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#71478

ESHID-603492

NFA Report for Potential Release Sites

33-002(b–c)
33-003(b)
33-004(k)
33-006(a)
33-008(a–b)
33-011(d)
33-013
33-017

(located in former
Operable Unit 1122)

Field Unit 3

**Environmental
Restoration
Project**

September 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-2943

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EXECUTIVE SUMMARY

This Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) report discusses investigations and results for ten potential release sites (PRSs) recommended for no further action (NFA) for human health. This report does not address ecotoxicological or other regulatory concerns. All PRSs are located within Technical Area 33 (TA-33) in the extreme southeastern section of Los Alamos National Laboratory (LANL). From 1948 until 1972, experiments on initiators, a component of nuclear weapons, were conducted at TA-33. After 1972, the site housed offices and storage facilities for a geology group, then, beginning in 1989, offices and shops for an electronics development group. The electronics group moved out in 1995. TA-33 is currently used for short-term experiments by various groups.

The PRSs included in this report are located at Main Site, South Site, and East Site. Main Site contained offices, shops, and laboratories. South Site was used as a firing area where aboveground high explosives (HE) tests were conducted from 1952 until approximately 1955. East Site was operational between 1955 and 1972 and was used as a firing site for testing experimental apparatus in nonexplosive projectiles. Except for storage and occasional short-term experiments, both firing sites have been inactive since 1972.

Sampling was conducted at Main, South, and East sites between May and November of 1996. The investigation consisted of collecting surface samples, hand-augered subsurface samples, and borehole drilling samples. All samples were submitted to the Environmental Restoration (ER) Project's sample management office. Analyses were performed for radionuclides, inorganic analytes, volatile and semivolatile organic compounds, polychlorinated biphenyls (PCBs), and HE, as appropriate.

Phase I sampling was conducted at two PRSs. Phase II sampling was performed at seven PRSs where Phase I investigation had determined the presence of contamination or where Phase I results were inconclusive. One PRS, an outfall, could not be found. The PRSs discussed in this report are listed in Table ES-1. Summaries of the investigations and their results follow Table ES-1.

Criteria for NFA for human health are listed in Section 3.6 of this report. Discussions of human health risk assessment at several PRSs are based on an industrial scenario, on the assumption that TA-33 will remain an industrial site under LANL control.

PRS 33-002(b) is sump TA-33-134, located at Material Disposal Area K (MDA K). The sump was further investigated because Phase I sampling, which may not have located the maximum contaminant concentrations, was inconclusive. Phase II sampling confirmed that tritium was present above screening action level (SAL), but below risk levels. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

TABLE ES-1
SUMMARY OF PROPOSED ACTIONS

		PROPOSED ACTION			
PRS No.	HSWA[a]	NFA Criterion	Further Action	Rationale	Section No.
33-002(b)	X	5	None	Acceptable risk	5.1.11
33-002(c)	X	5	None	Acceptable risk	5.2.11
33-003(b)	X	5	None	Acceptable risk	5.3.11
33-004(k)	X	1	None	Outfall not found	5.4.11
33-006(a)	X	5	None	Contamination below screening action levels (SALs) confirmed	5.5.11
33-008(a)	X	5	None	Acceptable risk	5.6.11
33-008(b)	X	5	None	Acceptable risk	5.7.11
33-011(d)	X	5	None	Acceptable risk	5.8.11
33-013	X	5	None	Acceptable risk	5.9.11
33-017	X	5	None	Acceptable risk	5.10.11

a. An X in this column indicates that the site is listed on the Hazardous and Solid Waste Amendments (HSWA) Module VIII of the Laboratory's RCRA operating permit (EPA 1990, 0306).

PRS 33-002(c) is sump TA-33-133, located at MDA K. The sump was further investigated because Phase I sampling was inconclusive. Phase I sampling may not have located the sump or the maximum contaminant concentrations associated with the sump. Phase II sampling confirmed that tritium was present below SAL. Further investigation of anomalous plutonium results from Phase I sampling verified that plutonium was not present at levels of concern. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

PRS 33-003(b) is underground chamber TA-33-6, located at MDA D in East Site. Archival research conducted after the RFI work plan was written indicated that PCBs may have been deposited as a result of a chamber experiment. Additional surface and subsurface samples were taken during 1996; no PCBs were detected at levels of concern. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

PRS 33-004(k) is an alleged outfall from bunker TA-33-87 at East Site. Investigation during the 1994 and 1996 field campaigns failed to locate either a drain line or an outfall. Based on these efforts, and the benign history of TA-33-87, the PRS is proposed for NFA for human health under Criterion 1: The PRS cannot be found.

PRS 33-006(a) is the shot pad at South Site where implosion studies were conducted in the mid-1950s. Uranium and copper are widely distributed in the site's soils. Risk assessment results indicated that these contaminants do not pose an unacceptable risk. The 1994 HE analyses at South Site were compromised by missed holding times. Limited resampling confirmed that HE is not present in

concentrations of concern. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

PRS 33-008(a) is a landfill that was established in 1984 as part of a debris cleanup at South Site. The landfill contains primarily wood debris. Phase I sampling performed in 1996 found no hazardous contamination at levels of concern. Further action is not warranted, and the PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

PRS 33-008(b) is a landfill that was established in 1984 as part of a debris cleanup at East Site. The landfill contains *primarily wood debris. Phase I sampling performed in 1996 found no hazardous* contamination at levels of concern, and further action is not warranted. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

PRS 33-011(d) was a paved outdoor storage area surrounding warehouse TA-33-20 at East Site. During the 1994 sampling campaign, lead, uranium, and tritium were detected above SALs in one asphalt sample and its duplicate. Phase II sampling, completed in 1996, indicated that contamination is at acceptable levels. The PRS is *proposed for NFA for human health under Criterion 5 because it has been* investigated and evaluated.

PRS 33-013 is a *paved drum storage area located east of the tritium facility,* TA-33-86. During the 1993 sampling campaign, cadmium, chromium, and tritium were observed above SALs. Beryllium was measured above soil background levels. Phase II sampling did not find these contaminants at levels of concern. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

PRS 33-017 was intended to assess potential contamination that may have resulted from operational releases at Main Site. Phase I sampling indicated that a wide area around Main Site did not contain contaminants above LANL background. The area east of former shop TA-33-39 contained elevated polycyclic aromatic hydrocarbons (PAHs) where vehicles had been parked and where vehicle maintenance was known to have occurred. Phase II sampling indicated that PAHs were present at insufficient concentrations to represent a hazard to human health or the environment. The PRS is recommended for NFA for human health under Criterion 5 because it has been investigated and evaluated.

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CONTENTS

LIST OF TABLES

APPENDIX A TABLES

APPENDIX B TABLES

LIST OF FIGURES

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1.0 INTRODUCTION

1.1 General Site History

Technical Area 33 (TA-33) is located at the southeastern corner of Los Alamos National Laboratory (LANL) (Fig. 1.1-1, Fig. 1.1-2). TA-33 is divided into five discontinuous sites (Fig. 1.1-3). Main Site was the location of offices, shops, a warehouse, and the tritium facility. Area 6, South Site, and East Site were firing sites. A large radiotelescope currently occupies the fifth site, formerly a staging and storage area.

TA-33 was established in 1947. All five sites were used until 1972 for testing a component of nuclear weapons called *initiators.* The firing sites have been inactive since 1972, except for storage and occasional short-term experiments. Between 1972 and 1989, Main Site housed offices and storage facilities that were used by a geology group. After 1989, the offices and shops housed an electronics development group. In 1995, the electronics group left TA-33. A tritium facility operated at Main Site from 1955 until 1990; Material Disposal Area K (MDA K) contains the septic tanks, sumps, and outfalls from this facility. Although not presently used for programmatic activities, the TA is still considered active; a few buildings are used for storage or for short-term projects.

This report evaluates potential release sites (PRSs) at East Site, South Site, and Main Site. At East Site, tests were conducted in underground chambers in 1948 and in 1952. Also at East Site, between 1955 and 1972, large guns fired non-exploding projectiles containing experimental apparatus into berms and catcherboxes. Similar experiments, as well as aboveground explosive tests, were performed at South Site between 1952 and 1955. Main Site contained storage and holding areas in addition to shops and offices. A tritium facility was in operation at Main Site between 1955 and 1990.

The following materials may have contributed to contamination at the PRSs discussed in this report: cadmium, chromium, lead, uranium, tritium, semivolatile organic compounds (SVOCs), high explosives (HE), and polychlorinated biphenyls (PCBs). Small volumes of other materials may have been used at any of these sites. Although radionuclides are regulated by the Department of Energy (DOE) and not regulated under the Resource Conservation and Recovery Act (RCRA), it is more efficient and cost-effective to investigate all types of potential contamination during a single site characterization. Therefore, radiochemical concerns are addressed in this report.

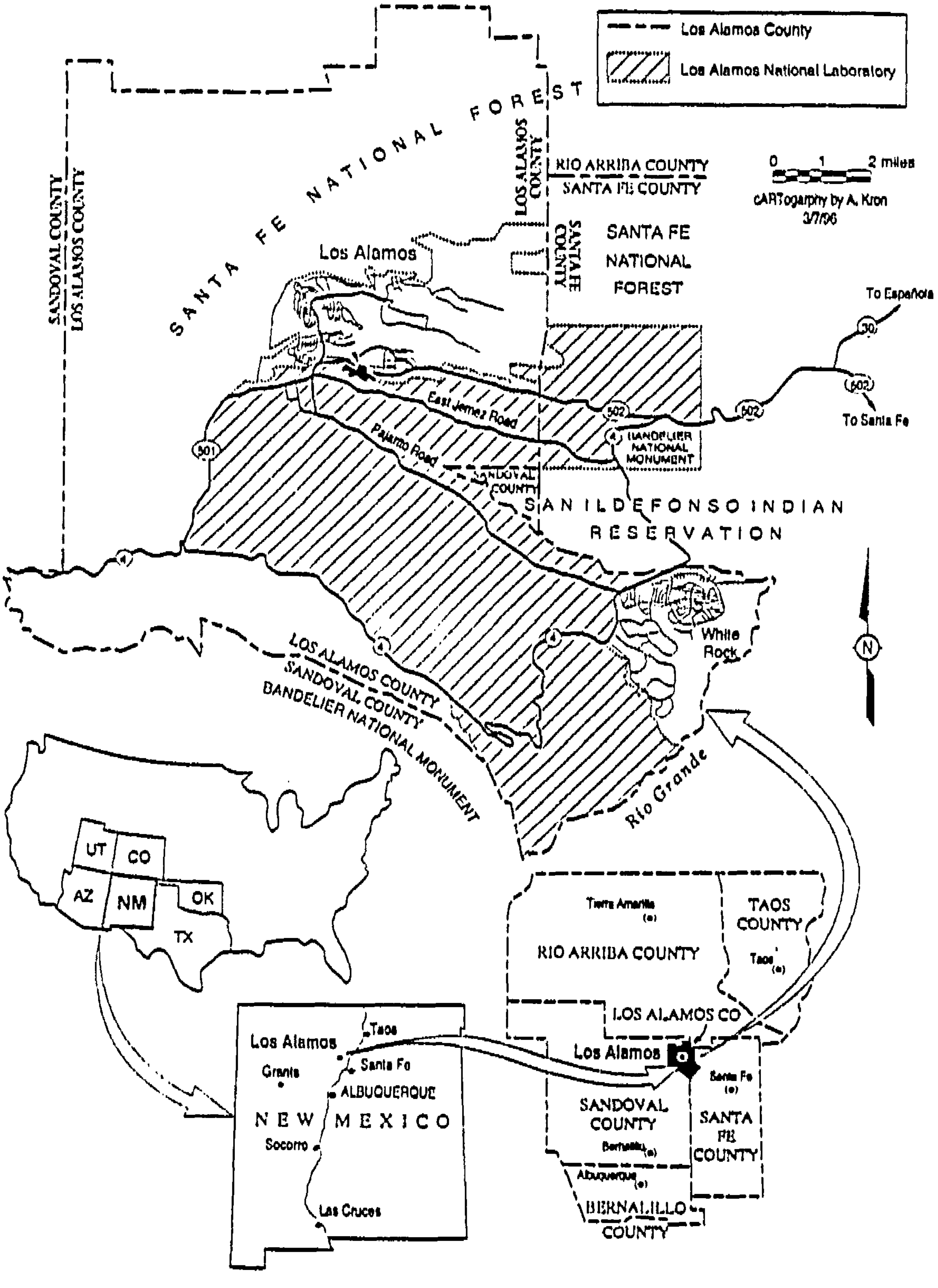


Fig. 1.1-1. Location of Los Alamos National Laboratory.

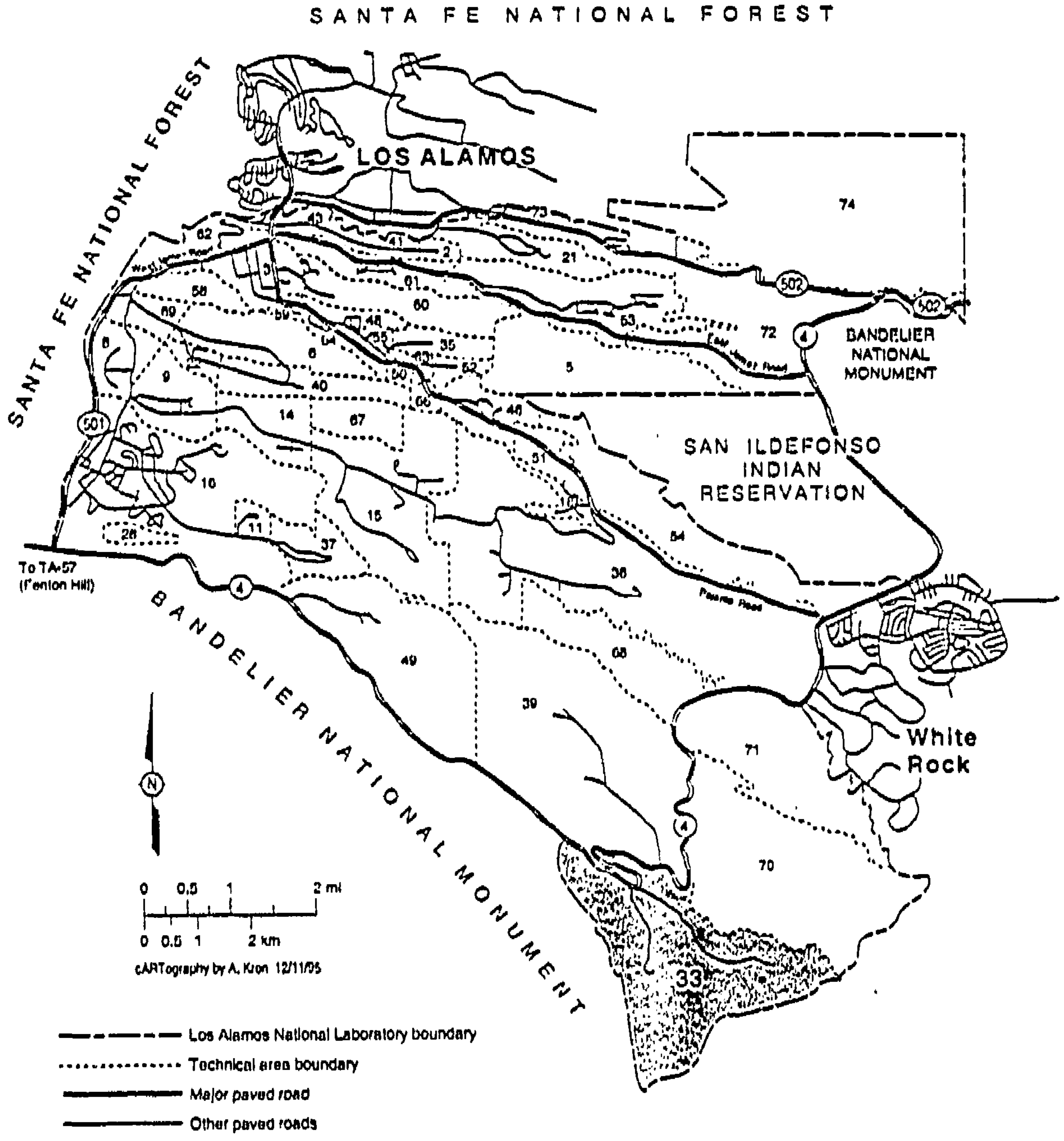


Fig. 1.1-2. Location of TA-33 with respect to Laboratory TAs and surrounding land holdings.

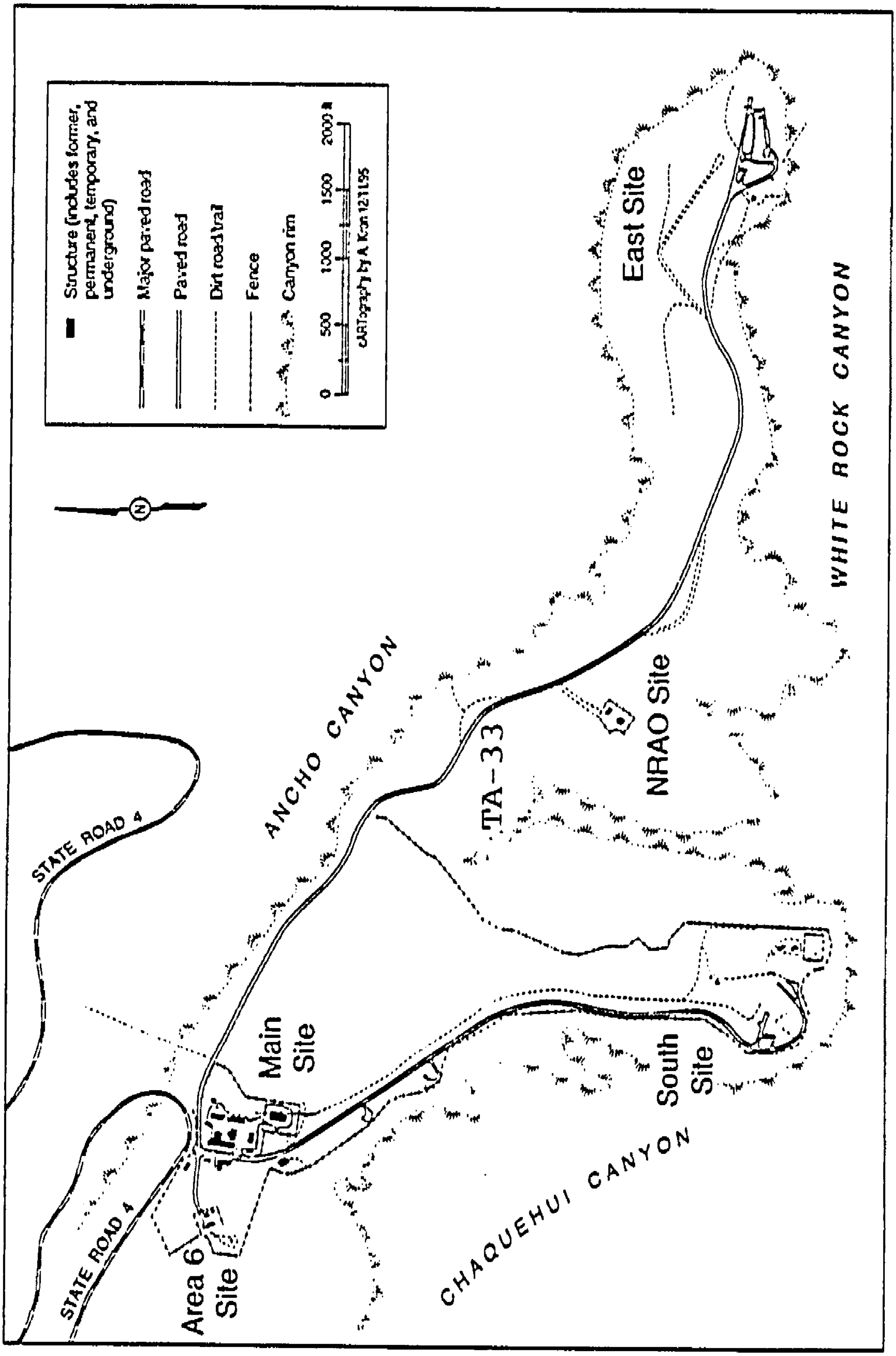


Fig. 1.1-3. TA-33, showing the discontinuous five sites.

1.2 RFI Overview

The TA-33 RFI Work Plan for Operable Unit 1122 was submitted to Environmental Protection Agency (EPA) Region 6 in May 1992 (LANL 1992, 0784). EPA approved the plan, with minor modifications, in July 1993 (EPA 1993, 02-090). Phase II and modified Phase I sampling plans were included in RFI reports submitted during September 1995 (Environmental Restoration Project 1995, 1263) and December 1995 (Environmental Restoration Project 1995, 1288). The technical approach of the plan used phased sampling to locate the sources of any contamination associated with LANL activities. Contaminants detected during Phase I reconnaissance sampling were subject to Phase II sampling. Three PRSs—33-011(d), 33-013, and 33-017—have undergone Phase II sampling as described in Section 5 of this report. At MDA K, Phase II sampling and analyses were conducted in 1996 in accordance with plans detailed in the September 1995 RFI report for MDA K (Environmental Restoration Project 1995, 1263). These previous reports are summarized in Table 1.2-1.

Conceptual models were developed for three different exposure scenarios (current use, recreational use, construction) as described in Section 3.1.2 of the RFI Work Plan for Operable Unit 1122. Primary release mechanisms at TA-33 include sediment transport and resuspension by wind. Other release mechanisms considered in the plan were landslide/erosion, biological activity, and dissolution in runoff (LANL 1992, 0784).

All PRSs in this report are recommended for no further action (NFA) for human health. Ecotoxicological and other regulatory concerns have not been addressed at the PRSs discussed in this report.

TABLE 1.2-1

PREVIOUS REPORTS FOR TA-33 PRSs DISCUSSED IN THIS REPORT

PRS	REPORT DATE	LANL ID
33-002(b)	September 1995	1263[a]
33-002(c)	September 1995	1263
33-003(b)	September 1995	1265
33-004(k)	September 1995	1265
33-006(a)	December 1995	1288
	September 1996	None[b]
33-008(a)	September 1995	1265
33-008(b)	September 1995	1265
33-011(d)	September 1995	1265
33-013	September 1995	1265
33-017	September 1995	1265

[a] As identified in Reference section of this report.
[b] Draft report submitted to DOE.

1.3 Field Activities

The 1996 sampling campaign at TA-33 was conducted by ICF-Kaiser personnel and is documented in the 1996 field summary report (ICF-Kaiser 1997, 02-120). For the PRSs in this report, fieldwork was performed between May and November of 1996. Field sampling activities included surface sample collection for field screening and fixed laboratory analysis, borehole drilling and subsurface sample collection, and use of a jackhammer for sampling under asphalt. Extensive field screening for PCBs was employed, as described in Section 5 of this report.

Sampling locations at TA-33 were selected using the criteria outlined in the RFI Work Plan for Operable Unit 1122 (LANL 1992, 0784) or in the individual Phase II sampling and analysis plans. For several PRSs, a grid was specified in which samples were selected randomly within each cell. Several sampling locations were targeted for resampling in the Phase II plans.

Radiation screening surveys were routinely conducted at each PRS prior to sampling. This was done as part of worker safety protocol and to determine shipping requirements for each sample. All sampling locations were surveyed using global positioning system equipment.

Before any sample was taken, each undisturbed sample location was checked for the presence of above-background levels of radioactivity and for volatile organic compounds (VOCs). All samples were collected using current standard operating procedures (SOPs) (LANL 1993, 0875). After collection, all samples were cooled with ice packs in portable ice chests and submitted to both LANL's mobile radiological analytical laboratory (MRAL) and LANL's on-site laboratory for screening of the containers before being sent off-site. Chain of Custody/Request for Analysis forms were completed for each sample. All 1996 surface samples were taken from the surface to a depth of 6 in. within a diameter of approximately 6–8 in. Soil was collected from each sampling location using a dedicated stainless steel spoon and bowl.

A CME 750™ auger rig, outfitted with a hollow stem auger (4.25-in. inner diameter) and stainless steel split-spoon samplers (2.5 ft by 4 in.), was used to drill borehole samples. At each PRS, samples were collected from borehole cores as specified in the sampling and analysis plans.

1.3.1 Quality Assessment Samples

A total of 297 samples were collected during the 1996 field campaign. Nine field duplicates were collected as quality assessment samples during the investigation by filling two sets of containers with soil from the same locations.

1.3.2 Deviations from RFI Work Plans and Phase II Sampling and Analysis Plans

The following deviations from the relevant work plans were performed:

- No samples were collected at 33-004(k) because the outfall could not be found.
- No debris samples were collected at landfills 33-008(a) and 33-008(b) because of the size and metallic nature of some of the debris. Instead, samples were collected from soil surrounding debris.
- Only three samples were collected, instead of four, from each of three boreholes at 33-008(b) because of the shallow depth to tuff.
- To break asphalt at PRS 33-011(d), a jackhammer was used instead of an impact core drill. No asphalt samples were collected.
- Laser-induced breakdown spectroscopy (LIBS) was not used during the 1996 field campaign because the equipment was not readily available and the field team was not trained in the technique. X-ray fluorescence (XRF) for screening inorganic constituents was considered equivalent and more suitable under field conditions.

2.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in Section 2.3 of the Installation Work Plan (IWP) for Environmental Restoration (LANL 1996, 1379). A discussion of the environmental setting, including climate, geology, hydrology, and a conceptual hydrogeologic model for the area and surroundings, is presented in Section 2.5 of the RFI Work Plan for Operable Unit 1122 (LANL 1992, 0784). A summary is presented in the following sections.

2.1 Climate

Los Alamos County has a semiarid, temperate, mountain climate. Summers are generally sunny with moderate, warm days and cool nights. High altitude, light winds, clear skies, and dry atmosphere allow summer temperatures to range from 50°F to 80°F at TA-33. During the winter, temperatures typically range from 14°F to 54°F. The average annual rainfall in the area of TA-33 is estimated to range from 8 to 19 in. Of this total, approximately 40% occurs as brief, intense thunderstorms during July and August. Intermittent stream flow in adjacent canyons can occur as a result of these storms. Spring snowmelt runoff may also induce intermittent stream flow in local canyons.

2.2 Geology

2.2.1 Geologic Setting

A detailed discussion of the geology of the entire Los Alamos area can be found in Section 2.4 of the 1996 IWP (LANL 1996, 1379). The geology of TA-33 is described in Section 2.5 of the RFI Work Plan for Operable Unit 1122 and summarized here. The Rio Grande's White Rock Canyon, which is 1000 ft deep, is the southeastern boundary of TA-33. Two tributaries of the Rio Grande form Ancho and Chaquehui Canyons and join White Rock Canyon at TA-33. The five separate sites at TA-33 are located on level mesas between the two tributary canyons. East Site and the National Radioastronomy Observatory (NRAO) site are located near the south rim of Ancho Canyon. South Site is located on the north rim of Chaquehui Canyon. Runoff from East Site drains primarily into White Rock Canyon. Runoff from Main Site, NRAO, and South Site drains into Chaquehui Canyon.

LANL activities were confined to the mesa between the two canyons, where bedrock is primarily composed of Unit 2 of the Tshirege Member of Bandelier Tuff. Deposits of Unit 3 are intermittent at the eastern end of TA-33. Unit 2 constitutes the bedrock at East Site, which is underlain by approximately 125 ft of Units 2, 1v, and 1g. At South Site, remnants of Unit 3 of the Tshirege Member are exposed at high points north and west of the site. Bedrock at South Site consists of Unit 2, approximately 50 ft in depth, underlain by approximately 150 ft of Units 1v and 1g. The tuffs at TA-33 are underlain by 650 ft of basalts, including tholeiitic, andesitic, and phreatomagmatic basalt deposits. Beneath the basalt layers are sedimentary deposits of the Puye Formation and the Santa Fe Group (Reneau et al. 1995, 02-092). Data on the subsurface geology at TA-33 were obtained from deep boreholes located at MDA K. A full description of the core logging of these boreholes is provided in the RFI report for MDA K submitted to EPA in September 1995 (Environmental Restoration Project 1995, 1263).

The geology at MDA K is described in detail in the RFI report for MDA K (Environmental Restoration Project 1995, 1263). In summary, at the 1993 boreholes, soils ranged from 0.2 to 1.3 ft deep and were underlain by weathered tuff. Unit 3 of the Tshirege Member of Bandelier Tuff, consisting of pumice and non-welded tuff, extended from near the surface to 10 ft. Unit 2, consisting of non-welded to slightly or moderately welded tuff with pumice, extended to 73 ft. Unit 1v extended from 73 ft to 170 ft; it consists of moderately welded tuff with pumice. The vapor-phase notch is at 170 ft. Below the vapor-phase notch is Unit 1g of the Tshirege Member. It consists of non-welded tuff with phenocrysts, lithics, and glassy pumice extending to 216 ft. Here is the base of the ash flow Bandelier Tuffs, with 6 ft of fallout/surge reworked,

glassy tuffs, pumice, and sand crystals. Below the tuffs are sediments of the Puye Formation, extending from 222 ft to 268 ft and containing abundant basaltic cinders. The Cerros del Rio basalts are encountered at 268 ft below the surface. Reneau et al. provide a detailed description of the geology and geomorphology of TA-33 (Reneau et al. 1995, 02-092).

Drilling in 1996 did not penetrate below the various units of the Bandelier Tuff because sampling and analysis indicates that tritium is bounded within the tuff.

2.2.2 Soils

A discussion of the soils in the Los Alamos area can be found in Section 2.4.1.3 of the IWP (LANL 1996, 1379). Soil at Main Site and the surrounding mesa top is classified as Hackroy Rock Complex (Nyhan et al. 1978, 0161). Field logs indicate that soils at MDA K range from 0- to 8-ft deep. Soils may be sandy and contain many pumice pebbles ranging up to 0.5 in. in size. Clay lenses may be intermixed with pulverized tuff. Soils in the drainages are sandy, with some clay and many small pebbles. Bedrock is exposed at many areas on the lower (eastern) part of the site, including the drainage channels east of the septic system.

Soil at South Site is classified as Hackroy Rock outcrop complex. Parent Hackroy soils are shallow, well-drained soils that form on mesa tops from weathered tuff. The surface layer is a brown, sandy loam approximately 4 in. thick. Hackroy subsoil is a reddish brown clay mixed with gravel or loam approximately 8 in. deep. The Hackroy Rock outcrop complex contains 20% Hackroy soils, 10% Nyjack soils, and 70% rock outcrop. Nyjack soil is similar to Hackroy but deeper and more loamy. Much of the soil at South Site was scraped to bedrock to build the berms.

Soil at East Site and NRAO is classified as Mesic Rock outcrop land type, containing 65% rock outcrop, 5% undeveloped soil, 5% Hackroy soil, and 25% narrow escarpments (Nyhan et al. 1978, 0161). Most of East Site has been scraped to bedrock to supply material for the berms. Soils at NRAO range from 0- to 1-ft deep.

2.3 Hydrology

The hydrology of the Pajarito Plateau is summarized in Section 2.4.2 of the IWP (LANL 1996, 1379). Few activities performed during the TA-33 1996 sampling campaign affected or were influenced by hydrological considerations. Drilling to the 120-ft depth at MDA K in 1996 did not encounter perched or ground water.

2.3.1 Surface Water

TA-33 is bounded by canyons. At TA-33, ephemeral surface water flow to local canyons may be expected during the spring snowmelt and summer thunderstorm seasons. Surface water does not collect on the mesas at the PRSs discussed in this report.

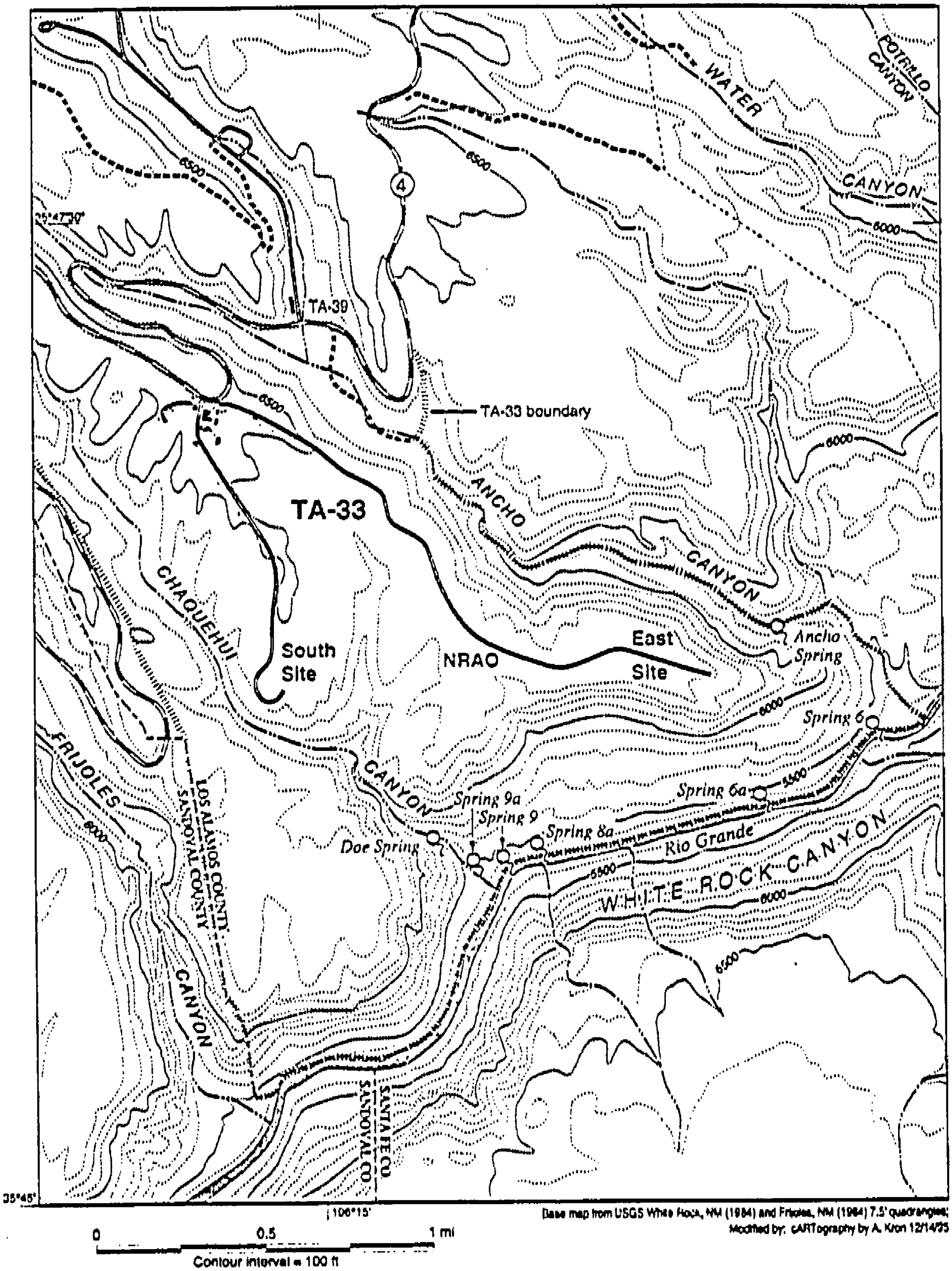
2.3.2 Groundwater

At East Site (elevation 6400 ft) the depth of groundwater is assumed to be 700 ft, based on the elevation (5700 ft) of a spring in Ancho Canyon. At South Site (elevation 6400 ft) the depth of groundwater is assumed to be 800 ft, based on the elevation (5600 ft) of Doe Spring in White Rock Canyon. No groundwater wells are located in or near TA-33. Deep drilling at MDA K at Main Site did not encounter perched water. In a geomorphological study of TA-33, no evidence was found of springs nearer the firing sites (Reneau et al. 1995, 02-092). Fig. 2.3.2-1 shows the topography of TA-33 and the relationship of the firing sites to known springs in Ancho and White Rock Canyons.

