055	33-004(i)	*outfall*	sediment	0	6	X	X		X	X		X	X
2	AAA1976	33-1056	33-004(i)	*drainage*	sediment	0	6	X	X		X				
3	AAA1977	33-1057	33-004(i)		sediment	0	6	X	X		X				
4	AAA1978	33-1058	33-004(i)	*outfall*	sediment	0	6	X	X		X				
5	AAA1979	33-1059	33-004(i)	*drainage*	sediment	0	6	X	X		X				
6	AAA1980	33-1060	33-004(i)		sediment	0	6	X	X		X				

RESULTS OF ANALYSES

#	SAMPLE ID	*RADIONUCLIDES (a)* U mg/kg	238Pu pCi/g	239Pu pCi/g	137Cs pCi/g	3H pCi/g	*INORGANICS* Ag mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Pb mg/kg	Sb mg/kg	Se mg/kg	Zn mg/kg
1	AAA1975	2.2	NA	NA	<1.06	NA	<1	2.44	130	0.62	<0.4	12	10	10	0.033	<0.2	37
2	AAA1976	*3.1*	NA	NA	<0.8	NA	<1	4.14	66	0.48	1.1	9.2	14	*79*	0.4	0.33	*210*
3	AAA1977	*3.9*	NA	NA	<0.5	NA	<1	2.52	59	0.53	0.6	7.1	11	*73*	0.04	<0.2	*120*
4	AAA1978	2.4	NA	NA	<1.09	NA	<1	1.6	42	0.39	<0.4	*60*	20	***800***	0.2	1.2	74
5	AAA1979	2.3	NA	NA	<1.13	NA	<1	1.88	62	0.36	<0.4	4.2	12	*71*	0.05	<0.2	69
6	AAA1980	2.7	NA	NA	<1.13	NA	<1	1.25	46	0.36	0.7	7.8	5.3	*210*	0.025	<0.2	*130*
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.0074*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

[1]Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

SVOCs ATTRIBUTED TO SWMU 33-017 and to be discussed in a later RFI report

Data Qualifications

QA data indicate that beryllium, chromium, lead, nickel, and zinc results may be low by as much as 35%. Arsenic blind results were low by 75%, but non-blind and matrix spike results were satisfactory. In sample AAA1978, adjustment does not bring chromium near SAL. QA data indicate that pesticide and herbicide results may be low by 80%. Neither was found in any sample. QA results indicate the gamma emitter cesium-137 results may be high by 25%; Cs-137 was not detected in any sample.

QA/QC results do not affect the assessment that lead is the only contaminant of concern at SWMU 33-004(i).

neighboring locations, a preliminary assessment of the extent of lead contamination and the associated risks is possible. Lead is consistently above background not only in most samples from SWMU 33-004(i) but also in samples from neighboring PRSs. The risk assessment for lead considers several exposure pathways in a residential setting to the most susceptible population, young children from birth to seven years. First, a credible residential exposure unit was defined as a 0.15–acre area that included SWMUs 33-004(i), 33-012(a)(Subsection 4.9), the vehicle maintenance area in SWMU 33-017 (report in preparation), and the top of the main drainage which is also part of SWMU 33-017. Mean and 95% upper confidence level (UCL) concentrations were calculated for lead (138 mg/kg and 211 mg/kg, respectively) using all 16 samples from these areas.

Risks were estimated using the EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model, Version 0.99d (EPA 1994, 02-099). 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.

Although one lead observation from SWMU 33-004(i) was as high as 800 mg/kg, the extent of lead contamination as indicated by other samples from this SWMU (including two samples downstream of the high observation) and neighboring PRSs is not sufficient to pose an unacceptable risk to even the most sensitive population under a conservative residential exposure scenario. NFA is therefore proposed for SWMU 33-004(i). Comparison to SALs and background for other inorganics, radionuclides, herbicides, pesticides, and PCBs indicates that none were detected at SWMU 33-004(i) at levels that warrant further investigation. SWMU 33-004(i) is proposed for NFA based on LANL Criterion 4 specifying that contaminants of concern be present in concentrations that would pose an acceptable level of risk under the

proposed future land use. These calculations were based on residential use.

Low levels of PAHs were found in all samples. These will be further addressed in a future RFI report dealing with the SWMU 33-017 vehicle maintenance area. The question of additive risk of two types of contamination is not considered relevant here. The PAHs are carcinogens, while lead risk reflects potential damage to the nervous systems of young children.

4.5 SWMUs 33-005(a,b,c) TA-33-21 Site

SWMUs 33-005(a,b,c) are discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.10, 3.2.4.1, 4.2.3.1, 4.2.3.2, and 4.2.5 (LANL 1992, 0784). They overlap SWMU 33-011(a), a storage and parking area. SWMUs 33-005(a,b,c) were designated to address a plutonium release in 1960 from former laboratory building TA-33-21. SVOCs detected at low levels in several samples appear to be related to use of the area implicit in SWMU 33-011(a), rather than the historical release addressed by SWMUs 33-005(a,b,c).

4.5.1 Unit Description

4.5.1.1 Description and Historical Information

SWMUs 33-005(a,b,c) encompass the former locations of the septic system, industrial line, drain line, and leach field associated with laboratory building TA-33-21, which was removed in 1974 (Fig. 4-5). Built in 1950, TA-33-21 was a laboratory building where projectiles used in initiator experiments were sectioned inside glove boxes. The glove boxes were also used for other experiments, some of which involved plutonium.

In 1960 a mixture of plutonium and beryllium powder was accidentally released, contaminating the entire building. The structure was decontaminated within weeks, but never used again. In 1974 the entire complex was decommissioned (Cox et al. 1975, 02-018). The building and associated drains, septic system, and piping were removed and taken to Area G at TA-54. All contaminated soil was removed until radiation readings were below detection levels of approximately 20 pCi/g gross alpha. The area was backfilled with clean soil and leveled. The level part of the site has

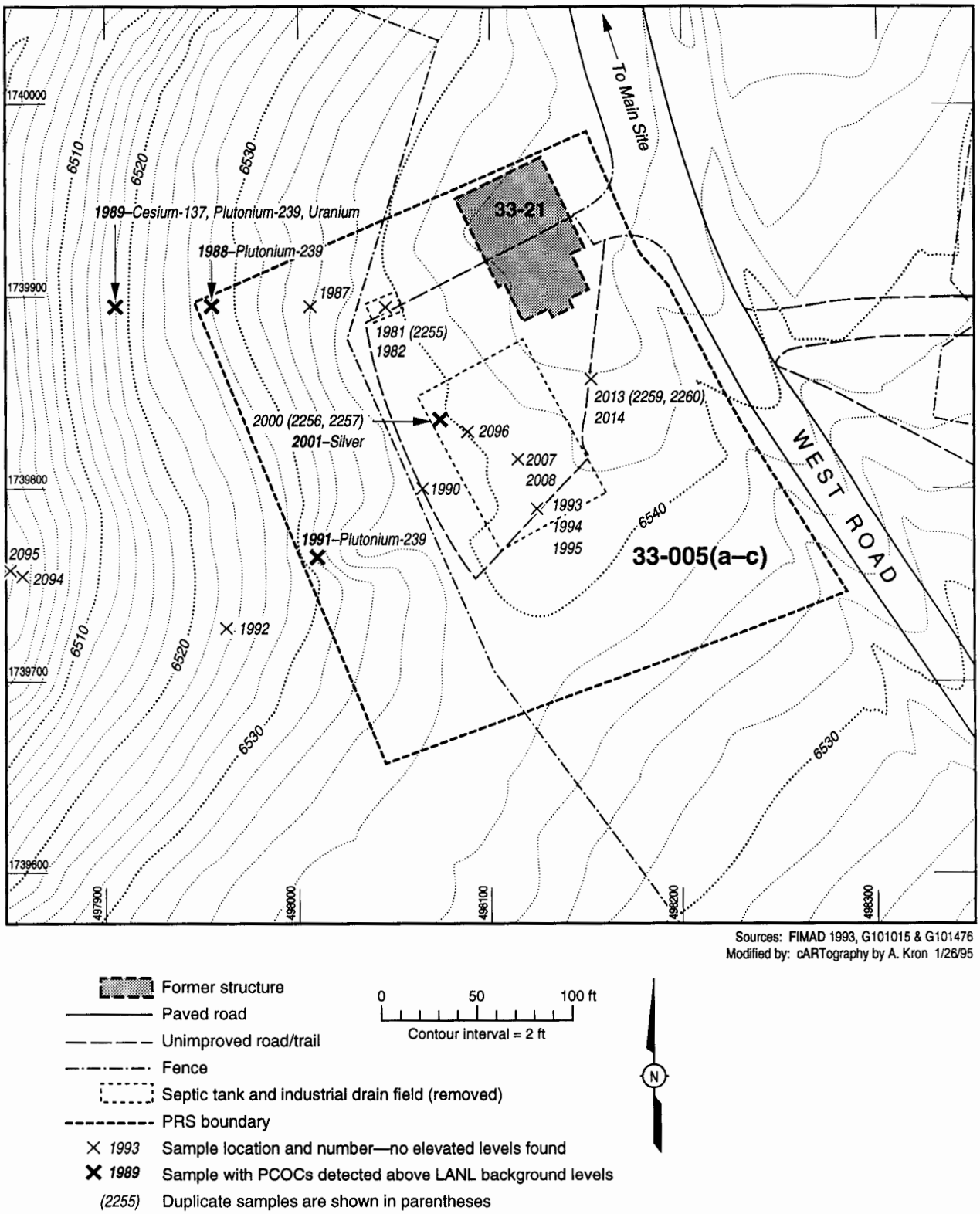


Fig. 4-5. Former TA-33-21 Site: PRS 33-005(a–c).

since been used as a storage lot and parking area. This storage area is SWMU 33-011(a), addressed in Subsection 4.12.

Potential contaminants specifically associated with SWMU 33-005(a,b,c) were plutonium, uranium, beryllium, and laboratory organic compounds.

4.5.1.2 Setting

The area is bounded on the east by the road leading to South Site (West Road) (Fig. 4-5). Most of the site is nearly level. The terrain slopes to the southwest into a tributary of Chaquehui Canyon, becoming fairly steep beyond the boundary of the storage lot. The site is unpaved with rock outcrops and weed patches. Chamisa thickets line the periphery.

During the 1974 cleanup, the area was scraped to tuff bedrock. Much of the area is now covered by bare, compacted soil. Hand-augering during sample collection revealed that the soil is shallow, in the range of 3 to 12 in. Water does not collect in the area but flows into the tributary as sheet runoff and through shallow channels.

4.5.2 Field Investigation and Subsurface Characterization

Sampling at this SWMU differed from that proposed in the RFI Work Plan for OU 1122 in the number of subsurface samples collected. The sampling plan called for five boreholes, each with one surface and five subsurface samples, a total of 30 samples. During sampling it became apparent that the soil added during the 1974 cleanup was very shallow. The excavated area did not have any appreciable material overlying the tuff. Surface samples were collected from a very shallow layer, usually less than three inches. Subsurface samples were collected using a hollow-core auger drill rig from within the tuff. Consequently, only one subsurface sample was taken at each borehole. Twenty-two samples, including five field duplicates and one collocated sample, were taken over the area (Fig. 4-5). Seventeen samples were surface samples and five were subsurface (four at 2 ft, one at 3 to 5 ft). In addition, three surface samples assigned to SWMU 33-017 were collected at locations relevant to the SWMU. A total of 25 laboratory samples were used in the decision for this SWMU (Fig. 4-5).

Selection of the sampling locations for SWMUs 33-005(a,b,c) was based on engineering drawings and current topography. Locations of each feature (e.g., building, septic tank, the industrial drain field, and outfalls) were surveyed based on analysis of several engineering drawings. The samples were located relevant to these features. Three samples from a borehole, AAA1981, AAA1982, and duplicate AAA2255, were taken at the location of the septic tank removed in 1974. Sample AAA1987 was collected at the outfall. Two additional samples were collected at 50 ft intervals down the associated drainage to the west. Three samples, AAA1993, AAA1994, and AAA1995, were taken in the location of the drain field removed in 1974. Sample AAA1991 was collected at the outfall. Three more surface samples were taken in the drainage leading west from the SWMU into a tributary of Chaquehui Canyon. The remaining sample locations were randomized within the storage area, including one sample from the Main Site SWMU 33-017 grid that fell within the storage area.

All SWMUs 33-005 (a,b,c) samples were analyzed for SVOCs, inorganics, gamma emitters, plutonium-238, -239, and uranium. The five subsurface samples were also analyzed for VOCs. Three surface samples were also analyzed for PCBs, herbicides, and pesticides (Table 4-7).

4.5.3 Potential Release Characterization

See Table 4-7 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Few inorganics were detected above background. Silver was at 1 mg/kg in sample AAA2001. Uranium was above LANL background at sample AAA1989. No pesticides, herbicides, or PCBs were detected in any sample (Table 4-7). One sample contained cesium-137 above background at 3.3 pCi/g. This sample was collected on the undeveloped slope leading into the drainage. Organic compounds, including PAHs, were found in most samples. These contaminants have been assigned to overlapping SWMU 33-011(a) as being more characteristic of that SWMU. They are addressed in Subsection 4-12.

As mentioned in Subsection 3.2.2.2 concerning local background at TA-33, plutonium-239 was found above grid and background surveillance ranges near these PRSs. These sampling locations are outside the area remediated

TABLE 4-7

SWMU 33-005(A,B,C): BUILDING 21 EFFLUENT FIELDS

SAMPLE INFORMATION

						BEGIN DEPTH	END DEPTH	ANALYSES PERFORMED							
										ORGANICS					
#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	in.	in.	INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA1981	33-1061	33-005(a)	*borehole*	soil	0	6	X	X		X				
2	AAA2255	33-1061	33-005(a)	duplicate	soil	0	6	X	X		X				
3	AAA1982	33-1061	33-005(a)		tuff	24	24	X	X	X	X				
4	AAA1987	33-1062	33-005(a)	*drainage*	soil	0	6	X	X		X				
5	AAA1988	33-1063	33-005(a)		soil	0	6	X	X		X				
6	AAA1989	33-1064	33-005(a)		soil	0	6	X	X		X				
7	AAA1990	33-1065	33-005(b)		soil	0	6	X	X		X				
8	AAA1991	33-1066	33-005(b)	*drainage*	soil	0	6	X	X		X				
9	AAA1992	33-1067	33-005(b)		soil	0	6	X	X		X				
10	AAA1995	33-1068	33-005(c)	*borehole*	soil	0	6	X	X		X	X		X	X
11	AAA1993	33-1068	33-005(c)	collocated	soil	0	6	X	X		X	X		X	X
12	AAA1994	33-1068	33-005(c)		tuff	36	60	X	X	X	X				
13	AAA2000	33-1070	33-005(c)	*borehole*	soil	0	6	X	X		X				
14	AAA2256	33-1070	33-005(c)	duplicate	soil	0	6	X	X		X				
15	AAA2257	33-1070	33-005(c)	duplicate	soil	0	6	X	X		X				
16	AAA2001	33-1070	33-005(c)		tuff	24	24	X	X	X	X				
17	AAA2007	33-1072	33-005(c)	*borehole*	soil	0	6	X	X		X	X		X	X
18	AAA2008	33-1072	33-005(c)		tuff	24	24	X	X	X	X				
19	AAA2013	33-1073	33-005(c)	*borehole*	soil	0	6	X	X		X				
20	AAA2259	33-1073	33-005(c)	duplicate	soil	0	6	X	X		X				
21	AAA2260	33-1073	33-005(c)	duplicate	soil	0	6	X	X		X				
22	AAA2014	33-1073	33-005(c)		tuff	24	24	X	X	X	X				
23	AAA2094	33-1147	33-017	*surface samples*	soil	0	6	X	X		X				
24	AAA2095	33-1148	33-017	neighbor	soil	0	6	X	X		X				
25	AAA2096	33-1149	33-017		soil	0	6	X	X		X				

TABLE 4-7 (Continued)