2.4 Biological Surveys

Biological resource field surveys were conducted at TA-33 for compliance with the Federal Endangered Species Act of 1973; the New Mexico Wildlife Conservation Act; the New Mexico Endangered Species Act; Executive Order 11990, Protection of Wetlands; Executive Order 11988, Floodplain Management; 10 CFR 1022; Department of Energy (DOE) Compliance with Floodplain/Wetlands Environmental Review Requirements (DOE 1979, 0633); and DOE Order 5400.1, General Environmental Protection Program (DOE 1988, 0075). The biological summary is included as Appendix B in the RFI Work Plan for Operable Unit 1122 (LANL 1992, 0784).

Environmental conditions at PRSs discussed in this RFI report were highly disturbed during construction in 1947 and the early 1950s. Currently, the firing sites are either scraped to bedrock or overgrown with chamisa. No habitats for threatened or endangered species were identified on the mesas. Bald eagles, golden eagles, and peregrine falcons forage—and possibly nest—in White Rock Canyon near TA-33. LANL activities are restricted at TA-33 between November 1 and July 1. Field surveys for these birds must be conducted at East Site before noisy equipment can be used. South Site is not affected by this restriction. Habitats for additional threatened and endangered species were mapped in the canyons below TA-33, but no such species were found during the surveys.



Base map from USGS White Rock, NM (1984) and Frijoles, NM (1984) 7.5' quadrangles;
Modified by: cARTography by A. Kron 12/14/95

Fig. 2.3.2-1. Springs at TA-33.

2.5 Cultural Surveys

A cultural resource survey was conducted at TA-33 as required by the National Historic Preservation Act (National Park Service 1983, 0632). Sixty-four archaeological sites were identified at TA-33. One large ruin is located within 100 ft of the MDA K drain field. The ruin was roped off during sampling activities. No archaeological sites were affected by investigation of the PRSs discussed in this report.

South Site: One small archaeological site is located approximately 100 ft northwest of PRS 33-008(a). The site is undisturbed and surrounded by juniper; it was not affected by operational activities or by the Environmental Restoration (ER) Project's sampling activities. No other archaeological sites are located on the mesa at South Site.

East Site: One archaeological site is located on the mesa at the west end of East Site. The site is undisturbed and surrounded by juniper. It is located near an area that was cleared in 1948 during the construction of East Site. No PRSs are nearby. No operational or ER activities have been conducted near this archaeological site.

Main Site: One archaeological site is located near TA-33-20 and PRS 33-011(d). The ruin is located outside the security fence. No ER activities took place in this archaeological area. A large ruin that is located southeast of TA-33-86 was not affected by activities in the paved area at PRS 33-013 or by the sumps at the west end of MDA K.

3.0 APPROACH TO DATA ASSESSMENT AND ANALYSIS

The ER Project's approach to data assessment is described in the policy document entitled Risk-Based Corrective Action Process (Dorries 1996, 1297). This approach includes

- sampling and analysis design,
- field investigation and collection of field and quality assurance (QA) samples,
- chemical and radiochemical analyses of samples and reporting of analytical data,
- baseline verification and validation of analytical data,
- organization of field and analytical data into PRS-specific data sets,
- exploratory data analysis,

- focused validation—when necessary—to further assess questionable data,
- comparison of validated analytical results with LANL background data,
- comparison of validated analytical results with SALs,
- evaluation of sufficiency of data sets to support site decisions, and
- assessment of human health and ecological risk.

The following sections provide an overview of the methods used to complete the steps listed above for the PRSs discussed in this RFI report.

3.1 Sample Analyses

Although neither NMED nor EPA reviewed or approved the relevant Phase II sampling and analysis plans, sampling proceeded at risk in spring 1996. Unless otherwise noted, samples were collected in accordance with the sampling design specified in the 1995 RFI Report for PRSs 33-003(b), 33-008(a), 33-008(b), 33-011(d), 33-013, and 33-017 (Environmental Restoration Project 1995, 1265), the RFI Report for PRS 33-006(a) (Environmental Restoration Project 1995, 1288), and the RFI Report for MDA K (Environmental Restoration Project 1995, 1263). All samples requiring chemical and radiochemical analyses and chain-of-custody documentation were submitted to the sample management office (SMO) and to the MRAL. Extensive use was made of field X-ray fluorescence and PCB field-screening kits, as described in appropriate sections of Section 5 in this report.

3.1.1 Analytical Methods

The following analytical suites were used for the sample analyses in this report: inorganic chemicals, radionuclides, VOCs, SVOCs, PCBs, and HE. Appendix A lists the target analytes for which analyses were performed for the purpose of this report.

All samples were analyzed by contract analytical laboratories using methods specified in ER SMO analytical subcontracts (LANL 1995, 1278). The allowed methods are current EPA SW-846 and Contract Laboratory Program (CLP) methods, or equivalent, for inorganic chemicals, VOCs, SVOCs, PCBs, and HE. Prior to analysis for inorganic chemicals, solid samples were digested according to EPA SW-846 method 3050 or equivalent (EPA 1992, 1207). The above-mentioned subcontracts specify LANL-approved methods for radiochemical analyses according to technologies identified in those subcontracts (e.g., tritium by liquid

scintillation). Analytical method selection is described in Appendix IV of the ER Project Quality Assurance Project Plan Requirements for Sampling and Analysis (QAPP) (LANL 1996, 1292). For each analyte, quantitation or detection limits are specified as contract-required estimated quantitation limits (EQLs) for organic chemicals and radionuclides, and as estimated detection limits (EDLs) for inorganic chemicals. These limits are included in Appendix III of the ER Project QAPP, along with the target analytes for each analytical suite.

3.1.2 Data Verification and Validation

Data verification and baseline validation procedures were used to determine if data packages received from the analytical laboratory were generated according to specifications, and if they contained sufficient data for decision-making. For analytical data used to make the decisions discussed in this RFI report, baseline data validation under the ER protocol was performed as described in the QAPP (LANL 1996, 1292).

This process produced validation reports, with data qualifiers that designated potential deficiencies in the affected results. Each data qualifier is accompanied by a reason code that provided information about the deficiency that led to qualification of the data. The validation reports were used to help make decisions and to direct the focused validations needed for evaluating the usability of data for this report.

Data were qualified (i.e., a marker was attached to the data results) for a variety of reasons during the baseline validation process. The baseline validation procedure used for routine analytical services provides information about the reason a qualifier was applied and its potential impact on the affected data. The purpose is not to reject data but rather to ensure that the relative quality of the data is understood so that the data may be used appropriately.

The following data qualifiers are used in the LANL ER Project baseline validation process:

A The data required for data review and evaluation are not available.

U The analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL.

J The analyte was positively identified, but below the sample-specific EQL/EDL. The associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.

J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific EQL/EDL.
RPM	Without further review of the raw data, the sample results are unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. Presence or absence cannot be verified. NOTE: Any results qualified as RPM must be evaluated for relevance to data use.
P	Professional judgment should be applied to using the data in decision-making.
PM	Professional judgment should be applied to using the data in decision-making. A manual review of raw data is recommended to determine if the defect impacts data use for decision-making.

A focused data validation may be required as a follow-up to the baseline validation. The purpose of a focused validation is to determine the technical adequacy of measurement data when

- the data are qualified as deficient or as requiring professional judgment during the verification/baseline validation process (for example, when holding times are exceeded or interferences are present, a focused validation may be required to assist in determining data adequacy for the intended use), or
- the data quality assessment process requires additional information either about the variability or uncertainty of the reported data or about the data quality prior to making a data use decision because of anomalies detected in a data set.

Details of quality assurance/quality control activities are presented in Section 4 of this report. Qualifiers resulting from baseline and focused validation are shown in the analytical results tables included in Section 5 of this report. Summaries of data quality evaluations and focused validation of analytical data relevant to this report are given in Appendix B. The RPM, P, and PM qualifiers do not appear in Section 5 data tables, nor in Appendix B, because they are replaced during focused validation according to the data's use.

3.2 Process for the Identification of Chemicals of Potential Concern (COPCs)

3.2.1 Inorganic Chemicals

Detected inorganic chemicals are compared with natural background distributions to determine if they should be retained as COPCs or eliminated from further consideration. The inorganic background data used in this report are taken from soil, sediment, and/or tuff samples collected throughout Los Alamos County. Those samples were chemically analyzed for certain inorganic (metal) chemicals (Longmire et al. 1995, 1142; Longmire et al. 1995, 1266). All PRS samples in this report were collected from disturbed soil or fill material; the all-soil horizons background data set was used because the soil master horizon cannot be identified in disturbed material.

Comparisons between site data and background data are initially performed by comparing each observed concentration datum with a chemical-specific background screening value that is the upper tolerance limit (UTL), or the maximum reported concentration, or the detection limit of a nondetected chemical. These background screening values are derived from LANL-wide soil, sediment, and/or tuff background data. Details on the calculation of these values are presented in Longmire et al. (1995, 1266).

3.2.2 Radionuclides

Comparing reported radiochemical results with minimum detectable activities and background data is necessary for determining the presence of radionuclides and for distinguishing concentrations of radionuclides associated with Laboratory operations from those attributable to global fallout and/or to naturally occurring radionuclides. The LANL ER Project requires that radiochemical data be reported by a laboratory on the basis of a detection test. Therefore, as part of the data validation/data assessment, reported results must be evaluated to ensure that only those results that represent detection are used to classify a radionuclide as a COPC. This is typically done by comparing the reported value with the associated minimum detectable activity, if one is reported. When the minimum detectable activity is not available or does not meet the data quality needs of the ER Project, the reported value will be tested against an estimated minimum detectable activity. This estimated value is based on instrument counting error. The counting error is typically reported as the analytical uncertainty at a value of 1-sigma (i.e., one standard deviation), and the estimated minimum detectable activity is computed as 3-sigma.

Detected radionuclides are either retained as COPCs or eliminated from further consideration based on a comparison with natural or anthropogenic background distributions. The radionuclide background data used in this RFI report have been taken from the following sources:

- soil, sediment, and/or tuff samples collected throughout Los Alamos County for which chemical analyses were performed for naturally occurring radioactive chemicals, specifically uranium (Longmire et al. 1995, 1142; Longmire et al. 1995, 1266) and
- background concentrations of radioactive chemicals associated with global fallout from atmospheric nuclear testing (e.g., plutonium and tritium) reported in LANL Environmental Surveillance reports (Purtymun et al. 1987, 0211; ESG 1988, 0408; ESG 1989, 0308; EPG 1990, 0497; EPG 1992, 0740).

Comparisons between site data and background data are initially performed by comparing each observed concentration datum with a radionuclide-specific background screening value that is either the UTL or the maximum reported activity. These background screening values are derived from LANL-wide soil, sediment, and/or tuff background data. Details regarding the calculation of these values are presented in Longmire et al. (1995, 1266). Certain radionuclides in certain media have no LANL-wide background data. For these exceptions, PRS sample-specific minimum detectable activities are used as nominal background screening values.

3.2.3 Organic Chemicals

Background data are not available for organic chemicals. Organic chemicals that have been positively identified in one or more samples have been carried forward in the screening assessment process for the PRSs in this RFI report. Chemicals that have not been detected in any sample have been removed from further consideration.

3.2.4 Risk-Based Screening Assessment

Inorganic chemicals and radionuclides that exceed background, as well as organic chemicals that are positively identified in one or more samples, require further evaluation if they also exceed SALs. SALs for nonradioactive chemicals are based on EPA Region 9 preliminary remediation goals (PRGs) for residential soil and tap water. Where appropriate, certain EPA Region 9 water PRGs are supplanted by Native American Pueblo, state, or federal water quality standards. Soil and water media have separate SALs for each chemical. The decision to

identify a chemical as a COPC when a SAL is not available is made on a case-by-case basis, taking into account the availability of process knowledge and toxicological information.

If more than one COPC is present at a site, a multiple chemical evaluation (MCE) is performed to determine if the potentially additive effect of chemicals detected below SALs warrants additional investigation. The method used for performing an MCE is summarized in the policy document entitled "Risk-Based Corrective Action Process" (Dorries 1996, 1297). These comparisons are the last quantitative steps in the screening assessment process for human health concerns. If COPCs remain after this step, then further evaluation is required. If no COPCs remain after this step and the data set is sufficient to support the decision, an NFA recommendation may be proposed based on human health concerns.

If COPCs remain after the screening assessment, there are several options for the PRS. A further site-specific evaluation may lead to eliminating a COPC without going into a formal risk assessment. The site may be proposed for further sampling, either for complete characterization or for remediation if it is cost-effective to proceed without a risk assessment. A risk assessment may be conducted to determine if the remaining COPCs present an unacceptable human health risk.

3.3 Human Health Assessment

3.3.1 Risk Due to Naturally Occurring Inorganic Chemicals in Soils (Background)

Risk is associated with exposure to inorganic chemicals that naturally occur in soil. Using the same methodology as site risk estimation to calculate background risk provides a frame of reference for risk levels calculated at a site. This information provides a basis for determining risk-based remediation goals, which in some circumstances may be set at target risks comparable to background rather than default values (e.g., a cancer risk of 10^{-6} or a hazard index of 1). Background risk can also affect decisions at sites that contain chemicals for which there is a toxicity threshold. For some inorganic chemicals, background intake may be near a toxicity threshold such that incremental intake associated with contamination may be unacceptable.

Background risk estimates provided in Table 3.3.1-1 were calculated using the same exposure assumptions by which SALs are calculated. SALs are based on health-protective assumptions for a residential scenario (EPA 1995, 1307). For soil exposure, the pathways include incidental soil ingestion, inhalation of resuspended dust, and dermal contact with soil. The background soil data used for these calculations were collected from several soil horizons at geographically diverse locations. Background risks are estimated for two statistics. One statistic is the median,

which represents the midpoint of the concentration range (technically, the median is the concentration value that divides the results into two equal groups, or where half the data are above and half are below). The second statistic represents the upper range of background concentration values, and is either a calculated UTL or a maximum concentration value.

The background risks based on the LANL SAL residential exposure model are provided in Table 3.3.1-1. Risks due to background concentration are presented for both noncarcinogenic and carcinogenic outcomes. The potential for adverse noncarcinogenic health effects is estimated by a hazard quotient. A chemical intake leading to a hazard quotient of up to 1 is not associated with adverse health effects. None of the median background concentrations result in hazard quotients greater than 1. The hazard quotient of the UTL concentration for manganese exceeds 1 (1.9). However, exposure to naturally occurring manganese is not expected to have significant health consequences because of the unlikely occurrence of the UTL concentration over an entire exposure area, the conservative assumptions used in the exposure assessment, and the margin of safety incorporated into the reference dose.

Three of the background inorganic chemicals provided in Table 3.3.1-1 are also carcinogens. Applying the default exposure assumptions used for SALs, the lifetime cancer risks due to residential soil exposure to background concentrations (UTL column) are estimated at approximately 1 excess case of cancer in 100 000 people for beryllium, 2 in 100 000 for arsenic, and 2 in 1 000 000 000 for cadmium (carcinogenic only by inhalation). EPA uses a range of 1 excess case of cancer in 10 000 people to 1 in 1 000 000 as a guidance for an acceptable range of cancer risk (EPA 1990, 0559).

These background risk estimates provide a frame of reference for a risk-based screening assessment and site decisions. If a site-specific risk assessment is necessary to further evaluate risks, background risks can also be calculated using site/scenario-specific assumptions to assist in any remedial action decisions for the site.

TABLE 3.3.1-1

RISK DUE TO BACKGROUND CONCENTRATIONS OF INORGANIC CHEMICALS IN SOIL ASSUMING A RESIDENTIAL SCENARIO[a]

INORGANIC CHEMICAL	BACKGROUND SOIL CONCENTRATION[b] (mg/kg)		HAZARD QUOTIENT		LIFETIME CANCER RISK	
	Median	UTL	Median	UTL	Median	UTL
Aluminum	10 000	38 700	0.1	0.5	NC[c]	NC
Antimony	0.6	1[d]	0.02	0.03	NC	NC
Arsenic	4	7.82	0.2	0.4	1×10^{-6}	2×10^{-5}
Barium	130	315	0.03	0.06	NC	NC
Beryllium	0.895	1.95	0.003	0.006	6×10^{-6}	1×10^{-5}
Cadmium[e]	0.2	2.6[d]	0.005	0.07	1×10^{-10}	2×10^{-9}
Chromium[f]	8.6	19.3	0.00009	0.0002	NC	NC
Cobalt	6	19.2	0.001	0.004	NC	NC
Copper	5.75	15.5	0.002	0.01	NC	NC
Lead[g]	12	23.3	0.03	0.06	NC	NC
Manganese	320	714	0.8	1.9	NC	NC
Mercury	0.05	0.1[d]	0.002	0.004	NC	NC
Nickel	7	15.2	0.005	0.01	NC	NC
Selenium	0.3	1.7[d]	0.0008	0.005	NC	NC
Thallium	0.2	1[d]	0.03	0.2	NC	NC
Uranium	0.9	1.87	0.004	0.008	NC	NC
Vanadium	21	41.9	0.04	0.08	NC	NC
Zinc	30.7	50.8	0.001	0.002	NC	NC

a. Risk estimates are based on reference doses, slope factors, and EPA Region 9 default exposure assumptions effective April 1996
b. Background concentrations taken from the Longmire et al. all soil horizons data set (1995, 1142)
c. NC = Noncarcinogen
d. Maximum detected background value
e. Cancer risks for cadmium are based solely on inhalation of resuspended dust
f. Naturally occurring chromium is assumed to exist in a trivalent state
g. Hazard quotient based on biokinetic uptake model

3.3.2 Risk Assessment

The human health risk assessments presented in Section 5.x.9 follow the process outlined in the policy document "Risk-Based Corrective Action Process" (Dorries 1996, 1297) and consist of the following steps:

- identification of COPC concentrations,
- exposure assessment,
- toxicity assessment, and
- risk characterization.

3.4 Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

This section reviews the impact of laboratory quality control (QC) results on data usability. The QC results are summarized in Appendix B of this report, together with results from field quality assurance (QA) samples. In addition, this report includes data from a few samples, collected in 1994, whose data usability was evaluated in earlier reports.

A total of 297 samples were collected during the 1996 field season at TA-33. Data from 166 of them were used for decisions discussed in this report, including 140 that were submitted for analysis at off-site laboratories, 16 that were analyzed on-site by PCB immunoassay kits, and 10 that were analyzed by the MRAL. All of the 144 laboratory samples were samples of soil or tuff. Nine field duplicate soil or soil/tuff samples were collected during 1996; those are listed in Table 4.0-1.

All data were subjected to routine data validation. Appendix B details the validation assessments of the 37 reports containing the laboratory results for the 144 laboratory samples. Their impact on data usability is summarized below. Where discrepancies exist between hard copy and the electronic copy, the results used in this report have been taken from the hard copy. Qualifiers and associated reason codes assigned by the routine data validators are in the Facility for Information Management, Analysis, and Display (FIMAD), but the explanations in Appendix B are more comprehensive.

4.1 Inorganic Analysis

A total of 77 of the 1996 field samples discussed in this report were analyzed for the standard suite of 23 inorganic chemicals, including mercury, as listed in Appendix A of this NFA report. Qualifications placed on these results by routine data validation are summarized in Appendix B, Table B-1, of this report.

TABLE 4.0-1

1996 FIELD DUPLICATE SAMPLES AT TA-33

SAMPLE ID	SITE ID	DEPTH (ft)	PRS	DUPLICATE SAMPLE ID
0333-96-1000	33-01692	1.5–2.5	33-008(b)	0333-96-0027
0333-96-1001	33-01328	7.5–9.5	33-002(b)	0333-96-0069
0333-96-1002	33-01328	10–15	33-002(b)	0333-96-0070
0333-96-1003	33-01328	30–31.3	33-002(b)	0333-96-0500
0333-96-1004	33-01328	40–41	33-002(b)	0333-96-0502
0333-96-1005	33-01653	24–25	33-001(a–o)	0333-96-0551
0333-96-1006	33-01559	0–0.5	33-013	0333-96-0574
0333-96-1007	33-01674	0–0.5	33-008(c)	0333-96-0658
0333-96-1008	33-01682	0–1	33-008(c)	0333-96-0684

A large number of qualifiers were assigned by the data validators. These qualifiers are reproduced in tables in Section 5.x.5 of this report. In general, as indicated by the notes in Table B-1, these qualifications do not seriously impact the usability of the data.

- Blank contamination affects several results from PRSs 33-008(a), 33-008(b), 33-011(d) and 33-013. In each Section 5.x.5, results above EQL but less than five times the contamination measured in the blank are not listed as detected. The reported values in these cases are less than LANL background UTLs. In the remaining cases, blank contamination indicates a slight positive bias, resulting in an overestimate of contamination. Blank contamination does not affect any conclusions or recommendations for these PRSs.

- In many of the laboratory reports for inorganic chemicals, potential low bias for several elements is indicated by low recovery from spiked samples. In general, the analytes for which recovery was a problem are not potential contaminants at the PRSs being investigated. However, spike recovery of 62% was below the acceptance level of 75% (and duplicate recovery was also low) for chromium in request 2117, which included most of the samples from PRS 33-008(b). There the data indicate that chromium is present above background levels (Section 5.7.5 of this report). The data are qualified as estimated with a negative bias, which is taken into account when evaluating chromium releases at PRS 33-008(b). Several other analytes were similarly qualified by the data validators, but the potential

biases are not large enough, relative to background levels and levels of concern, to impact the conclusions in Section 5.7.

- A potentially low bias was flagged for six manganese and three thallium results. In the remaining samples, manganese was found to be within the LANL background range. Thallium was reported as estimated (below the quantitation limit) in a few samples from PRSs 33-002(b,c), always within background levels. Archival research does not identify manganese or thallium as a potential contaminant at MDA K.
- Very low spike recoveries for antimony in three data packages (all from the same laboratory), including samples from PRSs 33-002(b,c) discussed in this report, resulted in rejection of the antimony data. However, archival research has not identified antimony as a potential contaminant at MDA K.

Relative standard deviations (RSDs) for inorganic chemicals, as measured by lab replicates, were generally under 10%, except for request 2117 (discussed above). RSDs of results for inorganic chemicals in the five field duplicate pairs were also generally less than 10%. Among the PRSs discussed in this report, field duplicate pair RSDs exceeded 10% only for calcium in the pair from 33-008(b) and for manganese in the pair from 33-013. Such RSDs are less than would be expected given the expected heterogeneity of the PRSs under consideration. The data indicate that (again excepting data in request 2117) significant variability has not been introduced into the analytical results by the sample collection and laboratory analytical processes.

4.2 Radiochemistry Analysis

A total of 71 of the field samples discussed in this report were analyzed for total uranium, 2 for isotopic uranium, 6 for isotopic plutonium, and 34 for tritium. Apart from the plutonium results, which were qualified as undetected, no qualifications were placed on any results by routine data validation (Table B-2 in this report). In addition to laboratory analyses, all but four of the laboratory samples from PRS 33-002(b) were analyzed for tritium by the MRAL.

During Phase I sampling, plutonium was detected above LANL and TA-33 background levels at PRS 33-002(c). During Phase II sampling, the MRAL analyzed six samples from PRS 33-002(c) for plutonium. Because MRAL levels were low, these samples were not forwarded to an off-site laboratory (Section 5.2.6 of this report).

Sample preparation techniques for uranium determine which UTL should be used for background comparison. A total digestion of the sample yields a LANL background UTL of 5.45 mg/kg. A digestion using the SW-846 method for sample preparation yields a UTL of 1.87 mg/kg (Longmire et al. 1995, 1142). For PRSs discussed in this report, a total digestion was used for uranium analyses of samples collected at PRSs 33-002(c) and 33-008(a, b). An SW-846 partial digestion was used for uranium analyses of samples at PRSs 33-011(d) and 33-013 (with the exception of sample 0333-96-0583, for which a total digestion was used).

The RSDs for laboratory replicates were all under 10%. Some high RSDs were observed in two of the field duplicate pairs from PRS 33-002(b). These were tuff samples for which field duplicate pairs consisted of samples from adjacent segments of core. Both pairs indicate the presence of tritium well above background levels. Given the heterogeneity expected in migration of water through tuff to these depths, discrepancies on the order of magnitude observed (50% at a depth of 9.5 ft; 250% at a depth of 41 ft) can be ascribed to the heterogeneity of tuff. Apart from these tritium results, RSDs for field duplicates were under 10%, comparable to those for laboratory replicates. These results indicate that significant variability has not been introduced into the data by the sample collection and laboratory analytical processes.

High tritium levels in some samples resulted in elevated detection levels and in blank contamination. These events do not impair the usability of the tritium data for decision-making because they lead to an overestimation of tritium concentrations. Plutonium detection limits for tuff samples in the laboratory were higher than for soil samples. Plutonium detection limits at the MRAL exceed background levels but are well below SALs. These observations affect data from PRS 33-002(b,c) and are discussed in context in Sections 5.1.5 and 5.2.5.

Twenty-three samples were analyzed for tritium by both the MRAL and an off-site laboratory. Above fixed-laboratory activities of 1 pCi/g, the results for such pairs of samples generally agree within a factor of five. The MRAL data are qualitatively usable in a context where the measured values range over five orders of magnitude, as is the case at PRS 33-002(b). Fixed-laboratory and MRAL results are compared in Tables 5.1.6-2 and 5.2.6-2 of this report.

4.3 Organic Analysis

4.3.1 Volatile Organic Analyses

Six of the field samples discussed in this report were analyzed for volatile organic compounds. No qualifications were placed on these results by routine data validation. Results are summarized in Table B-3 of this report.

4.3.2 Semivolatile Organic Analyses

Sixty-two of the field samples discussed in this report were analyzed for semivolatile organic compounds. Qualifications placed on these results by routine data validation are summarized in Table B-4 of this report. The minimal problems reported for semivolatiles do not affect the usability of those data.

Surrogate recovery problems and missed holding times for reanalysis led to qualification of some of the data from request 2110, which consisted of samples from 33-008(a). The analytes of concern include three PAHs with SALs below 1 mg/kg, which are reported above SAL in three reports with missed holding times (potentially biased low). Those analytes are carried forward into risk assessment, where upper confidence bounds are computed both with and without the rejected results, and the larger of the resulting values is used.

Semivolatile results for the field duplicate pairs were well within acceptable levels. Where an analyte was reported in one member of a pair and not the other, it was usually estimated (J-qualified) below the EQL in the former sample, or in one case (a phthalate) approximately 25% above the EQL.

4.3.3 PCB Analyses

Fifteen of the field samples discussed in this report were analyzed for PCBs by fixed-laboratory analysis. The qualifications placed on these results by routine data validation are summarized in Table B-5 of this report. The reported qualifications do not impact the usability of these data.

These 15 samples, plus 21 additional samples, were analyzed in the field using PCB immunoassay kits. The 15 samples for which both types of analyses were made indicate a positive bias for the field kits. In eight of the nine samples with laboratory results less than 1 mg/kg, the field kit reported results higher than results measured by the fixed laboratory. Two field estimates were in the 4–5 mg/kg range, whereas the laboratory results were between 0.5 and 1 mg/kg. Among the six samples for which the laboratory results exceeded 1 mg/kg, the bias was less consistent. Three of these field results agreed with the laboratory. Two field results in the 1–4 mg/kg range slightly underestimated laboratory results of 5–6.5 mg/kg. One field result of 4–15 mg/kg overestimated a laboratory result of 2.5 mg/kg.

Overall, it appears that the field results tend to overestimate the results that would have been obtained if the samples had been submitted to a fixed laboratory. This positive bias is less serious from a risk perspective because it would tend to support a remediation decision.

No field duplicate pairs were submitted for PCB analysis.

4.3.4 HE Analyses

Twenty-four of the 1996 field samples discussed in this report were analyzed for high explosives. No qualifications were placed on any results by routine data validation (Table B-6). All data are usable for decision-making purposes.

No high explosives were detected in the field duplicate pair of samples submitted for HE analysis.

5.0 SITE-SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

This report discusses the 1996 sampling and analysis of 10 PRSs located at Main Site, East Site, and South Site within TA-33. Site information, results of analyses, evaluation of contamination, and NFA recommendations for human health concerns are presented in this section. Table 5.0-1 summarizes the PRSs. Fig. 5.0-1 shows the PRSs at MDA K. Figures 5.0-2, 5.0-3, and 5.0-4 show PRS locations at the three remaining areas.

Evaluations of several PRSs are included in previous RFI reports. To clarify the discussion of investigations at PRSs 33-002(b), 33-002(c), 33-003(b), 33-006(a), 33-011(d), 33-013, and 33-017, reports of prior investigations at those PRSs are included as attachments to this report, as are the sampling plans for PRSs 33-008(a) and 33-008(b).

At the PRSs presented in this report, a select group of PAHs without SALs were detected at low detection frequencies and at low concentrations. Infrequent detections of these compounds at such low concentrations do not represent an industrial release or a contamination problem posing a potential risk to human health or the environment. SALs are not available for these compounds because of the absence of EPA-accepted toxicity criteria to calculate screening values. In general, the potential impacts from the low detections of these compounds is addressed during the evaluation of the PAHs which do have toxicity criteria and SALs. The PAHs consist of a large family of compounds with a rather large range of toxic potency.

In calculating site risks, EPA and most state agencies separate the PAHs into two categories: carcinogens and noncarcinogens. Carcinogenic PAHs are evaluated by considering the available data on the carcinogenic potency of different PAHs to develop toxicity equivalency factors (TEFs) for the individual PAHs. These TEFs indicate the carcinogenic potency of each compound relative to benzo(a)pyrene. Consequently, the PAHs analyzed that do have SALs encompass a substantial portion of the risk to low levels of those compounds in soils. In this

report, the list of PAHs detected without SALs includes acenaphthylene, a noncarcinogenic PAH very similar to acenaphthene; benzo(g,h,i)perylene, also a noncarcinogenic PAH; phenanthrene, a noncarcinogenic PAH very similar to pyrene; and 2-methylnaphthalene, a noncarcinogenic PAH very similar to naphthalene. Because noncarcinogenic PAHs in this report tend to have high SALs and those without SALs were detected at low concentrations, the evaluation of PAHs in this report is considered to be complete using only PAHs with available SALs.

The PRSs discussed in this section are listed in Table 5.0-1. With the exception of PRS 33-004(k), recommendations for NFA for human health are based on NMED/Environmental Restoration Project Criterion 5: The PRS has been characterized and available data indicate that contaminants are not present or are present in concentrations that pose an acceptable risk under the projected land use. Recommendation for PRS 33-004(k) is based on Criterion 1: The PRS was not located.

TABLE 5.0-1

PRSs IN THIS TA-33 RFI REPORT

SECTION	PRS ID	LOCATION	PRS TYPE	RECOMMENDATION
5.1	33-002(b)	Main Site	Sump at MDA K	NFA, Criterion 5 [a]
5.2	33-002(c)	Main Site	Sump at MDA K	NFA, Criterion 5
5.3	33-003(b)	East Site	Chamber at MDA D	NFA, Criterion 5
5.4	33-004(k)	East Site	Outfall from TA-33-87	NFA, Criterion 1
5.5	33-006(a)	South Site	South Site shot pad	NFA, Criterion 5
5.6	33-008(a)	South Site	South Site landfill	NFA, Criterion 5
5.7	33-008(b)	East Site	East Site landfill	NFA, Criterion 5
5.8	33-011(d)	Main Site	Surface storage at TA-33-20	NFA, Criterion 5
5.9	33-013	Main Site	Surface storage at TA-33-86	NFA, Criterion 5
5.10	33-017	Main Site	Vehicle maintenance area	NFA, Criterion 5

a. NFA for human health only

5.1 PRSs 33-002(b)

PRS 33-002(b) is sump TA-33-134 at MDA K. Phase II sampling was performed in 1996 because Phase I samples were not collected beneath the bottom of the sump. In addition, the sample with the highest MRAL-measured tritium concentration was not analyzed in a fixed laboratory. No contamination was found above levels of concern in either the 1993 or the 1996 sampling campaign. The PRS is recommended for NFA for human health under Criterion 5.

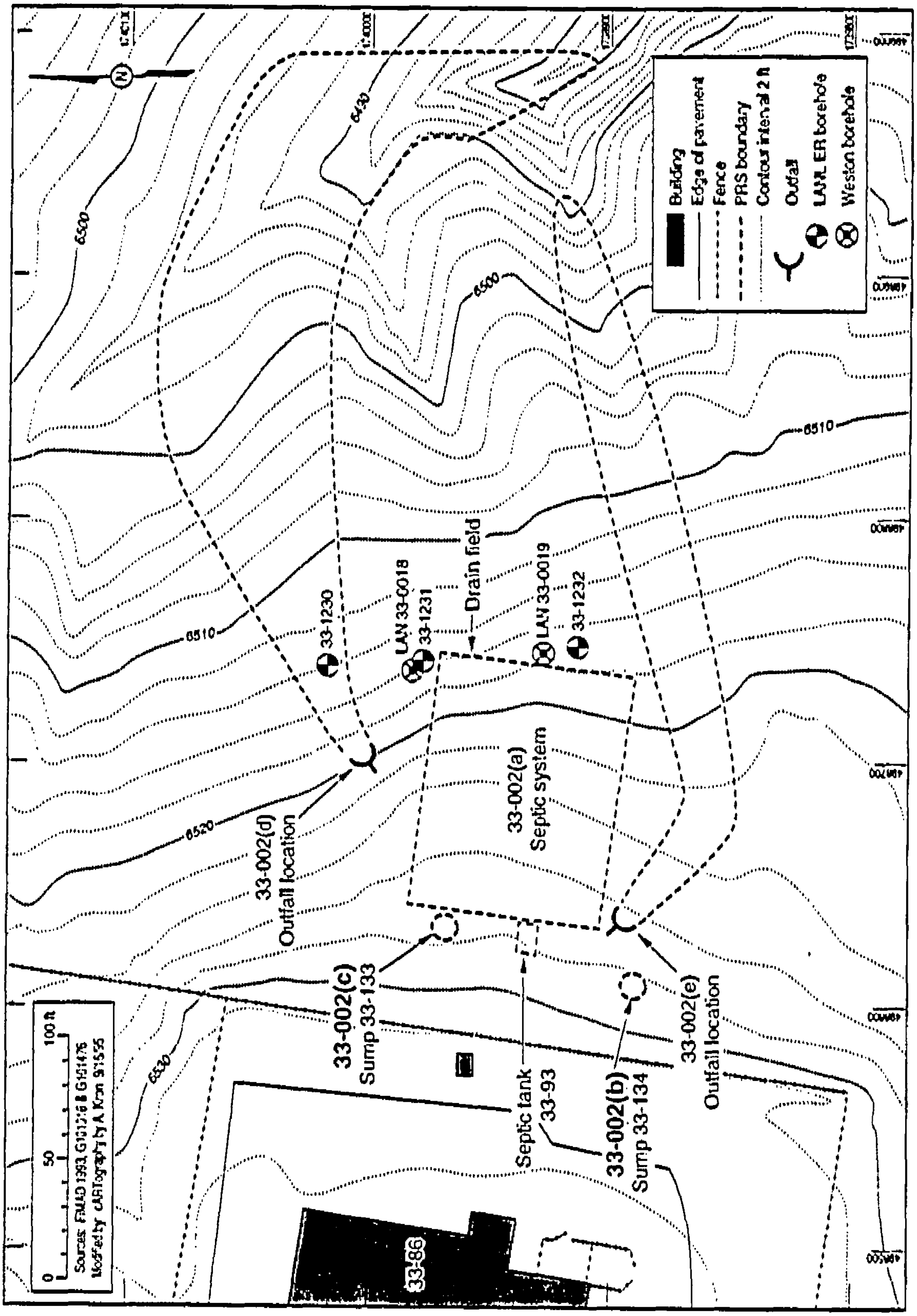


Fig 5.0-1. MDA K PRSs in this report.

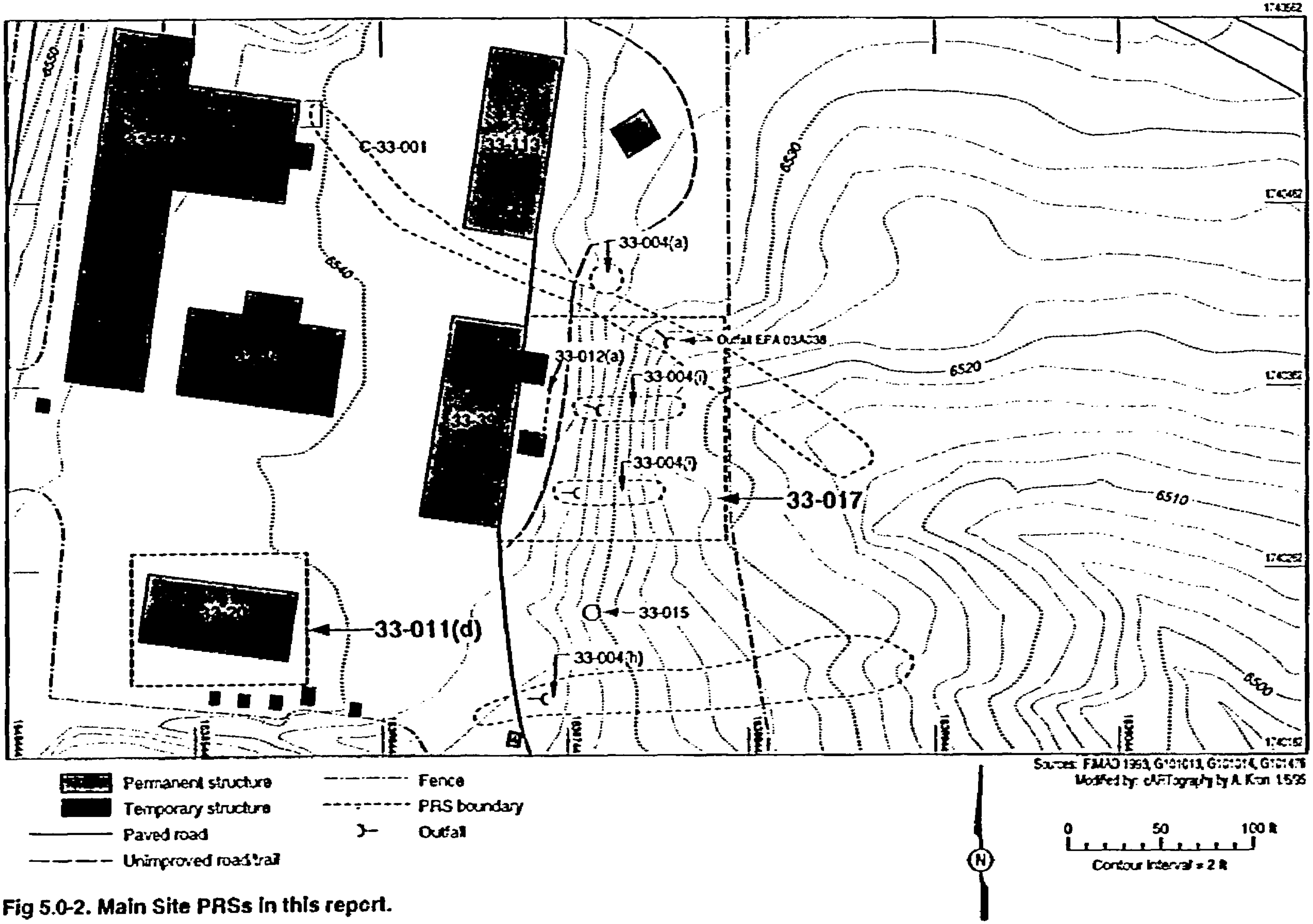


Fig 5.0-2. Main Site PRSs in this report.

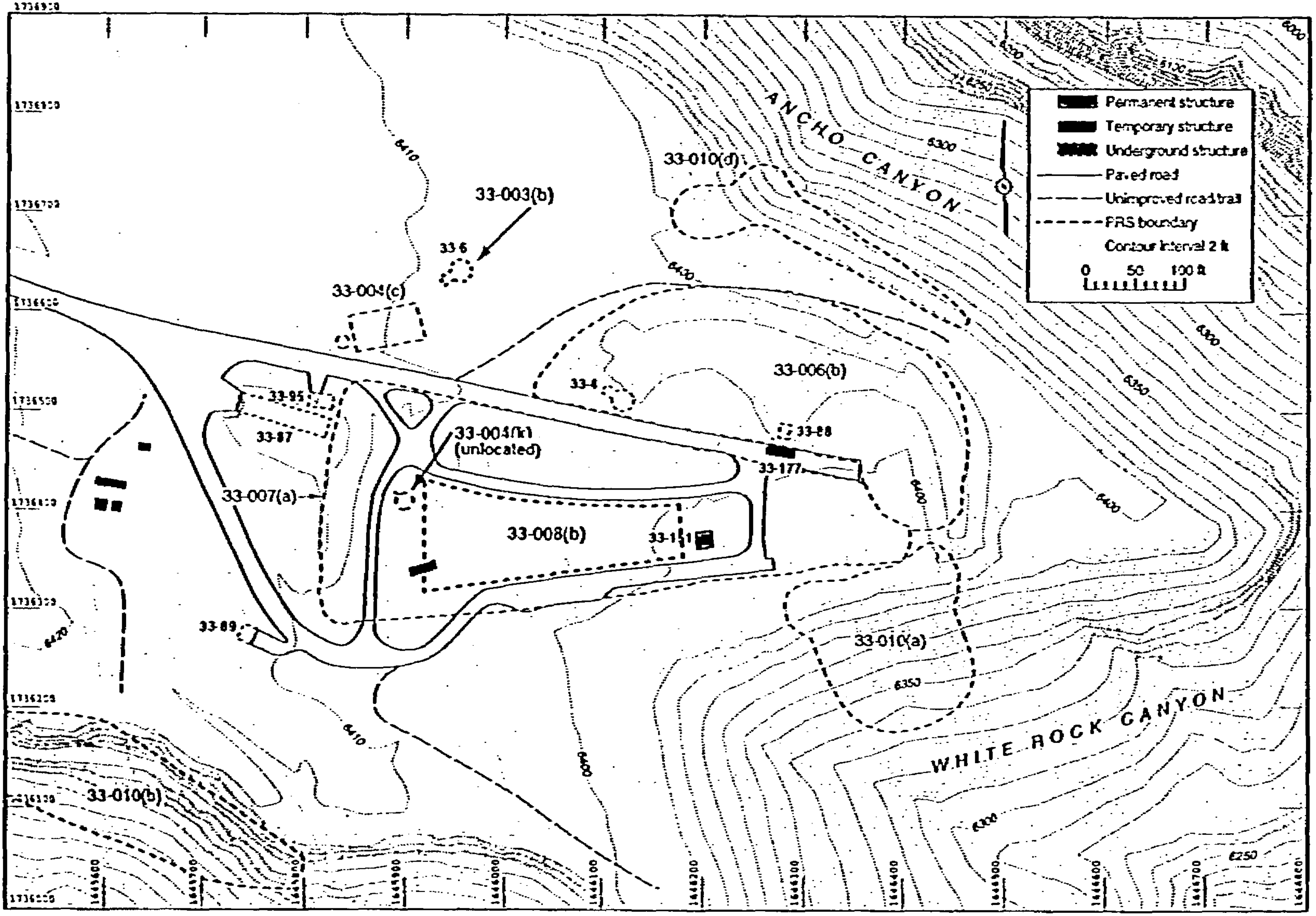
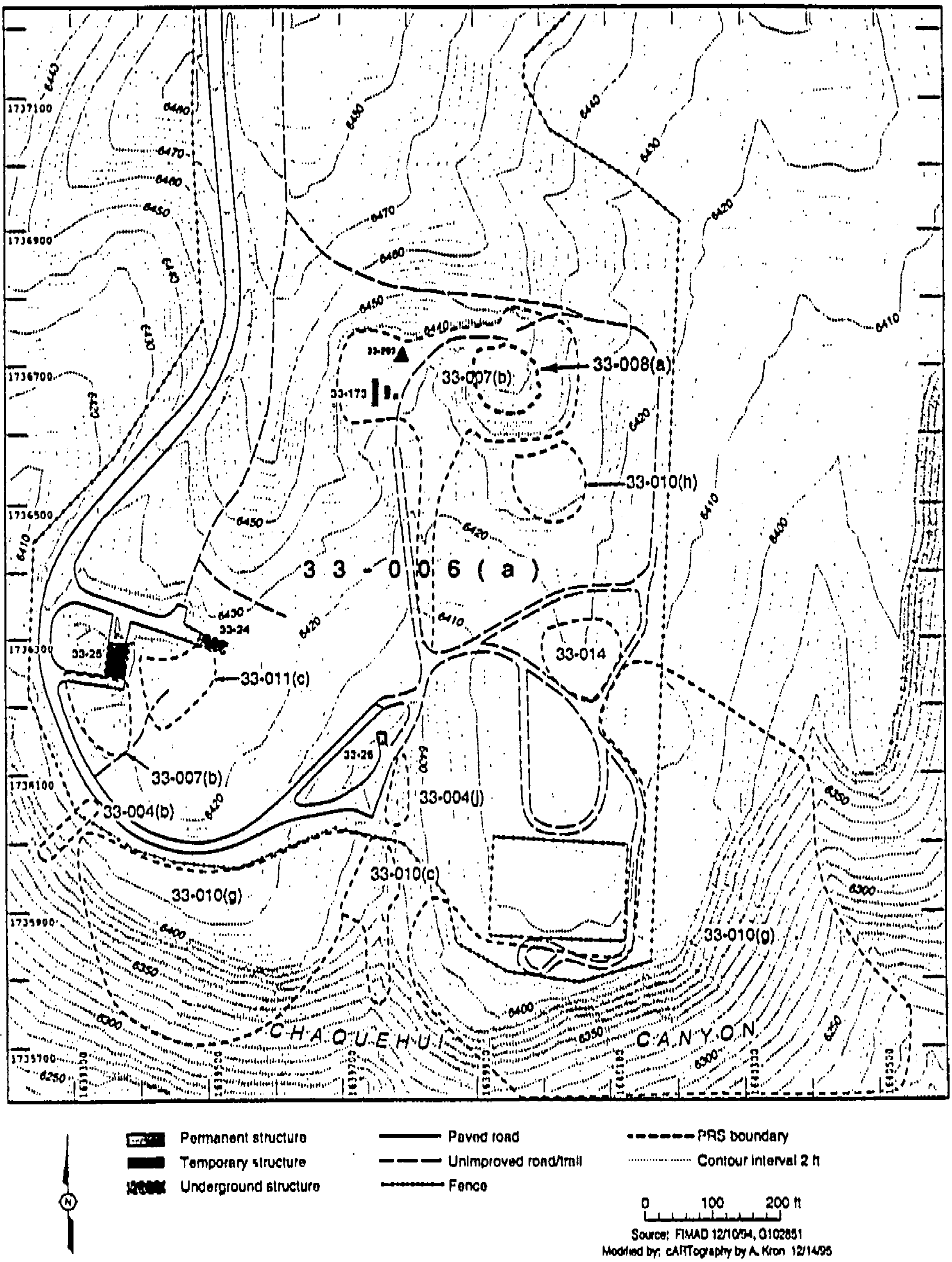


Fig 5.0-3. East Site PRSs in this report.



Source: FIMAD 12/10/94, G102851
Modified by: cARTography by A. Kron 12/14/95

Fig 5.0-4. South Site PRSs in this report.

5.1.1 History

PRS 33-002(b) is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.2.2.1, 4.1.4, and 4.2.3.1. The sump was constructed in 1955 when the tritium facility, TA-33-86, was constructed. A sink and floor drain in the southern section of TA-33-86 are connected to the sump. Archival information indicates that sump TA-33-134 received organic contaminants such as ethanol and methanol (less than 5 gal./year), trichloroethylene, and tritium-contaminated benzene and acetone (approximately 5 gal./year). The sump also may have received beryllium, mercury, and depleted uranium (LANL 1992, 0784).

5.1.2 Description

The sump is a rubble-filled, unlined seepage pit 6 ft in diameter and 9 ft deep. It might better be described as a dry well. Originally, a 3-inch-thick concrete cover, overlaid by 1 in. of soil, topped the sump. The cover was broken during sampling done by Roy F. Weston, Inc., personnel in 1989. The sump is located on a level area approximately 20 ft south of septic tank TA-33-93 (Fig. 5.1.2-1). Broken pieces of concrete mark the site. The entire area was cleared in the past and is now covered with weeds. Soil is pulverized rock with pumice pebbles and broken pieces of tuff.

5.1.3 Previous Investigation

Weston personnel collected a surface sample at sump TA-33-134 during investigations at TA-33 in 1989. That sample was analyzed for inorganic chemicals, radionuclides, pesticides, and PCBs. Only tritium, at 190 000 pCi/ml in soil moisture, was detected. Because no moisture analysis was reported, activity per gram of soil cannot be calculated (LANL 1989, 02-020).

The MDA K Phase I sampling plan, which was carried out in 1993, directed that fluid and sludge samples be collected from the sump. The plan also directed that a borehole be drilled next to the sump and three subsurface samples (plus a duplicate) be collected. This borehole was intended to determine if contamination was migrating from the sump to the environment. During the ER sampling campaign in 1993, only three samples were collected. The fluid and sludge samples were not collected because these components are not present in the sump. The drilling adjacent to the sump encountered the soil/tuff interface at 30 in. Because of the shallow depth of the hole, only a surface sample and a soil/tuff interface sample were collected. A third sample was taken at a depth of 5 ft from within the sump at the point of auger refusal. All samples were analyzed for uranium, tritium, plutonium, gamma emitters, inorganic chemicals, and SVOCs. The two subsurface samples were analyzed for VOCs.

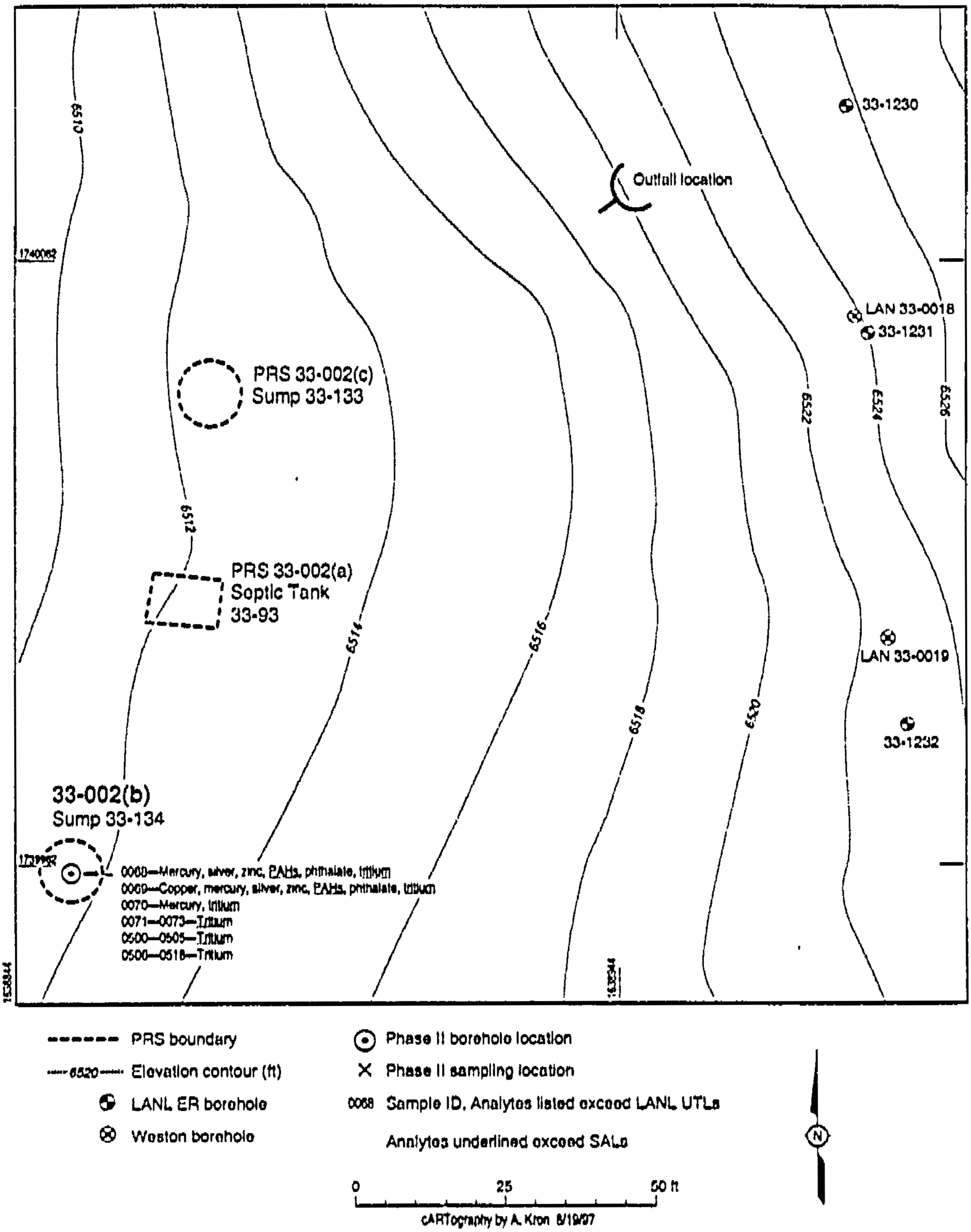


Fig. 5.1.2-1. PRS 33-002(b), sump TA-33-134 at MDA K.

Results indicated that one sample contained cadmium above UTL, but below SAL. Three samples contained trace levels of plutonium above its UTL. Tritium was found in all samples. Tritium exceeded 600 000 pCi/g in one sample. This sample was analyzed only by the MRAL.

Section 4.2 of the September 1995 RFI Report for MDA K, which discusses the Phase I investigation of PRS 33-002(b), is provided as Attachment 1 of this report.

5.1.4 Field Investigation

Sampling at PRS 33-002(b) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With building waste as the primary source, exposure routes for human receptors are ingestion and dermal contact. Because the sump is a subsurface structure, inhalation is not considered a likely exposure route, and no surface sampling was performed.

In the 1996 sampling campaign, a borehole was drilled directly into the sump. In accordance with the sampling plan, three samples were collected within the first 15 ft and were analyzed for uranium, plutonium, inorganic chemicals, VOCs, and SVOCs (Table 5.1.4-1).

In addition to the samples listed above, samples were collected at approximately 5-ft intervals below the 15-ft level and analyzed for tritium by the MRAL. A subset of samples from the same depth intervals was sent for fixed laboratory analysis (Table 5.1.4-2). The sampling plan directed that three samples be taken and analyzed from below the sample depth in which the MRAL results fell below tritium SAL. The final depth (117 ft) exceeded these requirements.

5.1.5 Evaluation of Inorganic Chemicals

In the three upper samples from the borehole, silver, copper, mercury, and zinc were detected above background but below their SALs (Table 5.1.5-1). Because two of the samples were taken in tuff, the 95%, 0.95 UTLs for Unit 3 of the Bandelier Tuff are shown below for comparison, in addition to LANL mixed-soil UTLs.

TABLE 5.1.4-1

SUMMARY OF SAMPLES (EXCLUDING TRITIUM) TAKEN FOR PRS 33-002(b)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	RADIO-NUCLIDES	INORGANIC CHEMICALS	VOCs	SVOCs
0333-96-0068	33-1328	Fill	1	2178[a]	2177	2176	2176
0333-96-0069	33-1328	Fill	9.5	2178	2177	2176	2176
0333-96-0070	33-1328	Tuff	15	2178	2177	2176	2176

a. ER analytical request number.

TABLE 5.1.4-2

SUMMARY OF TRITIUM SAMPLES TAKEN FOR PRS 33-002(b)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	FIXED LABORATORY	MRAL[a]
0333-96-0068	33-1328	Fill	1	2178[b]	2168
0333-96-0069	33-1328	Fill	9.5	2178	2168
0333-96-1001	33-1328	Fill	9.5	2178	2168
0333-96-0070	33-1328	Tuff	15	2178	2168
0333-96-1002	33-1328	Tuff	15	2178	2168
0333-96-0071	33-1328	Tuff	16.3	2178	2168
0333-96-0072	33-1328	Tuff	22.5	2178	2168
0333-96-0073	33-1328	Tuff	27	2178	2168
0333-96-0500	33-1328	Tuff	31	2232	2199
0333-96-1003	33-1328	Tuff	31	2232	2199
0333-96-0501	33-1328	Tuff	36.5	2232	2199
0333-96-0502	33-1328	Tuff	41	2232	2199
0333-96-1004	33-1328	Tuff	41	2232	2199
0333-96-0503	33-1328	Tuff	45	2232	2180
0333-96-0504	33-1328	Tuff	50	NA[c]	2180
0333-96-0505	33-1328	Tuff	52	NA	2180
0333-96-0506	33-1328	Tuff	60	2232	2180
0333-96-0507	33-1328	Tuff	62	NA	2180
0333-96-0508	33-1328	Tuff	65.5	NA	2180
0333-96-0509	33-1328	Tuff	72	2232	MRAL[d]
0333-96-0510	33-1328	Tuff	80	NA	MRAL[d]
0333-96-0511	33-1328	Tuff	84	NA	MRAL[d]
0333-96-0512	33-1328	Tuff	88	2232	MRAL[d]
0333-96-0513	33-1329	Tuff	93.5	NA	MRAL[d]
0333-96-0514	33-1330	Tuff	97	NA	MRAL[d]
0333-96-0515	33-1328	Tuff	103.4	2232	MRAL[d]
0333-96-0516	33-1328	Tuff	110	2232	MRAL[d]
0333-96-0517	33-1328	Tuff	115	2232	MRAL[d]
0333-96-0518	33-1328	Tuff	117	2232	MRAL[d]

a. MRAL = Mobile radiological analytical laboratory
b. ER laboratory analytical request number
c. NA = Not Analyzed
d. No MRAL request number assigned

TABLE 5.1.5-1

INORGANIC CHEMICALS DETECTED ABOVE UTLs AT PRS 33-002(b)

SAMPLE ID	DEPTH (ft)	COPPER (mg/kg)	MERCURY (mg/kg)	SILVER (mg/kg)	ZINC (mg/kg)
SAL	N/A[a]	2 800	23	380	23 000
(95%,.95) UTL	N/A	15.5	0.1	NA[b]	50.8
(95%,.95) UTL QBT3	N/A	2	NA	1.9	55.5
0333-96-0068	1	9.8	0.98	0.13	52.6
0333-96-0069	9.5[c]	22	2.9	0.3	88.4
0333-96-0070	15[c]	9.2	0.74	0.1 (U[d])	40.1

a. N/A = Not Applicable
b. NA = Not analyzed for in LANL background studies
c. n QBT3
d. U = Undetected—the listed value is the detection limit

5.1.6 Evaluation of Radionuclides

In surface sample 0333-96-0068, plutonium-239/240 was detected within the background range ascribed to worldwide fallout from atmospheric atomic testing. In sample 0333-96-0069, both plutonium-238 and plutonium-239/240 were detected (Table 5.1.6-1). This sample was taken at 9.5 ft and described as primarily "engineering fill materials." The levels were very low, and they may be the result of moving former surface material into the sump. Plutonium was not detected in the next sample, which was collected at 15 ft.

Tritium was detected above LANL's UTL in every sample. Both laboratory results and field screening MRAL results indicated that tritium levels are below SAL in all samples below 60 ft (Table 5.1.6-2).

TABLE 5.1.6-1

PLUTONIUM DETECTED AT PRS 33-002(b)

SAMPLE ID	DEPTH (ft)	PLUTONIUM-238 (pCi/g)	PLUTONIUM-239/240 (pCi/g)
SAL	N/A[a]	27	24
LANL UTL	N/A	0.01	0.025
0333-96-0068	1	0.001 (U[b])	0.007
0333-96-0069	9.5	0.003	0.003
0333-96-0070	15	0.001 (U)	0.001 (U)

a. N/A = Not Applicable
b. U = Undetected—the listed value is the detection limit

TABLE 5.1.6-2

TRITIUM DETECTED AT PRS 33-002(b)

SAMPLE ID	DEPTH (ft)	MRAL (pCi/g)	LABORATORY (pCi/g)
SAL	N/A[a]	260	260
LANL UTL	N/A	1	1
0333-96-0068	1	3112	24 852
0333-96-0069	9.5	135 354	104 065
0333-96-1001	9.5	97 466	76 179
0333-96-0070	15	64 181	73 060
0333-96-1002	15	133 651	59 366
0333-96-0071	16.3	12 952	5456
0333-96-0072	22.4	652	773
0333-96-0073	27.25	704	780
0333-96-0500	31.25	428	833
0333-96-1003	31.25	440	826
0333-96-0501	36.7	646	1000
0333-96-0502	41	924	1474
0333-96-1004	41	956	4036
0333-96-0503	45	937	4134
0333-96-0504	50	616	NA[b]
0333-96-0505	52	357	NA
0333-96-0506	60	94	199
0333-96-0507	62	142	NA
0333-96-0508	65	130	NA
0333-96-0509	72.2	75	142
0333-96-0510	80	26	NA
0333-96-0511	84	32	NA
0333-96-0512	88	34	75
0333-96-0513	93	63	NA
0333-96-0514	97	71	NA
0333-96-0515	103.4	6	20
0333-96-0516	110	3	8
0333-96-0517	115	ND[c]	2
0333-96-0518	117.4	3	3

a. N/A = Not Applicable
b. NA = Not Analyzed
c. ND = Not Detected

5.1.7 Evaluation of Organic Chemicals

Trace levels of PAHs that are typical of tar and asphalt products were found in the Phase II samples, as was a common plasticizer, di-n-butylphthlate (Table 5.1.7-1). Benzo(a)pyrene was found above its SAL in two of the three samples. No VOCs were detected.

TABLE 5.1.7-1

DETECTED ORGANIC CHEMICALS FOR PRS 33-002(b)

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0068	1	Anthracene	0.033 (J)[a]	18 000	0.33
		Benzo[a]anthracene	0.099 (J)	0.61	0.33
		Benzo[a]pyrene	0.099 (J)	0.061	0.33
		Benzo[b]fluoranthene	0.17 (J)	0.61	0.33
		Benzo[g,h,i]perylene	0.099 (J)	NS[b]	0.33
		Bis(2-ethylhexyl)phthalate	0.099 (B,U,J)[c]	32	0.33
		Chrysene	0.13 (J)	61	0.33
		Di-n-butylphthalate	0.033 (J)	6 500	0.33
		Fluoranthene	0.26 (J)	2 600	0.33
		Indeno[1,2,3-cd]pyrene	0.066 (J)	0.61	0.33
		Phenanthrene	0.2 (J)	NS	0.33
		Pyrene	0.23 (J)	1 900	0.33
0333-96-0069	9.5	Benzo[a]pyrene	0.068 (J)	0.061	0.33
		Benzo[b]fluoranthene	0.17 (J)	0.61	0.33
		Benzo[g,h,i]perylene	0.17 (J)	NS	0.33
		Bis(2-ethylhexyl)phthalate	1.5 (B)[d]	32	0.33
		Di-n-butylphthalate	0.2 (J)	6 500	0.33
		Indeno[1,2,3-cd]pyrene	0.14 (J)	0.61	0.33
		Pyrene	0.034 (J)	1 900	0.33
0333-96-0070	15	Bis(2-ethylhexyl)phthalate	0.11(B, J)	32	0.33

a. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit
b. NS = No SAL available
c. B,U,J = Analyte was detected in the laboratory blank. The analyte was not detected in the sample. The value listed is the estimated detection limit.
d. B = Analyte was detected in the laboratory blank

5.1.8 Risk-Based Screening Assessment

Using the maximum concentrations from both the 1993 and 1996 sampling campaigns at this PRS, an MCE calculation was performed for the noncarcinogenic contaminants. The MCE result for noncarcinogens was 0.2 (Table 5.1.8-1). Benzo[g,h,i]perylene and phenanthrene were not included in the calculation because they have no SALs. (See discussion in Section 5.0 of this report.) This MCE value is less than unity; therefore, no potential human-health risk based on additive effects is identified for this class of chemicals. They are not carried forward in the screening process.

Carcinogenic PAHs at very low concentrations were also detected at this PRS (Table 5.1.8-2). Benzo(a)pyrene was detected in two of three samples above its SAL of 0.061 mg/kg.

TABLE 5.1.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-002(b)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Cadmium	33-1520	AAA3900[a]	4	38	0.1
Copper	33-1328	0333-96-0069	22	2 800	0.007
Mercury	33-1328	0333-96-0069	2.9	23	0.1
Silver	33-1328	0333-96-0069	0.3	380	0.0008
Zinc	33-1328	0333-96-0069	88.4	23 000	0.004
Anthracene	33-1328	0333-96-0068	0.033	18 000	0.000002
Bis(2-ethylhexyl)-phthalate	33-1328	0333-96-0068	0.099	32	0.003
Chrysene	33-1328	0333-96-0068	0.13	61	0.002
Di-n-butylphthalate	33-1328	0333-96-0069	0.2	6 500	0.00003
Fluoranthene	33-1328	0333-96-0068	0.26	2 600	0.0001
Pyrene	33-1328	0333-96-0068	0.23	1 900	0.0001
				Total	0.2

a. 1993 sample—the 1993 report is include as Attachment 1 of this report

TABLE 5.1.8-2

PRS 33-002(b) CARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	BENZO[a]PYRENE (mg/kg)
SAL	N/A[a]	N/A	0.061
PRG[b]	N/A	N/A	0.26
0333-96-0068	33-1328	1	0.099(J[c])
0333-96-0069	33-1328	9.5	0.068(J)

a. N/A = Not Applicable

b. PRG = Preliminary Remediation Goal for industrial sites (EPA 1996, 1307)

c. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit

An MCE performed for the remaining carcinogens indicates that human health risk is low for those constituents (Table 5.1.8-3). Benzo[g,h,i]perylene was not included in the calculation because it has no SAL. No organic compounds were detected in the 1993 sampling campaign. There is no indication that PAHs were used as experimental compounds at the tritium facility. Concentrations at this sump are typical of industrial environments and are below the EPA Region 9 PRG of 0.26 mg/kg for benzo(a)pyrene. Because benzo(a)pyrene, a common industrial pollutant, was the only carcinogenic constituent detected above SAL, and the

concentrations of other PAHs were very low, PAHs are not carried forward in the screening assessment.