SWMU 33-005(A,B,C): BUILDING 21 EFFLUENT FIELDS

RESULTS OF ANALYSES

		RADIONUCLIDES (a)					*INORGANICS*										
		U	238P	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
#	SAMPLE ID	mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA1981	2.7	0.002	0.002	<0.74	NA	<1	4.7	160	0.87	<0.4	6.7	8	12	<0.06	<0.2	35
2	AAA2255	2.6	0.002	0.004	<0.72	NA	<1	3.9	160	0.88	<0.4	7.9	7.7	13	<0.06	<0.2	37
3	AAA1982	2.8	0.002	0.013	<0.85	NA	<1	2.98	69	0.59	<0.4	4.8	3	9	<0.07	<0.2	55
4	AAA1987	2.3	0.003	*0.044*	<0.57	NA	<1	2.56	60	0.49	<0.4	3.5	2.9	9	<0.06	<0.2	31
5	AAA1988	2.1	0.006	*0.105*	1.2	NA	<1	2.75	53	0.49	<4	3.5	3	11	<0.06	0.26	28
6	AAA1989	*3.1*	0.006	*0.132*	*3.31*	NA	<1	3.05	92	0.64	<0.4	5	4	21	<0.06	<0.2	30
7	AAA1990	2.2	0.003	0.009	<0.78	NA	<1	2.44	20	0.24	<0.4	1.4	<2	8	<0.06	<0.2	*81*
8	AAA1991	2.3	0.004	*0.07*	<0.56	NA	<1	2.8	50	0.66	<0.4	4.3	3.2	11	<0.06	0.31	23
9	AAA1992	2.2	0.006	0.02	<0.66	NA	<1	2.91	58	0.55	<0.4	3.5	4	13	<0.06	0.24	29
	AAA1992R	NA	NA	NA	<0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	AAA1995	2.8	0.011	0.002	<0.77	NA	<1.4	2.8	189	1.2	1.5	8.8	8.5	12.9	<11.2	<0.6	38.1
	AAA1995R	NA	0.011	0.002	<0.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	AAA1993	2.7	0.003	0.009	<0.7	NA	<1.4	1.8	161	0.99	1	7.1	11.3	11	<11.2	<0.6	33.6
	AAA1993R	NA	0.003	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	AAA1994	2.1	0.003	0.001	<0.67	NA	<1.4	0.98	78.5	0.3	<0.8	3.2	<2.8	4.1	<11.2	<0.6	21.4
	AAA1994R	NA	0.003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13	AAA2000	2.1	0.003	0.012	<0.46	NA	<1.4	1.2	55.5	0.52	<0.8	3.1	10.3	6.1	<11.2	<0.6	27.7
	AAA2000R	NA	0.003	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14	AAA2256	2.1	0.008	0.013	<0.73	NA	<1.4	1.9	57.2	0.46	<0.8	3	<2.8	6.4	<11.2	<0.6	26.4
	AAA2256R	NA	0.008	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15	AAA2257	2.2	0.006	0.001	<0.89	NA	<1.4	1.2	60.6	0.5	<0.8	3.2	<2.8	7	<11.2	<0.6	30.5
	AAA2257R	NA	0.006	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16	AAA2001	2.5	0.003	0.001	<0.65	NA	*1*	2.32	31	0.38	<0.4	2.1	<2	5	<0.07	<0.2	23
	AAA2001R	NA	0.003	NA	0.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17	AAA2007	2.2	0.007	0.008	<0.78	NA	<1.4	1	47.8	0.43	<0.8	2.6	<2.8	6.4	<11.2	<0.6	25.7
	AAA2007R	NA	0.007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18	AAA2008	2.3	0.004	0.001	<1.02	NA	<1.4	0.76	33.8	0.41	<0.8	1.6	<2.8	4.3	<11.2	<0.6	24.9
	AAA2008R	2.3	0.007	0.005	<0.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-7 (Continued)

SWMU 33-005(A,B,C): BUILDING 21 EFFLUENT FIELDS

		RADIONUCLIDES (a)					INORGANICS										
		U	238P	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
#	SAMPLE ID	mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
19	AAA2013	NA	0.007	NA	NA	NA	<1.4	1.3	67.3	0.62	0.81	3.1	3.4	7.8	<11.2	<0.6	39
20	AAA2259	0.13	0.002	0.013	<2.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	AAA2259R	NA	0.002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
21	AAA2260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22	AAA2014	2.3	0	0.002	<0.8	NA	<1.4	1.5	46.1	0.59	<0.8	2.4	<2.8	5.3	<11.2	<0.6	25.8
23	AAA2094	2.1	0.003	0.042	1.41	0.4	<1	2.4	62	0.61	<0.4	5.7	5	12	<0.06	<0.2	41
24	AAA2095	1.9	0.003	0.018	<0.48	0.2	<1	1.7	31	0.33	<0.4	5.5	3	7	<0.06	<0.2	36
25	AAA2096	2.5	0.001	0.013	<0.69	0.8	<1	3.15	42	0.37	<0.4	2.5	2.3	14	<0.06	1.23	45
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

R=reanalyzed

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

ORGANICS ATTRIBUTED TO SWMU 33-011(a)

DATA QUALIFICATIONS

QA/QC data for 33-005 PRSs indicate that antimony, arsenic, lead, and selenium recoveries may be low. All were found at background levels in field samples. Silver was a contaminant in one QC sample. This was not the batch that contained sample AAA2001; that silver result must be considered valid. Barium was also a contaminant, but barium results in the samples are all within background. Pesticide surrogate recoveries showed only about 50% of spiked concentrations, however no pesticides were detected in any samples. Toluene, a common lab contaminant, was found in the method blank. Its presence in several samples is considered lab contamination rather than a field contamination. No other anomalies were observed in QA/QC samples.

in the 1974 cleanup. Although above the Lab UTL of 0.052, the concentrations are far below SAL of 24 pCi/g.

4.5.4 Conclusion and Recommendation

Comparison to SAL and background for herbicides, pesticides, PCBs, and volatile organics indicates that none were detected at levels that warrant further investigation. Cesium-137 was detected at 82% of its SAL of 4 pCi/g. As discussed in Subsection 3.2.2.2, 40% of the grid samples had concentration above 1 pCi/g for cesium-137; the highest ranged from 1.7 to 2.6 pCi/g. These elevated values were not considered outliers and were accepted as natural variation in the background. Every effort was made to sample in areas that might have retained plutonium from the release; it was found slightly above background but well below SAL. SVOCs were detected above background and, in a few cases, above SALs. The elevated SVOCs were PAHs typical of asphalt, creosote, and diesel products. These are associated with use of the area for storage and parking rather than as the site of laboratory TA-33-21. These contaminants are addressed in overlapping SWMU 33-011(a) in Subsection 4.12.

SWMU 33-011(a) includes all areas affected by the SVOC results. NFA is proposed for SWMUs 33-005(a,b,c) based on LANL Criterion 4.

4.6 SWMU 33-010(e) Surface Disposal at Area 6

SWMU 33-010(e) is discussed in the RFI Work Plan for OU 1122 in Subsections 3.3.2.5 and 4.3.3.1 (LANL 1992, 0784). It is proposed for NFA based on results from samples collected in 1993. No contamination was found above background.

4.6.1 Unit Description

4.6.1.1 Description and Historical Information

During initial environmental reconnaissance in 1987 to identify potential release sites at LANL, investigators noted a debris area "...in the canyon southeast of TA-33-2 (Fig. 4-6). " No description or more definitive location was provided. During investigations for the RFI Work Plan for OU 1122 in 1990 and 1991, no trace of debris could be found for SWMU 33-010(e). Presumably, the debris was removed in the interval between the two

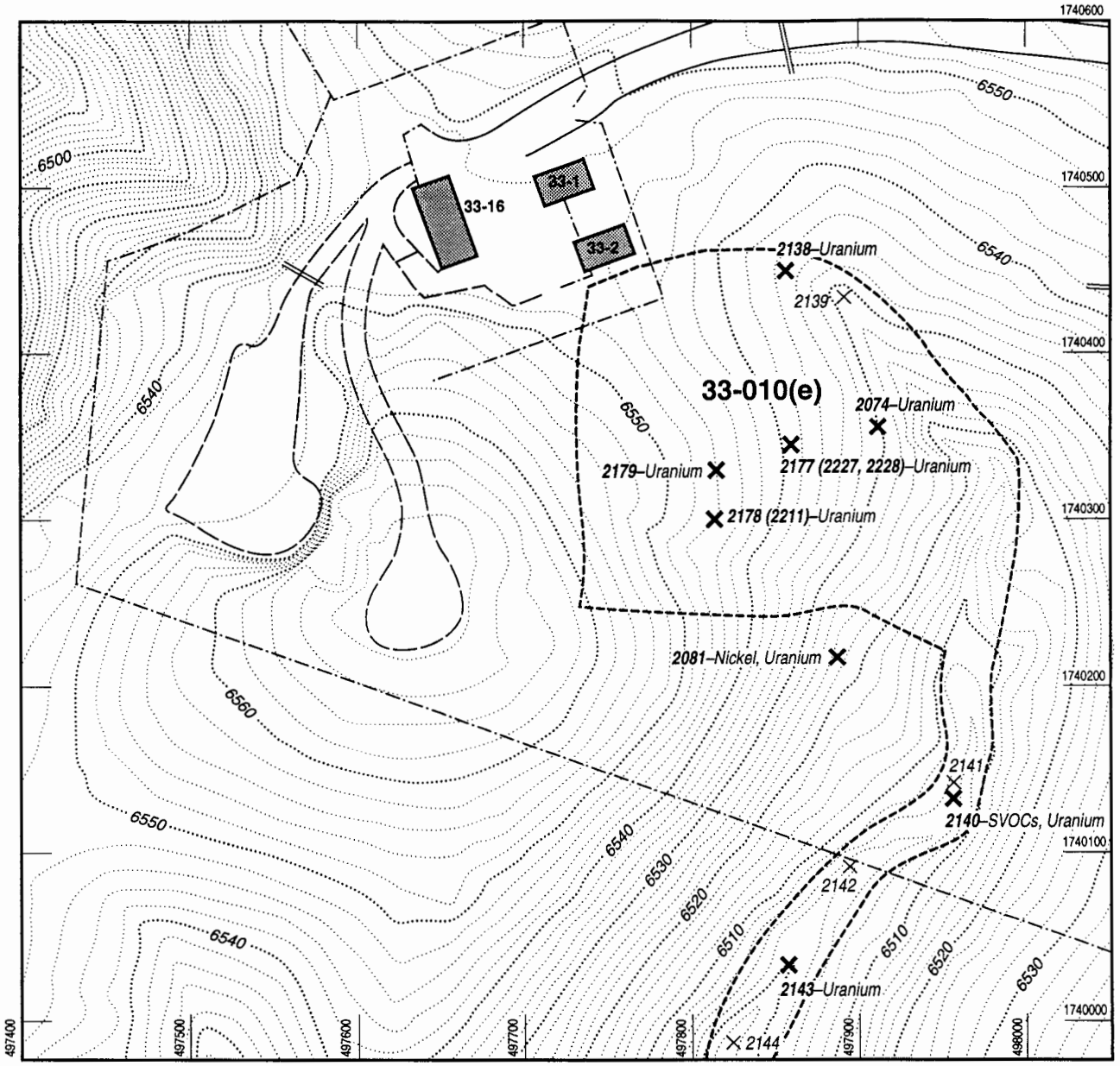


Fig. 4-6. Area 6: PRS 33-010(e).

investigations. The deputy group leader of W-3 stated that during the period of operations (1948 to 1955) at Area 6, the group may have used the area south of Area 6 for disposal of firing debris. Consequently, the area was treated in the RFI work plan as a valid SWMU. Inorganics and radionuclides were identified as potential contaminants As no organic stains were noted in the area, and drum storage was not mentioned in the SWMU Report, organics were not considered potential contaminants (LANL 1990, 0145).

4.6.1.2 Setting

SWMU 33-010(e) is located on the east-facing slope of the hillock south of Area 6 and extends east into the adjacent drainage (Fig. 4-6). The slope is fairly steep, with a 25% grade. The soil consists of pumice pebbles and pulverized tuff with little loam or clay. Soil depth is unknown; however, this slope lies very near the Area 6 cinder cone which may underlie parts of the SWMU. Vegetation is sparse with only scattered grass clumps. Junipers and a few shrubs, principally chamisa, grow at the top of the slope and in the drainage. This drainage also receives runoff from SWMU 33-004(d), described in Subsection 4.1, and from the roads leading to Area 6 and to South Site. There is no permanent surface water in this area.

4.6.2 Field Investigation and Subsurface Characterization

Radiation and geophysical (magnetic and electromagnetic) surveys were performed over the entire area southeast of Area 6. The radiation survey was conducted on a 15-ft grid. Neither survey revealed any anomalies that could be used to bias sampling locations (ICF-Kaiser 1994, 02-095). A 1983 aerial photo, RN83-125054, hinted that an unimproved vehicle track may have served the slope south of the site. As specified in the work plan, three surface samples and field duplicates were taken on the slope of the hillock. In the absence of any other information or field indications, sampling locations were selected at random over the area of the slope. In addition, two grid samples from SWMU 33-017 are located on this slope, and seven drainage samples collected for SWMU 33-004(d) (Subsection 4.1) are downslope (Fig. 4-6).

All samples were analyzed for inorganics, gamma emitters, and uranium. Several samples were analyzed for herbicides. All drainage samples and grid samples were also analyzed for SVOCs (Table 4-8).

4.6.3 Potential Release Characterization

See Table 4-8 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Except for the low level SVOCs in sample AAA2140 that were discussed in Subsection 4.1.4 as possibly related to a nearby treated telephone pole, no organic contaminants were found above detection limit in any sample. Uranium was above the LANL (99%, 0.95) UTL in many samples, but was below the local TA-33 (99%, 0.95) UTL in most of these samples. Nickel was slightly above background in one sample. Cesium-137 was slightly above background in one sample. No other inorganics or radionuclides were above background.

4.6.4 Conclusion and Recommendation

Although slope samples were located randomly due to lack of any indication of a disposal area, drainage sampling for SWMU 33-004(d) would detect movement of contaminants, if any were present. Comparisons to SALs and background indicate that contamination was not detected. Uranium values above LANL background are at low levels, mostly within ranges observed on the TA-33 grid and in local field blanks. Nickel was slightly above (99%, 0.95) UTLs for background in one sample, but was well below SALs. Low-level SVOCs in one drainage sample did not exceed SALs. Because no significant indications of a disposal area or contaminants of concern were detected, NFA is proposed at SWMU 33-010(e) based on LANL Criterion 4.

4.7 SWMU 33-010(f) Surface Disposal near TA-33-86

SWMU 33-010(f) is discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.6 and 4.2.3.1 (LANL 1992, 0784). It is proposed for NFA based on results from samples collected in 1993.