TABLE 5.1.8-3

MCE FOR CARCINOGENIC EFFECTS (EXCEPT BENZO[A]PYRENE) AT PRS 33-002(b)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Benzo[a]anthracene	33-1328	0333-96-0068	0.099	0.61	0.007
Benzo[b]fluoranthene	33-1328	0333-96-0069	0.17	0.61	0.3
Indeno[1,2,3-cd]pyrene	33-1328	0333-96-0069	0.14	0.61	0.2
				Total	0.5

Tritium was detected above SAL in 16 samples to a depth of 52 ft (Table 5.1.8-4). Therefore, tritium is carried forward in the screening process.

TABLE 5.1.8-4

PRS 33-002(b) TRITIUM WITH CONCENTRATIONS IN SOIL THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	MRAL (pCi/g)	LABORATORY (pCi/g)
SAL	N/A[a]	N/A	260	260
LANL UTL	N/A	N/A	1	1
0333-96-0068	33-1328	1	3112	24 852
0333-96-0069	33-1328	9.5	135 354	104 065
0333-96-1001	33-1328	9.5	97 466	76 179
0333-96-0070	33-1328	15	64 181	73 060
0333-96-1002	33-1328	15	133 651	59 366
0333-96-0071	33-1328	16.3	12 952	5456
0333-96-0072	33-1328	22.4	652	773
0333-96-0073	33-1328	27.25	704	780
0333-96-0500	33-1328	31.25	428	833
0333-96-1003	33-1328	31.25	440	826
0333-96-0501	33-1328	36.7	646	1000
0333-96-0502	33-1328	41	924	1474
0333-96-1004	33-1328	41	956	4036
0333-96-0503	33-1328	45	937	4134
0333-96-0504	33-1328	50	616	NA[b]
0333-96-0505	33-1328	52	357	NA

a. N/A = Not Applicable

b. NA = Not Analyzed

5.1.9 Human-Health Risk Assessment

A radiation dose due to tritium exposure was calculated for a worker at PRS 33-002(b). This assessment of risk was performed using the tritium plume subroutine of the Residual Radioactive Material (RESRAD) computer model, ver. 5.61.

The source term was estimated as the upper confidence limit (UCL) for the mean tritium activity, calculated using data from the uppermost 25 ft of the exposure unit, where approximately 95% of the tritium was detected. Because fixed laboratory and MRAL measurements agree well (a correlation coefficient of approximately 0.98 between the logarithms), both data sets were used to calculate the UCL. However, these 19 observations are not uniformly distributed across the first 25 ft below the surface. In addition, they show a trend within this depth (the highest values are at depths of 4–15 ft, with lower values both near the surface and below 15 feet). Therefore, it is inappropriate to estimate the mean tritium activity or its UCL within the exposure unit by a parametric method which assumes that the data constitute a random sample from a single distribution of known form such as the normal. Instead, a bootstrap procedure, a nonparametric, computer-based method that makes use of a Monte Carlo algorithm to generate an approximate distribution for the sample mean, was used. (For a discussion of statistical bootstrapping techniques and theory, see Efron and Tibshirani, 1986, 02-123.) To apply this algorithm in the present case, the data were resampled to produce 5000 "bootstrap data sets" distributed approximately uniformly with depth. The mean of each data set was computed and the 95% UCL was estimated as the 95th percentile of the 5000 means. The estimate of the mean activity obtained in this way was approximately 46 000 pCi/g, and the 95% UCL was 101 000 pCi/g. By comparison, the maximum concentration in the sump was 104 065 pCi/g at 9.5 ft. A duplicate at that depth had a tritium concentration of 76 179 pCi/g.

Long-term plans for TA-33 and MDA K indicate continued laboratory use (i.e., an industrial scenario). Based on future land use, the exposure pathways deemed credible at PRS 33-002(b) are inhalation resulting from tritium emissions from the soil; soil ingestion; and inhalation of dust. Based on PCT 96-013 guidance, most of the generic RESRAD parameters for mesa top sites were used and are provided in Appendix C of this report (Project Consistency Team 1996, 1210). Site-specific RESRAD parameters used in the calculation of dose from exposure to this sump area were selected as a reasonable maximum exposure for a receptor evaluated under a continued laboratory operations scenario.

Certain parameters listed in the RESRAD output are critical to the manner in which the dose is calculated. These parameters include the area of contamination, the thickness of the contaminated zone, the erosion rate of the contaminated zone, the evapotranspiration coefficient, and particulate loading in air.

The size of the contaminated area may affect dose via soil ingestion, dust inhalation, external gamma irradiation, and inhalation of tritium. RESRAD modifies daily soil and air intake values to reflect the potential contribution to total daily intake associated with the site. The thickness and erosion rate of the contaminated zone, as well as the infiltration rate, can affect the calculation of dose with time. The dose from exposure to this sump area has been calculated by assuming minimal erosion, an approximate area of 100 ft^2, an initial uniform contamination depth of 25 ft, and an evapotranspiration coefficient that specifies no infiltration. These assumptions result in a static contaminated zone. A modeling period of 1000 years (approximately 80 tritium half-lives) is used as the time limit for dose calculations.

For calculating dose, the evapotranspiration coefficient has been set at the RESRAD limit of 0.999, effectively eliminating leaching of radionuclides from the contaminated zone by water and resulting in a maximal soil-based dose. This value is based on the fact that the annual average evapotranspiration rate for the Los Alamos area exceeds the average annual infiltration rate, assuming no irrigation and a relatively high runoff coefficient of approximately 0.5. Because the value used for the evapotranspiration coefficient results in no infiltration, vadose- and saturated-zone hydrogeologic parameters in RESRAD have no influence on the calculation of dose.

The key RESRAD parameters used in the modeling for this sump area are presented in Table 5.1.9-1. Other parameters are detailed in the RESRAD calculations in Appendix C of this report.

TABLE 5.1.9-1

PARAMETERS USED IN RESRAD MODEL FOR PRS 33-002(b)

PARAMETER	VALUE	RATIONALE
Area of contaminated zone	9 m^2	10-ft diameter of sump
Thickness of contaminated zone	8 m	25 ft depth of maximum contamination
Initial tritium soil concentration	100 000 pCi/g	UCL of first 25 ft of contamination
Contaminated zone erosion rate	0.001 m/year	RESRAD default. At this rate, the depth of the contaminated zone is effectively infinite over the 1000-year modeling period.
Inhalation rate	14 900 m^3	Half of a worker's time is spent at light (0.8 m^3/hr) and half at moderate (2.5 m^3/hr) levels of activity.
Mass loading for inhalation	0.00009 g/m^3	Based on air-monitoring data reported in the 1990 Environmental Surveillance Report.
Fraction of total time spent outdoors on site	0.042	Exposure frequency is assumed to be 8 hr/day, 250 day/yr. The fraction of the work time spent indoors is assumed to be 80%.

Using the parameters described above, RESRAD results show that the dose for an individual working at the sump site in summer 1996, the year in which the tritium samples were collected, was 5.8 mrem/year. After one year, the dose falls to 4.2 mrem/yr. DOE regulations governing the protection of workers at DOE-owned sites is contained in 10CFR Part 835, Occupational Radiation Protection. The occupational dose limit for general employees is 5 000 mrem/yr. Dose to members of the public is limited to 100 mrem/year from DOE activities.

5.1.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.1.11 Conclusion and Recommendation

Phase I sampling did not penetrate the bottom of the sump. Because tritium was found at elevated levels during the Phase I investigation, 1996 sampling at PRS 33-002(b) was extended through the sump and into tuff to a depth of 117.5 ft. Although tritium was detected above SAL in all samples to a depth approaching 60 ft, a RESRAD-calculated dose of 5.8 mrem/year in 1996 indicates that concentrations are insufficient to exceed the recommended DOE dose limit of 100 mrem/year. This dose is reduced each year as tritium, with a half-life of 12.5 years, decays. Tritium concentrations drop dramatically with depth beyond 60 ft. The plume is bounded in the vertical direction relative to SALs. Tritium concentrations between 110 and 117 ft fall to 3 pCi/g.

Driving forces for vertical migration of the tritium plume in this area of MDA K have been minimized. Sand bags have been installed to divert runoff from the paved area around TA-33-86. A cooling water outfall and septic system discharges have been eliminated. Depth to groundwater at this part of TA-33 is estimated to be 800 ft. It is, therefore, highly unlikely that the tritium concentrations detected at depth at this PRS represent a source of contamination to the regional aquifer. In the absence of hydraulic driving forces, the tritium peak ceases its downward migration. Diffusion will continue to decrease the maximum activity within the plume, both vertically and horizontally. Radioactive decay of tritium will decrease overall activities within this area of TA-33.

An MCE for noncarcinogenic effects yielded a result of 0.1, far below the target level of 1. One carcinogenic PAH was found above its SAL in the sump, but below industrial PRG. There is no

pathway to the environment. Concentrations of PAHs at PRS 33-002(b) are below those commonly found in urban and industrial environments.

Because contaminant concentrations, including tritium, are below levels of concern, PRS 33-002(b) is proposed for NFA for human health under Criterion 5 because it has been investigated and evaluated.

5.2 PRSs 33-002(c)

PRS 33-002(c) is sump TA-33-133 at MDA K. Because the sump was not located during the 1993 sampling campaign, Phase II sampling was performed at this PRS. Tritium concentrations were below human health risk levels, as were concentrations of other contaminants. Therefore, this PRS is proposed for NFA for human health.

5.2.1 History

Sump TA-33-133 is discussed in the RFI Work Plan for Operable Unit 1122 in Sections 3.2.2.1, 4.1.4, and 4.2.4. The sump was constructed in 1955 when TA-33-86 was built. It originally served four sinks and four floor drains in the north section of TA-33-86. Sump TA-33-133 was disconnected in 1959. The drain line from the building was extended approximately 90 ft past the sump to create a noncontact cooling water drain and outfall. The sump may have received tritium and small quantities of solvents such as trichloroethylene, methanol, ethanol, acetone, and propanol. It has been inactive since 1959.

5.2.2 Description

PRS 33-002(c) is located approximately 100 ft east of the tritium facility and approximately 30 ft north of septic tank TA-33-93 (Fig. 5.2.2-1). The sump is an unlined pit, 6 ft in diameter and 8 ft in depth, that might better be called a dry well. Originally, the sump had a 3-inch-thick concrete cover overlain by soil. The cover was destroyed during Weston sampling in 1989. Piles of dirt mixed with broken tuff surround the sump location. Pieces of broken concrete are strewn about the site. The ground is level with a sparse growth of chamisa and weeds. A few juniper trees grow nearby. On the surface, the soil is fine sand intermixed with silt and clay, with abundant tuff pieces. There is little organic material. At 2.5 ft, a drilling core indicated that the soil is a fine sand and clay, mixed with pulverized tuff that is presumed to be bedrock.

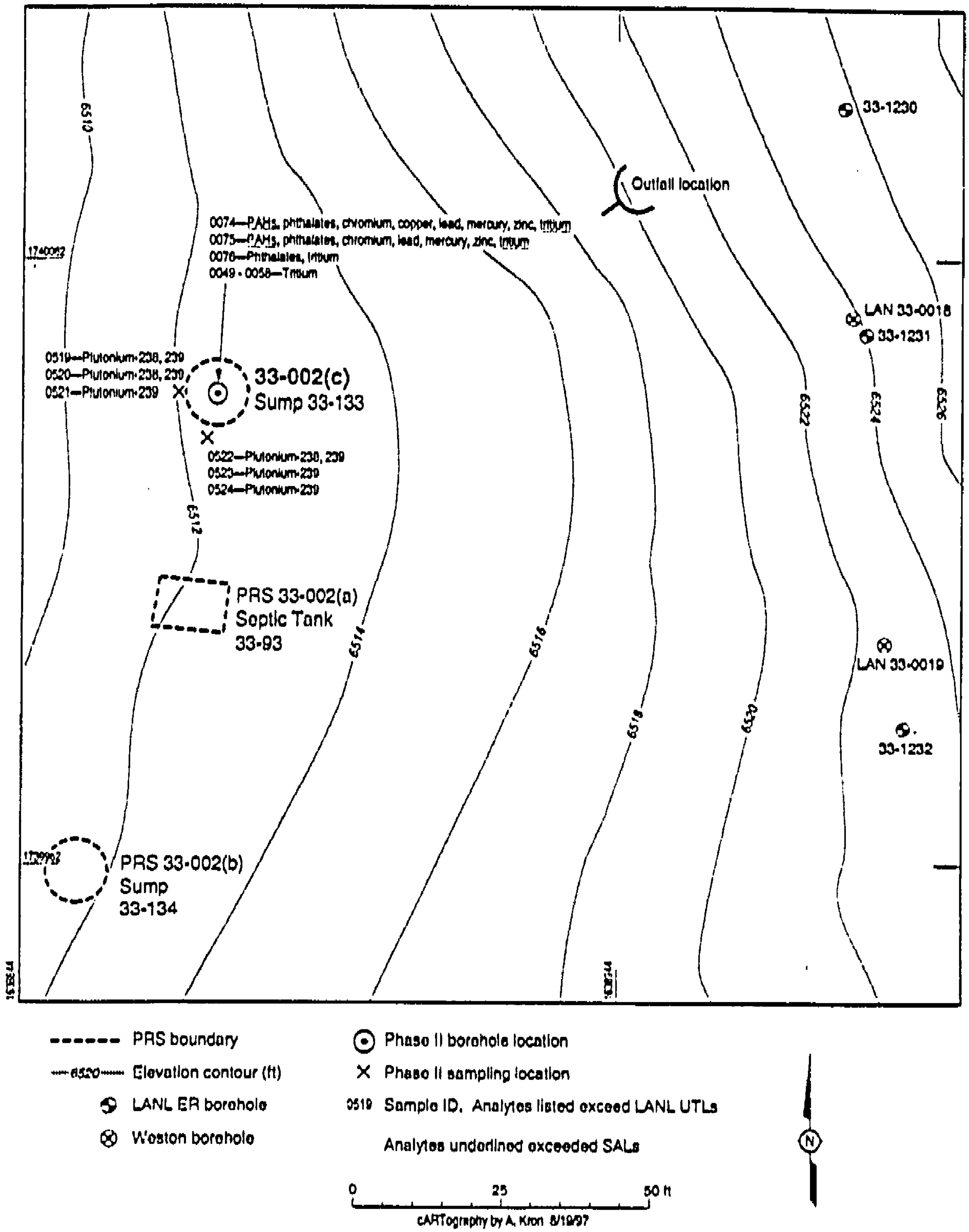


Fig. 5.2.2-1. PRS 33-002(c), sump TA-33-133 at MDA K.

5.2.3 Previous Investigation

Weston personnel collected two surface samples at sump TA-33-133 in 1989. Samples were analyzed for inorganic chemicals, radionuclides, VOCs, SVOCs, pesticides, and PCBs. Tritium was detected at 90 and 890 pCi/g. Trace levels of SVOCs were detected.

The Phase I sampling plan, which was carried out in 1993, directed that fluid and sludge samples be collected from the sump. The plan also directed that a borehole be drilled next to the sump. Three subsurface samples (plus one duplicate) were to be taken from the borehole to determine if possible contamination was migrating from the sump to the environment. During the ER sampling campaign in 1993, fluid and sludge were not present in the sump. Samples were not collected for these components. Drilling adjacent to the sump encountered the soil/tuff interface at 30 in. Because of the shallow depth of the hole, only a surface sample and a soil/tuff interface sample were collected. A sample was taken at a depth of 4 ft from within the sump at the point of auger refusal. All samples were analyzed for uranium, tritium, plutonium, gamma emitters, inorganic chemicals, and SVOCs. The two subsurface samples were analyzed for VOCs.

Plutonium-238 and plutonium-239/240, the solvent 2-hexanone (0.059 mg/kg), and tritium were found above background but below their SALs (Environmental Restoration Project 1995, 1263).

Section 4.3 of the September 1995 RFI Report for MDA K, which discusses the Phase I investigation of PRS 33-002(c), is provided as Attachment 2 of this report.

5.2.4 Field Investigation

Sampling at PRS 33-002(c) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With building waste as the primary source, exposure routes for human receptors are ingestion and dermal contact. Because the sump is a subsurface structure, inhalation is not considered a likely exposure route, and no surface sampling was performed.

In the 1996 sampling campaign, one borehole was drilled in the center of the sump, to a depth of 62 ft. Sample logs report a sharp change from fill to sump gravel at 4 ft. The tuff interface was located at 8 ft 3 in. The remaining samples were collected in tuff. The character of the tuff was soft and friable near the bottom of the sump and became progressively more consolidated with depth. For the first 12 ft, samples were analyzed for tritium, uranium, inorganic chemicals, VOCs, and SVOCs (Table 5.2.4-1).

TABLE 5.2.4-1

SUMMARY OF SAMPLES (EXCEPT TRITIUM) TAKEN FOR PRS 33-002(c)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	RADIO-NUCLIDES	INORGANIC CHEMICALS	VOCs	SVOCs
0333-96-0074	33-1697	Fill	5	2190[a]	2189	2188	2188
0333-96-0075	33-1697	Interface	8.5	2190	2189	2188	2188
0333-96-0076	33-1697	Tuff	12	2190	2189	2188	2188

a. ER analytical request number.

Samples collected every 5 ft thereafter were analyzed only for tritium by both fixed laboratory and by the MRAL (Table 5.2.4-2).

TABLE 5.2.4-2

SUMMARY OF TRITIUM SAMPLES TAKEN FOR PRS 33-002(c)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	FIXED LABORATORY	MRAL[a]
0333-96-0049	33-1697	Tuff	19.5	2195[b]	4/6/96[c]
0333-96-0050	33-1697	Tuff	24	2195	4/6/96
0333-96-0051	33-1697	Tuff	29	2195	4/6/96
0333-96-0052	33-1697	Tuff	31.5	2195	4/6/96
0333-96-0053	33-1697	Tuff	36	2195	4/6/96
0333-96-0054	33-1697	Tuff	40.5	2195	4/6/96
0333-96-0055	33-1697	Tuff	48.5	2195	4/6/96
0333-96-0056	33-1697	Tuff	52	2195	4/6/96
0333-96-0057	33-1697	Tuff	58.5	2195	4/6/96
0333-96-0058	33-1697	Tuff	62	2195	4/6/96

a. MRAL = Mobile radiological analytical laboratory
b. ER analytical request number
c. Date analyzed—no MRAL request number assigned

In the 1993 sampling campaign, plutonium-238 was detected, although it was well below its SAL. In 1996, additional analyses were performed to address concerns that plutonium might be widespread or present at higher concentrations. The three samples (0333-96-0074 through -0076) taken from the upper level of the sump were analyzed for plutonium by a fixed laboratory. Six additional samples from two locations near the original 1993 hand-augered hole were collected for MRAL analysis (Table 5.2.4-3).

TABLE 5.2.4-3

SUMMARY OF PLUTONIUM SAMPLES TAKEN FOR PRS 33-002(c)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	PLUTONIUM
0333-96-0074	33-1697	Fill	5	2190[a]
0333-96-0075	33-1697	Fill	8.5	2190
0333-96-0076	33-1697	Tuff	12	2190
0333-96-0519	33-1650	Soil	0.7	2247 MRAL[b]
0333-96-0520	33-1650	Tuff	1.3	2247 MRAL
0333-96-0521	33-1651	Tuff	0.7	2247 MRAL
0333-96-0522	33-1651	Tuff	2	2247 MRAL
0333-96-0523	33-1651	Tuff	2.5	2247 MRAL
0333-96-0524	33-1650	Tuff	1.7	2247 MRAL

a. ER analytical request number
b. MRAL = Mobile radiological analytical laboratory

5.2.5 Evaluation of Inorganic Chemicals

Chromium, copper, mercury, lead, and zinc were detected above background UTLs but below SALs in the initial 12-ft depth of the sump samples (Table 5.2.5-1). Because two of the samples were taken in tuff, the 95%,0.95 UTLs for Unit 3 of the Bandelier Tuff are shown below for comparison, in addition to LANL mixed-soil UTLs.

TABLE 5.2.5-1

INORGANIC CHEMICALS DETECTED ABOVE UTLs AT PRS 33-002(c)

SAMPLE ID	DEPTH (ft)	CHROMIUM (mg/kg)	COPPER (mg/kg)	MERCURY (mg/kg)	LEAD (mg/kg)	ZINC (mg/kg)
SAL	N/A[a]	210	2 800	23	400	23 000
95%,.95 UTL	N/A	19.3	15.5	0.1	23.3	50.8
95%,.95 UTL QBT3	N/A	2.1	2	NA[b]	16.2	55.5
0333-96-0074	5	173	36.7	1.4	126	271
0333-96-0075	8.5	46.4	12.3	0.3	86.4	86.8
0333-96-0076	12	18	1.6 (U[c])	0.09	5.8	28.5

a. N/A = Not Applicable
b. NA = Not Analyzed
c. U = Undetected—the listed value is the detection limit

5.2.6 Evaluation of Radionuclides

Uranium and plutonium, as analyzed by fixed laboratory, were not detected above LANL UTLs in the upper 5-12 ft of the borehole in the sump. Because a total digestion was used for sample preparation for uranium analysis, uranium results were compared to the total background UTL of 5.45 mg/kg (see Section 4.2 of this report). Uranium results at PRS 33-002(c) ranged from 2.9 to 3.6 mg/kg.

The samples collected from the two locations near the 1993 hand-augered site were analyzed by the MRAL. These samples contained plutonium above LANL UTLs but well below SALs (Table 5.2.6-1). MRAL plutonium-detection methods were inadequate to measure levels below background, but were adequate for comparing to SALs. Because plutonium concentrations are below SALs, plutonium will not be carried forward in the screening process.

TABLE 5.2.6-1

PLUTONIUM DETECTED BY MRAL ANALYSES AT PRS 33-002(c)

SAMPLE ID	DEPTH (ft)	PLUTONIUM-238 (pCi/g)	PLUTONIUM-239/240 (pCi/g)
SAL	N/A[a]	27	24
LANL UTL	N/A	0.014	0.052
0333-96-0519	0.5	0.83 (J)[b]	0.7 (J)
0333-96-0520	1	0.71 (J)	0.6 (J)
0333-96-0521	0.5	0.101 (U)[c]	1.21 (J)
0333-96-0522	1.5	0.65 (J)	4.97 (J)
0333-96-0523	2.5	0.8 (U)	0.67 (J)
0333-96-0524	1.5	0.79 (U)	0.67 (J)
0333-96-0524	1.5	0.70 (J)	0.59(U)

a. N/A = Not Applicable
b. J = Estimated—value is above detection limit but below the estimated quantitation limit
c. U = Undetected—value listed is the 1-sigma uncertainty

Tritium was detected above its LANL UTL in every sample, including samples screened by the MRAL. Samples taken at 4.5 and 8 ft contained tritium above its SAL (Table 5.2.6-2).

TABLE 5.2.6-2

TRITIUM DETECTED AT PRS 33-002(c)

SAMPLE ID	DEPTH (ft)	FIXED LABORATORY (pCi/g)	MRAL (pCi/g)
SAL	N/A[a]	260	260
LANL UTL	N/A	1	1
0333-96-0074	5	305	NA[b]
0333-96-0075	8.5	370	NA
0333-96-0076	12	113	NA
0333-96-0049	19.5	144	137
0333-96-0050	24	132	116
0333-96-0051	29	142	153
0333-96-0052	31.5	82	42
0333-96-0053	36	54	39
0333-96-0054	40.5	32	28
0333-96-0055	48.5	26	24
0333-96-0056	52	18	23
0333-96-0057	58.5	14	11
0333-96-0058	62	10	8

a. N/A = Not Applicable
b. NA = Not Analyzed

5.2.7 Evaluation of Organic Chemicals

Both common PAHs that are typical of tar and a common plasticizer were detected in Phase II sampling. Although three PAHs were found above their SALs, all were confined within the sump or at the interface (Table 5.2.7-1).

5.2.8 Risk-Based Screening Assessment

Using the maximum concentrations from both the 1993 and 1996 sampling campaigns at this PRS, an MCE calculation was performed for the noncarcinogenic contaminants (Table 5.2.8-1). Benzo[g,h,i]perylene and phenanthrene were not included in the calculation because they have no SALs. (See discussion in Section 5.0 of this report.) The MCE result for noncarcinogens was less than 1, indicating that noncarcinogens are not a human health risk at PRS 33-002(c). Therefore, noncarcinogens are not carried forward in the screening process.

TABLE 5.2.7-1

DETECTED ORGANIC CHEMICALS FOR PRS 33-002(c)

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0074	5	Acenaphthene	0.38	360	0.33
		Anthracene	0.1(J[a])	18 000	0.33
		Benzo[a]pyrene	0.42	0.061	0.33
		Benzo[a]anthracene	0.66	0.61	0.33
		Benzo[b]fluoranthene	1.1	0.61	0.33
		Benzo[g,h,i]perylene	0.59	NS[b]	0.33
		Bis(2-ethylhexyl)phthalate	0.45 (B[c],U[d])	32	0.33
		Chrysene	0.52	61	0.33
		Di-n-butylphthalate	0.069(J)	6 500	0.33
		Fluoranthene	0.49	2 600	0.33
		Indeno[1,2,3-cd]pyrene	0.56	0.61	0.33
		Phenanthrene	0.24(J)	NS	0.33
		Pyrene	0.45	1 900	0.33
0333-96-0075	8.5	Acenaphthene	0.067(J)	2 200	0.33
		Benzo[a]pyrene	0.13(J)	0.061	0.33
		Benzo[b]fluoranthene	0.27(J)	0.61	0.33
		Benzo[g,h,i]perylene	0.13(J)	NS	0.33
		Bis(2-ethylhexyl)phthalate	0.43 (B,U)	32	0.33
		Di-n-butyl phthalate	0.067(J)	6 500	0.33
		Fluoranthene	0.13(J)	2 600	0.33
		Indeno[1,2,3-cd]pyrene	0.10(J)	0.61	0.33
		Phenanthrene	0.10(J)	NS	0.33
		Pyrene	0.13(J)	1 900	0.33
0333-96-0076	12	Di-n-butylphthalate	0.07(J)	6 500	0.33

a. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit
b. NS = No SAL available
c. B = Analyte was detected in the laboratory blank
d. U = Undetected—result given is the detection limit

TABLE 5.2.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-002(c)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Copper	33-1697	0333-96-0074	36.7	2 800	0.01
Mercury	33-1697	0333-96-0074	1.4	23	0.06
Lead	33-1697	0333-96-0074	126	400	0.3
Zinc	33-1697	0333-96-0074	271	23 000	0.01
Acenaphthene	33-1697	0333-96-0074	0.067	2 200	0.00003
Anthracene	33-1697	0333-96-0074	0.1	18 000	0.000006
Chrysene	33-1697	0333-96-0074	0.52	61	0.009
Di-n-butylphthlate	33-1697	0333-96-0074	0.07	6 500	0.00001
Fluoranthene	33-1697	0333-96-0074	0.49	2 600	0.0002
Pyrene	33-1697	0333-96-0074	0.45	1 900	0.0002
				Total	0.4

Three carcinogenic PAHs were found above SALs (Table 5.2.8-2). PAHs are carried forward in the screening process.

TABLE 5.2.8-2

PRS 33-002(c) CARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	BENZO[a]PYRENE (mg/kg)	BENZO[a]ANTHRACENE (mg/kg)	BENZO[b]FLUORANTHENE (mg/kg)
SAL	N/A[a]	N/A	0.061	0.61	0.61
PRG[b]	N/A	N/A	0.26	2.6	2.6
0333-96-0074	33-1697	5	0.42	0.66	1.1
0333-96-0075	33-1697	8.5	0.13(J[c])	0.33(U[d])	0.27(J)

a. N/A = Not Applicable
b. PRG = Preliminary Remediation Goal for industrial sites (EPA 1996, 1307)
c. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit
d. U = Undetected—value listed is the detection limit of the analytical instrument

Two additional carcinogens, chromium and ideno[1,2,3-cd]pyrene, were detected below SAL but above UTLs. An MCE result of 1.7 indicates that these contaminants may represent a carcinogenic hazard to human health at PRS 33-002(c) (Table 5.2.8-3). Therefore, these contaminants are carried forward in the screening process.

TABLE 5.2.8-3

MCE FOR CARCINOGENIC EFFECTS AT PRS 33-002(c)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Chromium	33-1697	0333-96-0074	173	210	0.8
Ideno[1,2,3-cd]pyrene	33-1697	0333-96-0074	0.56	0.61	0.9
				Total	1.7

5.2.9 Human-Health Risk Assessment

In two samples, tritium was found above its SAL. The risk assessment for PRS 33-002(b), described in Section 5.1.9 of this report, determined that a site-specific concentration of 101 000 pCi/g of tritium produces a dose of 5.8 mrem/year, far below the DOE exposure limit to the public of 100 mrem/year. Because the maximum tritium concentration (370 pCi/g) at sump 33-002(c) is far below 101 000 pCi/g, no separate risk assessment was performed. Because the relation of activity to dose is linear, a dose at PRS 33-002(c) can be estimated at 0.02 mrem/year under the same assumptions used at PRS 33-002(b).

An MCE for carcinogens indicates that PAHs and chromium may be of concern at this PRS. PAHs are common industrial pollutants. Except for benzo(a)pyrene in one sample, levels at this PRS are below industrial PRGs and do not indicate that PAHs were used experimentally in the tritium facility. Therefore, LANL does not propose a cleanup at this site for PAHs.

The industrial cleanup level for chromium is 450 mg/kg. The sample containing highest chromium was collected at a depth of 5 ft. Two samples—one at 8.5 ft and one at 12 ft—were collected below it and showed decreasing concentrations, with the level below UTL at 12 feet. Because the concentration is approximately one-third of the cleanup level and contamination has been bounded, no cleanup of the sump is proposed.

5.2.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.2.11 Conclusion and Recommendation

Phase I sampling, which used hand augering, did not locate sump TA-33-133. Phase II sampling, using a drill rig, located the sump and drilled through it into tuff to a depth of 62 ft. An MCE for noncarcinogenic effects determined that these chemicals do not present a hazard to human health. Radiological screening by the MRAL confirmed that plutonium is present above background, but well below SAL. Low levels of PAHs found in the sump are not inconsistent with industrial sites. Chromium is present well above background UTLs, but below industrial cleanup levels. Because contamination is confined to the sump and contamination is bounded above 12 ft, no cleanup is proposed for these contaminants.

Tritium was detected somewhat above its SAL, but far below levels that could produce a dose of the DOE limit of 100 mrem/year. Tritium contamination relative to SAL was bounded at depth by sampling between 8 ft and 12 ft. Because of the low tritium levels and the short tritium half-life, contamination of regional groundwater is considered to be unlikely. No perched aquifer was found by deep drilling near PRS 33-002(c) during the Phase I investigation of MDA K (Environmental Restoration Project 1995, 1263).

Because tritium and other contaminant concentrations are below human health risk-based levels of concern, PRS 33-002(c) is proposed for NFA for human health under Criterion 5.

5.3 PRS 33-003(b)

PRS 33-003(b) is chamber TA-33-6 at MDA D, East Site. It is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.5.2.1 and 4.5.3.1 (LANL 1992, 0784). HE and inorganic chemicals, principally beryllium, were identified in the work plan as potential contaminants. Subsequent archival investigation indicated that less than 5 lb. of PCBs may have been present in neutron detectors in the chamber. Because PCBs may have been deposited on the surface by an explosive test shot in the chamber, a revised sampling plan for the surface- and subsurface-soil components was included in the September 1995 TA-33 RFI report (Environmental Restoration Project 1995, 1265).

Based on results of the revised sampling, PRS 33-003(b) is recommended for NFA for human health.

5.3.1 History

Chamber TA-33-6 was constructed in 1948 and used for initiator tests involving milligram quantities of beryllium. Polonium-210 (with a half-life of 138 days) was the radiological component of the initiators. Chamber TA-33-6 was used twice, once in December 1948 and again in April 1952. Both tests required detonation of HE, and the second test destroyed the chamber. Debris from the detonation was ejected through the elevator shaft and spread over the mesa. A 10-ft-deep crater formed around the chamber (Blackwell 1952, 02-034). The crater was later filled with the ejected debris and covered with uncontaminated soil (Blackwell 1953, 02-035). In 1963 the depression was refilled (The Zia Company 1963, 02-030).

5.3.2 Description

MDA D is located at East Site. The mesa is level; no drainage patterns are evident. A thin layer of hard-packed soil covers bedrock tuff. The area is covered with weeds interspersed with a few chamisa shrubs. A surface concrete pad—the staging area for chamber TA-33-6—is located

approximately 50 ft north of East Site Road, near septic tank TA-33-96, and approximately 350 ft south of the rim of Ancho Canyon (Fig. 5.3.2-1).

The chamber is an octagonal, vault-like structure, which is 18 ft long x 18 ft wide x 11 ft high. It is buried, with its roof approximately 30 ft below grade. Access was gained through a 4-ft x 6-ft elevator shaft at the side of the chamber. The elevator shaft, which is now filled, was approximately 46 ft deep. The few remaining surface indications of the chamber include an 8-ft x 12-ft concrete pad (broken at the east end where the shaft was located) and a 6-ft x 10-ft depression up to 2 ft deep (located in the area of the shaft).

5.3.3 Previous Investigation

Existing surface data for PRS 33-003(b) at East Site include 16 surface soil samples that were collected by LANL's Environmental Surveillance Program in 1977. The surveillance samples were analyzed for tritium, uranium, and cesium-137; all results were within background ranges. These data are summarized in the RFI Work Plan for Operable Unit 1122 (LANL 1992, 0784).