TABLE 4-8

SWMU 33-010(E): AREA 6 SURFACE DISPOSAL

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED							
										ORGANICS					
								INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2074	33-1127	33-017		soil	0	6	X	X		X				
2	AAA2081	33-1134	33-017		soil	0	6	X	X		X				
3	AAA2177	33-1224	33-010(e)		sediment	0	6	X	X						X
4	AAA2227	33-1224	33-010(e)	duplicate	sediment	0	6	X	X						X
5	AAA2228	33-1224	33-010(e)	duplicate	sediment	0	6	X	X						X
6	AAA2178	33-1225	33-010(e)		soil	0	6	X	X						
7	AAA2211	33-1225	33-010(e)	duplicate	soil	0	6	X	X						
8	AAA2179	33-1226	33-010(e)		soil	0	6	X	X						
9	AAA2138	33-1185	33-004(d)	*drainage*	sediment	0	6	X	X		X				
10	AAA2139	33-1186	33-004(d)		sediment	0	6	X	X		X				
11	AAA2140	33-1187	33-004(d)		sediment	0	6	X	X		X				
12	AAA2141	33-1188	33-004(d)	collocated	sediment	0	6	X	X		X				
13	AAA2142	33-1189	33-004(d)		sediment	0	6	X	X		X				
14	AAA2143	33-1190	33-004(d)		sediment	0	6	X	X		X				
15	AAA2144	33-1191	33-004(d)		sediment	0	6	X	X		X				

RESULTS OF ANALYSES

#	SAMPLE ID	RADIONUCLIDES (a)					INORGANICS										
		U	238Pu	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
		mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA2074	*3.8*	0.003	0.01	<0.84	2.48	<1	2.8	150	0.59	<0.4	13	8	11	0.07	0.6	33
2	AAA2081	*3.1*	0.002	0.02	<0.76	5.31	<1	2.9	260	1.1	<0.4	19	*32*	16	<0.06	0.5	57
3	AAA2177	*4.4*	NA	NA	<1.17	NA	<1.4	0.86	98.1	0.43	<0.8	6.1	6.4	9.1	<11.2	<0.6	20.4
4	AAA2227	*4.3*	NA	NA	<0.88	NA	<1.4	0.9	97.9	0.39	<0.8	4.9	6.9	17.5	<11.2	<0.6	20.1
5	AAA2228	*4.2*	NA	NA	<0.94	NA	<1.4	1.3	97.3	0.39	<0.8	7.4	5.9	10.7	<11.2	<0.6	24.6
6	AAA2178	*4.7*	NA	NA	<1.22	NA	<1.4	1.4	84.2	0.32	<0.8	6.1	3.4	10.3	<11.2	<0.6	22.5
7	AAA2211	*4.6*	NA	NA	*2*	NA	<1.4	0.64	86.3	0.36	<0.8	5.4	7.8	10.1	<11.2	<0.6	22.5
8	AAA2179	*4.9*	NA	NA	<1.08	NA	<1.4	0.7	69.1	0.27	<0.8	5.3	6.1	9.2	<11.2	<0.6	17.5
9	AAA2138	*3*	NA	NA	<0.76	NA	<1.4	1.6	124	0.62	<0.8	9.2	6	19	<11.2	<0.6	43
10	AAA2139	1.1	NA	NA	<0.65	NA	<1.4	<0.6	40.6	0.32	<0.8	3	<2.8	5	<11.2	<0.6	18
11	AAA2140	*3.6*	NA	NA	<0.52	NA	<1.4	2.5	141	0.94	0.82	9.1	12	26	<11.2	<0.6	52
12	AAA2141	2.2	NA	NA	<0.56	NA	<1.4	5.8	61.8	0.22	<0.8	7.4	13	25	<11.2	<0.6	84
13	AAA2142	2.1	NA	NA	<0.55	NA	<1.4	<0.6	74.7	0.28	2.3	15.3	18	12	<11.2	<0.6	62
14	AAA2143	*3.1*	NA	NA	<0.77	NA	<1.4	1.0	100	0.64	<0.8	7.4	9	23	<11.2	<0.6	36
15	AAA2144	2.5	NA	NA	<0.51	NA	<1.4	1.0	93.9	0.54	1.3	12.5	19	14	<11.2	<0.6	52
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

#	ORGANICS DETECTED					
	SAMPLE ID	SVOCs	RESULT	*SAL*	*UNITS*	UNITS
11	AAA2140	Fluoranthene	0.49	*3200*	*0.33*	mg/kg
	AAA2140	Phenanthrene	0.62	*nc*	*0.33*	mg/kg
	AAA2140	Pyrene	0.49	*2400*	*0.33*	mg/kg

nc=not calculated due to insufficient toxicity data

Data Qualifications

QA/QC data indicate that blanks were contaminated with low levels of the herbicide 2,4-D and inorganics barium and selenium. The contamination does not affect the conclusions for decision purposes. The herbicide dinoseb was not detected in one blind sample, but laboratory surrogates were all recovered in the field samples. Other QA/QC data associated with these samples did not show any anomalous results.

4.7.1 Unit Description

4.7.1.1 Description and Historical Information

The SWMU consists of two small surface disposal areas; one about 15 ft square, the other about 10 ft wide and 20 ft long (Fig. 4-7). Pieces of concrete, the concrete remains of a culvert, piles of tuff, piles of cured asphalt, rusty metal rebar and strapping bands, rusty metal cans, and other debris are piled about. The piles are located about 50 ft apart. They lie about 100 ft southeast of MDA K and 300 ft southeast of the decommissioned tritium facility, TA-33-86. Nothing is known of the origins of the piles, although some debris appears to be the result of roadwork. Potential contaminants included inorganics, radionuclides, herbicides, and pesticides.

4.7.1.2 Setting

The piles are located on the slope of a small tributary to the drainage leading east from Main Site (Fig. 4-7). The soil consists of pumaceous pebbles mixed with clay. Though the soil depth is unknown, nearby bedrock drainages indicate soil/tuff interfaces at one to five feet may be expected. The area is sparsely wooded with piñon and juniper trees and covered with scattered grasses. No water collects on the site.

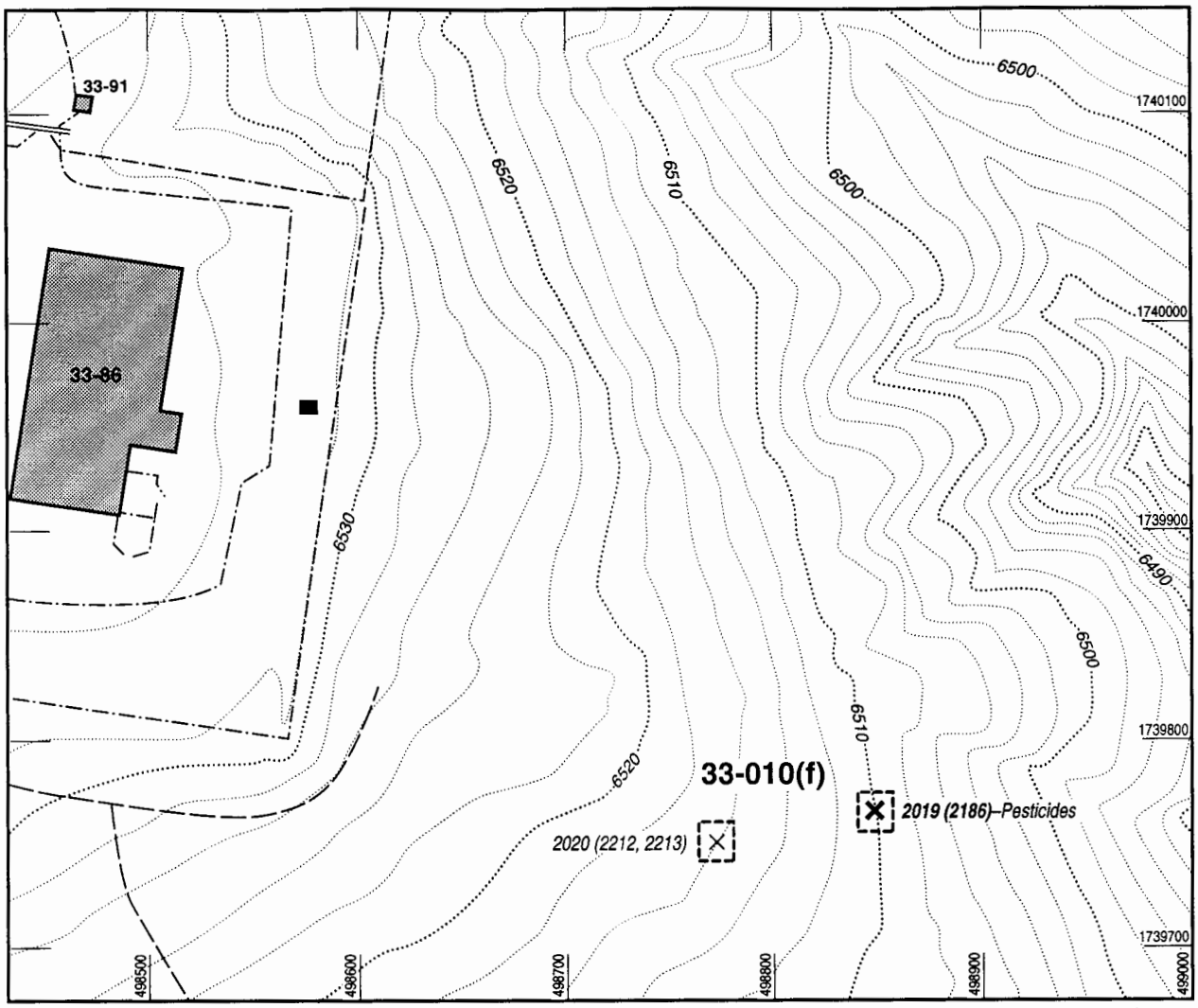
4.7.2 Field Investigation

Prior to sampling, 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, two samples were collected at random within each pile, one in duplicate, one in triplicate, for a total of five sets of results (Fig. 4-7).

Samples were analyzed for inorganics, gamma emitters, and tritium. One pair was also analyzed for herbicides and pesticides (Table 4-9).

4.7.3 Potential Release Characterization

See Table 4-9 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Low levels (0.0024 to 0.011 mg/kg) of pesticides were found in two samples. Low levels (1.4 to 1.8 pCi/g) of tritium were found in all samples, far below soil SAL of 820 pCi/g and well within the TA-33 grid range. No other analytes were found above background (Table 4-9).



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

0 50 100 ft
Contour interval = 2 ft

N

Fig. 4-7. Main Site: PRS 33-010(f).

TABLE 4-9

SWMU 33-010(F): SURFACE DISPOSAL SOUTHEAST OF TA-33-86

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED							
										ORGANICS					
								INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2019	33-1074	33-010(f)	*surface samples*	soil	0	6	X	X					X	X
2	AAA2186	33-1074	33-010(f)	Duplicate	soil	0	6	X	X					X	X
3	AAA2020	33-1075	33-010(f)		soil	0	6	X	X						
4	AAA2212	33-1075	33-010(f)	Duplicate	soil	0	6	X	X						
5	AAA2213	33-1075	33-010(f)	Duplicate	soil	0	6	X	X						

RESULTS OF ANALYSES

#	SAMPLE ID	RADIONUCLIDES (a)					INORGANICS										
		U	238Pu	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
		mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA2019	NA	NA	NA	<0.62	1.5	<1	1.86	110	0.68	<0.4	6.6	6	12	0.18	<0.20	34
2	AAA2186	NA	NA	NA	<0.60	1.4	<1	2.3	86	0.49	<0.4	5.1	4.6	9	0.19	0.28	36
3	AAA2020	NA	NA	NA	1.2	1.6	<1	2.5	89	0.63	<0.4	7.5	7	6	0.2	<0.20	30
4	AAA2212	NA	NA	NA	0.67	1.6	<1	2.9	81	0.55	<0.4	7.1	6	13	0.15	0.31	30
5	AAA2213	NA	NA	NA	0.96	1.8	<1	2.8	88	0.62	<0.4	7	6	13	0.17	<0.20	29
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	*14*	*5 600*	*4*	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	*33.7*	*0.27(f)*	*1.39(f)*	*62.3*

#	ORGANICS DETECTED					
	SAMPLE ID	PESTICIDES	RESULT	*SAL*	*EQL*	UNITS
1	AAA2019	DDE [p,p'-]	0.0015	*2.1*	*0.001*	mg/kg
	AAA2019	Endosulfan II	0.0046	*4*	*0.001*	mg/kg
2	AAA2186	BHC [beta-]	0.0024	*nc*	*0.002*	mg/kg
	AAA2186	DDE [p,p'-]	0.0024	*2.1*	*0.001*	mg/kg
	AAA2186	DDT [p,p'-]	0.0058	*2.1*	*0.004*	mg/kg
	AAA2186	Endosulfan II	0.011	*4*	*0.001*	mg/kg

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

Data Qualifications

QA/QC data for a blind QA standard indicates that only 17% of the herbicide Dinoseb concentration was recovered; Dinoseb was not detected in any sample. The blind tritium QA sample showed cross contamination, yielding a recovery of 248% and indicating that tritium results may be elevated. No other anomalies were found in the QA/QC data to affect a decision of NFA.

4.7.4 Conclusion and Recommendation

SWMU 33-010(f) appears to be a dumping area for items not associated with experimental activities at TA-33. There were no visible indications of soil staining and sampling locations were chosen at random. Because sampling as specified in the work plan failed to detect contamination at levels of concern, NFA is proposed at this PRS based on LANL Criterion 4.

4.8 SWMU 33-011(e) Drum Storage at TA-33-22

SWMU 33-011(e) is discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.12 and 4.2.3.1 (LANL 1992, 0784). It is proposed for NFA based on results from samples collected in 1993.

4.8.1 Unit Description

4.8.1.1 Description and Historical Information

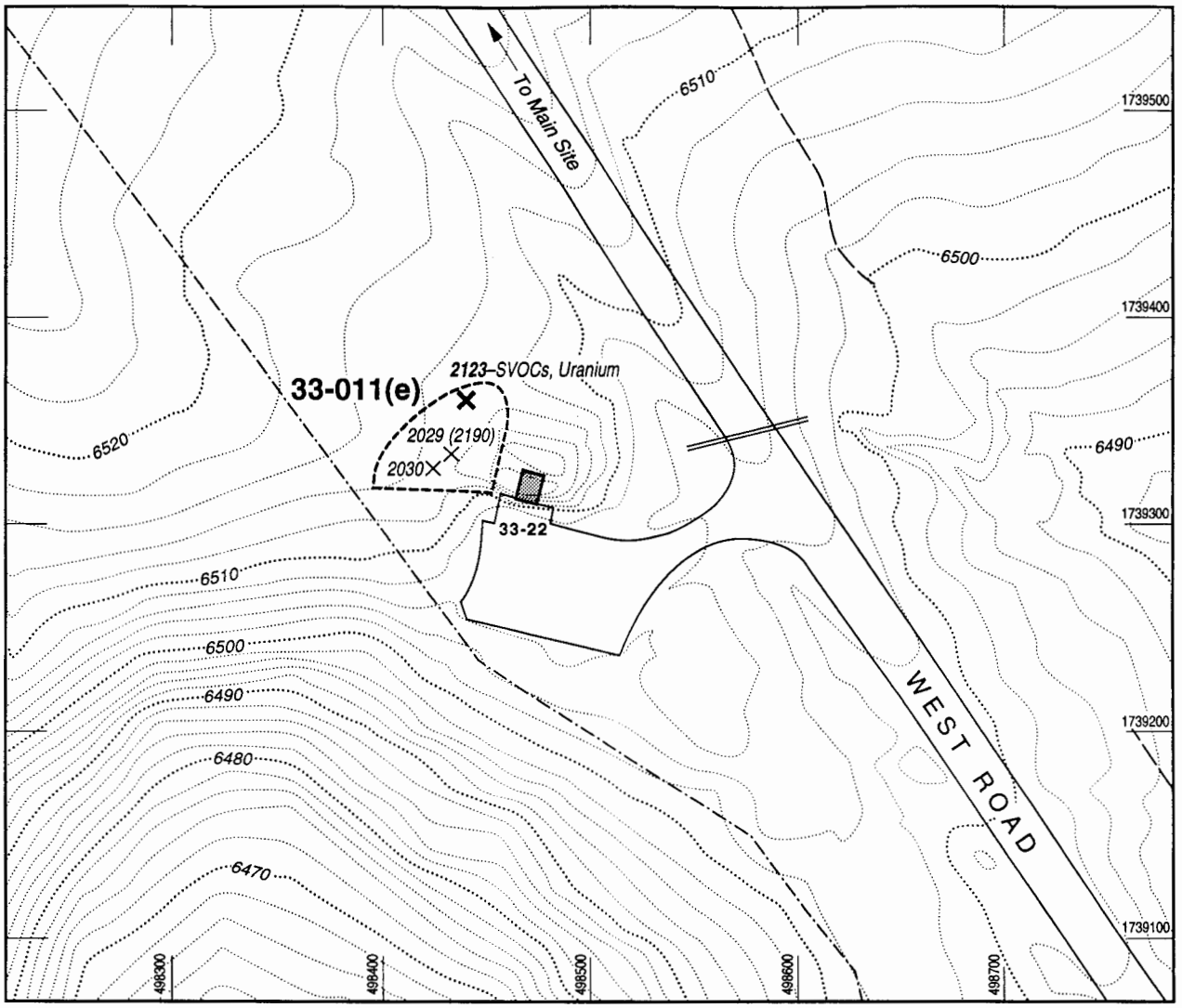
SWMU 33-011(e) was a former drum storage areas located within 30 ft northwest of bunkered magazine TA-33-22 (Fig. 4-8) The area was a storage site for drums with unknown contents. Soil sampling in 1987 found uranium and gamma emitters above background (LANL 1990, 0145).

4.8.1.2 Setting

The area is unpaved with a sparse grass cover. No trace remains of the former storage location. The area is level with a slight slope to the southwest into a tributary of Chaquehui Canyon (Fig. 4-8). Soil is sandy and rocky. Depths are unknown but nearby bedrock outcrops indicate soil/tuff interface may be within three feet. Tuff bedrock outcrops nearby on the canyon rim.

4.8.2 Field Investigation

Prior to sampling, SWMU 33-011(e) was included in the general grid-based radiation survey called for in the work plan. The presampling radiation survey showed no levels above background. There were no screening or surface indications to bias sampling. As specified in the work plan, two surface soil samples and a duplicate were taken at random locations within a 20 x 100 ft area in SWMU 33-011(e) (Fig. 4-8). In addition, sample AAA2123 from the SWMU 33-017 grid is located approximately 20 ft north of the site. All samples were analyzed for uranium and gamma emitters. Two



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

0 50 100 ft
Contour interval = 2 ft

N

Fig. 4-8. Main Site: PRS 33-011(e).

were analyzed for herbicides and one for pesticides. The grid sample was also analyzed for inorganics, tritium, plutonium, and SVOCs (Table 4-10).