In 1989, Weston personnel collected samples from three boreholes at TA-33-6. Nine subsurface samples were collected. Seven were analyzed for uranium; six, for inorganic chemicals; and seven, for HE. Three samples were analyzed for VOCs. Cadmium, mercury, lead, and zinc, which were detected at the bottom of the elevator shaft, were above LANL (95%,0.95) UTLs but far below their respective SALs. Results are discussed in Section 5.3.3.1 of the September 1995 RFI report (Environmental Restoration Project 1995, 1265) and reviewed in Section 5.3.4 of this report.

The 1994 LANL ER Project sampling at East Site included nine surface samples taken within 100 ft of the chamber. All samples were analyzed for inorganic chemicals, radionuclides, and HE. Three were analyzed for SVOCs. Results indicated that HE, radionuclides, and SVOCs need not be carried forward as COPCs. At the time of sampling, PCBs were not recognized as potential contaminants.

Section 5.1 of the September 1995 RFI Report for TA-33, which discusses the Phase I investigation of PRS 33-003(b), is provided as Attachment 3 of this report.

5.3.4 Field Investigation

Sampling at PRS 33-003(b) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With surface disposal and landfill as the primary source, exposure routes for human receptors are ingestion, inhalation, and dermal contact. Both surface and subsurface sampling was performed.

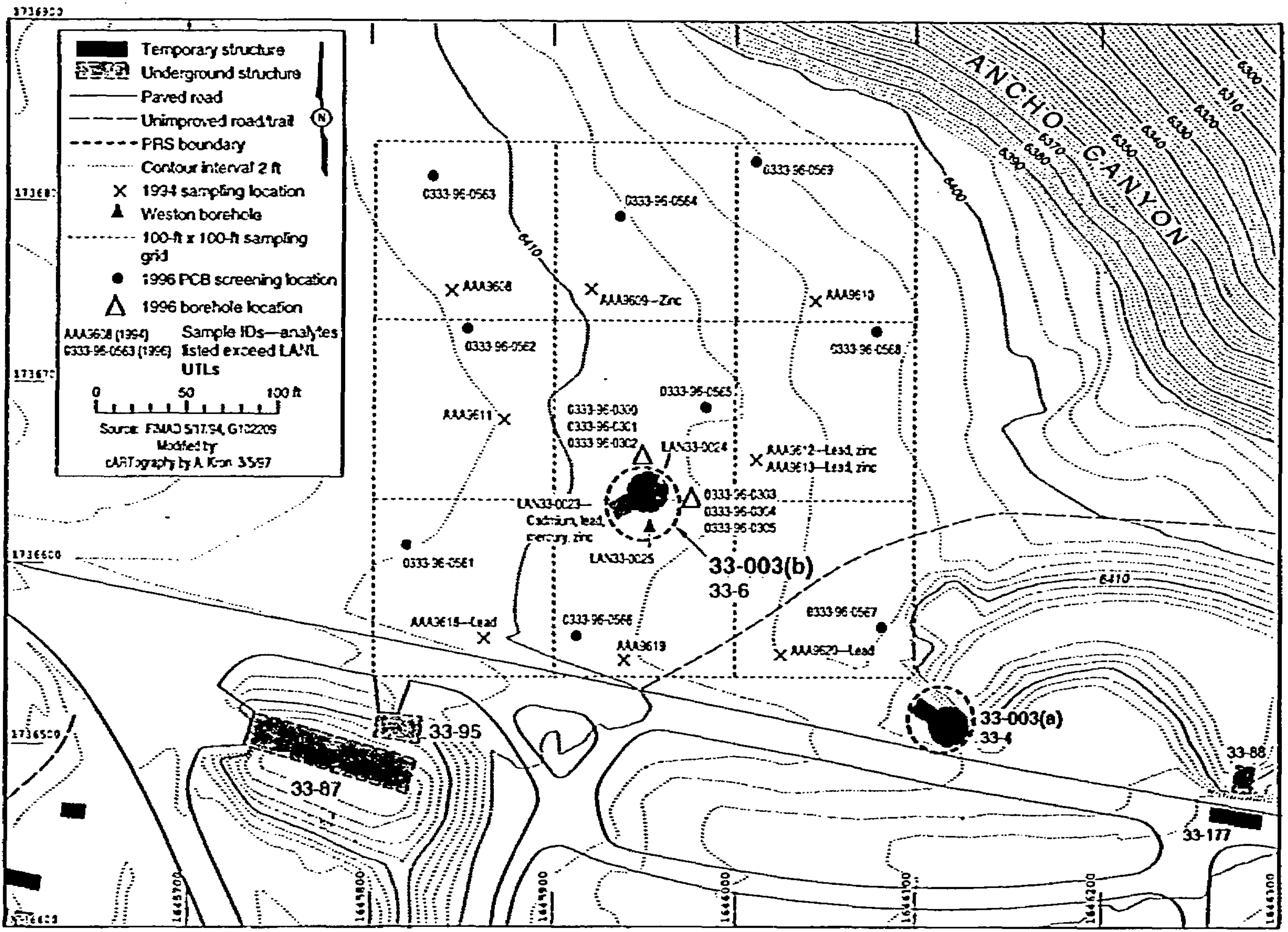


Fig. 5.3.2-1. PRS 33-003(b), chamber TA-33-6 at MDA D.

5.3.4.1 Surface Sampling

As directed by the revised sampling plan, nine surface samples were collected from a 100-ft x 100-ft grid to a distance of 150-200 ft from the elevator shaft (Environmental Restoration Project 1995, 1265). One 1994 sample was assigned to each cell of the grid for the purpose of assessing inorganic chemicals (Fig. 5.3.2-1). All 1994 samples were analyzed for inorganic chemicals, uranium, cesium-137, cobalt-60, and HE (Table 5.3.4-1).

In the 1996 sampling campaign, nine locations, one within each grid cell, were field-screened for PCBs (Table 5.3.4-2). Sample locations were selected randomly within each cell (Fig. 5.3.2-1). D-TECH PCB soil kits were used for field screening (see Section 4.2 of this report).

TABLE 5.3.4-1

SUMMARY OF 1994 SURFACE SAMPLES TAKEN FOR PRS 33-003(b)

SAMPLE ID	SITE ID	DEPTH (ft)	MEDIUM	INORGANIC CHEMICALS	RADIO-NUCLIDES	HE
AAA9608	33-1300	0–0.5	Soil	19256[a]	19470	17610
AAA9609	33-1301	0–0.5	Soil	19256	19470	17610
AAA9610	33-1302	0–1	Soil	19256	19470	17610
AAA9611	33-1303	0–1	Soil	19256	19470	17610
AAA9612	33-1304	0–1	Soil	19256	19470	17610
AAA9613	33-1452	0–1	Soil	19256	19470	17610
AAA9618	33-1376	0–0.5	Soil	19880	19473	17608
AAA9619	33-1387	0–0.5	Soil	19880	19473	17608
AAA9620	33-1395	0–0.5	Soil	19880	19473	17608

a. ER analytical request number

TABLE 5.3.4-2

SUMMARY OF PCB SCREENING SURFACE SAMPLES TAKEN FOR PRS 33-003(b)

SAMPLE ID	LOCATION ID	DEPTH (ft)
0333-96-0561	33-1736	0–0.5
0333-96-0562	33-1737	0–0.5
0333-96-0563	33-1738	0–0.5
0333-96-0564	33-1739	0–0.5
0333-96-0565	33-1740	0–0.5
0333-96-0566	33-1741	0–0.5
0333-96-0567	33-1742	0–0.5
0333-96-0568	33-1743	0–0.5
0333-96-0569	33-1744	0–0.5

5.3.4.2 Borehole Sampling

In 1989, Weston personnel drilled three boreholes at PRS 33-003(b) (Fig. 5.3.2-1). Borehole LAN33-0023, which was drilled to a depth of 47 ft, was located in the elevator shaft. Borehole LAN33-0024, drilled to a depth of 29 ft, was located above the chamber. Borehole LAN33-0025, drilled to 58 ft, was located beside the chamber. Various samples were analyzed for inorganic chemicals, radionuclides, VOCs, and HE (Table 5.3.4-3).

Borehole logs describe the material through which the three boreholes penetrated. The shaft was filled with a gravel-sand-tuff mixture. Wood fragments were encountered between 5 and 20 ft. Below 20 ft, the fill was gravel and sand with pumice fragments. Rusty wire, clips, chain fragments, and other debris were found at the bottom of the shaft. The roof borehole penetrated tuff and pumice fragments mixed with sand. A 6-ft void was encountered between 12 and 18 ft. The drill brought up concrete fragments from the roof at 29 ft. The borehole adjacent to the chamber struck tuff at 1.5 ft. Drilling alternated between tuff and pumice/tuff/sand. A void was encountered between 33 and 42 ft. Some burned material may have been found at 30 ft.

In accordance with the sampling and analysis plan for the ER Project's 1996 sampling campaign, two boreholes were drilled to a minimum of 15 ft. One borehole was located 3 ft north of the shaft; the second borehole was located 4 ft east of the shaft. Three samples were collected from each borehole. Drilling penetrated matrix material similar to the Weston boreholes described above. During sampling, tuff was encountered at 2.5 ft in borehole 33-1745 and at 4 ft in borehole 33-1746. A 10-ft-deep layer of fill, alleged to have resulted from the 1952 explosion, was not found, even though boreholes were sited in the area indicated in memos and photos. The only wood fragments from the explosion debris were found within the elevator shaft, implying that most of the debris may have been bulldozed there.

During 1996 drilling of the borehole east of the chamber, an irregular cavity was encountered at a depth of 12.5. The drill rig was adjusted to perform hammer-drilling down to 20 ft, and one sample was collected. The sample, consisting of engineering fill of sand and silt, was screened for PCBs. Because results were negative, the sample was not submitted for laboratory analysis. The source of the cavity is unknown but presumed to be either an artifact of chamber construction or a subsidence as a result of the explosion. At the conclusion of drilling, cuttings were returned to the cavities and the boreholes were capped with bentonite. Biodegradable polyjute matting was used to plug the bottom of the hole penetrating the cavity.

All samples were analyzed for inorganic chemicals. Four samples were submitted for PCB fixed-laboratory analysis (Table 5.3.4-4).

TABLE 5.3.4-3

SUMMARY OF 1989 WESTON BOREHOLE SAMPLES TAKEN FOR PRS 33-003(b)

SAMPLE ID	LOCATION ID	MEDIUM	DEPTH (ft)	INORGANIC CHEMICALS	RADIO-NUCLIDES	VOCs	HE
LAN-0023-1	Shaft	Fill	38	C[a]	C	NA[b]	C
LAN-0023-2	Shaft	Fill	43	C	C	C	C
LAN-0023-3	Shaft	Fill	47	NA	C	NA	C
LAN-0024-1	Roof	Fill	23	C	C	NA	C
LAN-0024-2	Roof	Fill	28	C	C	NA	C
LAN-0025-1	Adjacent	Fill	28	NA	NA	C	NA
LAN-0025-2	Adjacent	Fill	43	C	C	NA	C
LAN-0025-3	Adjacent	Fill	48	C	C	NA	C
LAN-0025-3	Duplicate	Fill	48	C	C	NA	C
LAN-0025-4	Adjacent	Tuff	58	NA	NA	C	NA

a. C = Sample collected
b. NA = Not Analyzed

TABLE 5.3.4-4

SUMMARY OF 1996 BOREHOLE SAMPLES TAKEN FOR PRS 33-003(b)

SAMPLE ID	LOCATION ID	DEPTH (ft)	MATRIX	INORGANIC CHEMICALS	PCBs
0333-96-0300	33-1745	4.5–5	Tuff	2144	2143
0333-96-0301	33-1745	9–10	Tuff	2144	NA[a]
0333-96-0302	33-1745	14–15	Tuff	2144	NA
0333-96-0303	33-1746	0–1.5	Sand	2144	2143
0333-96-0304	33-1746	4–5	Tuff	2144	2143
0333-96-0305	33-1746	10–11.5	Tuff	2144	2143

a. NA = Not Analyzed

5.3.5 Evaluation of Inorganic Chemicals

5.3.5.1 Surface Sampling

In five of the nine 1994 ER surface samples, lead and zinc were detected above LANL (95%,0.95) UTLs, but well below their respective SALs (Table 5.3.5-1). This information was not reported in the 1994 RFI report because all results were below the set of UTLs in use at that time. A trace of mercury (0.02 mg/kg) was detected in sample AAA9608, but not in a laboratory reanalysis of the same sample. Because mercury contamination was not confirmed, it is considered a laboratory contaminant.

TABLE 5.3.5-1

INORGANIC CHEMICALS ABOVE LANL UTLs IN SURFACE SAMPLES TAKEN FOR PRS 33-003(b)

SAMPLE ID	DEPTH (ft)	LEAD (mg/kg)	ZINC (mg/kg)
SAL	N/A	400	23 000
(95%, .95) UTL	N/A	23.3	50.8
AAA9609	0–0.5	12.6	66.2
AAA9612	0–1	44.4	64.2
AAA9613	0–1	24.2	71.3
AAA9618R	0–0.5	38.9	31
AAA9620	0–0.5	24.9	39

5.3.5.2 Borehole Sampling

No inorganic chemicals were detected above UTLs in the 1996 ER borehole samples. In the Weston 1989 samples from the bottom of the elevator shaft (and thus confined), cadmium, mercury, lead, and zinc were detected above LANL (95%,0.95) UTLs but below their respective SALs (Table 5.3.5-2). No other inorganic analytes were found above their UTLs in any Weston sample. Cadmium and mercury were not detected in any sample with a pathway to the environment.

TABLE 5.3.5-2

INORGANIC CHEMICALS ABOVE LANL UTLs IN WESTON BOREHOLE SAMPLES TAKEN FOR PRS 33-003(b)

SAMPLE ID	DEPTH (ft)	CADMIUM (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)
SAL	N/A	38	400	23	23 000
(95%, .95) UTL	N/A	2.7	23.3	0.1	50.8
0023-2	43	7.1	79	2.1	852
0023-3	47	4.9	4	1.1	652

5.3.6 Evaluation of Radionuclides

Because no uranium, cesium-137, or cobalt-60 was found above LANL UTLs in any sample analyzed for PRS 33-003(b), no radionuclide analyses were specified in the 1996 sampling plan. Polonium-210 was the only radionuclide used at 33-003(b). With a half-life of 139 days, it has decayed over approximately 45 years to nondetectable levels. Polonium-210 is an alpha emitter and decays directly to stable lead-206, which cannot be distinguished from the naturally occurring lead isotope.

5.3.7 Evaluation of Organic Chemicals

In accordance with the revised sampling and analysis plan, all samples were screened for PCBs using the D-Tech immunoassay field screening kit. Trace levels of PCBs, below the LANL cleanup level of 1 mg/kg, may have been detected in two of the nine surface-soil screening samples (Table 5.3.7-1). Because the plan specified that only samples with screening results above 1 mg/kg be submitted for laboratory analysis, no surface samples were analyzed in a fixed laboratory.

Four of six borehole samples were submitted for laboratory analysis. No PCBs were detected in any screening or laboratory sample from a borehole. (Weston did not analyze for PCBs in 1989.) Laboratory analysis included the following Aroclors™: 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

TABLE 5.3.7-1

PCBs DETECTED IN SURFACE SAMPLES AT PRS 33-003(b)

SAMPLE ID	DEPTH (ft)	PCBs (mg/kg)
0333-96-0566	0–0.5	0.5–1
0333-96-0567	0–0.5	0.5–1

5.3.8 Risk-Based Screening Assessment

No contaminant was found above SAL in any sampling campaign. The PCBs detected in two samples are below their SALs of 1 mg/kg and their presence is questionable. As discussed in Section 4.3.3 of this report, PCB field screening results near detection limits of approximately 0.5 mg/kg tend to be higher than results analyzed under the stricter analytical conditions of a fixed laboratory with detection limits near 0.03 mg/kg. PCBs are not carried forward in the screening process.

Weston sampling found cadmium (7.1 and 4.9 mg/kg), lead (79 mg/kg), mercury (2.1 and 1.1 mg/kg), and zinc (852 and 652 mg/kg) well below their SALs at a depth of 43–47 ft in the bottom of the elevator shaft. These will not be carried forward in the screening assessment process because there is no pathway for migration (Environmental Restoration Project 1995, 1265).

Using the maximum concentrations at this PRS, an MCE calculation was performed for the noncarcinogenic surface contaminants. The MCE result for noncarcinogens was 0.1 (Table 5.3.8-1). This MCE value is less than unity; therefore, no potential human-health risk based on additive effects is identified for this class of chemicals. They are not carried forward in the screening process.

No carcinogens were found above LANL UTLs at PRS 33-003(b).

TABLE 5.3.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-003(b)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Lead	33-1304	AAA9612	44.4	400	0.1
Zinc	33-1452	AAA9613	71.3	23 000	0.003
				Total	0.1

5.3.9 Human-Health Risk Assessment

Because no contaminant was carried forward in the screening process, no human-health risk assessment was performed for PRS 33-003(b).

5.3.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.3.11 Conclusion and Recommendation

PRS 33-003(b) is a buried underground chamber. As indicated by the depth of the Weston borehole above the chamber, the top of the chamber is located approximately 30 ft below the surface of the mesa. LANL photograph 6759, taken during construction, shows that the chamber was constructed in solid tuff with little space between the structure and surrounding tuff. An archival search indicated that no more than 5 lb. of PCBs may have been present in neutron detectors located inside the chambers. No studies are available in the literature that investigate the probable fate of PCBs under the explosive effects of 600 lb. of TNT in an initially enclosed chamber. The physical condition of the chamber is not known, but drilling activities did not indicate any standing water that could act as a hydraulic head to force movement of contaminants from the chamber. An exposure pathway for subsurface contaminants is considered unlikely.

The archival description of the chamber test in 1952 indicated that debris was ejected from the shaft and spread over the mesa (Blackwell 1952, 02-034). A subsequent memo indicated that debris was bulldozed into the hole formed around the chamber and was covered with uncontaminated fill (Blackwell 1953, 02-035). As was discussed in Section 5.3.4.2 of this report, Weston drilling logs indicate that wood fragments were found in the elevator shaft, but not in the two external boreholes. The 1996 ER Project's borehole drilling did not encounter the

expected debris. It can be reasonably concluded from physical evidence that either all debris was deposited in the shaft or some may have been removed from the site.

In the work plan, the primary release mechanisms developed for the conceptual models of the three different exposure scenarios (current use, recreational use, and construction) include sediment transport and resuspension by wind. As discussed in Section 5.3.8, surface and subsurface sampling at PRS 33-003(b) did not detect contaminants of concern for these pathways. Except for somewhat elevated levels of lead and zinc, as is common at TA-33, contaminants are confined to the elevator shaft and are present only at low levels. PCBs, if present at all, are not present at levels of concern.

This site is proposed for NFA for human health based on Criterion 5 because it has been investigated and evaluated. It has been found that the PRS does not present a significant risk to human health.

5.4 PRS 33-004(k)

PRS 33-004(k), an alleged outfall from bunker TA-33-87, is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.5.2.3 and 4.5.3.2 (LANL 1992, 0784). Investigation during the 1994 and 1996 field campaigns failed to locate either a drain line or outfall. Based on these efforts and the benign history of TA-33-87, this PRS is proposed for NFA for human health under Criterion 1: The PRS cannot be found.

5.4.1 History

PRS 33-004(k) is the alleged outfall of a drain line from control bunker TA-33-87 at East Site. LANL engineering drawing C-3304 shows a floor drain near the front door. This drain is connected to a perforated pipe that extends the length of the building. According to the drawing, an 8-in. cast-iron pipe extends 54 ft southeast of the building, followed by an 8-in. vitrified-clay pipe extending another 71 ft to an outfall. Bunker TA-33-87 was completed in June 1955 to support shot tests at East Site. The bunker housed electronic equipment to support field tests. There is no record of radioactive materials being used or stored in the building; however, photo processing may have occurred there.

5.4.2 Description

TA-33-87 is located in the central section of East Site. The area is level; paved roads surround the bunker (Fig. 5.4.2-1). A berm covers the building, and the route of the alleged pipe is covered by this berm. The berm itself and the terrain surrounding the berm are covered with chamisa.

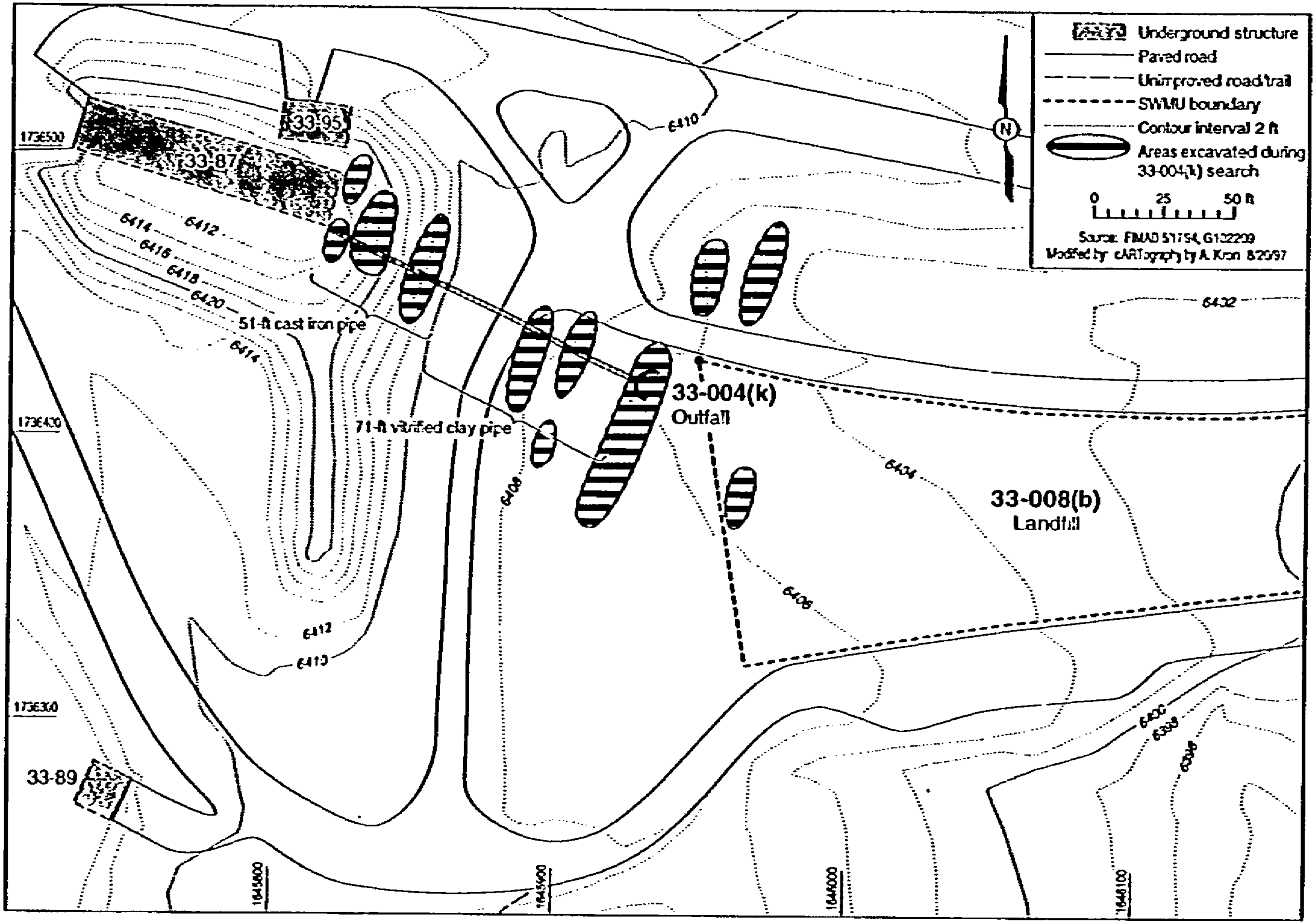


Fig. 5.4.2-1. PRS 33-004(k), site of alleged outfall from TA-33-87.

5.4.3 Previous Investigation

No previous investigations have been performed for this PRS. Attempts to locate the PRS were unsuccessful.

5.4.4 Field Investigation

In 1994, magnetic and electromagnetic surveys were performed within the area east of the bunker where the alleged pipe was shown on the engineering drawings. These surveys did not indicate the presence of a pipe at the expected locations. In 1995, a ground-penetrating radar survey was conducted. The survey detected two anomalies at the southeast corner of the building. Eleven trenches were dug by shovel, both parallel and perpendicular to the anomalies (Fig. 5.4.2-1). Continuous bedrock tuff was encountered at a depth of 1.5 ft; there was neither pipe nor trench to contain a pipe. In 1996, the inside of the building was inspected to determine the location of floor drains in order to aid in the search for the drainpipe. No floor drains were found. The sink and toilet in the building are served by septic system TA-33-96 north of the bunker, which is not associated with the outfall.

5.4.5 Evaluation of Inorganic Chemicals

No samples were collected for analysis of inorganic chemicals.

5.4.6 Evaluation of Radionuclides

No samples were collected for analysis of radionuclides.

5.4.7 Evaluation of Organic Chemicals

No samples were collected for analysis of organic chemicals.

5.4.8 Risk-Based Screening Assessment

Although no data were collected for this PRS, archival information concerning use of bunker TA-33-87 indicates that activities in the building were benign. LANL photograph CN711901, dated August 9, 1971 (near the end of initiator activities at East Site), shows a room full of electronic equipment. In 1994, sampling of septic tank TA-33-96 indicated that no contaminants had been disposed of through the sinks (Environmental Restoration Project 1995, 1288). The floor drain allegedly draining to this pipe and outfall was not found during a 1996 inspection of the building. If this floor drain did exist, the engineering drawing shows it at the opposite end of the building from the sink and, therefore, unlikely to receive spilled liquids.

5.4.9 Human-Health Risk Assessment

Because no contaminant was carried forward in the screening process, no human-health risk assessment was performed for PRS 33-004(k).

5.4.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed. LANL believes that if a PRS does not exist, no further action will be required to evaluate it biologically.

5.4.11 Conclusion and Recommendation

Despite a conscientious field search, as described in Section 5.4.4 of this report, no drainpipe or outfall could be found by remote sensing or by trenching along the path indicated in the engineering drawing. No floor drain could be found in the building at the indicated location (or any other location) in 1996. The primary release mechanisms for the conceptual models of three different contaminant exposure scenarios (current use, recreational use, construction) at TA-33 are sediment transport and resuspension by wind, leading to dust inhalation and soil ingestion. If a floor drain did exist during W-3 firing site operations and was later covered during remodeling, of which there is no record, the only exposure pathway for contaminant transport would have been through a perforated pipe buried under a 16-ft-high berm. Such an event is unlikely. Therefore, archival and physical evidence preclude contaminant transport from the building as a viable exposure pathway for human or ecological receptors.

This site is proposed for NFA for human health based on Criterion 1 because the PRS could not be found. A Class III permit modification will be requested to remove PRS 33-004(k) from the HSWA Module of LANL's RCRA Hazardous Waste Facility Permit.

5.5 PRS 33-006(a)

PRS 33-006(a) is the shot pad at South Site that was used for implosion studies in the 1950s. Results of HE analyses for most of the samples from the South Site 1994 sampling and analysis campaign were rejected because of missed holding times. A subset of locations was resampled in 1996. Results indicate that no HE was detected in any sample. Based on data presented in the September 1995 RFI report and resampling results, the PRS is recommended for NFA for human health under Criterion 5.

5.5.1 History

The South Site shot pad is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.4.2.4 and 4.4.3.3 (LANL 1992, 0784), and in RFI Report LA-UR-95-4439 (Environmental Restoration Project 1995, 1288). The buildings at South Site were completed, and testing began, in 1950. Uranium shells holding initiators were used in implosion tests using 275–5000 lb. of HE. The apparatus and neutron detectors were put into large copper shells for electrical shielding, then each assemblage was covered by a wooden shack prior to detonation (Hoard 1990, 02-022). The detonations spread debris, shrapnel, and wood fragments over the entire South Site valley and beyond. When the implosion test program was transferred to other LANL groups in the mid-1950s, implosion tests were discontinued at TA-33. The shot pad has been inactive since that time.

5.5.2 Description

South Site is located in a small valley approximately 400 ft wide by 500 ft long. The entire area drains to Chaquehui Canyon through a short arroyo and down the steep canyon wall. The shot pad atop TA-33-26 is located in the middle of this valley (Fig. 5.5.2-1). Much of the valley was scraped to bedrock during site construction. The pad itself is located directly above X-unit vault TA-33-26 and is approximately 40 ft in diameter. The pad is covered with sand. Runoff from the pad enters the main drainage arroyo that serves the whole of South Site. Soils are thin and bedrock outcrops protrude throughout the areas. Chamisa covers large areas of the site.

5.5.3 Previous Investigation

Weston sampling in 1989 did not detect HE in any sample collected over a wide area at South Site.

The 1994 ER investigations are described in an RFI report that was submitted during December 1995. Forty-six surface samples were collected over a wide area, and eleven surface samples were collected in the main South Site drainage arroyo. Uranium and copper were found above their SALs at several locations, but a risk assessment determined that concentrations met acceptable human-health risk criteria. HE concentrations were well below their SALs, but the analytical data were suspect because excessive holding times elapsed between HE extraction from soil and analysis of the extract. A resampling plan was submitted (Environmental Restoration Project 1995, 1288).

Section 5.5 of the December 1995 RFI Report for TA-33, which discusses the Phase I investigation of PRS 33-006(a), is provided as Attachment 4 of this report.

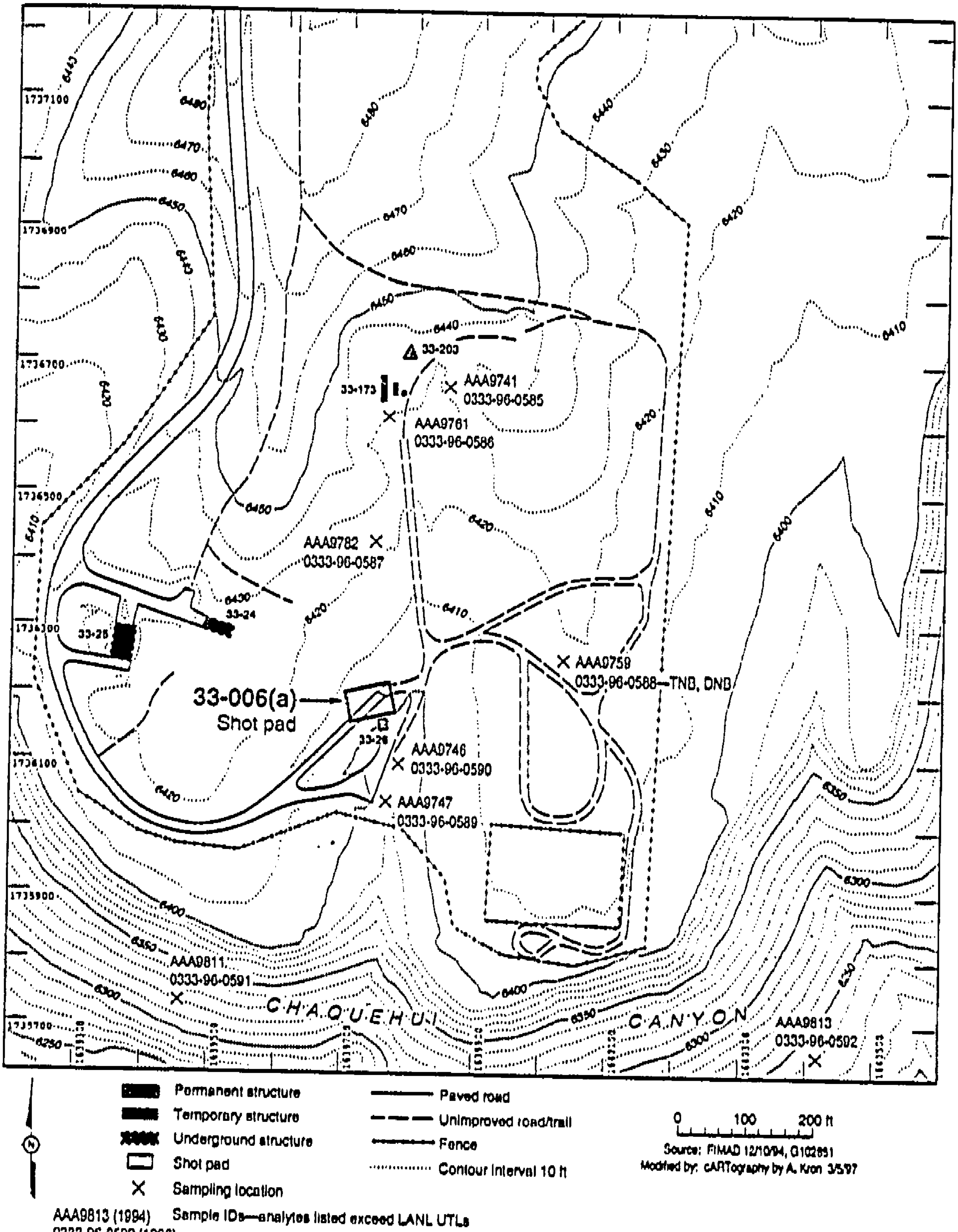


Fig. 5.5.2-1. PRS 33-006(a), shot pad at South Site.

5.5.4 Field Investigation

Sampling at PRS 33-006(a) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With surface disposal as the primary source, exposure routes for human receptors are ingestion and dermal contact. Inhalation is also considered a likely exposure route. Because contaminants were deposited at PRS 33-006(a) by fallout from implosion studies, only surface sampling was performed.

Prior to sampling in 1994, ER Project personnel and an explosives expert conducted an extensive search of the sampling area for residual pieces of HE. This was done as a safety precaution for the sampling crew. No HE pieces were found. During the search, the expert commented that residual HE at a firing site is a result of incomplete detonation, and no such event occurred at TA-33.

As specified in the sampling plan, eight surface samples were collected during July 1996 at designated resampling locations within PRS 33-006(a) (Fig. 5.5.2-1) (Environmental Restoration Project 1995, 1288). The purpose of the resampling effort was to compare HE results with the 1994 rejected data to determine if the rejected results contained usable information. In the 1996 campaign, great care was taken to resample the designated locations. Sampling stakes from the 1994 campaign were still intact in the field to guide resampling.

All samples were analyzed only for HE (Table 5.5.4-1).

Approximately 80% of the 1994 Phase I HE results were rejected by data validation. Data were sufficiently complete to determine that while there may be trace amounts of explosives in surface samples at South Site, they are not present at levels of concern, even if the estimated results are multiplied by a factor of 5–10 to compensate for missed holding times (Environmental Restoration Project 1995, 1288). However, a limited surface resampling campaign was conducted in 1996 to confirm this assessment. Table 5.5.7-1 shows the criteria used for choosing the specific resampling locations.

TABLE 5.5.4-1

SUMMARY OF SURFACE RESAMPLES TAKEN FOR PRS 33-006(a)

SAMPLE ID	LOCATION ID	DEPTH (ft)	MEDIUM	HE
0333-96-0585	33-1360	0–0.5	Soil	2401[a]
0333-96-0586	33-1402	0–0.5	Soil	2401
0333-96-0587	33-1324	0–0.5	Soil	2401
0333-96-0588	33-1446	0–0.5	Soil	2401
0333-96-0589	33-1366	0–0.5	Soil	2401
0333-96-0590	33-1365	0–0.5	Soil	2401
0333-96-0591	33-1351	0–0.5	Soil	2401
0333-96-0592	33-1353	0–0.5	Soil	2401

a. ER analytical request number

5.5.5 Evaluation of Inorganic Chemicals

No samples were analyzed for inorganic chemicals at PRS 33-006(a) during resampling.

5.5.6 Evaluation of Radionuclides

No samples were analyzed for radionuclides at PRS 33-006(a) during resampling.

5.5.7 Evaluation of Organic Chemicals

Low levels of two HE species were found in one sample of the resampling set. Results of HE resampling are shown in Table 5.5.7-2. Included for comparison are Phase I results from the 1994 sampling campaign. RDX above its SAL in the 1994 sample AAA9759 was not confirmed in 1996 sample 0333-96-0588. Data from 1994 samples resulted from focused validation of analytical spectra; detection limits are lower than for the 1996 routine HE analyses.

TABLE 5.5.7-1

SOUTH SITE HE RESAMPLING LOCATIONS

SAMPLE ID 1994/1996	LOCATION	DESCRIPTION	CRITERION
AAA9741/0333-96-0585	33-1360	Drainage	Drainage with most HE detected
AAA9746/0333-96-0590	33-1365	Drainage	High RDX
AAA9747/0333-96-0589	33-1366	Drainage	Drainage with no HE detected
AAA9759/0333-96-0588	33-1446	Burn area	RDX>8 mg/kg, several detections >1 mg/kg; data had analytical problems
AAA9761/0333-96-0586	33-1402	Gun mount	High HMX
AAA9782/0333-96-0587	33-1324	Operational release	Dirty sample, analytical problems
AAA9811/0333-96-0591	33-1351	Operational release	High A-DNT, other detections, high surrogate recovery
AAA9813/0333-96-0592	33-1353	Operational release	High A-DNT, several unknowns

TABLE 5.5.7-2

HE DETECTED IN SOUTH SITE SURFACE RESAMPLES

SAMPLE ID	DEPTH (ft)	HE SPECIES	1994 RESULT (mg/kg)	1996 RESULT (mg/kg)	SAL (mg/kg)
AAA9741/0333-96-0585	0–0.5	HMX	1.1 (J+)[a]	2 (U)[b]	3 259
		RDX	0.50 (J)[c]	1 (U)	4.0
		TNB	0.17 (J)	0.025 (U)	3.3
AAA9746/0333-96-0590	0–0.5	RDX	0.59 (J+)	1 (U)	4.0
		TNT	0.07 (J+)	0.025 (U)	15
AAA9747/0333-96-0589	0–0.5	None	No HE detected	No HE detected	N/A[d]
AAA9759/0333-96-0588	0–0.5	A-DNT	1.20 (J2)[e]	0.025 (U)	NS[f]
		HMX	0.36 (J2)	2 (U)	3259
		RDX	8.20 (J2)	1 (U)	4.0
		TNT	0.81 (J2)	0.025 (U)	15
		Tetryl	1.85 (J2)	0.065 (U)	650
		TNB	ND[g]	1.9	3.3
		DNB	ND	1.5	26
AAA9761/0333-96-0586	0–0.5	HMX	0.83 (R)[h]	2 (U)	3259
AAA9782/0333-96-0587	0–0.5	HMX	0.30 (J-)[i]	2 (U)	3259
		RDX	0.20 (J-)	1 (U)	4.0
		TNT	0.27 (R)	0.025 (U)	15
AAA9811/0333-96-0591	0–0.5	A-DNT	5.35 (J+)	0.025 (U)	NS
		NB	0.51 (J+)	0.026 (U)	33
		2-NT	0.16 (J+)	0.025 (U)	NS
		3-NT	0.51 (J+)	0.025 (U)	650
		4-NT	0.51 (J+)	0.025 (U)	650
		RDX	0.54 (J+)	1 (U)	4.0
AAA9813/0333-96-0592	0–0.5	A-DNT	0.36 (J)	0.025 (U)	NS

a. J+ = Estimated quantity, biased high based on surrogate recovery
b. U = Undetected. The listed value is the detection limit
c. J = Estimated quantity—result is above detection limit but below estimated quantitation limit
d. N/A = Not Applicable
e. J2 = Estimated from confirmation column data
f. NS = No SAL available
g. ND = Not detected by focused validation of laboratory spectra
h. R = Rejected
i. J+ = Estimated quantity, biased low based on surrogate recovery

5.5.8 Risk-Based Screening Assessment

RDX above SAL in the 1994 sample AAA9759 was not confirmed in 1996 sample 0333-96-0588 taken at the same location. The 1996 sample results indicated that di- and trinitrobenzene were detected above EQL but below SALs. An MCE yielded a result of 0.6, below the target level of 1 (Table 5.5.8-1). No other analyte in the HE suite was detected.

TABLE 5.5.8-1

MCE FOR CARCINOGENIC EFFECTS AT PRS 33-006(a)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Trinitrobenzene	33-1697	0333-96-0074	1.9	3.3	0.58
Dinitrobenzene	33-1697	0333-96-0074	1.5	26	0.06
				Total	0.6

5.5.9 Human-Health Risk Assessment

Because no contaminant was carried forward in the screening process, no human-health risk assessment was performed for this PRS.

5.5.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.5.11 Conclusion and Recommendation

All contaminants except HE are discussed in the Phase I report and included in Attachment 4 of this report. None were carried forward to Phase II. Initial 1994 analyses for HE implied that explosive compounds or their degradation products were not widespread at South Site, even if analytical results were low by a factor of 5–10. Although holding times between extraction from soil and actual analysis were exceeded by as much as nine months in some 1994 samples, the extracts were kept frozen in the dark during that time. This is standard treatment to deter the action of soil microbes and photolysis, the principal agents of degradation for various HE species.

The 1996 HE resampling was performed to assess whether missed holding times adversely affected results of the 1994 sampling campaign. Valid 1996 analytical results from a different laboratory indicate that no HE compound is present above its SAL.

Shrapnel is widespread at South Site. Although no shrapnel pickup is planned while TA-33 is under administrative control, a 1996 shrapnel pickup was performed in Chaquehui Canyon and Bandelier National Monument. The focus of the pickup campaign was to reduce hazards in publicly accessible areas and to prevent movement of shrapnel off-site (Environmental Restoration Project 1997, 02-122).

This site is proposed for NFA for human health based on Criterion 5 because all potential contaminants have been investigated and evaluated. No significant risk to human health has been found.

5.6 PRS 33-008(a)

PRSs 33-008(a) is a landfill that was created during a 1984 cleanup of South Site. After the 1992 ER RFI work plan was submitted, archival information was discovered that made proposed trenching, as specified in the sampling plan, impractical due to the contents of the landfill. A revised plan was executed in 1996. Because the risk associated with contamination in the borehole samples is acceptable, the landfill is recommended for NFA for human health under Criterion 5.

5.6.1 History

PRS 33-008(a) is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.4.2.10 and 4.4.7 (LANL 1992, 0784). The landfill was created at South Site during the 1984 cleanup; at that time, radioactive and salvageable material were removed. Remaining material was buried. The surface of the landfill was leveled and the corners were marked with metal posts.

The RFI Work Plan for Operable Unit 1122, which was approved by EPA in 1993, proposed trenching through each landfill to determine if the contents included hazardous material (LANL 1992, 0784). After submittal of the work plan, LANL discovered photos that had been taken during the cleanup. These photos indicate that the buried debris includes massive items such as telephone poles and railroad ties and that the material is tightly packed within the landfill. It became clear that trenching with a backhoe, as directed in the work plan, was unsafe. A revised plan was submitted to EPA in September 1995 (Environmental Restoration Project 1995, 1265). No regulatory review occurred prior to implementation.

5.6.2 Description

The 50-ft by 60-ft landfill at South Site is located within a horseshoe-shaped berm, TA-33-43 (Fig. 5.6.2-1). The floor of the berm at bedrock is Unit 2 of Bandelier Tuff. At its highest point, the berm is approximately 15 ft high. The landfill grades from the floor to the inside curve of the berm and may be 8 ft at its deepest point. The inside of the berm is graded so that no water collects in the landfill. The four corners of the landfill are marked with metal pipe. Over the years, a thick stand of chamisa had grown on the landfill, but it was removed during the 1996 sampling campaign. A few parts of buried timbers are exposed.

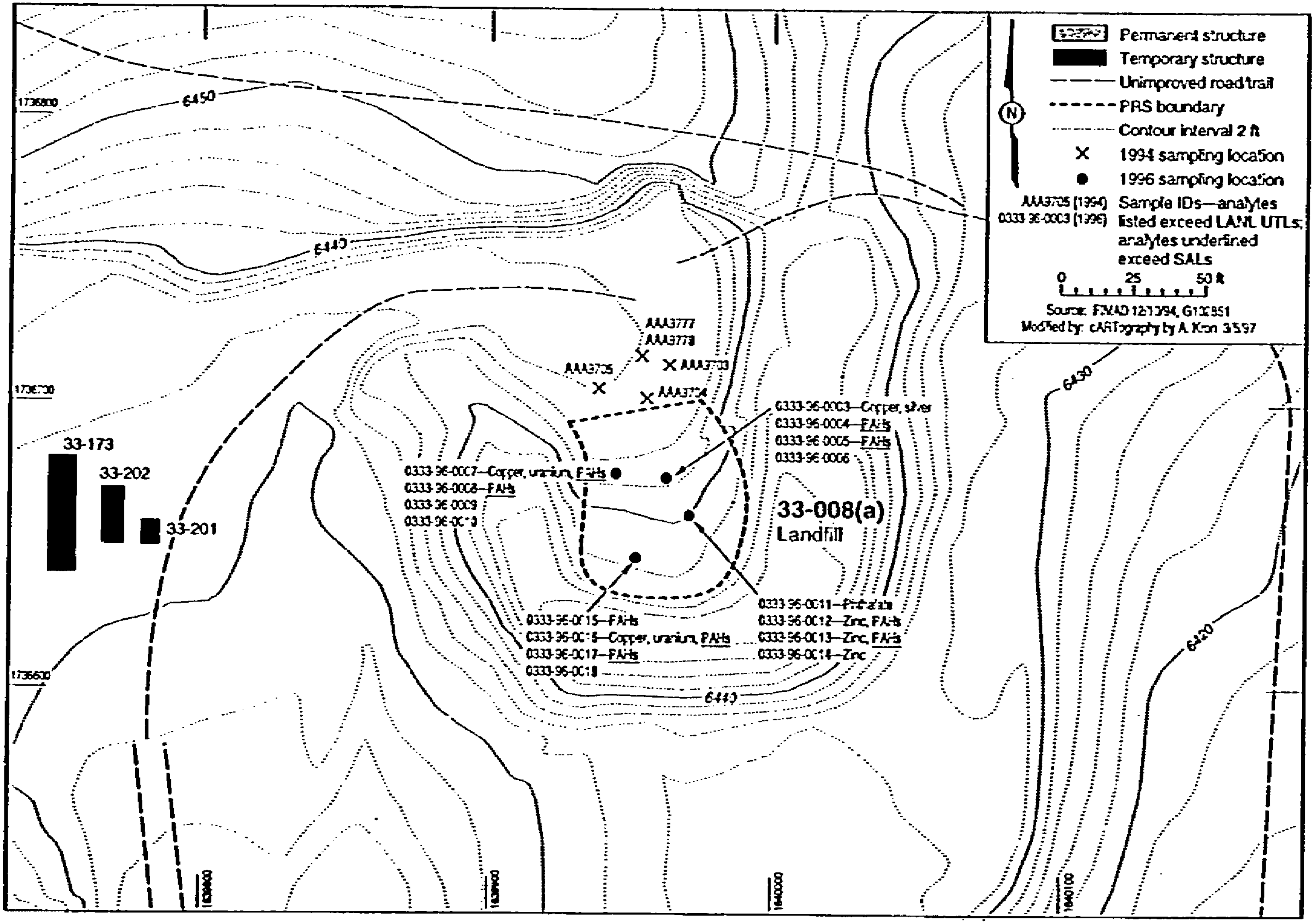


Fig. 5.6.2-1. PRS 33-008(a), landfill at South Site.

5.6.3 Previous Investigation

During the 1994 campaign at South Site, as part of the investigation of PRS 33-007(b), samples AAA9703, AAA9704, and AAA9705 were taken from within the berm at the lower edge of the landfill. A fourth sample and a collocated neighbor, AAA9777 and AAA9778, were taken within the berm as part of the investigation of PRS 33-006(a) (Fig. 5.6.2-1). All samples were analyzed for inorganic chemicals, gamma emitters, and HE (Table 5.6.3-1). The three samples at the lower edge of the fill were also analyzed for SVOCs. The 33-006(a) neighbors were analyzed for uranium.

No contaminants were found above LANL background UTLs in any sample. During 1994 trenching to investigate the 33-007(b) berm, a chain link blasting mat was unearthed. The mat was left in the landfill.

5.6.4 Field Investigation

The sampling and analysis plan from the September 1995 RFI Report is included as Attachment 5 of this report. Sampling at PRS 33-008(a) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With landfills as the primary source, exposure routes for human receptors are ingestion and dermal contact. Because the landfill is a subsurface structure, inhalation is not considered a likely exposure route, and limited surface sampling was performed.

In April 1994, a geophysical survey was performed at South Site that including the area of the landfill. The survey found anomalous readings on the landfill not associated with known surface structures. The anomaly was attributed to buried metal (ICF-Kaiser 1995, 02-108).

In 1996, four samples were collected from each of four locations that had been randomly selected within the four quadrants of the landfill, for a total of 16 samples (Fig. 5.6.2-1). The boreholes were drilled to the soil/tuff interface. Two boreholes were 5 ft deep, one was 10 ft deep, and the fourth was 12.5 ft deep. Tuff was observed at uneven depths, indicating that the area was not leveled prior to depositing the fill. Samples were collected using a remotely operated rotary drill with a split-spoon sampler. The drill encountered numerous wood objects, but those had decayed and offered little resistance to efficient boring.

Debris observed included chain link fencing, metal pieces, and timbers. The odor of creosote was detected by the sampling team and noted in the sampling log (ICF-Kaiser 1996, 02-120). Because of the large size and solid nature of the debris, in a deviation from the work plan, no debris was sampled. Because the primary concern is whether hazardous material is migrating from the landfill, soil samples were collected from areas adjacent to the debris.

All samples were analyzed for uranium, inorganic chemicals, SVOCs, and HE (Table 5.6.4-1).

5.6.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were detected above background UTLs in the 1994 surface samples collected downslope from the landfill. Arsenic data from that sample set was suspect and subsequently rejected. No arsenic results are available from 1994. Because arsenic values in the 1996 samples ranged from 0.94 to 2.5 mg/kg, arsenic is not considered a COPC at this PRS. In the 1996 samples, copper, silver, and zinc were detected above LANL (95%,0.95) UTLs in scattered locations, but concentrations were well below their respective SALs (Table 5.6.5-1).

TABLE 5.6.3-1

SUMMARY OF 1994 SAMPLES TAKEN FOR PRS 33-008(a)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	RADIO-NUCLIDES	INORGANIC CHEMICALS	SVOCs	HE
AAA9703	33-1	Soil	0-.5	19472[a]	19113	17839	17840
AAA9704	33-1	Soil	0-.5	19472	19113	17839	17840
AAA9705	33-1	Soil	0-.5	19472	19113	17839	17840
AAA9777	33-1358	Soil	0-.5	19414	19405	NA[b]	17786
AAA9778	33-1464	Soil	0-.5	19414	19405	NA	17786

a. ER analytical request number
b. NA = Not Analyzed

TABLE 5.6.4-1

SUMMARY OF SAMPLES TAKEN FOR PRS 33-008(a)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	URANIUM	INORGANIC CHEMICALS	SVOCs	HE
0333-96-0003	33-1665	Soil	0-1	2112[a]	2111	2110	2113
0333-96-0004	33-1665	Soil	2.5-3	2112	2111	2110	2113
0333-96-0005	33-1665	Soil/tuff	3-3.5	2112	2111	2110	2113
0333-96-0006	33-1665	Tuff	4-5	2112	2111	2110	2113
0333-96-0007	33-1666	Soil	0-1	2112	2111	2110	2113
0333-96-0008	33-1666	Soil	2.5	2112	2111	2110	2113
0333-96-0009	33-1666	Soil/tuff	2.5-3.5	2112	2111	2110	2113
0333-96-0010	33-1666	Tuff	4-5	2112	2111	2110	2113
0333-96-0011	33-1667	Soil	0-1	2112	2111	2110	2113
0333-96-0012	33-1667	Soil	2.5-5	2112	2111	2110	2113
0333-96-0013	33-1667	Soil	7.5-10	2112	2111	2110	2113
0333-96-0014	33-1667	Tuff	10-12.5	2112	2111	2110	2113
0333-96-0015	33-1668	Soil	2.5-3.5	2112	2111	2110	2113
0333-96-0016	33-1668	Soil	5-6	2112	2111	2110	2113
0333-96-0017	33-1668	Soil/tuff	6-7	2112	2111	2110	2113
0333-96-0018	33-1668	Tuff	10	2112	2111	2110	2113

a. ER analytical request number

TABLE 5.6.5-1

INORGANIC CHEMICALS DETECTED ABOVE LANL UTLs AT PRS 33-008(a)

SAMPLE ID	DEPTH (ft)	COPPER (mg/kg)	SILVER (mg/kg)	ZINC (mg/kg)
SAL	N/A[a]	2 800	380	23 000
(95%, .95) UTL	N/A	15.5	NC[b]	50.8
0333-96-0003	1	36.8	0.36 (J)[c]	30.2
0333-96-0007	1	45.2	0.21 (U)[d]	23.8
0333-96-0012	5	6.6	0.21 (U)	108
0333-96-0013	10	4.8	0.21 (U)	207
0333-96-0014	12.5	2.5 (J)	0.20 (U)	202
0333-96-0016	6	19.7	0.20 (U)	44.6

a. N/A = Not Applicable
b. NC = Not Calculated
c. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit
d. U = Undetected—the listed value is the detection limit.

5.6.6 Evaluation of Radionuclides

No radiation was detected during routine field screening of sampling locations at PRS 33-008(a). In the 1994 samples, no gamma emitters or uranium were detected above LANL and TA-33 background UTLs. Low levels of uranium above background UTLs were found in two 1996 samples within the landfill (Table 5.6.6-1). Because a total digestion was used for sample preparation for uranium analysis, uranium results were compared to the total background UTL of 5.45 mg/kg (see Section 4.2 of this report). Because LANL records and isotopic analysis at TA-33 indicate that depleted uranium was used during the time period that relevant East Site activities took place, the SAL for depleted uranium is used for comparison in the table. However, uranium levels are also below the SAL for natural uranium (29 mg/kg).

TABLE 5.6.6-1

URANIUM DETECTED ABOVE LANL UTL AT PRS 33-008(a)

SAMPLE ID	DEPTH (ft)	URANIUM (mg/kg)
SAL[a]	N/A	130
(95%, .95) UTL	N/A	5.45[b]
0333-96-0007	1	7.4
0333-96-0016	6	9.1

a. Assuming depleted uranium
b. UTL for uranium using total digestion sample preparation

5.6.7 Evaluation of Organic Chemicals

No organic compounds were detected in samples from the 1994 sampling campaign.

In the 1996 sampling campaign, 10 of the 16 samples taken in the landfill itself contained low levels of SVOCs, primarily PAHs (Table 5.6.7-1). These chemicals are found in creosote products that are used to treat timbers. Five of the 16 samples contained large amounts of other organic chemicals found in creosote that interfered with attempts by the analytical laboratory to clean the material prior to analysis. As a result, no surrogates were recovered. The samples were reextracted four days beyond holding times and surrogate recovery was adequate. Results for three of the samples are reported here with notation. No analytes were detected in two samples (0333-96-0006 and 0333-96-0009) from the set.

TABLE 5.6.7-1

DETECTED ORGANIC CHEMICALS FOR LANDFILL PRS 33-008(a)

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0004	3	Acenaphthene	0.75 (J-)[a]	2 200	1.7
		Acenaphthylene	0.83 (J-)	NS[b]	1.7
		Anthracene	2.6	18 000	1.7
		Benzo[a]pyrene	2.5	0.061	1.7
		Benzo[a]anthracene	5.1	0.61	1.7
		Benzo[b]fluoranthene	3.8	0.61	1.7
		Benzo[k]fluoranthene	1.8	6.1	1.7
		Benzo[g,h,i]perylene	1.1 (J-)	NS	1.7
		Carbazole	1.6 (J-)	22	1.7
		Chrysene	5.7	61	1.7
		Dibenzo[a,h]anthracene	0.44 (J-)	0.061	1.7
		Dibenzofuran	0.54 (J-)	250	1.7
		Fluoranthene	27	2 600	1.7
		Fluorene	0.86 (J-)	2 300	1.7
		Indeno[1,2,3-cd]pyrene	1.3(J-)	0.61	1.7
		Phenanthrene	5.7	NS	1.7
		Pyrene	15	1 900	1.7
0333-96-0005 Extracted 4 days beyond holding time	3.5	Acenaphthene	0.36(J)[c]	2 200	1.7
		Anthracene	1.1 (J)	18 000	1.7
		Benzo[a]anthracene	1.8	0.61	1.7
		Benzo[a]pyrene	0.9 (J)	0.061	1.7
		Benzo[b]fluoranthene	0.44 (J)	0.61	1.7
		Benzo[g,h,i]perylene	0.41 (J)	NS	1.7
		Benzo[k]fluoranthene	0.6 (J)	6.1	1.7
		Carbazole	0.98 (J)	22	1.7
		Chrysene	1.9	61	1.7
		Fluoranthene	9.5	2 600	1.7
		Fluorene	0.4 (J)	2 300	1.7
		Indeno[1,2,3-cd]pyrene	0.43 (J)	0.61	1.7
		Phenanthrene	3.5	NS	1.7
		Pyrene	5.4	1 900	1.7
0333-96-0007 Extracted 4 days beyond holding time	1	Acenaphthene	.58 J	2 200	1.4
		Anthracene	2	18 000	1.4
		Benzo(a)anthracene	.71(J)	0.61	1.4
		Benzo(a)pyrene	.51(J)	0.061	1.4
		Benzo(b)fluoranthene	.66(J)	0.61	1.4
		Benzo(k)fluoranthene	.32 (J)	6.1	1.4
		Carbazole	.62(J)	22	1.4
		Chrysene	1.3 (J)	61	1.4

TABLE 5.6.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR LANDFILL PRS 33-008(a)

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
		Dibenzofuran	.44 (J)	250	1.4
		Fluoranthene	1.6	2 600	1.4
		Fluorene	.6 (J)	2 300	1.4
		Naphthalene	.37 (J)	1 000	1.4
		Phenanthrene	1.8	NS	1.4
		Pyrene	1.4	1 900	1.4
0333-96-0008 Extracted 4 days beyond holding time	2.5	Acenaphthene	.15 (J)	2 200	0.35
		Anthracene	.23 (J)	18 000	0.35
		Benzo(a)anthracene	.14 (J)	0.61	0.35
		Benzo(a)pyrene	.078 (J)	0.061	0.35
		Carbazole	.099 (J)	22	0.35
		Chrysene	.17 (J)	61	0.35
		Dibenzofuran	.11 (J)	250	0.35
		Fluoranthene	.51	2 600	0.35
		Fluorene	.15 (J)	2 300	0.35
		Phenanthrene	.68	NS	0.35
		Pyrene	.38	1 900	0.35
0333-96-0011	1	Di-n-butylphthalate	0.071 (J)	6 500	0.34
0333-96-0012	5	Fluoranthene	0.54 (J)	2 600	1.4
		Phenanthrene	0.83 (J)	NS	1.4
		Pyrene	0.34 (J)	1 900	1.4
0333-96-0013	10	Anthracene	0.35 (J)	18 000	0.69
		Benzo[a]anthracene	0.3(J)	0.61	0.69
		Benzo[b]fluoranthene	0.15 (J)	0.61	0.69
		Carbazole	0.14 (J)	22	0.69
		Chrysene	0.26 (J)	61	0.69
		Fluoranthene	1.5	2 600	0.69
		Phenanthrene	1.2	NS	0.69
		Pyrene	0.99	1 900	0.69
0333-96-0015	3.5	Acenaphthene	0.16 (J)	2 200	0.69
		Anthracene	0.44 (J)	18 000	0.69
		Benzo[a]anthracene	0.28 (J)	0.61	0.69
		Carbazole	0.22 (J)	22	0.69
		Chrysene	0.41 (J)	61	0.69
		Fluoranthene	0.63 (J)	2 600	0.69
		Fluorene	0.18 (J)	2 300	0.69
		Naphthalene	0.26 (J)	1 000	0.69
		Phenanthrene	0.75	NS	0.69
		Pyrene	0.58 (J)	1 900	0.69

TABLE 5.6.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR LANDFILL PRS 33-008(a)

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0016	6	Acenaphthene	4.2	2 200	3.4
		Acenaphthylene	0.76 (J)	NS	3.4
		Anthracene	4.7	18 000	3.4
		Benzo[a]pyrene	1.6 (J)	0.061	3.4
		Benzo[a]anthracene	3.2 (J)	0.61	3.4
		Benzo[b]fluoranthene	2.3 (J)	0.61	3.4
		Benzo[k]fluoranthene	1.2 (J)	6.1	3.4
		Carbazole	3.5	22	3.4
		Chrysene	3.7	61	3.4
		Dibenzofuran	2.8 (J)	250	3.4
		Fluoranthene	11	2 600	3.4
		Fluorene	4.2	2 300	3.4
		Methylnaphthalene [2-]	3.2 (J)	NS	3.4
		Naphthalene	11	1 000	3.4
		Phenanthrene	15	NS	3.4
		Pyrene	7.6	1 900	3.4
0333-96-0017	7	Acenaphthene	0.55 (J)	2 200	0.68
		Anthracene	0.41 (J)	18 000	0.68
		Benzo[a]pyrene	0.18 (J)	0.061	0.68
		Benzo[a]anthracene	0.37 (J)	0.61	0.68
		Carbazole	0.34 (J)	22	0.68
		Chloroanaline [4-]	0.74 (J)	260	1.4
		Chrysene	0.38 (J)	61	0.68
		Dibenzofuran	0.36 (J)	250	0.68
		Fluoranthene	1.3	2 600	0.68
		Fluorene	0.5 (J)	2 300	0.68
		Methylnaphthalene [2-]	0.41 (J)	NS	0.68
		Naphthalene	0.82	1 000	0.68
		Phenanthrene	1.8	NS	0.68
		Pyrene	0.96	1 900	0.68

a. J - = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit. The estimated value is likely to be biased low because of poor surrogate recovery.
b. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit.
c. NS = No SAL available

100

5.6.8 Risk-Based Screening Assessment

An MCE for noncarcinogens yielded a result of 0.2, indicating that noncarcinogen contaminants do not represent a human health hazard (Table 5.6.8-1). Acenaphthylene, 2-methylnaphthalene, benzo[g,h,i]perylene, and phenanthrene were not included in the calculation because they have no SAL. (See discussion in Section 5.0 of this report.) Because of the low indication of risk to human health, noncarcinogens will not be carried forward in the screening process.

At this PRS, four carcinogenic PAHs that are found in creosote were detected above their SALs (Table 5.6.8-2). These were expected because ER Project personnel had access to archival information and photographs provided by the principal investigator of the 1984 cleanup at South Site (Buhl 1988, 02-038).

An MCE for the remaining carcinogens yields a result of 0.5, indicating that two carcinogens are not a risk to human health (Table 5.6.8-3). The risk due to carcinogens is analyzed in Section 5.6.9 of this report.

Archival information indicates that, of all radionuclides, depleted uranium was the primary form used at South Site. Uranium was detected above background UTL, but well below its SAL. Therefore, uranium will not be carried forward in the screening process.

TABLE 5.6.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-008(a)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Copper	33-1666	0333-96-0007	45.4	2 800	0.02
Silver	33-1665	0333-96-0003	0.36	380	0.0009
Zinc	33-1667	0333-96-0013	207	23 000	0.009
Acenaphthene	33-1668	0333-96-0016	4.2	2 200	0.002
Anthracene	33-1668	0333-96-0016	4.7	18 000	0.0003
Chloroaniline [4-]	33-1668	0333-96-0017	0.74	260	0.003
Chrysene	33-1665	0333-96-0004	5.7	61	0.09
Dibenzofuran	33-1668	0333-96-0016	2.8	250	0.01
Di-n-butylphthalate	33-1667	0333-96-0011	0.071	6 500	0.00001
Fluoranthene	33-1665	0333-96-0004	27	2 600	0.01
Fluorene	33-1668	0333-96-0016	4.2	300	0.01
Naphthalene	33-1668	0333-96-0016	11	1 000	0.01
Pyrene	33-1665	0333-96-0004	15	1 900	0.008
				Total	0.2

TABLE 5.6.8-2

PRS 33-008(a) CARCINOGENS WITH CONCENTRATIONS THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	BENZO[a] PYRENE (mg/kg)	BENZO[a] ANTHRACENE (mg/kg)	BENZO[b] FLUOR-ANTHENE (mg/kg)	IDENO [1,2,3-cd] PYRENE (mg/kg)
SAL	N/A[a]	N/A	0.061	0.61	0.61	0.61
PRG[b]	N/A	N/A	0.26	2.6	2.6	2.6
0333-96-0004	33-1665	2.5-3	2.5	5.1	3.8	1.3(J)[c]
0333-96-0005	33-1665	3-3.5	0.9(J)	1.8	0.44(J)	0.43(J)
0333-96-0007	33-1666	0-1	0.51(J)	0.71(J)	0.66(J)	1.4(U)[d]
0333-96-0008	33-1666	2.5	0.078(J)	0.14(J)	0.35(U)	0.35(U)
0333-96-0016	33-1668	6	1.6(J)	3.2(J)	2.3(J)	0.033(J)
0333-96-0017	33-1668	3.5	0.18(J)	0.37(J)	0.33(U)	0.33(U)

a. N/A = Not Applicable
b. PRG = Preliminary Remediation Goal for industrial sites (EPA 1996, 1307)
c. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit
d. U = Undetected—value listed is the detection limit of the analytical instrument

TABLE 5.6.8-3

MCE FOR CARCINOGENIC EFFECTS AT PRS 33-008(a)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Benzo[k]fluoranthene	33-1665	0333-96-0004	1.8	6.1	0.3
Carbazole	33-1668	0333-96-0016	3.5	22	0.2
				Total	0.5

5.6.9 Human-Health Risk Assessment

Sampling of soil adjacent to debris indicated that no inorganic contaminants are migrating from solid objects in the landfill. Benzo(a)pyrene [B(a)P] and several other carcinogenic PAHs were identified as COPCs in the screening assessment. However, due to the low concentrations of these compounds, a quantitative human-health risk assessment was not performed for this PRS. A qualitative evaluation of these COPCs is presented.

Benzo(a)pyrene and other PAHs were detected above their SALs in 6 of 16 samples (including three of the rejected samples), with benzo(a)pyrene detected at a maximum concentration of 2.5 mg/kg. Most of these contaminants were present at a depth of 3–7 ft. A human health risk assessment at this site would be based on an industrial land use, with shorter exposure duration, smaller exposure area, and smaller exposure frequencies. These detections do not indicate a significant contaminant release scenario or potential human-health concern at an industrial facility such as TA-33. Low levels of these contaminants were expected due to the presence of telephone poles and other treated wood in the landfill. Sampling at the lower edge of the landfill in 1994 indicated that PAHs are not leaching from the site. Only one sample collected at the soil/tuff interface contained PAHs, with benzo(a)pyrene below industrial PRG. This indicates PAHs are not leaching into tuff.

Human-health risk assessment for PAH compounds is based on industrial land use, rather than on residential SALs. The smaller exposure area, shorter exposure duration, and smaller exposure frequency, as well as the fact that an adult worker exposure is characterized (i.e., children and infants are excluded) in the industrial exposure scenario, would preclude the realization of human-health impacts from exposure to such low concentrations of these analytes in soil. Therefore, additional evaluation of PAHs for human-health risk will not be pursued.

5.6.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.6.11 Conclusions and Recommendations

During the 1984 cleanup of South Site, radioactive material was collected and removed from the site. Appropriate items were recycled (Buhl 1988, 02-038). The remaining material was deposited in a landfill, PRS 33-008(a), including large wooden items such as pieces of shacks, telephone poles, railroad ties used for catcher box construction, and assorted hardware.