4.8.3 Potential Release Characterization

See Table 4-10 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Uranium was found above LANL (99%, 0.95) UTL in one sample (Table 4-10). Aniline, for which no SAL is available, was found at 0.4 mg/kg in the grid sample.

4.8.4 Conclusion and Recommendation

Radionuclides were indicated as the potential contaminants in the SWMU Report (LANL 1990, 0145). No radionuclides were detected significantly above background ranges in the 1993 sampling campaign, nor were any other contaminants identified in these samples at levels of concern. No physical indications, such as soil staining, are present. In the absence of any indications to the contrary, NFA is proposed at SWMU 33-011(e) based on LANL Criterion 4.

4.9 SWMU 33-012(a) Drum Storage at TA-33-39

SWMU 33-012(a) is discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.9 and 4.2.3.1 (LANL 1992, 0784). It is proposed for NFA based on results from samples collected in 1993. Low level PAHs characteristic of asphalt have been assigned to SWMU 33-017, to be discussed in a future RFI report.

4.9.1 Unit Description

4.9.1.1 Description and Historical Information

SWMU 33-012(a) was a satellite storage area about 20 ft square, now unused, on the east side of shop TA-33-39. The area consists of an asphalt pad between the building and a storage shed. The part of SWMU 33-017 known as the vehicle maintenance area is south of the storage shed. The pad was used to store 55-gal. drums of solvents and solvent-contaminated oil for recycling. Potential contaminants were identified as organics, PCBs, and inorganics.

TABLE 4-10

SWMU 33-011(E): DRUM STORAGE AT MAGAZINE TA-33-22

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED							
										ORGANICS					
								INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2029	33-1084	33-011e	*surface samples*	soil	0	6		X					X	X
2	AAA2190	33-1084	33-011e	duplicate	soil	0	6		X						X
3	AAA2030	33-1085	33-011e		soil	0	6		X						
4	AAA2123	33-1176	33-017		soil	0	6	X	X		X				

RESULTS OF ANALYSES

#	SAMPLE ID	RADIONUCLIDES (a)				
		U	238Pu	239Pu	137Cs	3H
		mg/kg	pCi/g	pCi/g	pCi/g	pCi/g
1	AAA2029	2.2	NA	NA	<0.62	NA
2	AAA2190	2.4	NA	NA	1.02	NA
3	AAA2030	2.8	NA	NA	<0.59	NA
4	AAA2123	*4.2*	0.003	0.032	<0.95	0.4
	SALs (b)	*95*	*27*	*24*	*4*	*820*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*
	TA-33 UTLs(e)	*4.84*	*0.0074*	*0.058*	*2.75*	*23.2*

#	SAMPLE ID	INORGANICS													
		Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
4	AAA2123	<1	2.26	63	0.39	<0.4	3.5	3	11	<0.02	0.34	22
	SALs (b)	*400*	*14*	*5 600*	*4*	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	*33.7*	*0.27(f)*	*1.39(f)*	*62.3*

#	SAMPLE ID	ORGANICS DETECTED				
		SVOC	RESULT	*SAL*	*EQL*	UNITS
4	AAA2123	Aniline	0.41	*nc*	*nd*	mg/kg

Data Qualifications

The QC discussion for pesticides in sample AAA2190 indicated that the sample was lost. Continuing calibration indicated that several compounds were beyond the 15% limit of calibration and results are estimates. No pesticide was detected in any sample above lab reporting limits. No anomalies were seen in any other data.

[1] Symbols and notes identical to those in footnote to Table 4-2 (p. 55).

4.9.1.2 Setting

The SWMU is level and paved. An unimproved road around the east side of the shop separates the SWMU from the heavily-vegetated slope to the east. No water collects on the SWMU; sheet runoff with no definite drainage patterns discharges to the east.

4.9.2 Field Investigation

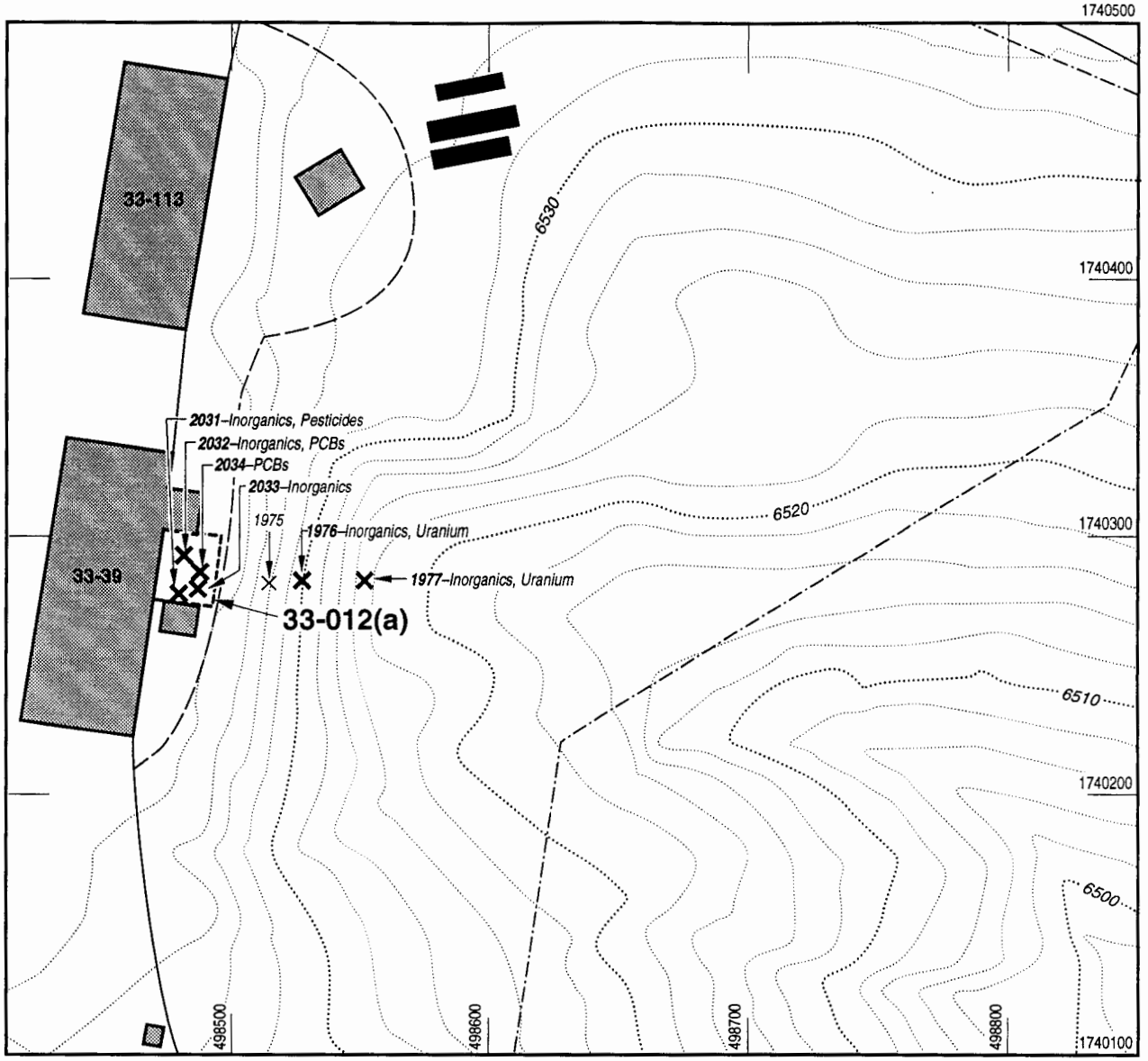
Prior to sampling, SWMU 33-012(a) was included in the general grid-based radiation survey called for in the work plan. No anomalies were found. As specified in the work plan, four samples were collected: two at random locations within the SWMU, two at the edge of the pavement. All were soil samples collected from under asphalt or disintegrating asphalt pieces (Fig. 4-9). Three were collected about 6-in. deep; one was taken 10 to 14 in. below asphalt. In addition, three samples associated with SWMU 33-004(i) are relevant to this SWMU and were used in making the NFA decision. All samples for this SWMU were analyzed for inorganics, gamma emitters, SVOCs, and PCBs. Two samples were analyzed for herbicides and pesticides. (Table 4-11).

4.9.3 Potential Release Characterization

See Table 4-11 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Zinc (120 to 820 mg/kg) and lead (53 to 118 mg/kg) were elevated above background but far below SALs of 24 000 and 400 mg/kg respectively. No other inorganics were found above background. Uranium in two of the three drainage samples collected for SWMU 33-004(i) were above LANL, but below TA-33, UTLs. Low levels of SVOCs found in the samples are attributed to SWMU 33-017. PCBs at 2.3 and 0.25 mg/kg were found in two samples. A very low level (0.013 mg/kg) of the pesticide DDT was found in one sample (Table 4-11).

4.9.4 Conclusion and Recommendation

Comparison to background and SALs for inorganics, radionuclides, herbicides, and pesticides indicate that these analytes were not detected at levels that warrant further investigation. PCBs did not approach the LANL-recommended cleanup level of 10 mg/kg (LANL 1994). Lead and PAH contamination appear to be part of a wider pattern of contamination in the



Sources: FIMAD 1993, G101013, G101014, G101476
Modified by: cARTography by A. Kron 1/19/95

Permanent structure
Temporary structure
Paved road
Unimproved road/trail
Fence
PRS boundary

× 1975 Sample location and number—no elevated levels found

✕ 2031 Sample with PCOCs detected above LANL background levels

0 50 100 ft
Contour interval = 2 ft

N

Fig. 4-9. Main Site: PRS 33-012(a).

TABLE 4-11

SWMU 33-012(a): DRUM STORAGE AT TA-33-39

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED							
										ORGANICS					
								INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2031	33-1086	33-012a	*under asphalt*	soil	6	10	X	X		X	X		X	X
2	AAA2032	33-1087	33-012a		soil	10	14	X	X		X	X			
3	AAA2033	33-1088	33-012a		soil	0	6	X	X		X	X			
4	AAA2034	33-1089	33-012a		soil	0	4	X	X		X	X			
5	AAA1975	33-1055	33-004i	*outfall*	sediments	0	6	X	X		X	X		X	X
6	AAA1976	33-1056	33-004i	*drainage*	sediments	0	6	X	X		X				
7	AAA1977	33-1057	33-004i		sediments	0	6	X	X		X				

RESULTS OF ANALYSES

#	SAMPLE ID	*RADIONUCLIDES (a)*					*INORGANICS*										
		U	238Pu	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
		mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA2031	NA	NA	NA	0.95	NA	<1	2.36	63	0.44	2.3	12	13	*104*	<0.1	<0.2	*820*
2	AAA2032	NA	NA	NA	<1.05	NA	<1	1.8	54	0.44	2	31	17	*118*	0.1	<0.2	*610*
3	AAA2033	NA	NA	NA	<0.75	NA	<1	2.1	180	0.35	0.5	15	13	*53*	0.13	<0.2	*210*
4	AAA2034	NA	NA	NA	<0.89	NA	<1	1.3	120	0.5	<0.4	9.4	<2	9	0.11	<0.2	41
5	AAA1975	2.2	NA	NA	<1.06	NA	<1	2.44	130	0.62	<0.4	12	10	10	0.033	<0.2	37
6	AAA1976	*3.1*	NA	NA	<0.8	NA	<1	4.14	66	0.48	1.1	9.2	14	*79*	0.4	0.33	*210*
7	AAA1977	*3.9*	NA	NA	<0.5	NA	<1	2.52	59	0.53	0.6	7.1	11	*73*	0.04	<0.2	*120*
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

#	SAMPLE ID	PESTICIDES		RESULT	*SAL*	*EQL*	UNITS
1	AAA2031	DDT [p,p'-]		0.013	*2.1*	*0.004*	mg/kg

	SAMPLE ID	PCBs		RESULT	*SAL*	*EQL*	UNITS
2	AAA2032	Aroclor 1254		2.3	*10*	*0.021*	mg/kg
4	AAA2034	Aroclor 1254		0.25	*10*	*0.021*	mg/kg

SWMU 33-004(i) AND SWMU 33-012(a) SVOCs ATTRIBUTED TO SWMU 33

Data Qualifications

QA/QC data indicates selenium contamination in the non-blind sample. The duplicate and blind results were in control. Cs-137 recovery was 128% in the blind sample. Dinoseb was not recovered in the blind sample, though its surrogate was in control. Pesticide recovery was low for endosulfans due to coelution.

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

area east of TA-33-39. The levels observed in SWMU 33-012(a) samples are lower than in nearby samples. Lead contamination in a 0.15-acre exposure unit here, including results from SWMU 33-012(a) samples, is evaluated in Subsection 4.4 of this RFI report in connection with SWMU 33-004(i). Further characterization of SVOC contamination in this part of Main Site, including SWMU 33-012(a),will be proposed in a future RFI report in connection with SWMU 33-017.

With the transfer of PAH and lead contamination to overlapping PRSs, NFA is proposed for SWMU 33-012(a) based on LANL Criterion 4.

4.10 SWMU 33-015 Incinerator at Main Site

SWMU 33-015 is discussed in the OU 1122 RFI Work Plan Subsections 3.2.2.13 and 4.2.3.1. It is proposed for NFA based on results from samples collected in 1993. Inorganics typical of paint pigments and photographic film were found. Lead level was 88% of SAL in one sample, but is considered an acceptable risk to the most susceptible population.

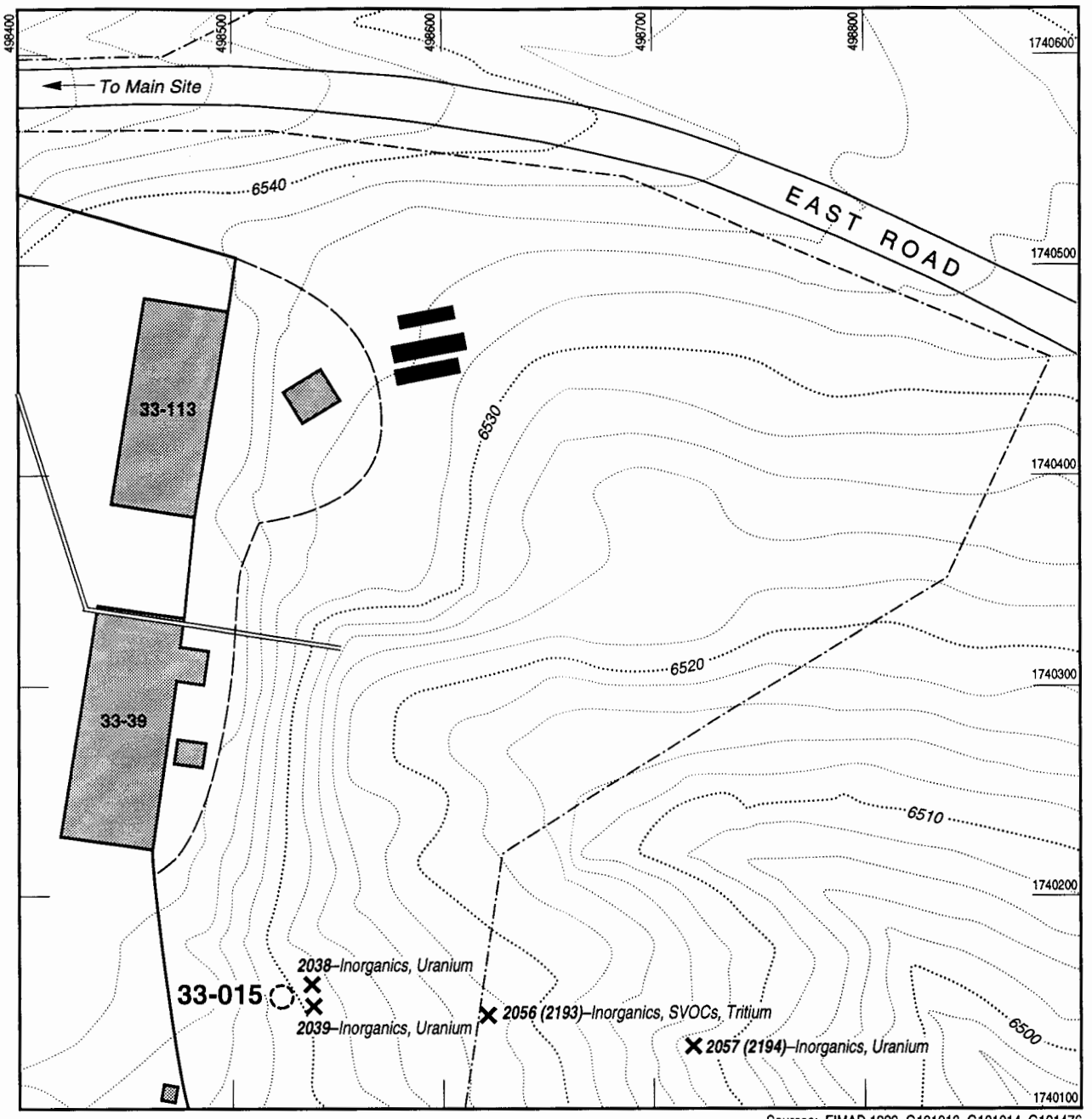
4.10.1 Unit Description

4.10.1.1 Description and Historical Information

SWMU 33-015 is a small incinerator located about 50 ft southeast of shop TA-33-39 (Fig. 4-10). The incinerator is about 4 ft square and 6 ft high, covered with several layers of paint, and mounted on a concrete base. Portions at the base of the structure have rusted through. The incinerator was installed in the mid-1950s, but there is no record of length of use. Site personnel claim it was used only to burn office waste. Inorganics and uranium were considered possible contaminants due to their use throughout Main Site.

4.10.1.2 Setting

The incinerator is situated on the slope at the east end of the Main Site fenced area. About 15 ft below the structure is the drainage ditch serving the south end of Main Site. The entire area has very shallow soils; tuff bedrock exposed in nearby ditches indicate possible depths of up to one foot. No water collects at the site.



Sources: FIMAD 1993, G101013, G101014, G101476
Modified by: cARTography by A. Kron 1/26/95

Permanent structure
Temporary structure
Paved road
Unimproved road/trail
Fence
Storm drain/culvert
PRS boundary
✕ 2038 Sample with PCOCs detected above LANL background levels (or above TA-33 background for tritium)
(2194) Duplicate samples are shown in parentheses

N

0 50 100 ft
Contour interval = 2 ft

Fig. 4-10. Main Site: PRS 33-015.

4.10.2 Field Investigation

Surface soil samples AAA2038 and AAA2039 were taken within 2 feet of the incinerator, one at each downslope corner of the concrete base. In addition, samples AAA2056 and AAA2057 (with duplicate and collocated samples) from SWMU 33-017 are located in the downslope drainage (Fig. 4-10). All samples were analyzed for inorganics, uranium, and gamma emitters. Four drainage samples were analyzed for SVOCs (Table 4-12).

4.10.3 Potential Release Characterization

See Table 4-12 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. One drainage sample contained trace amounts of PAHs and TICs. Four samples contained low-level tritium in soil moisture. Concentrations of all these contaminants, which are not specifically associated with the incinerator, were far below SALs.

The two samples adjacent to the incinerator contained silver, cadmium, lead, zinc, and uranium above background, but below SALs (Table 4-13). Arsenic at 5.3 mg/kg is above local grid background UTL but below LANL background UTL. Silver and zinc also appeared, at much lower levels, in the duplicate pair of drainage samples AAA2056 and AAA2193 (Table 4-12). Since the samples contained more than one contaminant, a multiple constituent calculation was performed as described in Subsection 4.2.3 and Appendix J of the IWP (LANL 1993, 1017). If the sum of the multiple constituent ratios (SMCR) is greater than one, then it is appropriate to perform a risk assessment. The SMCR of 0.285 for sample AAA 2039 is well below the action level. The SMCR for sample AAA2038, at 1.105, exceeds the action level.

4.10.4 Conclusion and Recommendation

Results from an initial multi-component constituent screening test indicate that inorganics may present a hazard at SWMU 33-015. However, lead is the largest contributor to the SMCR value of 1.1. In analyzing the multiple constituent effect, it is more appropriate to calculate the SMCR using constituents that have similar biological effects. Because lead has a different exposure model (blood lead level in young children from birth to seven years) from other inorganics (carcinogenic or systemic effects), it is

TABLE 4-12

SWMU 33-015: INCINERATOR AT MAIN SITE

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH IN.	END DEPTH IN.	ANALYSES PERFORMED INORG	RAD	ORGANICS VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2038	33-1093	33-015	*surface samples*	soil	0	6	X	X						
2	AAA2039	33-1094	33-015		soil	8	8	X	X						
3	AAA2056	33-1109	33-017	*drainage*	sediment	0	6	X	X		X				
4	AAA2193	33-1109	33-017	duplicate	sediment	0	6	X	X		X				
5	AAA2057	33-1110	33-017		soil	0	6	X	X		X				
6	AAA2194	33-1110	33-017	collocated	soil	0	6	X	X		X				

RESULTS OF ANALYSES

#	SAMPLE ID	RADIONUCLIDES U mg/kg	238Pu pCi/g	239Pu pCi/g	137Cs pCi/g	3H pCi/g	INORGANICS Ag mg/kg	As mg/kg	Ba mg/kg	Be mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Pb mg/kg	Sb mg/kg	Se mg/kg	Zn mg/kg
1	AAA2038	*9.1*	NA	NA	<1.08	NA	*19*	0.95	170	0.86	*4.4*	12	6.8	*350*	<0.1	<0.2	*740*
2	AAA2039	*10.2*	NA	NA	<0.98	NA	*9.5*	5.3	190	0.88	*8.9*	13	9.2	11	<0.1	0.42	*350*
3	AAA2056	2.5	0.003	0.008	<0.64	*27.7*	*1*	2.7	78	0.81	0.8	7.2	11	31	<0.04	<0.2	*110*
4	AAA2193	2.3	0.003	0.011	<0.58	*27.4*	*1*	1.7	74	0.7	1	6.7	12	22	<0.04	<0.2	*110*
5	AAA2057	*4.3*	0.003	0.005	<0.87	12.2	*1*	2.2	62	0.45	0.6	4.3	13	6	<0.04	<0.2	20
6	AAA2194	2.5	0.002	0.007	<0.35	8.5	<1	1.8	40	0.38	0.9	4	5.6	12	<0.04	0.3	30
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

#	ORGANICS DETECTED SAMPLE ID	SVOCS	RESULT	SAL	EQL	UNITS
3	AAA2056	Fluoranthene	0.41	*3200*	*0.33*	mg/kg
	AAA2056	Phenanthrene	0.37	*nc*	*0.33*	mg/kg
	AAA2056	Pyrene	0.36	*2400*	*0.33*	mg/kg

Data Qualifications

QA/QC blind data indicate that beryllium, chromium, lead, nickel, and zinc results may be low by as much as 35%. The non-blind sample was in control. Arsenic blind results were low by 75%, however the non-blind and matrix spike results were satisfactory. The gamma emitter cesium-137 results may be high by 25%; Cs-137 was not detected in any sample. No other anomalies were noted. Adjustment of confidence intervals for these contaminants does not affect the decision.

[1]Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

TABLE 4-13

INORGANICS FOUND ABOVE BACKGROUND AT SWMU 33-015

SAMPLE ID	SILVER mg/kg	CADMIUM mg/kg	LEAD mg/kg	URANIUM mg/kg	ZINC mg/kg
AAA2038	19	4.4	350	9.1	740
AAA2039	9.5	8.9	11	10.2	350
LANL UTL	*not analyzed*	*2.7*[1]	*33.7*	*2.82*	*101*
TA-33 UTL	*not calculated*	*2.7*[1]	*39*	*4.84*	*62.3*
SAL	*400*	*80*	*400*	*95*	*24 000*
MCR 2038	*0.048*	*0.055*	*0.875*	*0.096*	*0.031*
MCR 2039	*0.024*	*0.111*	*0.028*	*0.107*	*0.015*

[1] Maximum concentration. UTL not calculated because of insufficient data.

appropriate to compute an SMCR excluding lead from the calculation. By omitting lead, the revised SMCR is 0.23, well below the action level of one.

Because lead at 350 mg/kg is near its SAL of 400, a preliminary risk assessment was performed using EPA's IEUBK (EPA 1994, 02-099) to verify that no unacceptable risk would be expected. Results indicate an estimated 4.9 % of children with a blood level exceeding 10 µg/dL, which is acceptable by EPA criteria. (Lead exposure is discussed in Subsection 4.4.4 of this RFI report.)

Applying these results, NFA is proposed at SWMU 33-015 based on LANL Criterion 4. The probability of lead paint on the incinerator will have to be addressed under a decontamination and decommissioning regime.

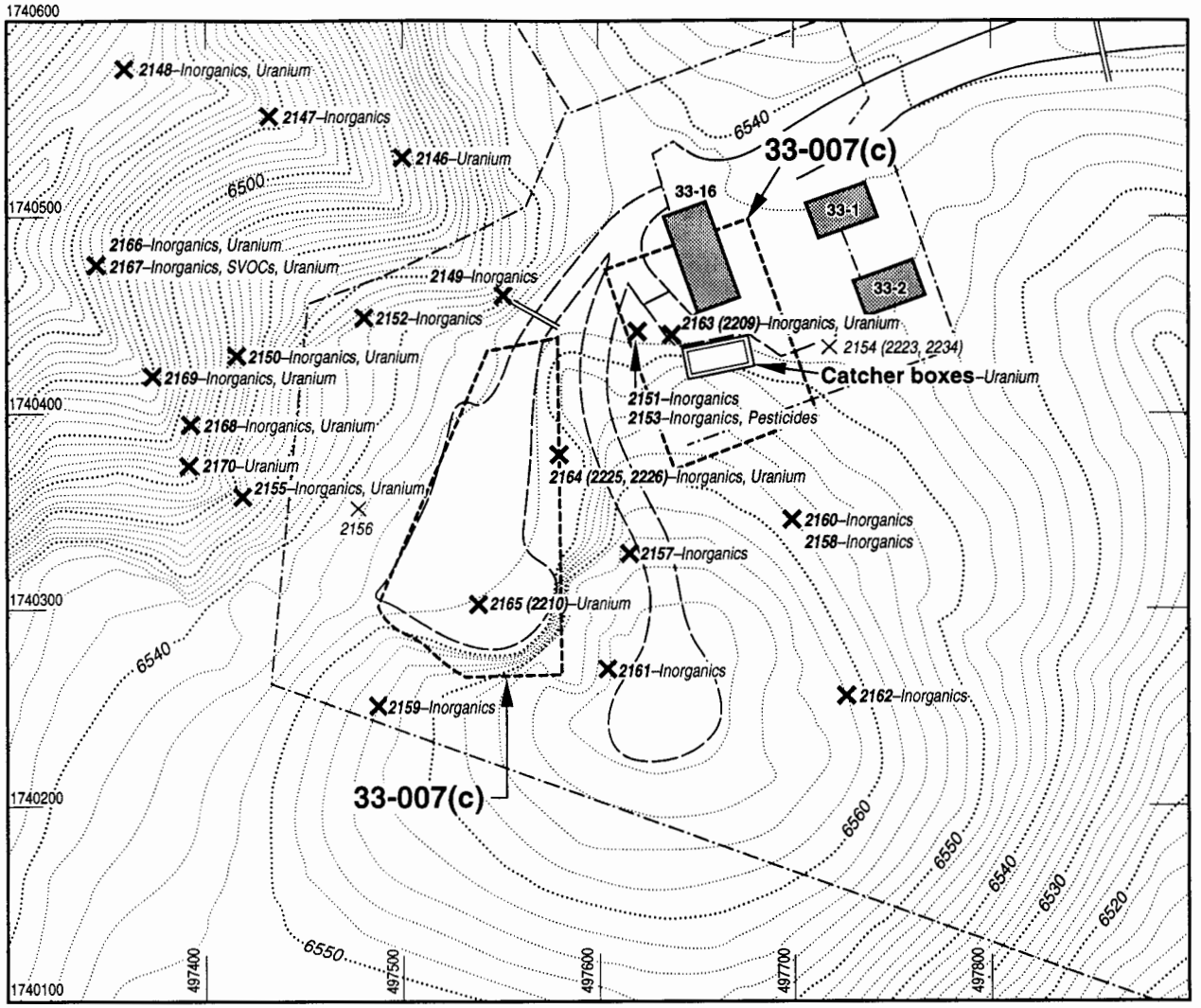
4.11 SWMU 33-007(c) Area 6 Firing Areas

SWMU 33-007(c) is discussed in the RFI Work Plan for OU 1122 Subsections 3.3.2.1 and 4.3.3.1 (LANL 1992, 0784). In the 1993 sampling campaign, inorganics were detected near SALs at three points. During the 1994 sampling campaign, uranium chunks were found in and near two catcher boxes. Proposals for further action such as an expedited cleanup await receipt of 1994 inorganics and radionuclide data.

4.11.1 Unit Description

4.11.1.1 Description and Historical Information

SWMU 33-007(c) consists of the area surrounding three firing pads and a pair of catcher boxes (Fig. 4-11). One concrete pad lies immediately west of TA-33-16. The 6-ft square catcher boxes are about 20 ft south of the pad and



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. 4-11. Area 6: PRS 33-007(c).

the building. Two concrete pads are in a level area excavated into a basaltic cinder cone. The firing areas were developed in 1948 for use with gun-type tests of beryllium-polonium initiators. During firing, projectiles often cracked open, contaminating the areas with polonium-210, which has since decayed to undetectable levels. Tests at Area 6 ceased about 1955.

Potential contaminants identified in the RFI work plan were inorganics, high explosive residues, uranium, cobalt-60, and tritium.

4.11.1.2 Setting

A cone formed of basaltic cinders protrudes above the tuff mesa at Area 6 (Fig. 4-11). This cone is a large feature that extends about 300 ft below the surface of the mesa, as was discovered during drilling at MDA K. The cinders range from pea-size or smaller to two-inch diameter. A part of the cone was excavated during construction of the firing site, leaving a 10-ft cliff at the eastern end. A branch of Chaquehui Canyon cuts through the western end, where a steep slope of excavated cinders was formed when the site was leveled. The ground is porous; no water collects at the site. Drainage from the SWMU is primarily to the west by two small drainage channels (Fig. 4-11).

4.11.2 Field Investigation

A total of 31 samples are considered relevant to decisions for SWMU 33-007(c) including: 14 surface, 2 collocated, and 6 duplicate samples collected in the area surrounding the firing pads. SWMU 33-007(c) overlaps two other PRSs at Area 6. Thus, selected samples from SWMU 33-004(g) drainage at the northwest corner of the site were appropriate, as were three samples (with duplicates) from SWMU 33-009 at the southeast corner of Area 6. See Fig. 4-14 for sample locations. See Table 4-11 for the assignment of sample to PRS.

All samples for SWMU 33-007(c)were analyzed for inorganics, high explosives, uranium, and gamma emitters. In addition, three samples were analyzed for herbicides; two of these three were also analyzed for pesticides and PCBs (Table 4-14).