Conceptual models were developed to evaluate three exposure scenarios: current use, recreational use, and construction. The primary release mechanisms for contaminants at this

site include sediment transport and resuspension by wind. Those release mechanisms are unlikely at landfill PRS 33-008(a) because of its protected location inside the berm. Other release mechanisms considered were landslide/erosion, biological activity, and dissolution in runoff (LANL 1992, 0784). These scenarios are unlikely at South Site because the contaminants are buried, the depths to bedrock tuff are shallow, the depths to groundwater are large, the conditions are generally dry, and any runoff events forming a stream to Chaquehui Canyon are rare. In addition, South Site is an inactive facility and receives very little worker traffic.

Geophysical surveys indicate that metal objects are present in the landfill. Sampling and analysis indicate that the material in the landfill contains low levels of carcinogenic PAHs that are found in creosotes used as wood preservatives. All the material is buried, and sampling at the foot of the landfill indicates that the material is not leaching to the drainages. The landfill is constructed on slightly sloping bedrock tuff that does not collect and hold water. Therefore, no potential exists for developing a hydrostatic head that would force PAHs downward into the groundwater, which is estimated to be at least 700 ft below the mesa top (the depth to Doe Springs at 5 700 ft in White Rock Canyon). Samples taken from the drainage below the landfill indicated that contaminants are not migrating downslope from the site.

A search for regulatory drivers concerning landfills determined that, in 1984, it was permissible under the State of New Mexico Solid Waste Regulations for a land owner to dispose of solid waste on his property, provided that the disposal did not present a threat to human health and the environment (Shanley 1997, 02-121).

This site is proposed for NFA for human health based on Criterion 5 because it has been investigated, evaluated, and shown to present little risk to human health. The location of the landfill is marked with metal posts. Upon approval of the NFA recommendation, the TA-33 facility manager will be notified that the ER Project has completed its activities at this PRS.

5.7 PRS 33-008(b)

PRS 33-008(b) is a landfill that was created during the 1984 cleanup of East Site. Sampling and analysis from borehole drilling performed during the 1996 campaign indicated that the risk associated with contamination in the borehole samples is acceptable. The landfill is recommended for NFA for human health.

5.7.1 History

PRS 33-008(b) is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.5.2.6 and 4.5.6. In 1984, a LANL cleanup of East Site was performed. During cleanup, radioactive material and salvageable material were removed. The remaining material was buried in the landfill (Buhl 1984, 02-038). However, no sampling was done to identify RCRA hazardous constituents. The surface of the landfill was leveled and compacted; corners of the landfill were marked with metal posts.

The RFI Work Plan for Operable Unit 1122, which was approved by EPA in 1993, proposed trenching through the landfill to determine if the contents included hazardous material (LANL 1992, 0784). After submittal of the work plan, LANL discovered photos that had been taken during the cleanup. These photos indicate that the buried debris includes massive items such as telephone poles and railroad ties and that the material is tightly packed within the landfill. It became clear that trenching with a backhoe, as described in the work plan, was unsafe. As with landfill PRS 33-008(a), an alternate sampling plan was developed that used drilling rather than trenching (Environmental Restoration Project 1995, 1265).

5.7.2 Description

The landfill at East Site occupies the space between the firing pads east of bunker TA-33-87 and shack TA-33-151 (Fig. 5.7.2-1). According to LANL engineering drawing ENG-C 3304, this area may have originally been excavated to provide material for the nearby berms. The landfill is well compacted and covered; there is no surface indication of its existence. The four corners are marked with metal poles. The surface is level and covered with a sparse growth of weeds and grasses. Thick stands of chamisa grow along most of the perimeter.

There are no surface drainages leading from the landfill. The main drainage from East Site into White Rock Canyon is separated from the landfill by a paved road elevated above the surface of the PRS.

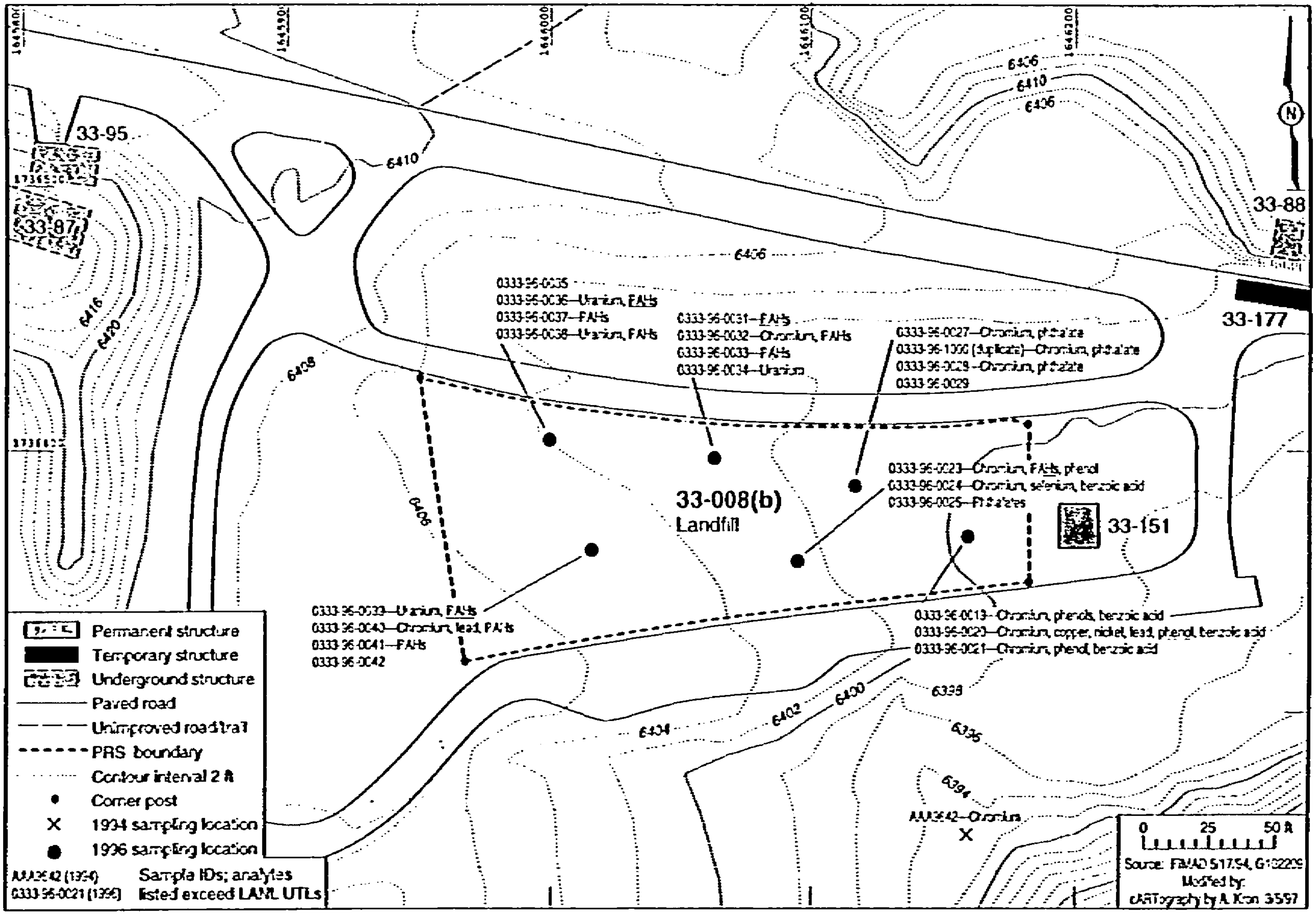


Fig. 5.7.2-1. PRS 33-008(b), landfill at East Site.

5.7.3 Previous Investigation

During the 1994 campaign, no samples were collected from the surface of PRS 33-008(b). Discussion of one 1994 sample taken in the drainage leading from East Site is included in Section 5.7.4 of this report, even though that drainage channel receives runoff from a wide area surrounding the landfill.

5.7.4 Field Investigation

The sampling and analysis plan from the September 1995 RFI report is included as Attachment 6 of this report. Sampling at PRS 33-008(b) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With landfills as the primary source, exposure routes for human receptors are ingestion and dermal contact. Because the landfill is a subsurface structure, inhalation is not considered a likely exposure route, and limited surface sampling was performed.

In 1994, sample AAA9642 was collected from the drainage leading from the landfill area. This drainage serves the entire central area of East Site.

In the 1996 campaign, a total of 22 samples were collected from six locations in the landfill (Table 5.7.4-1). Depth to tuff varied between 1.5 and 4.5 ft. Borehole depths ranged from 4.5 ft to 7.5. For boreholes locations 33-1690, 33-1691, and 33-1692, only three samples were collected because of the shallow depths to tuff. Rotting timbers, some of which had almost fully decomposed, were encountered in all boreholes. One borehole contained large nuts and bolts 4–5 in. in diameter. The matrix in the landfill boreholes was sand and engineering gravel. In a deviation from the work plan, none of the debris was collected as samples, because of the large and solid nature of the debris. Instead, soil surrounding the debris was collected to determine if hazardous chemicals are leaching from the debris.

5.7.5 Evaluation of Inorganic Chemicals

In two of the 1996 samples, lead was detected barely above LANL's (95%,0.95) UTL; one of these samples also contained copper and nickel above their UTLs but below their SALs (Table 5.7.5-1). Selenium was found above UTL but below SAL in a third sample.

In the 1994 sampling campaign, sample AAA9642, collected from the drainage that serves the central area of East Site, contained chromium above LANL UTL. In the 1996 samples, chromium was detected in 10 samples at elevated levels. Chromium results were qualified by data validation in the 18 samples analyzed under Request Number 2117 because matrix spike

recoveries of 62% were below acceptance criteria of 75%. Chromium results for the four samples in Request Number 2135 were not qualified.

5.7.6 Evaluation of Radionuclides

No radiation was detected during routine field screening of sampling locations at PRS 33-008(b). Uranium was detected barely above LANL's (95%,0.95) UTL in four samples (Table 5.7.6-1). Because a total digestion was used for sample preparation for uranium analysis, uranium results were compared to the total background UTL of 5.45 mg/kg (see Section 4.2 of this report). The SAL for depleted uranium is used in the table for comparison because archival and isotopic analyses elsewhere at TA-33 indicate that depleted uranium was used during the time period of activities at the East Site firing pads. Uranium results are also well below the SAL (29 mg/kg) for natural uranium.

TABLE 5.7.4-1

SUMMARY OF SAMPLES TAKEN FOR PRS 33-008(b)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	URANIUM	INORGANIC CHEMICALS	SVOCs
AAA9642[a]	33-1391	Soil	0–0.5	19358[b]	19253	17674
0333-96-0019	33-1690	Soil	1.5	2118	2117	2116
0333-96-0020	33-1690	Soil	3.5	2118	2117	2116
0333-96-0021	33-1690	Tuff	5	2118	2117	2116
0333-96-0023	33-1691	Soil	2.5	2118	2117	2116
0333-96-0024	33-1691	Soil	3.5	2118	2117	2116
0333-96-0025	33-1691	Tuff	4.5	2118	2117	2116
0333-96-0027	33-1692	Soil	2.5	2136	2135	2134
0333-96-1000	33-1692	Soil	2.5	2136	2135	2134
0333-96-0028	33-1692	Soil	3.5	2136	2135	2134
0333-96-0029	33-1692	Tuff	6.5	2136	2135	2134
0333-96-0031	33-1693	Soil	1	2118	2117	2116
0333-96-0032	33-1693	Soil	1.3	2118	2117	2116
0333-96-0033	33-1693	Soil	4	2118	2117	2116
0333-96-0034	33-1693	Tuff	6	2118	2117	2116
0333-96-0035	33-1694	Soil	2.5	2118	2117	2116
0333-96-0036	33-1694	Soil	3.5	2118	2117	2116
0333-96-0037	33-1694	Soil	4.5	2118	2117	2116
0333-96-0038	33-1694	Tuff	7.5	2118	2117	2116
0333-96-0039	33-1695	Soil	2.5	2118	2117	2116
0333-96-0040	33-1695	Soil	3.5	2118	2117	2116
0333-96-0041	33-1695	Soil	5	2118	2117	2116
0333-96-0042	33-1695	Tuff	7	2118	2117	2116

a. 1994 sampling campaign
b. ER analytical request number

TABLE 5.7.5-1

INORGANIC CHEMICALS DETECTED ABOVE LANL BACKGROUND UTLs AT PRS 33-008(b)

SAMPLE ID	DEPTH (ft)	CHROMIUM (mg/kg)	COPPER (mg/kg)	NICKEL (mg/kg)	LEAD (mg/kg)	SELENIUM (mg/kg)
SAL	N/A	210	2 800	1 500	400	380
(95%,.95) UTL	N/A	19.3	15.5	15.2	23.3	1.7
AAA9642	0–0.5	20.3	NA[a]	6.7 (U)[b]	12.7	0.53 (U)
0333-96-0019	1.5	58.3 (J-)[c]	12.9	13.7	18.6	0.62
0333-96-0020	3.5	144 (J-)	24.2	25.5	25.5	0.88
0333-96-0021	5	26.5 (J-)	6.9 (U)	7	9.2	0.21 (U)
0333-96-0023	2.5	40.1 (J-)	9.9	10.9	15.9	0.44 (J)
0333-96-0024	3.5	27.4 (J-)	12	11	8.8	4.1
0333-96-0027	2.5	47	9.8	11.6	19.9	0.49 (U)
0333-96-1000	2.5	42	10.5	11.6	16.4	0.49 (U)
0333-96-0028	3.5	22.6	12.8	8.9 (J)	11.3	0.56 (U)
0333-96-0032	1.3	52.8 (J-)	41	7.3	17.7	0.69
0333-96-0040	3.5	20.1 (J-)	12.4	8.6	25.6	0.71

a. NA = Not Analyzed
b. U = Undetected—the listed value is the detection limit
c. J- = Estimated as likely to be low based on poor matrix spike recovery

TABLE 5.7.6-1

URANIUM DETECTED ABOVE LANL BACKGROUND UTL AT PRS 33-008(b)

SAMPLE ID	DEPTH (ft)	URANIUM (mg/kg)
SAL[a]	N/A	130
(95%, .95) UTL	N/A	5.45[b]
0333-96-0034	6	5.7
0333-96-0036	3.5	5.6
0333-96-0038	7.5	5.5
0333-96-0039	2.5	6

a. Assuming depleted uranium
b. UTL for uranium using total digestion sample preparation

5.7.7 Evaluation of Organic Chemicals

Organic compounds were detected in 18 of the 22 samples collected at this PRS. Of the organic chemicals detected in the landfill, most are found in creosote. Several phenols and benzoic acid were detected, as well as phthalate components of common plasticizers (Table 5.7.7-1).

TABLE 5.7.7-1

DETECTED ORGANIC CHEMICALS FOR PRS 33-008(b)

SAMPLE ID	DEPTH (ft)	SVOC	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0019	1.5	Benzoic acid	0.4 (J)[a]	360	0.36
		Dichlorophenol [2,4-]	0.072 (J)	200	0.36
		Dinitrophenol [2,4-]	0.87 (J)	130	1.6
		Pentachlorophenol	6.4	2.5	1.6
		Trichlorophenol [2,4,5-]	0.8 (J)	6 500	1.6
0333-96-0020	3.5	Benzoic acid	1.6 (J)	360	1.9
		Pentachlorophenol	0.79 (J)	2.5	1.9
0333-96-0021	5	Benzoic acid	0.21 (J)	360	0.88
		Pentachlorophenol	0.036 (J)	2.5	0.88
0333-96-0023	2.5	Benzo[a]pyrene	0.072(J)	0.061	0.36
		Benzo[a]anthracene	0.072 (J)	0.61	0.36
		Benzo[b]fluoranthene	0.11 (J)	0.61	0.36
		Benzo(g,h,i)perylene	0.036 (J)	NS[b]	0.36
		Chrysene	0.11 (J)	24	0.36
		Fluoranthene	0.14 (J)	2 600	0.36
		Pentachlorophenol	0.072 (J)	2.5	0.89
		Phenanthrene	.014 (J)	NS	0.36
		Pyrene	.014 (J)	1 900	0.36
0333-96-0024	3.5	Benzoic acid	0.27 (J)	360	0.94
0333-96-0025	4.5	Bis(2-ethylhexyl)phthalate	1.9 (B)	32	0.34
		Butylbenzylphthalate	0.21 (J)	13 000	0.34
		Di-n-octylphthlate	0.31 (J)	1 300	0.34
0333-96-0027	2.5	Bis(2-ethylhexyl)phthalate	1.6 (J)	32	1.9
0333-96-1000		Bis(2-ethylhexyl)phthalate	2.1	32	1.9
0333-96-0028	3.5	Bis(2-ethylhexyl)phthalate	0.74 (J)	32	1.9
0333-96-0031	1	Acenaphthene	0.033 (J)	2 200	0.33
		Anthracene	0.066 (J)	18 000	0.33
		Benzo[a]pyrene	0.16(J)	0.061	0.33
		Benzo[a]anthracene	0.23 (J)	0.61	0.33
		Benzo[b]fluoranthene	0.2 (J)	0.61	0.33
		Benzo[k]fluoranthene	0.2 (J)	6.1	0.33
		Benzo[g,h,i]perylene	0.13 (J)	22	0.33
		Chrysene	0.26 (J)	24	0.33
		Dibenzo(a,h)anthracene	0.033 (J)	0.061	0.33
		Fluoranthene	0.53	2 600	0.33
		Ideno(1,2,3-cd)pyrene	0.13 (J)	0.61	0.33
		Phenanthrene	0.3 (J)	NS	0.33
		Pyrene	0.46	1 900	0.33

TABLE 5.7.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR PRS 33-008(b)

SAMPLE ID	DEPTH (ft)	SVOC	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0032	1.3	Benzo[a]anthracene	0.034 (J)	0.61	0.34
		Benzo[b]fluoranthene	0.068 (J)	0.61	0.34
		Chrysene	0.034 (J)	24	0.34
		Fluoranthene	0.1 (J)	2 600	0.34
		Phenanthrene	0.068 (J)	NS	0.34
		Pyrene	0.068 (J)	1 900	0.34
0333-96-0033	4	Benzo[b]fluoranthene	0.035 (J)	0.61	0.34
		Butylbenzylphthalate	0.035 (J)	13 000	0.34
		Fluoranthene	0.069 (J)	2 600	0.34
		Phenanthrene	0.035 (J)	NS	0.34
		Pyrene	0.069 (J)	1 900	0.34
0333-96-0036	3.5	Acenaphthylene	0.069 (J)	NS	0.34
		Anthracene	0.1 (J)	18 000	0.34
		Benzo[a]pyrene	0.66	0.061	0.34
		Benzo[a]anthracene	0.62	0.61	0.34
		Benzo[b]fluoranthene	1.4	0.61	0.34
		Benzo(g,h,i)perylene	0.28 (J)	NS	0.34
		Chrysene	0.86	24	0.34
		Dibenzo(a,h)anthracene	0.1 (J)	0.061	0.34
		Fluoranthene	0.28 (J)	2 600	0.34
		Ideno(1,2,3-cd)pyrene	0.24 (J)	0.61	0.34
		Phenanthrene	0.035 (J)	NS	0.34
		Pyrene	0.52	1 900	0.34
0333-96-0037	4.5	Anthracene	0.071 (J)	18 000	0.35
		Benzo[a]anthracene	0.035 (J)	0.61	0.35
		Benzo[b]fluoranthene	0.035 (J)	0.61	0.35
		Chrysene	0.071 (J)	24	0.35
		Fluoranthene	0.14 (J)	2 600	0.35
		Phenanthrene	0.11 (J)	NS	0.35
		Pyrene	0.11 (J)	1 900	0.35
0333-96-0038	7.5	Anthracene	0.033 (J)	18 000	0.33
		Benzo[a]anthracene	0.067 (J)	0.61	0.33
		Benzo[b]fluoranthene	0.067 (J)	0.61	0.33
		Chrysene	0.067 (J)	24	0.33
		Dibenzofuran	0.033 (J)	250	0.33
		Fluoranthene	0.2 (J)	2 600	0.33
		Fluorene	0.033 (J)	300	0.33
		Phenanthrene	0.17 (J)	NS	0.33
		Pyrene	0.13 (J)	1 900	0.33

TABLE 5.7.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR PRS 33-008(b)

SAMPLE ID	DEPTH (ft)	SVOC	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0039	2.5	Anthracene	0.07 (J)	18 000	0.35
		Benzo[a]pyrene	0.1 (J)	0.061	0.35
		Benzo[a]anthracene	0.14 (J)	0.61	0.35
		Benzo[b]fluoranthene	0.17 (J)	0.61	0.35
		Benzo[g,h,i]perylene	0.07 (J)	NS	0.35
		Chrysene	0.14 (J)	24	0.35
		Fluoranthene	0.24 (J)	2 600	0.35
		Ideno(1,2,3-cd)pyrene	0.035 (J)	0.61	0.35
		Phenanthrene	0.17 (J)	NS	0.35
		Pyrene	0.24(J)	1 900	0.35
0333-96-0040	3.5	Anthracene	0.035 (J)	18 000	0.35
		Benzo[a]pyrene	0.035 (J)	0.061	0.35
		Benzo[a]anthracene	0.07 (J)	0.61	0.35
		Benzo[b]fluoranthene	0.07 (J)	0.61	0.35
		Chrysene	0.07 (J)	24	0.35
		Fluoranthene	0.1 (J)	2 600	0.35
		Phenanthrene	0.1 (J)	NS	0.35
		Pyrene	0.1 (J)	1 900	0.35
0333-96-0041	5	Fluoranthene	0.036 (J)	2 600	0.36
		Phenanthrene	0.036 (J)	NS	0.36
		Pyrene	0.036 (J)	1 900	0.36

a. J = Estimated value--the analyte was detected above the detection limit but below the estimated quantitation limit
b. NS = No SAL available

5.7.8 Risk-Based Screening Assessment

An MCE, with a value of 0.1, that was performed for noncarcinogens indicates that the contaminants do not represent a health hazard (Table 5.7.8-1). Acenaphthylene, benzo[g,h,i]perylene, and phenanthrene were not included in the calculation because they have no SAL. (See discussion in Section 5.0 of this report.) Because screening indicates that risk to human health is low, noncarcinogens will not be carried forward in the screening process.

Uranium, detected above background but well below SAL, will not be carried forward in the screening process.

At this PRS, pentachlorophenol and carcinogenic PAHs, both characteristic of creosote, were detected above their SALs (Table 5.7.8-2). The PAHs were expected because ER Project personnel had inspected archival information and photographs provided by the principal investigator of the 1984 cleanup at East Site (Buhl 1988, 02-038).

TABLE 5.7.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-008(b)

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Copper	33-1690	0333-96-0020	24.2	2 800	0.009
Lead	33-1695	0333-96-0040	25.6	400	0.06
Nickel	33-1690	0333-96-0020	25.5	1 500	0.02
Selenium	33-1691	0333-96-0024	4.1	380	0.01
Acenaphthene	33-1693	0333-96-0031	0.033	2 200	0.000015
Anthracene	33-1694	0333-96-0036	0.1	18 000	0.005
Benzoic acid	33-1690	0333-96-0020	1.6	360	0.004
Bis(2-ethylhexyl)phthalate	33-1692	0333-96-1000	2.1	32	0.07
Butylbenzylphthalate	33-1691	0333-96-0025	0.21	13 000	0.00002
Chrysene	33-1694	0333-96-0036	0.86	61	0.014
Dibenzofuran	33-1694	0333-96-0038	0.033	250	0.0001
2,4-Dichlorophenol	33-1690	0333-96-0019	0.072	200	0.0004
2,4-Dinitrophenol	33-1690	0333-96-0019	0.87	130	0.007
Fluoranthene	33-1693	0333-96-0031	0.53	2 600	0.004
Fluorene	33-1694	0333-96-0038	0.033	2 300	0.00001
Pyrene	33-1694	0333-96-0036	0.52	1 900	0.0003
2,4,5-Trichlorophenol	33-1690	0333-96-0019	0.08	6 500	0.00001
				Total	0.1

TABLE 5.7.8-2

PRS 33-008(b) CARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	BENZO[a] PYRENE (mg/kg)	BENZO[a] ANTHRA-CENE (mg/kg)	BENZO[b] FLUOR-ANTHENE (mg/kg)	DIBENZO[a,h] ANTHRA-CENE (mg/kg)	PENTA-CHLORO-PHENOL (mg/kg)
SAL	N/A[a]	N/A	0.061	0.61	0.61	0.061	2.5
PRG[b]	N/A	N/A	0.26	2.6	2.6	0.26	7.9
0333-96-0019	33-1690	1.5	0.33(U)[c]	0.33(U)	0.33(U)	0.33(U)	6.5
0333-96-0023	33-1691	2.5	0.072(J)[d]	0.072(U)	0.11(U)	0.33(U)	0.072(J)
0333-96-0031	33-1693	1	0.16(J)	0.23(J)	0.2(J)	0.033(J)	1.6(U)
0333-96-0036	33-1694	3.5	0.66	0.62	1.4	0.1(J)	1.6(U)
0333-96-0039	33-1695	2.5	0.1(J)	0.33(U)	0.33(U)	0.33(U)	1.6(U)

a. N/A = Not Applicable
b. PRG = Preliminary Remediation Goal for industrial sites (EPA 1996, 1307)
c. U = Undetected—value listed is the detection limit of the analytical instrument
d. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit

5.7.9 Human-Health Risk Assessment

Pentachlorophenol, other phenols, benzo(a)pyrene, and several other carcinogenic PAHs were found above SALs in samples collected at PRS 33-008(b). However, due to the low concentrations of these compounds, a quantitative human-health risk assessment was not performed for this PRS. A qualitative evaluation of these COPCs is presented.

Phenols and PAHs were detected above their SALs in 5 of 22 samples, with pentachlorophenol detected at a maximum concentration of 6.5 mg/kg and benzo(a)pyrene detected at a maximum concentration of 0.66 mg/kg. Only benzo(a)pyrene in sample 0333-96-0036 exceeds industrial PRGs. These concentrations, present at a depth of 1–7 ft, do not indicate a significant contaminant release scenario or potential human-health concern at an industrial facility such as TA-33. Low levels of these contaminants, components of creosotes, were expected due to the presence of telephone poles, railroad ties, and other treated wood in the landfill.

Human-health risk assessment for these compounds would be based on industrial land use, rather than on residential SALs, for this PRS. The smaller exposure area, shorter exposure duration, and smaller exposure frequency, as well as the fact that an adult worker exposure is characterized (i.e., children and infants are excluded) in the industrial exposure scenario, reduce human-health impacts from exposure to such low concentrations of these analytes in soil. In addition, East Site is an inactive area that receives little worker traffic, and the contaminants are buried. Therefore, additional evaluation of phenols and PAHs for human-health risk will not be pursued.

Chromium, also a carcinogen, was detected above background UTL. The data validation process indicated that some chromium results, including those in sample 0333-96-0020, may be low by as much as 38%. If the maximum concentration of 144 mg/kg is normalized to account for this suspected bias, the adjusted concentration is estimated to be 199 mg/kg, still below the chromium SAL of 210 mg/kg, and less than half of the 450 mg/kg PRG for chromium at industrial sites (EPA 1995, 1307). Because East Site is considered an industrial area under continued institutional control, chromium will not be carried forward in the screening process.

5.7.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.7.11 Conclusions and Recommendations

During the 1984 cleanup of East Site, radioactive material was collected and removed from the site. Appropriate items were recycled (Buhl 1988, 02-038). The remaining material was deposited in a landfill, PRS 33-008(b), including large wooden items, such as pieces of shacks, telephone poles, railroad ties used for catcher box construction, and assorted hardware.

In the work plan, conceptual models were developed for three different exposure scenarios: current use, recreational use, and construction. The primary release mechanisms at TA-33 include sediment transport and resuspension by wind. Other release mechanisms considered in the plan were landslide/erosion, biological activity, and dissolution in runoff. All these release mechanisms are unlikely at landfill PRS 33-008(b).

Sampling and analysis indicate that the material in the landfill contains low levels of carcinogenic PAHs found in creosotes, which are common wood preservatives. Although concentrations of several PAHs exceeded their respective SALs, the source is a ubiquitous one and not unique to LANL activities at East Site. Elevated chromium found in several samples did not exceed SALs nor did chromium concentrations drive the MCE above the target value of 1. All the material is buried, and sampling at the nearest East Site runoff point demonstrates that hazardous amounts of the material is not leaching to the drainages. The landfill is constructed on bedrock tuff. The condition of the samples taken from the landfill indicate that the landfill does not collect and hold water and therefore does not have the potential to develop a hydrostatic head and force PAHs downward to groundwater, which is estimated to be at least 800 ft below the mesa top (the depth to Ancho Spring at 5 600 ft in Ancho Canyon).

Inspection of the data indicates that PAH contamination above SALs is confined to the upper 2-5 to 3.5 ft of the landfill. Contaminant concentrations in samples collected at depth in each borehole are below SALs. In addition, concentrations typically decrease with-increasing depth. These observations indicate that contamination is bounded vertically in relation to SALs.

Sampling in the drainage below the landfill indicated that contaminants are not migrating downslope from the site. The amount of metal in the landfill is not known. A geophysical survey of the landfill in 1994 did not reveal large metallic pieces in the fill (ICF Kaiser Engineers 1994, 02-081).

A search for regulatory drivers concerning landfills determined that, in 1984, it was permissible under the State of New Mexico Solid Waste Regulations for a land owner to dispose of solid waste on his property, provided that the disposal did not present a threat to human health and the environment (Shanley 1997, 02-121).

This site is proposed for NFA for human health based on Criterion 5 because it has been investigated, evaluated, and found to present little risk to human health. The location of the landfill is marked with metal posts. Upon approval of the NFA recommendation, the TA-33 facility manager will be notified that the ER Project has completed its activities at this PRS.

5.8 PRS 33-011(d)

PRS 33-011(d) is the paved area surrounding warehouse TA-33-20. Between 1953 and 1972, the area was used for outdoor storage. In the 1994 sampling campaign, lead, uranium, and tritium were detected above their SALs in one asphalt sample and its duplicate. Phase II sampling, which was completed in 1996, found one sample with lead above its SAL but below industrial cleanup level. No other contaminants were detected at levels of concern. The PRS is proposed for NFA for human health.

5.8.1 History

PRS 33-011(d) is discussed in the RFI Work Plan for Operable Unit 1122 in Sections 3.2.2.7 and 4.2.3.1 (LANL 1992, 0784). The PRS is located on the asphalt pavement surrounding warehouse TA-33-20 at Main Site. Site workers have indicated that uranium, lead, and beryllium metals were stored in and around the warehouse until 1972. Scrap from recovered shots and material intended for recovery were also stored south of the building. All such material has been removed. The building is now used for storage.

5.8.2 Description

Warehouse TA-33-20 is a Quonset structure located within the developed area of Main Site (Fig. 5.8.2-1). The warehouse is surrounded by pavement used for parking and storage. Runoff from the pavement flows east downslope into the principal drainage that collects runoff from all PRSs at Main Site.

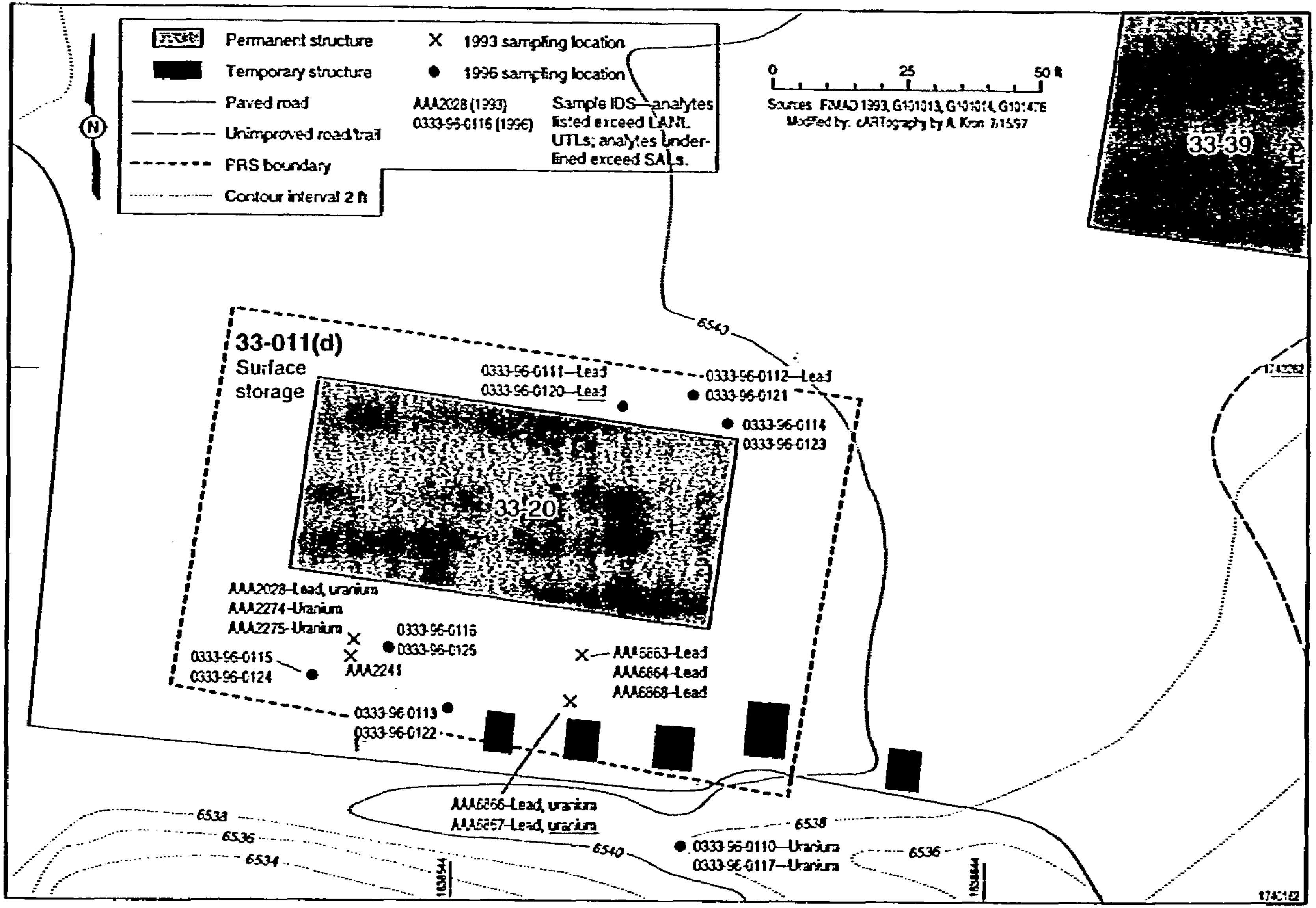


Fig. 5.8.2-1. PRS 33-011(d), storage at TA-33-20.