TABLE 4-14

SWMU 33-007(C): AREA 6 FIRING SITE

SAMPLE INFORMATION

						BEGIN DEPTH	END DEPTH	ANALYSES PERFORMED							
										ORGANICS					
#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	IN.	IN.	INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA2150	33-1197	33-007c		soil	0	6	X	X			X	X	X	X
2	AAA2151	33-1198	33-007c	colocated	soil	0	6	X	X				X		
3	AAA2152	33-1199	33-007c		soil	0	6	X	X			X	X	X	X
4	AAA2153	33-1200	33-007c		soil	0	6	X	X				X		X
5	AAA2154	33-1201	33-007c		soil	0	6	X	X				X		
6	AAA2223	33-1201	33-007c	duplicate	soil	0	6	X	X				X		
7	AAA2224	33-1201	33-007c	duplicate	soil	0	6	X	X				X		
8	AAA2155	33-1202	33-007c		soil	0	6	X	X				X		
9	AAA2156	33-1203	33-007c		soil	0	6	X	X				X		
10	AAA2157	33-1204	33-007c		soil	0	6	X	X				X		
11	AAA2158	33-1205	33-007c		soil	0	6	X	X				X		
12	AAA2160	33-1207	33-007c	collocated	soil	0	6	X	X				X		
13	AAA2159	33-1206	33-007c		soil	0	6	X	X				X		
14	AAA2161	33-1208	33-007c		soil	0	6	X	X				X		
15	AAA2162	33-1209	33-007c		soil	0	6	X	X				X		
16	AAA2163	33-1210	33-007c		soil	0	6	X	X				X		
17	AAA2209	33-1210	33-007c	duplicate	soil	0	6	X	X				X		
18	AAA2164	33-1211	33-007c		soil	0	6	X	X				X		
19	AAA2225	33-1211	33-007c	duplicate	soil	0	6	X	X				X		
20	AAA2226	33-1211	33-007c	duplicate	soil	0	6	X	X				X		
21	AAA2165	33-1212	33-007c		soil	0	6	X	X				X		
22	AAA2210	33-1212	33-007c	duplicate	soil	0	6	X	X				X		
23	AAA2146	33-1193	33-004(g)	*drainage*	sediment	0	6	X	X		X		X		
24	AAA2147	33-1194	33-004(g)		sediment	0	6	X	X		X		X		
25	AAA2148	33-1195	33-004(g)		sediment	0	6	X	X		X		X		
26	AAA2149	33-1196	33-004(g)	*culvert*	sediment	0	6	X	X		X		X		
27	AAA2166	33-1213	33-009	*surface*	soil	0	6	X	X		X	X		X	X
28	AAA2167	33-1214	33-009	collocated	soil	0	6	X	X		X	X			X
29	AAA2168	33-1215	33-009		soil	0	6	X	X		X	X			
30	AAA2169	33-1216	33-009		soil	0	6	X	X		X	X			
31	AAA2170	33-1217	33-009		soil	0	6	X	X		X	X			

TABLE 4-14 (Continued)

SWMU 33-007(C): AREA 6 FIRING SITE

RESULTS OF ANALYSES

		RADIONUCLIDES					INORGANICS										
		U	238Pu	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
#	SAMPLE ID	mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA2150	3.2	NA	NA	<0.59	NA	<1	2.72	240	0.81	<0.4	6.3	44	13	<0.07	0.41	67
2	AAA2151	2.6	NA	NA	0.7	NA	<1	1.9	100	0.35	<0.4	4.6	8	80	0.25	<0.2	47
	AAA2151R	NA	NA	NA	NA	NA	NA	1.8	NA	NA	NA	NA	NA	NA	NA	0.4	NA
3	AAA2152	2.6	NA	NA	<0.7	NA	<1	5.04	330	1.2	<0.4	12	60	15	<0.07	0.93	57
4	AAA2153	2.5	NA	NA	<0.72	NA	<1	2.63	110	0.51	<0.4	5.9	14	57	<0.07	<0.2	44
5	AAA2154	2.8	NA	NA	<0.77	NA	<1	3.4	150	0.86	<0.4	9	25	17	0.22	<0.2	56
	AAA2154R	NA	NA	NA	NA	NA	<1	NA	150	0.85	<0.4	10	24	30	NA	NA	65
6	AAA2223	2.6	NA	NA	1.38	NA	<1	2.7	130	0.75	0.5	10	21	13	<0.1	0.4	64
7	AAA2224	2.5	NA	NA	<0.78	NA	<1	3.2	150	0.9	0.5	11	22	14	0.27	0.3	70
8	AAA2155	4	NA	NA	<0.76	NA	<1	3	250	0.65	0.9	8.5	67	39	0.13	0.6	75
	AAA2155R	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9	AAA2156	1.9	NA	NA	<0.74	NA	<1	1.49	74	0.75	<0.4	6.2	5	36	<0.07	<0.2	38
10	AAA2157	2.4	NA	NA	<0.5	NA	<1	10.9	370	2.3	<0.4	30	41	21	<0.1	1.2	61
11	AAA2158	NA	NA	NA	<0.71	NA	<1	5.46	290	1.2	0.5	14	39	20	<0.07	0.45	46
12	AAA2159	2.5	NA	NA	<0.67	NA	<1	4.73	320	1.4	<0.4	27	50	19	<0.07	0.62	46
13	AAA2160	2.4	NA	NA	1.49	NA	<1	5.04	280	1.4	<0.4	17	38	16	<0.07	0.76	50
14	AAA2161	1.9	NA	NA	<0.65	NA	<1	11.2	700	2.4	0.4	25	53	16	0.105	1.5	60
15	AAA2162	2.6	NA	NA	1.11	NA	<1	3.5	310	1.5	<0.4	15	47	14	0.13	0.8	47
16	AAA2163	2.8	NA	NA	<0.47	NA	<1	4.9	210	1	0.5	18	33	21	0.15	0.9	50
17	AAA2209	3.8	NA	NA	<0.8	NA	<1	5.2	230	1.2	<0.4	13	32	26	<0.1	0.4	51
18	AAA2164	72	NA	NA	<0.59	NA	<1	4	230	1.3	4.4	52	850	150	2.6	<0.2	210
19	AAA2225	91	NA	NA	<0.63	NA	<1	4.58	260	1.3	3.8	62	530	130	0.34	0.44	220
20	AAA2226	84	NA	NA	0.86	NA	<1	3.6	200	1.1	3.6	54	440	120	2.2	<0.2	190
21	AAA2165	2.6	NA	NA	0.88	NA	<1	1.6	100	0.23	<0.4	6.3	8	24	0.15	0.3	26
22	AAA2210	3.4	NA	NA	1.21	NA	<1	1.8	200	0.34	0.5	7.7	11	33	<0.1	0.4	41
23	AAA2146	3.4	NA	NA	<0.69	NA	<1.4	1.2	133	0.9	<0.8	6.8	10.7	11.7	<11.2	<0.6	46.8
24	AAA2147	2.6	NA	NA	<0.44	NA	<1.4	1	204	0.76	1.8	10.3	45.9	14.2	<11.2	<0.6	108
25	AAA2148	3.4	NA	NA	<0.67	NA	<1	4.01	210	0.93	<0.4	8	38	14	<0.07	1.1	51
26	AAA2149	2.8	NA	NA	<0.67	NA	<1.4	1.1	291	0.74	1.5	7.4	52.3	15.6	<11.2	<0.6	78.5
27	AAA2166	3.1	NA	NA	1.11	NA	<1	2.4	220	0.84	<0.4	7	46	13	<0.1	0.7	39
28	AAA2167	3	NA	NA	<0.94	NA	<1	1.7	160	0.52	<0.4	4.4	32	10	<0.04	0.5	27
29	AAA2168	5.5	NA	NA	<0.82	NA	<1	2.5	220	0.74	1.1	6.6	45	38	0.15	0.8	130
30	AAA2169	3.3	NA	NA	<0.89	NA	<1	1.3	130	0.63	<0.4	4.3	34	7	<0.04	0.3	30
31	AAA2170	4	NA	NA	<0.6	NA	<1	1.4	49	0.51	<0.4	2.4	9	7	<0.04	<0.2	19
	SALs (b)	95	27	24	4	820	400	(h)	5 600	(h)	80	400	1 600	400	32	400	24 000
	EQLs (c)	1.4	0.01	0.01	1	(g)	2	2	40	1	1	2	8	0.6	12	1	4
	LANL UTLs(d)	2.82	0.140(f)	0.025	1.5	nd	NA	11.1	748	2.26	2.7(f)	33.5	20.7	33.7	<5(f)	1.7(f)	73.3
	TA-33 UTLs(e)	4.84	0.007	0.058	2.75	23.2	NA	4.36	268	1.51	2.7(f)	20.7	17	(i)	0.27(f)	1.39(f)	62.3

TABLE 4-14 (Continued)

SWMU 33-007(C): AREA 6 FIRING SITE

	ORGANICS DETECTED					
#	SAMPLE ID	PESTICIDE & SVOC	RESULT	SAL	EQLs	UNITS
4	AAA2153	D [2,4-]	2.32	800		mg/kg
28	AAA2167	Butylbenzylphthalate	0.44	16,000	0.33	mg/kg

PCBs assigned to SWMU 33-009

Data Qualifications

QA/QC data indicate that the lab blank for herbicides was severely contaminated, throwing those analyses into question. Comparison of estimated detection limits of 0.5-6 mg/kg against SALs of 80-11,000 mg/kg gives confidence that no herbicides are present above SAL. Pesticide results may be as much as 50% low, with endosulfans as much as 85% low. Uranium may be as much as 20% low. Adjustment of confidence levels for these contaminants does not affect an NFA decision.

[1]Symbols and notes identical to those in footnote to Table 4-1.

The catcher box area south of TA-33-16 was trenched in the summer of 1994 as specified in the RFI work plan. During trenching, pieces of corroding uranium metal were found, as well as non-radioactive solid parts of experimental devices. As specified in the work plan, six samples were collected in the boxes and analyzed for inorganics and radionuclides. The area surrounding the boxes has been fenced.

4.11.3 Potential Release Characterization

See Table 4-14 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. Samples AAA2157 and AAA2161, collected at the top of the basaltic cinder cone, showed arsenic, beryllium, chromium, and nickel above TA-33 local background. Because these results were likely due to the composition of the cinder cone rather than contamination, a set of eight samples were taken to determine the cinder background levels for inorganics. These samples were collected on slopes of the cone facing away from Area 6 and were unlikely to have been affected by experimental operations. Results from the background sample do not show elevated concentrations of the elements of concern. Table 4-15 compares values from the two samples with background (AAB series) taken for this purpose, framework studies and local UTLs, and soil SALs.

TABLE 4-15

INORGANICS AT THE AREA 6 CINDER CONE

SAMPLE ID[1]	ARSENIC mg/kg	BERYLLIUM mg/kg	CADMIUM mg/kg	CHROMIUM mg/kg	NICKEL mg/kg	LEAD mg/kg	ANTIMONY mg/kg	ZINC mg/kg
AAA2157	10.9	2.3	<0.4	30	41	21	<0.1	61
AAA2161	11.2	2.4	0.4	25	53	16	0.1	60
AAB2401	1.2	0.63	1.1	8.1	8.6	11.4	<0.16	27.1
AAB2402	1.2	0.50	0.84	5.8	8.0	12.2	<0.12	23.3
AAB2403	2.0	1.4	1.1	11.9	14.8	14.5	<0.12	30.9
AAB2404	1.5	0.86	1.0	8.3	16.0	13.8	<0.10	31.2
AAB2405	1.9	0.77	1.0	8.4	17.1	15.5	<0.12	35.7
AAB2406	1.9	1.1	0.85	9.2	20.7	11.2	<0.11	32.8
AAB2407	1.3	0.95	0.89	9.4	23.5	12.0	<0.10	36.6
AAB2408	1.7	1.4	0.89	10.8	32.9	10.1	<0.12	38.8
LANL UTL	*11.6*	*3.31*	*2.7*[2]	*34.2*	*26.7*	*39*	*2.5*[2]	*101*
TA-33 UTL	*4.36*	*1.51*	*2.7*	*20.7*	*17.0*	*NA*[3]	*0.27*[2]	*62.3*
Soil SAL	*11.2*	*4*	*80*	*400*	*1 600*	*400*	*32*	*24 000*

[1] AAA are RFI field samples and AAB samples are cinder-cone background samples.
[2] Maximum. UTL not calculated because of insufficient data.
[3] UTL not calculated because of non-normal distribution.

Sample AAA2164 and two duplicates, taken at the edge of the cinder cone firing pad, contained the inorganics cadmium, chromium, nickel, lead, antimony, uranium, and zinc well above local and Lab-wide background. Arsenic and barium were near local UTL. With the exception of uranium, all were below respective SALs, far below SAL in most cases. Table 4-16 lists concentrations and the multiple constituent ratios. The SAL for natural uranium is used in Table 4-16. The TMCRs for these samples are, respectively 1.930, 1.827, and 1.716. No other samples near the cinder cone contained concentrations of these or any other contaminants near SALs. Many samples contained uranium, nickel, lead, and zinc slightly above LANL backgrounds.

TABLE 4-16

INORGANICS IN FIRING PAD SAMPLES

SAMPLE ID	CADMIUM (mg/kg)	CHROMIUM (mg/kg)	NICKEL (mg/kg)	LEAD (mg/kg)	ANTIMONY (mg/kg)	URANIUM (mg/kg)	ZINC (mg/kg)
AAA2164	4.4	52	850	150	2.6	72	210
AAA2225	3.8	62	530	130	0.34	91	220
AAA2226	3.6	54	440	120	2.2	84	190
LANL UTL	*2.7*[1]	*34.2*	*26.7*	*39*	*2.5*[1]	*2.82*	*101*
TA-33 UTL	*2.7*[1]	*20.7*	*17.0*	*33.7*	*0.25*[1]	*4.84*	*62.3*
Soil SALs	*80*	*400*	*1 600*	*400*	*32*	*95*	*24 000*
MCR 2164	*0.055*	*0.130*	*0.531*	*0.375*	*0.081*	*0.758*	*0.009*
MCR 2225	*0.048*	*0.155*	*0.331*	*0.325*	*0.011*	*0.958*	*0.009*
MCR 2226	*0.045*	*0.135*	*0.275*	*0.300*	*0.069*	*0.884*	*0.008*

[1] Maximum. UTL not calculated because of insufficient data.

Very low levels of PCBs were detected in two samples. The pesticide 2,4-D was detected in one sample, at a concentration far below SAL. Butylbenzlphthalate was found in one sample. No organics were detected in any other sample.

4.11.4 Evaluation and Recommendations

No recommendations can be made concerning the disposition of SWMU 33-007(c) at this time. Pockets of corroding uranium metal were found in the catcher boxes during 1994 trenching. The catcher boxes have been fenced and posted as a radioactive area. Results from the 1994 sampling in the boxes have not been received. The 1994 results will determine if RCRA wastes are present. The boxes are expected to require remediation and an

expedited cleanup may be proposed. The small volume of the catcher boxes, about 22 yd^3, makes this area an excellent place to test experimental technologies to remove uranium from soil. This option may be explored as time permits.

Inorganics at three locations fail the multiple constituent test using the SAL for natural uranium, which was in general use at the time of Area 6 activities (Drake 1971, 02-097). These points will receive further consideration in conjunction with decisions for the catcher boxes.

4.12 SWMU 33-011(a) Drum Storage near former TA-33-21

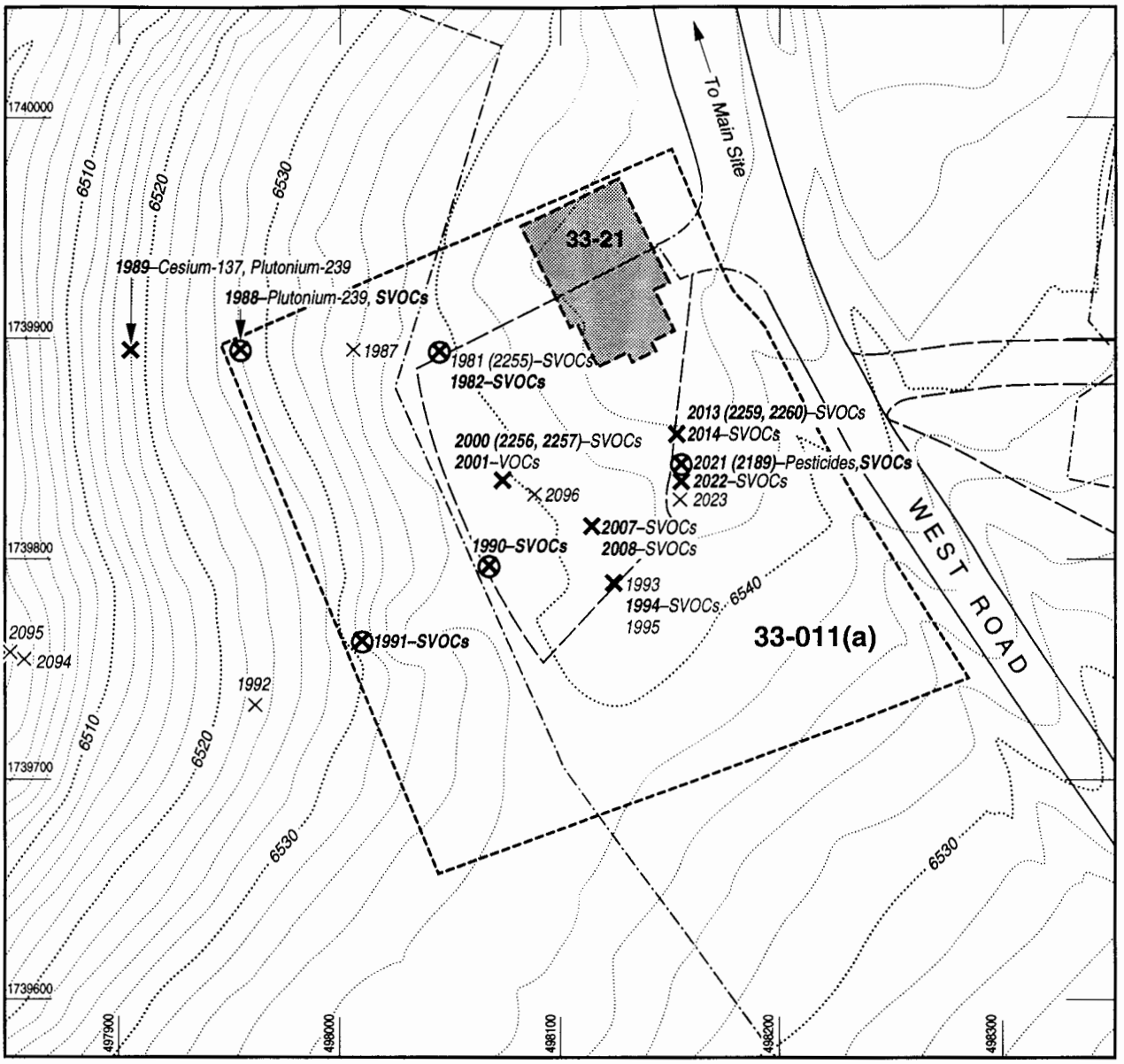
SWMU 33-011(a) is discussed in the RFI Work Plan for OU 1122 Subsections 3.2.2.11 and 4.2.3.1 (LANL 1992, 0784). Concentrations of PAHs above background were found in samples in this SWMU and in overlapping SWMUs 33-005(a,b,c). Since PAHs were expected contaminants at this PRS but not at SWMU 33-005(a,b,c), boundaries of SWMU 33-011(a) are expanded to include the entire storage area and all SVOC contamination assigned to this PRS.

4.12.1 Unit Description

4.12.1.1 Description and Historical Information

SWMU 33-011(a) was identified in the RFI Work Plan for OU 1122 as a drum storage area next to West Road (Fig. 4-12). The drums mentioned in the original SWMU Report (LANL 1990, 0145) were removed before work plan investigations began. Drilling equipment is now stored in the area. After completion of the work plan an aerial photograph, RN87-111003, was located that showed the drums. The three samples shown as being assigned to SWMU 33-011(a) in Table 4-17 were collected in this area.

SWMU 33-011(a) has been redefined to include the entire storage area at the site of former building TA-33-21 [discussed in connection with SWMUs 33-005(a,b,c) in Subsection 4.5 of this RFI report]. The area has been and is still used extensively for storage. Currently, drilling pipe is stacked in several locations around the site. Samples associated with SWMUs 33-005(a,b,c) contained PAHs typical of oil, asphalt, diesel, or combustion products. This contamination appears to be associated with the more recent



Sources: FIMAD 1993, G101015 & G101476
Modified by: cARTography by A. Kron 1/26/95

Former structure
Paved road
Unimproved road/trail
Fence
PRS boundary
× 1992 Sample location and number—no elevated levels found
✕ 1989 Sample with PCOCs detected above LANL background levels
⊗ 1990 Sample with PCOCs detected above SALs (for contaminant in bold face)
(2259, 2260) Duplicate samples are shown in parentheses

0 50 100 ft
Contour interval = 2 ft

N

Fig. 4-12. Storage Area: PRS 33-011(a).

TABLE 4-17

SWMU 33-011(A): STORAGE SITE

SAMPLE INFORMATION

#	SAMPLE ID	SITE ID	ASSIGNED PRS	TYPE	MATRIX	BEGIN DEPTH in.	END DEPTH in.	ANALYSES PERFORMED							
										ORGANICS					
								INORG	RAD	VOCs	SVOCs	PCBs	HE	PEST	HERB
1	AAA1981	33-1061	33-005(a)	*septic borehole*	soil	0	6	X	X		X				
2	AAA2255	33-1061	33-005(a)	duplicate	soil	0	6	X	X		X				
3	AAA1982	33-1061	33-005(a)		soil	24	24	X	X	X	X				
4	AAA1987	33-1062	33-005(a)	*surface*	soil	0	6	X	X		X				
5	AAA1988	33-1063	33-005(a)		soil	0	6	X	X		X				
6	AAA1989	33-1064	33-005(a)		soil	0	6	X	X		X				
7	AAA1990	33-1065	33-005(b)		soil	0	6	X	X		X				
8	AAA1991	33-1066	33-005(b)		soil	0	6	X	X		X				
9	AAA1992	33-1067	33-005(b)		soil	0	6	X	X		X				
10	AAA1995	33-1068	33-005(c)	collocated	soil	0	6	X	X		X	X		X	X
11	AAA1993	33-1068	33-005(c)	*drainfield borehole*	soil	0	6	X	X		X	X		X	X
12	AAA1994	33-1068	33-005(c)		soil	36	60	X	X	X	X				
13	AAA2000	33-1070	33-005(c)	*drainfield borehole*	soil	0	6	X	X		X				
14	AAA2256	33-1070	33-005(c)	duplicate	soil	0	6	X	X		X				
15	AAA2257	33-1070	33-005(c)	duplicate	soil	0	6	X	X		X				
16	AAA2001	33-1070	33-005(c)		soil	24	24	X	X	X	X				
17	AAA2007	33-1072	33-005(c)	*drainfield borehole*	soil	0	6	X	X		X	X		X	X
18	AAA2008	33-1072	33-005(c)		soil	24	24	X	X	X	X				
19	AAA2013	33-1073	33-005(c)	*drainfield borehole*	soil	0	6	X	X		X				
20	AAA2259	33-1073	33-005(c)	duplicate	soil	0	6	X	X		X				
21	AAA2260	33-1073	33-005(c)	duplicate	soil	0	6	X	X		X				
22	AAA2014	33-1073	33-005(c)		soil	24	24	X	X	X	X				
23	AAA2021	33-1076	33-011(a)	*surface*	soil	0	6				X	X		X	X
24	AAA2189	33-1076	33-011(a)	duplicate	soil	0	6				X	X		X	X
25	AAA2022	33-1077	33-011(a)		soil	0	6	X	X		X	X			
26	AAA2023	33-1078	33-011(a)		soil	0	6				X	X			
27	AAA2094	33-1147	33-017		soil	0	6	X	X		X				
28	AAA2095	33-1148	33-017	neighbor	soil	0	6	X	X		X				
29	AAA2096	33-1149	33-017		soil	0	6	X	X		X				

TABLE 4-17 (Continued)

SWMU 33-011(A): STORAGE SITE

RESULTS OF ANALYSES

		RADIONUCLIDES (a)					INORGANICS										
		U	238Pu	239Pu	137Cs	3H	Ag	As	Ba	Be	Cd	Cr	Ni	Pb	Sb	Se	Zn
#	SAMPLE ID	mg/kg	pCi/g	pCi/g	pCi/g	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	AAA1981	2.7	0.002	0.002	<0.74	NA	<1	4.7	160	0.87	<0.4	6.7	8	12	<0.06	<0.2	35
2	AAA2255	2.6	0.002	0.004	<0.72	NA	<1	3.9	160	0.88	<0.4	7.9	7.7	13	<0.06	<0.2	37
3	AAA1982	2.8	0.002	0.013	<0.85	NA	<1	2.98	69	0.59	<0.4	4.8	3	9	<0.07	<0.2	55
4	AAA1987	2.3	0.003	0.044	<0.57	NA	<1	2.56	60	0.49	<0.4	3.5	2.9	9	<0.06	<0.2	31
5	AAA1988	2.1	0.006	0.105	1.2	NA	<1	2.75	53	0.49	<4	3.5	3	11	<0.06	0.26	28
6	AAA1989	*3.1*	0.006	0.132	*3.31*	NA	<1	3.05	92	0.64	<0.4	5	4	21	<0.06	<0.2	30
7	AAA1990	2.2	0.003	0.009	<0.78	NA	<1	2.44	20	0.24	<0.4	1.4	<2	8	<0.06	<0.2	81
8	AAA1991	2.3	0.004	0.07	<0.56	NA	<1	2.8	50	0.66	<0.4	4.3	3.2	11	<0.06	0.31	23
9	AAA1992	2.2	0.006	0.02	<0.66	NA	<1	2.91	58	0.55	<0.4	3.5	4	13	<0.06	0.24	29
	AAA1992R	NA	NA	NA	<0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	AAA1995	2.8	0.011	0.002	<0.77	NA	<1.4	2.8	189	1.2	1.5	8.8	8.5	12.9	<11.2	<0.6	38.1
	AAA1995R	NA	0.011	0.002	<0.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	AAA1993	2.7	0.003	0.009	<0.7	NA	<1.4	1.8	161	0.99	1	7.1	11.3	11	<11.2	<0.6	33.6
	AAA1993R	NA	0.003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	AAA1994	2.1	0.003	0.001	<0.67	NA	<1.4	0.98	78.5	0.3	<0.8	3.2	<2.8	4.1	<11.2	<0.6	21.4
	AAA1994R	NA	0.003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13	AAA2000	2.1	0.003	0.012	<0.46	NA	<1.4	1.2	55.5	0.52	<0.8	3.1	10.3	6.1	<11.2	<0.6	27.7
	AAA2000R	NA	0.003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14	AAA2256	2.1	0.008	0.013	<0.73	NA	<1.4	1.9	57.2	0.46	<0.8	3	<2.8	6.4	<11.2	<0.6	26.4
	AAA2256R	NA	0.008	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15	AAA2257	2.2	0.006	0.001	<0.89	NA	<1.4	1.2	60.6	0.5	<0.8	3.2	<2.8	7	<11.2	<0.6	30.5
	AAA2257R	NA	0.006	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16	AAA2001	2.5	0.003	0.001	<0.65	NA	*1*	2.32	31	0.38	<0.4	2.1	<2	5	<0.07	<0.2	23
	AAA2001R	NA	0.003	NA	0.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17	AAA2007	2.2	0.007	0.008	<0.78	NA	<1.4	1	47.8	0.43	<0.8	2.6	<2.8	6.4	<11.2	<0.6	25.7
	AAA2007R	NA	0.007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18	AAA2008	2.3	0.004	0.001	<1.02	NA	<1.4	0.76	33.8	0.41	<0.8	1.6	<2.8	4.3	<11.2	<0.6	24.9
	AAA2008R	2.3	0.007	0.005	<0.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19	AAA2013	NA	0.007	NA	NA	NA	<1.4	1.3	67.3	0.62	0.81	3.1	3.4	7.8	<11.2	<0.6	39
20	AAA2259	0.1267	0.002	0.013	<2.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	AAA2259R	NA	0.002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
21	AAA2260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22	AAA2014	2.3	0	0.002	<0.8	NA	<1.4	1.5	46.1	0.59	<0.8	2.4	<2.8	5.3	<11.2	<0.6	25.8
23	AAA2021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
24	AAA2189	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25	AAA2022	NA	NA	NA	NA	NA	<1	1.4	86	0.47	<0.4	4.4	<2	23	0.27	0.5	22
26	AAA2023	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27	AAA2094	2.1	0.003	0.042	1.41	0.4	<1	2.4	62	0.61	<0.4	5.7	5	12	<0.06	<0.2	41
28	AAA2095	1.9	0.003	0.018	<0.48	0.2	<1	1.7	31	0.33	<0.4	5.5	3	7	<0.06	<0.2	36
29	AAA2096	2.5	0.001	0.013	<0.69	0.8	<1	3.15	42	0.37	<0.4	2.5	2.3	14	<0.06	1.23	45
	SALs (b)	*95*	*27*	*24*	*4*	*820*	*400*	(h)	*5 600*	(h)	*80*	*400*	*1 600*	*400*	*32*	*400*	*24 000*
	EQLs (c)	*1.4*	*0.01*	*0.01*	*1*	*(g)*	*2*	*2*	*40*	*1*	*1*	*2*	*8*	*0.6*	*12*	*1*	*4*
	LANL UTLs(d)	*2.82*	*0.01*	*0.052*	*1.4*	*nd*	*NA*	*11.6*	*1140*	*3.31*	*2.7*	*34.2*	*26.7*	*39*	*2.5(f)*	*1.7(f)*	*101*
	TA-33 UTLs(e)	*4.84*	*0.007*	*0.058*	*2.75*	*23.2*	*NA*	*4.36*	*268*	*1.51*	*2.7(f)*	*20.7*	*17*	(i)	*0.27(f)*	*1.39(f)*	*62.3*

TABLE 4-17 (Continued)

SWMU 33-011(A): STORAGE SITE

#	ORGANICS DETECTED SAMPLE ID	VOCs AND SVOCs	RESULT	SAL	EQL	UNITS
3	AAA1982	Acetone	0.13	8000	0.02	mg/kg
	AAA1982	Anthracene	0.39	24000	0.33	mg/kg
	AAA1982	Benzo[a]anthracene	**0.83**	0.64	0.33	mg/kg
	AAA1982	Benzo[a]pyrene	**0.79**	0.1	0.33	mg/kg
	AAA1982	Benzo[b]fluoranthene	0.6	0.7	0.33	mg/kg
	AAA1982	Benzo[g,h,i]perylene	0.63	44	0.33	mg/kg
	AAA1982	Benzo[k]fluoranthene	0.57	1.5	0.33	mg/kg
	AAA1982	Chrysene	0.85	22	0.33	mg/kg
	AAA1982	Fluoranthene	170	3200	0.33	mg/kg
	AAA1982	Indeno[1,2,3-cd]pyrene	**0.54**	0.41	0.33	mg/kg
	AAA1982	Phenanthrene	1.5	nd	0.33	mg/kg
	AAA1982	Pyrene	1.9	2400	0.33	mg/kg
5	AAA1988	Acenaphthene	0.49	4800	0.33	mg/kg
	AAA1988	Anthracene	0.73	24000	0.33	mg/kg
	AAA1988	Benzo[a]anthracene	**1.4**	0.64	0.33	mg/kg
	AAA1988	Benzo[a]pyrene	**1.6**	0.1	0.33	mg/kg
	AAA1988	Benzo[b]fluoranthene	**1.4**	0.7	0.33	mg/kg
	AAA1988	Benzo[g,h,i]perylene	0.57	44	0.33	mg/kg
	AAA1988	Benzo[k]fluoranthene	**1.6**	1.5	0.33	mg/kg
	AAA1988	Chrysene	1.6	22	0.33	mg/kg
	AAA1988	Fluoranthene	2.6	3200	0.33	mg/kg
	AAA1988	Fluorene	0.5	3200	0.33	mg/kg
	AAA1988	Indeno[1,2,3-cd]pyrene 0	**0.6**	0.41	0.33	mg/kg
	AAA1988	Naphthalene	0.44	3200	0.33	mg/kg
	AAA1988	Phenanthrene	2.7	nd	0.33	mg/kg
	AAA1988	Pyrene	2.9	2400	0.33	mg/kg
2	AAA2255	Fluoranthene	0.45	3200	0.33	mg/kg
	AAA2255	Phenanthrene	0.4	nd	0.33	mg/kg
	AAA2255	Pyrene	0.42	2400	0.33	mg/kg
7	AAA1990	Acenaphthene	12.9	4800	0.33	mg/kg
	AAA1990	Acenaphthylene	0.49	nd	0.33	mg/kg
	AAA1990	Anthracene	18.6	24000	0.33	mg/kg
	AAA1990	Benzo[a]anthracene	**26.9**	0.64	0.33	mg/kg
	AAA1990	Benzo[a]pyrene	**28.8**	0.1	0.33	mg/kg
	AAA1990	Benzo[b]fluoranthene	**28.4**	0.7	0.33	mg/kg
	AAA1990	Benzo[g,h,i]perylene	12.6	44	0.33	mg/kg
	AAA1990	Benzo[k]fluoranthene	**21.4**	1.5	0.33	mg/kg

#	ORGANICS DETECTED SAMPLE ID	VOCs AND SVOCs	RESULT	SAL	EQL	UNITS
12	AAA1994	Di-n-butyl phthalate	3	8000	0.33	mg/kg
13	AAA2000	Di-n-butyl phthalate	0.51	8,000	0.33	mg/kg
	AAA2000	Butyl benzyl phthalate	0.56	16,000	0.33	mg/kg
16	AAA2001	Acetone	0.068	8,000	0.02	mg/kg
	AAA2001	Isopropyltoluene [4-]	0.006	nd	0.005	mg/kg
17	AAA2007	Di-n-butyl phthalate	2.1	8,000	0.33	mg/kg
18	AAA2008	Di-n-butyl phthalate	3.5	8,000	0.33	mg/kg
19	AAA2013	Di-n-butyl phthalate	3.2	8,000	0.33	mg/kg
	AAA2013	Phenanthrene	0.45	nd	0.33	mg/kg
	AAA2013	Butylbenzylphthalate	0.77	6,000	0.33	mg/kg
	AAA2013	Pyrene	0.46	2,400	0.33	mg/kg
	AAA2013	Fluoranthene	0.46	3,200	0.33	mg/kg
22	AAA2014	Di-n-butyl phthalate	3.6	8,000	0.33	mg/kg
14	AAA2256	Di-n-butyl phthalate	1.3	8,000	0.33	mg/kg
	AAA2256	Butyl benzyl phthalate 0	0.98	6,000	0.33	mg/kg
15	AAA2257	Di-n-butyl phthalate	2	8,000	0.33	mg/kg
23	AAA2021	Anthracene	0.37	24,000	0.33	mg/kg
	AAA2021	Benzo[a]anthracene	**0.87**	0.64	0.33	mg/kg
	AAA2021	Benzo[a]pyrene	**1.1**	0.1	0.33	mg/kg
	AAA2021	Benzo[b]fluoranthene	**0.8**	0.7	0.33	mg/kg
	AAA2021	Benzo[g,h,i]perylene	0.45	44	0.33	mg/kg
	AAA2021	Benzo[k]fluoranthene	1.2	1.5	0.33	mg/kg
	AAA2021	Chrysene	1.1	22	0.33	mg/kg
	AAA2021	Fluoranthene	1.8	3,200	0.33	mg/kg
	AAA2021	Indeno[1,2,3-cd]pyrene	**0.56**	0.1	0.33	mg/kg
	AAA2021	Phenanthrene	1.7	nd	0.33	mg/kg
	AAA2021	Pyrene	1.9	2,400	0.33	mg/kg
25	AAA2022	Fluoranthene	0.35	3,200	0.33	mg/kg
	AAA2022	Pyrene	0.4	2,400	0.33	mg/kg

TABLE 4-17 (Continued)

SWMU 33-011(A): STORAGE SITE

#	ORGANICS DETECTED SAMPLE ID	VOCs AND SVOCs	RESULT	SAL	EQL	UNITS
	AAA1990	Chrysene	***29.2***	*22*	*0.33*	mg/kg
	AAA1990	Dibenzofuran	5.6	*nd*	*0.33*	mg/kg
	AAA1990	Dibenzo[a,h]anthracene	***4.7***	*0.086*	*0.33*	mg/kg
	AAA1990	Dimethylphenol [2,4-]	0.7	*1600*	*0.33*	mg/kg
	AAA1990	Fluoranthene	54.1	*3200*	*0.33*	mg/kg
	AAA1990	Fluorene	15.1	*3200*	*0.33*	mg/kg
	AAA1990	Indeno[1,2,3-cd]pyrene	***14.3***	*0.1*	*0.33*	mg/kg
	AAA1990	Methylnaphthalene [2-]	9.3	*nd*	*0.33*	mg/kg
	AAA1990	Methylphenol [2-]	0.37	*4000*	*0.33*	mg/kg
	AAA1990	Methylphenol [4-]	0.98	*4000*	*0.33*	mg/kg
	AAA1990	Naphthalene	26.6	*3200*	*0.33*	mg/kg
	AAA1990	Phenanthrene	66.8	*nd*	*0.33*	mg/kg
	AAA1990	Pyrene	51	*2400*	*0.33*	mg/kg
8	AAA1991	Benzo[a]pyrene	***0.52***	*0.1*	*0.33*	mg/kg
	AAA1991	Benzo[b]fluoranthene	0.69	*0.7*	*0.33*	mg/kg
	AAA1991	Benzo[k]fluoranthene	0.47	*1.5*	*0.33*	mg/kg
	AAA1991	Chrysene	0.54	*22*	*0.33*	mg/kg
	AAA1991	Fluoranthene	0.99	*3200*	*0.33*	mg/kg
	AAA1991	Phenanthrene	0.9	*nd*	*0.33*	mg/kg
	AAA1991	Pyrene	1.2	*24000*	*0.33*	mg/kg

#	ORGANICS DETECTED SAMPLE ID	VOCs AND SVOCs	RESULT	SAL	EQL	UNITS
24	AAA2189	Benzo[a]anthracene	0.52	*0.64*	*0.33*	mg/kg
	AAA2189	Benzo[a]pyrene	***0.66***	*0.1*	*0.33*	mg/kg
	AAA2189	Benzo[b]fluoranthene	0.51	*0.7*	*0.33*	mg/kg
	AAA2189	Benzo[k]fluoranthene	0.79	*1.5*	*0.33*	mg/kg
	AAA2189	Chrysene	0.7	*22*	*0.33*	mg/kg
	AAA2189	Fluoranthene	1.1	*3,200*	*0.33*	mg/kg
	AAA2189	Indeno[1,2,3-cd]pyrene	0.35	*0.41*	*0.33*	mg/kg
	AAA2189	Phenanthrene	1	*nd*	*0.33*	mg/kg
	AAA2189	Pyrene	1.2	*2,400*	*0.33*	mg/kg

#	SAMPLE ID	PESTICIDES	RESULT	SAL	EQL	UNITS
23	AAA2021	DDE [p,p'-]	0.0019	*2.1*	*0.001*	mg/kg
	AAA2021	DDT [p,p'-]	0.0048	*2.1*	*0.004*	mg/kg
	AAA2021	Dieldrin	0.001	*0.044*	*0.001*	mg/kg
	AAA2021	Endosulfan I	0.006	*4*	*0.004*	mg/kg
	AAA2021	Endosulfan II	0.0021	*4*	*0.001*	mg/kg
	AAA2021	Endrin aldehyde	0.0087	*nd*	*0.14*	mg/kg
24	AAA2189	DDT [p,p'-]	0.004	*2.1*	*0.004*	mg/kg
	AAA2189	DDE [p,p'-]	0.002	*2.1*	*0.001*	mg/kg
	AAA2189	Endosulfan II	0.002	*4*	*0.001*	mg/kg

[1] Symbols and notes identical to those in footnote to Table 4-2 (see p. 55).

DATA QUALIFICATIONS

QA/QC data for 33-005 PRSs indicate that antimony, arsenic, lead, and selenium recoveries may be low. All were found at background levels in field samples. Silver was a contaminant in one QC sample, but was not found in any sample. Barium was also a contaminant, but barium results in the samples are all within background. Pesticide surrogate recoveries showed only about 50% of spiked concentrations, however no pesticides were detected in any samples. Toluene, a common lab contaminant, was found in the method blank. Its presence in several samples is considered lab contamination rather than a field contamination. No other anomalies were observed in QA/QC samples.

QA/QC data for 33-011(a) indicate that antimony, arsenic, lead, and selenium recoveries may be biased low, though all were found at background levels in field samples. Silver was a contaminant in one QC sample, but was not found in any sample. Barium was also a contaminant, but barium results in the samples are all within background. Alpha and gamma emitters and tritium recoveries were high in blind samples associated with 33-011(a) samples. Pesticide surrogate recoveries showed only about 50% of spiked concentrations, however no pesticides were detected in the field samples. Two herbicides show low recoveries in one QC blind sample, but neither was detected in field samples. Toluene, a common lab contaminant, was found in the method blank. Its presence in several samples is considered lab contamination rather than a field hit. No other anomalies were observed in QA/QC samples. None of these anomalies invalidates the data for decisions.

use of the area for storage and parking rather than its historical use as the site of laboratory TA-33-21. For this reason the boundaries of SWMU 33-011(a) have been extended to encompass the entire storage and parking area and the channels that drain to the southwest. The overlapping SWMUs 33-005(a,b,c) are proposed for NFA in Subsection 4.5.

Potential contaminants for SWMU 33-011(a) were SVOCs, PCBs, and oils.

4.12.1.2 Setting

Redfined SWMU 33-011(a) occupies approximately 0.33 of an acre. It is bounded on the east by West Road leading to South Site, and on the west by a barbed-wire fence. Much of the area is bare, compacted soil, with patches of weeds. During the 1974 cleanup of TA-33-21 (see Subsection 4.5), the area was scraped to bedrock and covered with clean soil (Cox et al. 1974, 02-018). Hand-augering during sample collection revealed that the soil is very shallow, often less than three inches. Runoff is southwest into a tributary of Chaquehui Canyon, by sheet runoff and faint bedrock channels.

4.12.2 Field Investigation

A total of 29 samples were evaluated for this storage area. These include the three surface samples and one duplicate that were collected in the area where drums were indicated in 1987 aerial photographs. As there were no screening or surface indications to bias sampling, sampling locations were randomized within this small area (about 20 ft square). In addition, the 17 surface samples and 5 subsurface samples assigned to SWMUs 33-005(a,b,c) are re-evaluated in this subsection for the evidence they provide of releases from storage and other post-1974 activities. Additionally, three samples from the operational release grid sampling for SWMU 33-017 are relevant to this area (Fig. 4-12).

All samples were analyzed for SVOCs. Seven samples were analyzed for PCBs, five for herbicides and pesticides, and three for tritium. Most were analyzed for inorganics and the radionuclides uranium, plutonium, and gamma emitters (Table 4-17).

4.12.3 Potential Release Characterization

See Table 4-17 for results of all radionuclide and inorganic analyses and any organic compounds that were detected. No inorganics were detected above background in the storage area. Uranium was detected above LANL UTL in sample AAA1989. Tritium levels were slightly above background. One drainage sample contained elevated levels of cesium-137 as described in Subsection 4.5. Low levels of plutonium-239 were found in two samples. PCBs were not found in any sample. Trace levels (0.0007 to 0.009 mg/kg) of pesticides were found far below SALs.

Organic compounds, including some TICs and low levels of VOCs, were found in many samples. Several samples contained SVOCs above SALs. In particular, concentrations of carcinogenic PAHs (cPAHs) ranged from 4.7 to 29.2 mg/kg in the randomly located surface sample, AAA1990. The elevated PAHs are typical of organic products such as asphalt or diesel.

For urban, nonindustrialized areas Bradley et al. (1994, 1144) calculated a 12.4-mg/kg concentration of these cPAHs at the 95% UCL. Since not all the cPAHs are equally carcinogenic, Bradley proposed comparing each cPAH to the most toxic cPAH, benzo(a)pyrene (BaP). He then calculated a factor to adjust each cPAH concentration to be equivalent to BaP in carcinogencity. By applying the calculated toxic equivalency factor (TEF-BaP) to each cPAH concentration, Bradley could calculate a total toxicity level. Estimates of hazards associated with each sample location were made by comparing the calculated totals from the results with a total toxicity 95%-UCL of 3 mg/kg. Table 4-18 presents the calculations for the three samples with TEF-BaP cPAH levels above 1.0, and compares them with the UCLs for urban totals and the urban TEF data. Only sample AAA1990 exceeds these levels.

4.12.4 Evaluation and Recommendations

Analytical results for radionuclides, herbicides, and PCBs show that none were detected at levels significantly above background concentrations. Pesticides and VOCs were detected above background, but below SALs. Low-SAL SVOCs, all of which are PAHs, were detected in 6 of the 26 samples collected in the storage yard.

TABLE 4-18

CONTAMINATION ABOVE BACKGROUND AT SWMU 33-011(a)

CARCINOGENIC POLYNUCLEAR AROMATIC HYDROCARBON (cPAH)	TEF[1]	SAMPLE NUMBER AAA1988		SAMPLE NUMBER AAA1990		SAMPLE NUMBER AAA2021	
		mg/kg	Toxic equivalent	mg/kg	Toxic equivalent	mg/kg	Toxic equivalent
Benzo[a]pyrene	1.0	1.6	1.60	28.8	28.8	1.10	1.10
Benzo[a]anthracene	0.1	1.4	0.14	26.9	2.69	0.87	0.087
Benzo[b]fluoranthene	0.1	1.4	0.14	28.4	2.84	0.80	0.080
Benzo[k]fluoranthene	0.01	1.6	0.00	21.4	0.21	1.20	0.12
Chrysene	0.001	1.6	0.00	29.2	0.02	1.10	0.001
Dibenzo[a]anthracene	1.0	0.00	0.00	4.7	4.70	0	0
Indeno(1,2,3-cd)pyrene	0.1	0.6	0.06	14.3	1.43	0.56	0.056
Totals	NA	11.2	1.94	153.7	40.7	5.63	1.44
95% UCL [2] urban total	*NA*	*12.4*	*NA*	*12.4*	*NA*	*12.4*	*NA*
95% UCL urban TEF total	*NA*	*NA*	*3*	*NA*	*3*	*NA*	*3*

[1] Toxic equivalency factor
[2] Upper confidence level

For five of these samples the total cPAH and B(a)P-toxic equivalency factor(TEF-BaP) concentrations were below 12.42 mg/kg and 3.3 mg/kg, respectively, which are the 95% UCL for mean background levels of PAH in urban soils (Bradley 1994, 1144). Only one sample, AAA1990, contained PAHs at levels exceeding the Bradley urban background levels. Sample AAA1990 was collected from a location only inches away from a large stack of drilling pipe known to have been coated with an oil-based preservative. This information, together with the fact that lower levels of PAH were found in other samples, leads to the conclusion that the elevated levels of PAH in sample AAA1990 are not the result of releases from SWMU 33-011(a) but may be the result of runoff from the pipe. The pipe is now dry and rusty.

Statistics on the cPAH data were developed in accordance with EPA's risk assessment guidance. Both the arithmetic mean and the 95% UCL for each PAH detected in the pipe storage yard exposure unit are lower than the corresponding PAH-specific arithmetic means and 95% UCLs described by Bradley as urban background levels. These data are summarized in Table 4-19.

Although the mean and 95% UCL concentrations of cPAHs in soils in the pipe storage yard are less than the corresponding urban background

TABLE 4-19

STATISTICS ON CPAH DATA AT SWMU 33-011(a)

COMPOUND	ARITHMETIC MEAN (LANL) mg/kg	ARITHMETIC MEAN (URBAN BACKGROUND) mg/kg	95% UCL (LANL) mg/kg	95% UCL (URBAN BACKGROUND) mg/kg
Benzo(a)anthracene	0.625	1.319	0.976	1.858
Benzo(a)pyrene	0.708	1.323	1.118	1.816
Benzo(b)fluoranthene	0.659	1.435	1.029	1.973
Benzo(k)fluoranthene	0.651	1.681	1.009	2.522
Chrysene	0.721	1.841	1.141	2.693
Dibenzo(a,h)anthracene	0.260	0.388	0.340	0.521
Indeno(1,2,3-cd)pyrene	0.438	0.987	0.637	1.293

concentrations described by Bradley, the cPAH concentrations in sample AAA1990 exceed the maximum concentrations found by Bradley. Consequently, a risk assessment was performed to evaluate potential risks to both children and adults under various scenarios. Exposure parameters for each scenario are described in Appendix K of the IWP (LANL 1992, 0768). The results of the assessment are summarized in Table 4-20.

TABLE 4-20

RESULTS OF RISK ASSESSMENT AT SWMU 33-011(a)

SCENARIO	ADULT CANCER RISK	ADULT NON-CANCER RISK	CHILD CANCER RISK	CHILD NON-CANCER RISK
Residential	0.00007	None	0.00004	None
Camper	0.000004	None	0.000003	None
Hiker	0.000002	None	Not applicable	None
Long-term worker	0.000004	None	Not applicable	None
Construction worker	0.0000007	None	Not applicable	None

The results show that potential risks to both adults and children under both the residential and recreational scenarios are within ranges that could be considered acceptable under certain circumstances. The potential risks under the recreational scenario are at least an order of magnitude lower than they are under the residential scenario. As part of a public involvement project, LANL plans to solicit input from the public on whether the most appropriate future land use at this and other areas of TA-33 should be recreational.

There are several compelling reasons to dedicate at least parts of TA-33 to recreational use in the future. First, TA-33 is adjacent to Bandelier National Monument and the site would be a logical extension to existing monument lands, available to hikers and campers. Moreover, there are scenic vistas of the Rio Grande and Rio Grande Canyon from parts of the site. This concern is in keeping with EPA's perspective on preserving areas with public access and aesthetic value; for example, in its regulations on Prevention of Significant Deterioration of Air Quality, EPA defines acceptable air quality impacts from new or modified sources more stringently in Class I areas (e.g., the Grand Canyon) than it did in other areas.

If parts of TA-33 and SWMU 33-011(a) in particular are dedicated to recreational use, then no additional site characterization or remediation is considered necessary. (Once again, however, the project will solicit public participation in that decision-making process). Minimizing remediation (if the risks to the public are deemed acceptable) benefits the area ecology, which has already adapted to environmental changes that resulted from historical site activity and which would be adversely assaulted by remediation activities.

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