5.8.3 Previous Investigation

Phase I sampling was performed at this PRS in 1993. Prior to sampling at TA-33, Main Site was surveyed for radiation at points on the grid specified in the work plan. No radioactivity was detected. However, at the time of sample collection, radioactivity was detected on asphalt at PRS 33-011(d). As specified in the work plan, two asphalt samples and three soil samples from below the asphalt were taken at three locations. Of these, one asphalt and one soil sample (AAA6866 and AAA6867) were taken at the radioactive point. All samples were analyzed for inorganic chemicals, uranium, and gamma emitters. Five of the samples (AAA6863, AAA6864, AAA6866, AAA6867, and AAA6868) were also analyzed for tritium and plutonium.

Only uranium and lead were found at levels of concern and carried forward to the Phase II investigation. Lead and uranium results from the 1993 sampling campaign are provided in tables in Sections 5.8.5 and 5.8.6, respectively, of this report.

Section 4.5 of the September 1995 RFI Report for TA-33, which discusses the Phase I investigation of PRS 33-011(d), is provided as Attachment 7 of this report.

5.8.4 Field Investigation

Sampling at PRS 33-011(d) conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With surface disposal as the primary source, exposure routes for human receptors are inhalation and dermal contact. Because the PRS is paved, ingestion of contaminated soil is not considered a likely exposure route. Storage of potentially hazardous material ended over 35 years ago at this PRS with subsequent wind, rain, and snow scouring the site. Because the primary concern is exposure of material that may have migrated under the asphalt cover, only subasphalt sampling was performed.

Fourteen samples, all under asphalt, were collected in 1996 in accordance with the Phase II sampling plan. Asphalt in the parking areas was broken using an electric jackhammer and the soil beneath the asphalt was collected. Six of these samples were collected at the soil/tuff interface beneath the asphalt.

During preliminary field screening, a radioactive spot was located in the drainage south of the paved area. The spot read approximately twice background on the sodium iodide detector. Samples 0333-96-0110 and -0117 were taken at that point. Field screening of the 1993 location with elevated uranium did not detect above background radiation and the point was not resampled.

In a deviation from the work plan, because an impact core drill was not available, a jackhammer was used instead.

Twelve soil samples were analyzed for uranium and inorganic chemicals (Table 5.8.4-1). Samples 33-96-0110 and -0117 were analyzed for isotopic uranium only.

TABLE 5.8.4-1

SUMMARY OF SAMPLES TAKEN FOR PRS 33-011(d)

SAMPLE ID	SITE ID	MEDIUM	DEPTH (ft)	RADIO-NUCLIDES	INORGANIC CHEMICALS
0333-96-0110	33-1570	Soil	0–0.5	2366[a]	NA[b]
0333-96-0111	33-1566	Soil	0–0.5	2366	2365
0333-96-0112	33-1567	Soil	0–0.5	2366	2365
0333-96-0113	33-1568	Soil	0–0.5	2366	2365
0333-96-0114	33-1569	Soil	0–0.5	2366	2365
0333-96-0115	33-1571	Soil	0–0.5	2366	2365
0333-96-0116	33-1572	Soil	0–0.5	2366	2365
0333-96-0117	33-1570	Soil/tuff	0–0.5	2377	NA
0333-96-0120	33-1566	Soil/tuff	0.5–1	2377	2376
0333-96-0121	33-1567	Soil/tuff	0.5–1	2377	2376
0333-96-0122	33-1568	Soil/tuff	0.5–1	2377	2376
0333-96-0123	33-1569	Soil/tuff	0.5–0.75	2377	2376
0333-96-0124	33-1571	Soil/tuff	0.5–0.75	2377	2376
0333-96-0125	33-1572	Soil	0.5–0.75	2377	2376

a. ER analytical request number
b. NA = Not Analyzed

5.8.5 Evaluation of Inorganic Chemicals

In the 1993 campaign, lead was found above its background UTL in all samples and above its soil SAL in asphalt sample AAA6866. These data are provided in Table 5.8.5-1. Because no other inorganic chemical was found above its SAL, only lead was carried forward in the screening process for inorganic chemicals. Extended sampling in the 1996 campaign detected lead above its LANL background UTLs in 3 of 14 samples, with lead above its SAL in soil sample 0333-96-0120 (Table 5.8.5-1).

5.8.6 Evaluation of Radionuclides

In the 1993 campaign, samples AAA6866 and AAA6867, which were taken from the radioactive spot, contained uranium levels above SAL. Three samples contained uranium slightly above the LANL UTL. These data are provided in Table 5.8.6-1.

TABLE 5.8.5-1

LEAD DETECTED ABOVE LANL BACKGROUND UTLs AT PRS 33-011(d)

SAMPLE ID	DEPTH (ft)	LEAD (mg/kg)
SALs	N/A	400
(95%, .95) UTL	N/A	23.3
AAA2028 [a]	0–0.5	110
AAA6863	0–0.5	45
AAA6864	0–1	40
AAA6866	0–0.5	690
AAA6867	0–1	139
AAA6868	0–1	40
0333-96-0111	0–0.5	31
0333-96-0112	0–0.5	300
0333-96-0120	0.67–1	774

a. Prefix AAA indicates 1993 sample

TABLE 5.8.6-1

URANIUM DETECTED ABOVE THE LANL BACKGROUND UTL AT PRS 33-011(d) IN 1993

SAMPLE ID	DEPTH (ft)	URANIUM (mg/kg)
SALs	N/A	130 [a]
(95%, .95) UTL	N/A	5.45
AAA2028	0–0.5	6.8
AAA2274	0–0.5	6.7
AAA2275	0–0.5	6.3
AAA6866	0–0.5	3 200 [b]
AAA6867	0–1	899 [b]

In the 1996 campaign, uranium was detected above background but below its SAL in two samples (Table 5.8.6-2). Because a partial digestion was used for sample preparation for uranium analysis, uranium results were compared to the background UTL of 1.87 mg/kg (see Section 4.2 of this report). Uranium results at PRS 33-011(d) ranged from 0.53 to 1.6 mg/kg. Total uranium reported in Table 5.8.6-2 is calculated from the isotopic results and is compared to the total uranium UTL of 5.45 mg/kg. Isotopic analysis indicated that depleted uranium was stored at the site.

TABLE 5.8.6-2

URANIUM DETECTED ABOVE THE LANL BACKGROUND UTL
AT PRS 33-011(d) IN 1996

SAMPLE ID	DEPTH (ft)	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)	URANIUM (mg/kg)
SALs	N/A	13	10	67	130[a]
(95%, .95) UTL	N/A	1.94	0.084	1.82	5.45[b]
0333-96-0110	0–0.5	2.7	0.18 (J)[c]	6.2	18.6
0333-96-0117	0.17–0.58	2.3	0.14 (J)	4.6	13.8

a. SAL for depleted uranium
b. UTL for uranium using total digestion sample preparation
c. J = Estimated value—the analyte was detected above the detection limit but belowthe estimated quantitation limit

5.8.7 Evaluation of Organic Chemicals

Because PRS 33-011(d) was a holding area for metal objects suitable for outdoor storage, no samples were analyzed for organic chemicals in either the Phase I or Phase II sampling campaigns.

5.8.8 Risk-Based Screening Assessment

Elevated levels of lead were found in samples from the former storage area (Table 5.8.8-1). Results indicate that although lead contamination is widespread in the area surrounding TA-33-20, it would not pose a risk to the most sensitive population (children under seven years of age) because this area is expected to remain an industrial site. Because no lead concentration exceeded the EPA Region 9 industrial cleanup level of 1000 mg/kg, which has been adopted by LANL, lead will not be carried forward in the screening process.

TABLE 5.8.8-1

PRS 33-011(D) NONCARCINOGENS WITH CONCENTRATIONS

IN SOIL THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	LEAD (mg/kg)
AAA6866	33-1081	0–0.5	690
0333-96-0120	33-1566	0.67–1	774

Uranium, which was not found above SAL in 1996 despite an extensive search, will not be carried forward in the screening process.

5.8.9 Human-Health Risk Assessment

Because no contaminant was carried forward in the screening process, no risk assessment was performed for PRS 33-011(d).

5.8.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.8.11 Conclusion and Recommendation

In 1993, Phase I sampling indicated that uranium and lead concentrations were elevated in and under the asphalt on the south side of warehouse TA-33-20. Extended Phase II sampling was performed in 1996 to investigate the extent of contamination in a larger area surrounding the building. Neither contaminant was found at levels of concern under the industrial scenario to be expected at Main Site.

Although lead was detected above its SAL at 1 of the 14 locations sampled in 1996, overall results indicated that high levels of lead are not widespread at the site. All concentrations were below the EPA Region 9 industrial cleanup level of 1000 mg/kg, that has been adopted by LANL (EPA 1995, 1307).

Field screening at the 1993 location of high uranium concentration did not detect radiation above background, thereby indicating that all contamination was removed during 1993 sample collection. Sampling and analysis at the only 1996 location showing elevated screening readings indicated that uranium was found above background, but well below its SAL.

This site is proposed for NFA for human health based on Criterion 5 because it has been investigated, evaluated, and shown to represent minor risk to human health.

5.9 PRS 33-013

PRS 33-013 was a drum storage area on pavement east of the tritium facility, TA-33-86. In the 1993 sampling campaign, cadmium, chromium, and tritium were observed above their SALs. Beryllium was measured above soil background levels. Phase II sampling failed to detect elevated inorganic contaminants, indicating that these contaminants are not widespread. An NFA for human health is proposed for the PRS.

5.9.1 History

PRS 33-013, an asphalt pad, was once used as a drum storage area for liquid waste. It is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.2.2.8 and 4.3.4 (LANL 1992, 0784). The PRS is located northeast of TA-33-86 and lies within the security fence surrounding the old tritium facility. Long-time employees describe the northeast section within the fence as a storage area for material awaiting disposal. Items included vacuum pumps from throughout LANL, barrels of waste oil, and dumpsters of miscellaneous solid wastes. No effort was made to cover the area. Many containers leaked and several containers remained in the area for years.

5.9.2 Description

The area is level, approximately 50 ft square, and paved with asphalt as an extension of the parking lot and driveway around TA-33-86 (Fig. 5.9.2-1). Weeds grow in the soil on three sides of the pad and in cracks in the pavement. Runoff from the area is to the east, toward the drainage that leads to Chaquehui Canyon. East of the fence the ground slopes at a moderate grade without obvious channeling. The surface material—soil with pumice—is sparsely vegetated; some of it may be fill from grading the site prior to building TA-33-86.

5.9.3 Previous Investigation

In the 1993 sampling campaign, three samples were taken at random locations 0–6 in. under the asphalt paving, which is 2–3 in. thick (Fig. 5.9.2-1). All samples were analyzed for inorganic chemicals, gamma emitters, and SVOCs. In addition, two samples were analyzed for tritium and one was analyzed for herbicides. Because the crumbling nature of the asphalt and the dry conditions at TA-33, VOCs were not specified in the approved sampling and analysis plan.

Cadmium, chromium, and tritium were detected above SAL and carried forward in the screening process. Tritium was discussed in depth in the RFI report for MDA K, which included all surface samples collected at Main Site. A risk assessment determined that tritium is not a threat to human health at TA-33 (Environmental Restoration Project 1995, 1263).

Section 4.6 of the September 1995 RFI Report for TA-33, which discusses the Phase I investigation of PRS 33-013, is provided as Attachment 8 of this report.

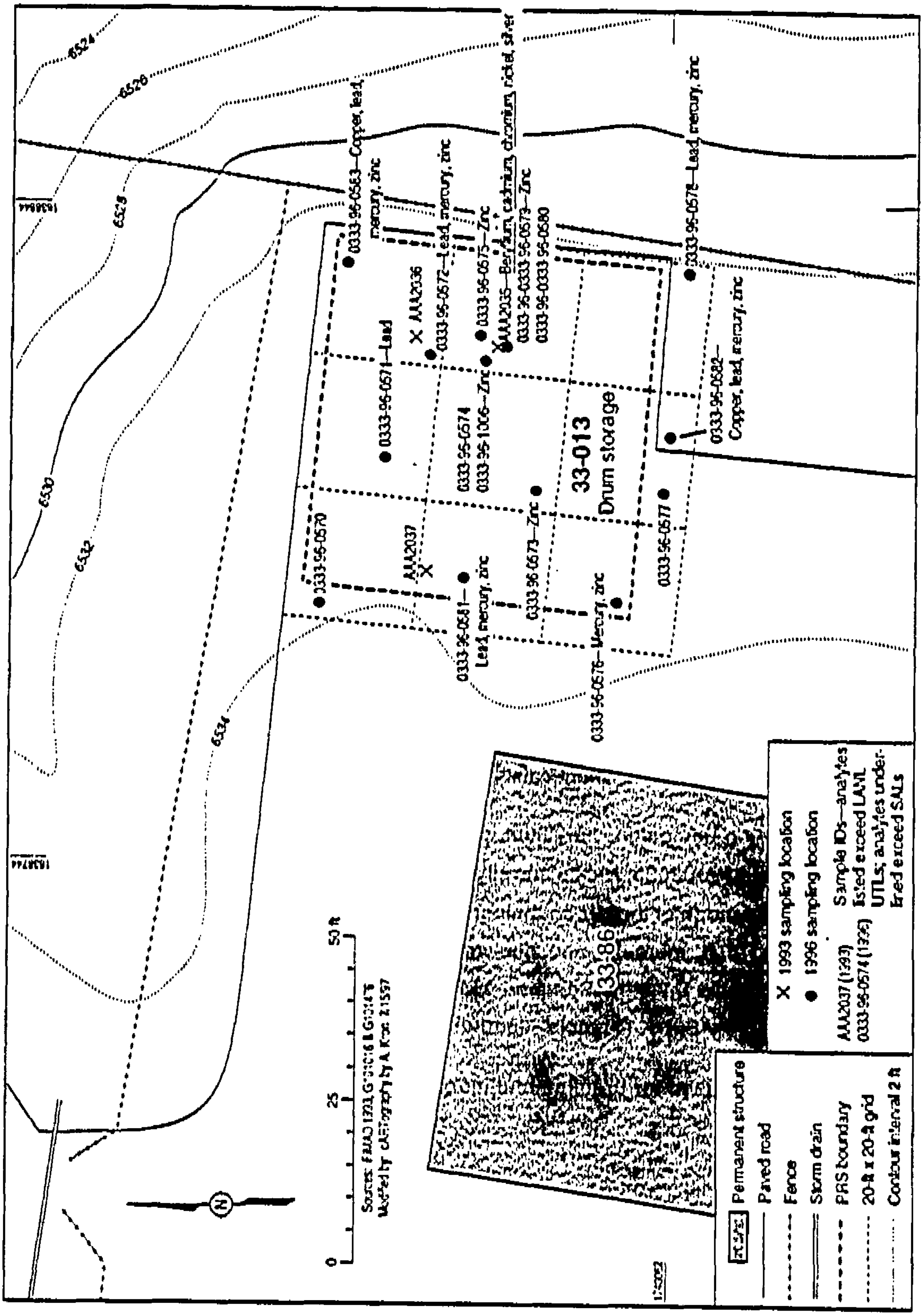


Fig. 5.9.2-1. PRS 33-013, drum storage at TA-33-86.

5.9.4 Field Investigation

Sampling at PRS 33-013 conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With surface disposal as the primary source, exposure routes for human receptors are inhalation and dermal contact. Although the PRS is paved, ingestion of contaminated soil is considered a likely exposure route because the asphalt is deteriorating and crumbling. To assess potential for contaminants being released from this site by runoff or wind, surface samples were collected in cracks and from graveled areas at the pavement edges.

During the 1996 campaign, 15 samples were collected at PRS 33-013. Nine of these samples were collected from random locations within each cell of a nine-cell grid distributed over the storage area (Fig. 5.9.2-1). All were soil samples: some collected from cracks in the asphalt, some from gravel between the asphalt paving and the fence line. Field screening was performed using XRF. In a deviation from the work plan, LIBS was not used because the equipment was not available and the field team was not well trained in the technique. The XRF technique is considered equivalent. Samples from Location IDs 33-1090 and 33-1092 were collected at the same locations as the 1993 samples. Sample AAA2035 from the 1993 campaign contained high levels of inorganic chemicals and is included in this discussion (Table 5.9.4-1).

5.9.5 Evaluation of Inorganic Chemicals

In the 1993 sampling campaign, beryllium, cadmium, and chromium were measured above their SALs in sample AAA 2035. Nickel and silver were found above their UTLs. In the extended sampling from 1996, none of these contaminants were detected above their UTLs. In the 1996 campaign, copper, lead, mercury, and zinc were found at somewhat elevated levels, but far below their SALs (Table 5.9.5-1). Samples 0333-96-0579 and -0580 were taken at the same location as sample AAA2035. (Sample -0580 did not contain contaminants above UTLs.)

All samples were analyzed for uranium and inorganic chemicals.

TABLE 5.9.4-1

SUMMARY OF SAMPLES TAKEN FOR PRS 33-013

SAMPLE ID	LOCATION ID	MATRIX	DEPTH (ft)	URANIUM	INORGANIC CHEMICALS
AAA2035[a]	33-1090	Soil*	0–0.5	14596[b]	14594
0333-96-0570	33-1557	Soil*	0–0.5	2424	2423
0333-96-0571	33-1556	Soil	0–0.5	2424	2423
0333-96-0572	33-1555	Soil	0–0.5	2424	2423
0333-96-0573	33-1560	Soil	0–0.5	2424	2423
0333-96-0574	33-1559	Soil*	0–0.5	2424	2423
0333-96-1006	33-1559	Soil	0–0.5	2424	2423
0333-96-0575	33-1558	Soil*	0–0.5	2424	2423
0333-96-0576	33-1563	Soil	0–0.5	2424	2423
0333-96-0577	33-1562	Soil*	0–0.5	2424	2423
0333-96-0578	33-1561	Soil	0–0.5	2424	2423
0333-96-0579	33-1090	Soil	0–0.5	2424	2423
0333-96-0580	33-1090	Soil	0.5–1	2424	2423
0333-96-0581	33-1092	Soil	0–0.5	2424	2423
0333-96-0582	33-1572	Soil	0–0.5	2424	2423
0333-96-0583	33-1656	Soil	0–0.5	2759	2758

a. 1993 sample
b. ER analytical request number
* On asphalt

5.9.6 Evaluation of Radionuclides

No uranium was detected above its LANL background UTL in any sample. Because a partial digestion was used for sample preparation for uranium analysis, uranium results were compared to the background UTL of 1.87 mg/kg (see Section 4.2 of this report). Uranium results at PRS 33-013 ranged from 0.23 to 0.88 mg/kg. Sample 0333-96-0583 was collected at a later date than the original sampling and analyzed using a total digestion. Its concentration of 2.08 is compared against the total UTL of 5.45 mg/kg. Tritium was detected in two 1993 samples. These results were included in a risk assessment for MDA K, which is located east of the fence bordering PRS 33-013. The MDA K risk assessment indicated that tritium exposure was within EPA and DOE guidelines (Environmental Restoration Project 1995, 1263). Tritium will not be carried forward in the screening process.

5.9.7 Evaluation of Organic Chemicals

Because no SVOCs were found in 1993 samples at levels of concern, no organic analyses were performed during Phase II sampling at this PRS.

TABLE 5.9.5-1

INORGANIC CHEMICALS EXCEEDING UTLs AT PRS 33-013

SAMPLE ID	DEPTH (ft)	BERYLLIUM (mg/kg)	CADMIUM (mg/kg)	CHROMIUM (mg/kg)	COPPER (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	NICKEL (mg/kg)	SILVER (mg/kg)	ZINC (mg/kg)
SALs	N/A	Background	38	210	2 800	400	23	1 500	380	23 000
(95%,.95) UTL	N/A	1.95	2.7	19.3	15.5	23.3	0.1	15.2	NA[a]	50.8
AAA2035*	0–0.5	7.8	620	670	NA	11	NA	100	10	14
0333-96-0571	0–0.5	0.53 (U)[b]	0.53 (U)	3.1	3.9	26	0.11 (U)	3.6	2.1 (U)	37 (J-)[c]
0333-96-0572	0–0.5	0.51 (U)	0.51 (U)	4.6	6.5	57	0.3	3.5	2.0 (U)	59(J-)
0333-96-0573	0–0.5	0.54 (U)	0.54 (U)	3.2	3.9	7.5	0.11 (U)	2.5	2.2 (U)	120(J-)
0333-96-1006	0–0.5	0.52 (U)	0.52 (U)	3.8	4.9	8.6	0.10 (U)	3.8	2.1 (U)	57(J-)
0333-96-0575	0–0.5	0.53 (U)	0.53 (U)	3.2	14	8.4	0.11 (U)	2.9	2.1 (U)	55(J-)
0333-96-0576	0–0.5	0.52 (U)	0.52 (U)	5.1	6.4	15	0.33	4.7	2.1 (U)	83(J-)
0333-96-0578	0–0.5	0.51 (U)	1.7	7	13	35	0.35	6.5	2.0 (U)	190(J-)
0333-96-0579	0–0.5	0.53 (U)	0.53 (U)	2.9	3.8	7.5	0.11 (U)	3.4	2.1 (U)	53(J-)
0333-96-0581	0–0.5	0.53 (U)	0.53 (U)	5.2	7.7	24	1	4.4	2.1 (U)	68(J-)
0333-96-0582	0–0.5	0.50 (U)	0.50 (U)	15	17	16	0.44	9.2	2.0 (U)	76(J-)
0333-96-0583	0–0.5	0.42 (U)	0.7	3.1	19.9	40.4	0.14	3.1	0.52 (U)	165

*1993 sample
a. NA = Not analyzed
b. U = Undetected—the listed value is the detection limit
c. J-=Estimated value likely to be low

5.9.8 Risk-Based Screening Assessment

In 1996 samples, no contaminants were detected above SALs at PRS 33-013, indicating that widespread contamination does not exist. The carcinogens beryllium, cadmium, and chromium, for which Phase II sampling was conducted at this PRS, were not found above their LANL background UTLs. These two chemicals will not be carried forward in the screening process. An MCE result of 0.1 for noncarcinogenic chemicals indicates that this grouping is not of concern (Table 5.9.8-1). Nickel and silver were not verified above UTL in the 1996 sampling at sample location 33-1090. Therefore, they are not included in the MCE. Their normalized values of 0.07 and 0.03 would not affect the conclusion that noncarcinogenic inorganic chemicals at PRS 33-013 do not pose a human health risk. Therefore, noncarcinogens will not be carried forward in the screening process.

TABLE 5.9.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-013

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Copper	33-1572	0333-96-0582	17	2 800	0.006
Lead	33-1555	0333-96-0572	57	400	0.1
Mercury	33-1572	0333-96-0582	0.44	23	0.02
Zinc	33-1561	0333-96-0578	190	23 000	0.008
				Total	0.1

5.9.9 Human-Health Risk Assessment

Because no contaminant was carried forward in the screening process, no risk assessment was performed for this PRS.

5.9.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.9.11 Conclusion and Recommendation

In Phase I sampling at PRS 33-013, cadmium and chromium were found in one sub-asphalt sample at the 600 mg/kg level. Phase II sampling was designed to determine if those levels were reproducible at that location and if contamination was widespread. The sampling and analysis plan specified a grid of nine cells over the PRS, with a random sample taken from each cell, thus insuring coverage of the entire PRS. Neither cadmium nor chromium was found at levels of concern in Phase II sampling at PRS 33-013. Cadmium was detected in only 1 of 13 samples at 1.7 mg/kg, which is below its UTL of 2.7 mg/kg. Chromium results ranged from 2.8 to 15 mg/kg, with a mean of 4.8 mg/kg. All results were below the LANL UTL of 19.3 and far below the SAL of 210 mg/kg. These results indicate that contamination is not widespread or at hazardous levels, and that this small area of contamination was cleaned up during the 1993 sampling event.

Tritium, which was detected in Phase I sampling, was included in a risk assessment for MDA K. Levels were found to be acceptable from both a human-health and ecological perspective. Uranium was not present at levels of concern in either Phase I or Phase II sampling.

The original sampling results could not be reproduced, and elevated levels of contamination were not found. A sample taken at depth beneath the contaminated Phase I location contained no contaminants above UTL, suggesting that contaminants were not mobile vertically and that possible contamination is bounded at depth by this investigation. Contamination was minimal in samples at the periphery of the pad and no contaminants above UTL were found in sample 0333-96-0578 that receives runoff from the pad.

This site is proposed for NFA for human health based on Criterion 5 because it has been investigated and evaluated.

5.10 PRS 33-017

Investigation of PRS 33-017 was intended to assess possible widespread contamination resulting from operations at Main Site. Phase I sampling indicated that a wide area around Main Site did not contain contaminants above LANL background. Only samples from the area east of former shop TA-33-39 showed contamination, with PAHs occurring in a parking and vehicle maintenance area. Phase II sampling focused on this area. While PAHs were found, they were

not present at concentrations sufficient to warrant widespread cleanup of the area. The PRS is recommended for NFA for human health under Criterion 5.

5.10.1 History

PRS 33-017 encompasses the eastern section of the fenced area at Main Site. It is discussed in the RFI Work Plan for Operable Unit 1122, Sections 3.2.2.2 and 4.2.3.1 through 4.2.3.3 (LANL 1992, 0784). PRS 33-017 was the location of diverse activities at Main Site. Historic operating activities included emissions of fumes from the uranium cut-off shack TA-33-40; air emissions from shop TA-33-39; tritium releases from the high-pressure tritium facility TA-33-86; stack emissions from shop TA-33-119, where uranium was processed; a possible atmospheric release of plutonium from the spill in TA-33-21 [PRSs 33-005(a,b,c)]; and any other operations or releases that are not associated with other known PRSs. One specific site, located east of shop TA-33-39 and used for vehicle maintenance, was included in PRS 33-017.

The primary potential contaminants were identified as uranium, plutonium, tritium, SVOCs, and inorganic chemicals (specifically beryllium, cadmium, and lead). Pesticides, herbicides, and PCBs may also have been used in the area encompassed by this PRS.

5.10.2 Description

Most of PRS 33-017 is located within the security fence at Main Site, where laboratory and office buildings are surrounded by asphalt pavement (Fig. 5.10.2-1). The paved area is level with only a slight slope to the east. All runoff from Main Site converges on the east side of the site in a shallow tributary to Chaquehui Canyon. The eastern third of the site is unimproved. Construction of Main Site resulted in a steep bank approximately 20 ft high at the head of the drainage. Runoff and cooling water blowdown has aided vigorous vegetation growth in this area. East of Main Site, native piñon-juniper woodland covers the drainage and surrounding land.

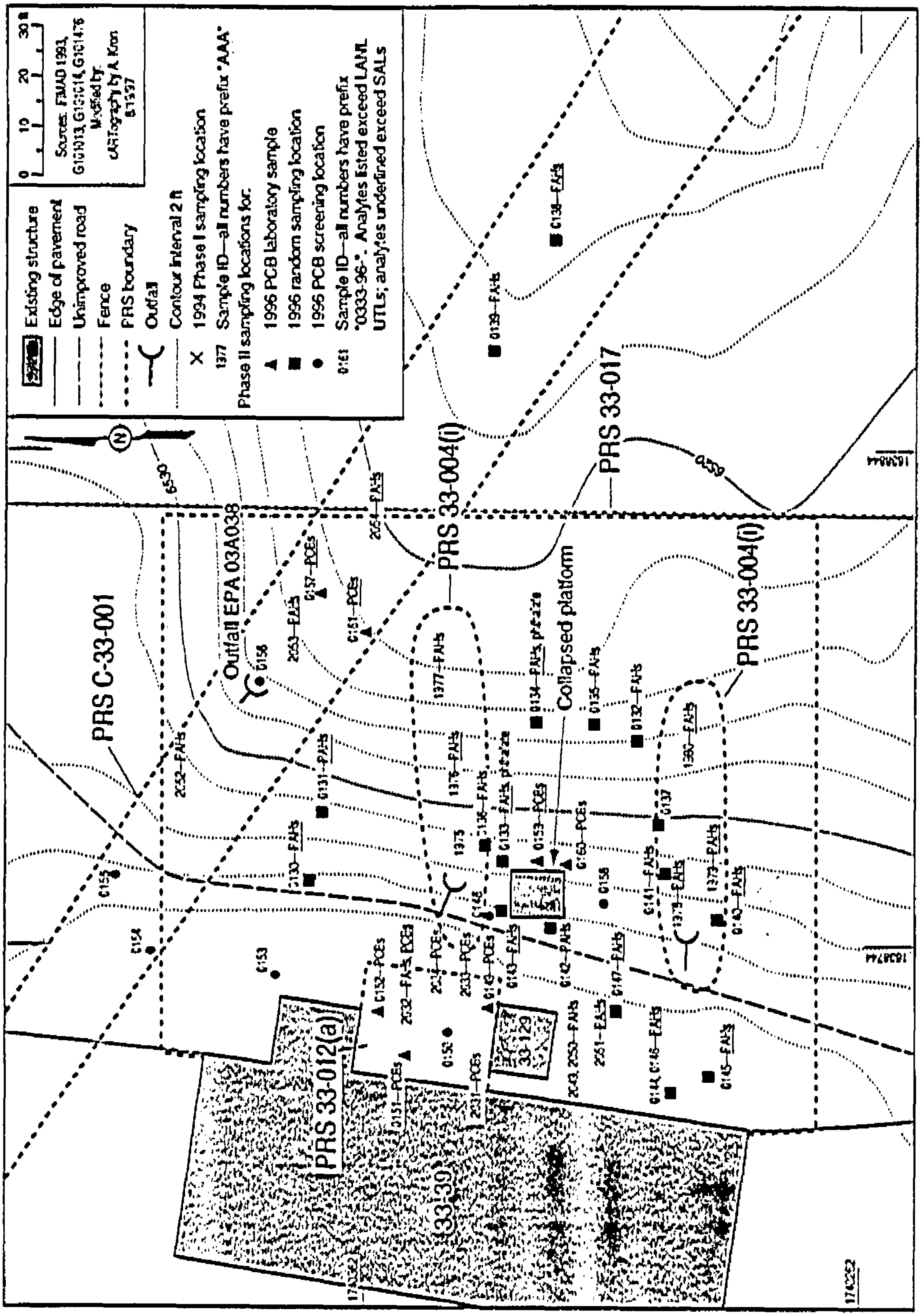


Fig. 5.10.2-1. PRS 33-017, vehicle maintenance area at Main Site.

5.10.3 Previous Investigation

As part of the 1993 sampling campaign, 56 grid samples were taken from a wide area around Main Site (LANL 1992, 0784). Twenty additional samples were collected from the main drainage. Six samples were taken from the vehicle maintenance area east of shop TA-33-39. All 82 were assigned to PRS 33-017. Ten additional samples were collected from two overlapping PRSs, 33-004(l) and 33-012(a), embedded in the vehicle maintenance area. All PRS 33-017 samples were analyzed for inorganic chemicals; 80 samples were analyzed for radionuclides by gamma spectroscopy and for SVOCs; 75 samples, for plutonium; 74 samples, for uranium and tritium; 14 samples, for herbicides; 9 samples, for pesticides; and 4 samples, for PCBs.

Elevated levels of lead and SVOCs were found in samples from the vehicle maintenance area. A risk assessment for lead in this area was addressed in Section 4.4.4 of RFI Report LA-UR-95-882. Results indicate that although lead contamination is widespread in the area east of TA-33-39, it would not pose a risk to the most sensitive population, which is children under seven years of age (Environmental Restoration Project 1995, 1212). No lead concentration exceeded the EPA Region 9 industrial PRG of 1000 mg/kg, which has been adopted by LANL.

The same exposure unit used for the lead risk assessment, approximately 0.15 acres located east of TA-33-39, was used for a preliminary risk assessment of the PAHs. Results indicated that the estimated carcinogenic risk to construction workers is low at both the mean and the 95% UCL concentrations: 2.7E-07 and 5.6E-07, respectively. Estimated residential risk based on the mean PAH concentration was 3.1E-06, and when based on all seven 95% UCLs, estimated risk rises to 2.1E-05. These calculations are included in Attachment 9 of this report.

To further address PAH contamination, a Phase II sampling plan was implemented. Because low levels of PCBs were detected at the site, PCBs were included in the plan.

Section 4.8 of the September 1995 RFI Report for TA-33, which discusses the Phase I investigation of PRS 33-017, is provided as Attachment 9 of this report.

5.10.4 Field Investigation

Sampling at PRS 33-017 conformed to the current use (industrial) or construction scenario of the conceptual model described in the RFI Work Plan for Operable Unit 1122, Section 3.1.2 (LANL 1992, 0784). With surface disposal as the primary source, exposure routes for human receptors are ingestion and dermal contact. Because the PRS is paved, graveled, or heavily vegetated, inhalation of contaminated soil is not considered a likely exposure route. Because contaminants were deposited by spills or runoff, only surface sampling was performed.

In the 1996 sampling campaign, a total of 25 soil samples were collected at PRS 33-017. Of these, 18 were analyzed for SVOCs and 7 were analyzed for PCBs. In the January 1995 RFI Report for TA-33, SVOCs in the 1993 samples for PRS 33-012(a) were assigned to PRS 33-017, and are included in this report. At that time, the SAL for PCBs was 10 mg/kg. Since that time, PCB cleanup levels have been reduced to 1 mg/kg. Therefore, low levels of PCBs found in PRS 33-012(a) are also discussed in this report (Table 5.10.4-1).

The sampling and analysis plan specified that one subsurface sample was to be taken at a point of visible staining. Because no staining was found, the subsurface sample 0333-96-0144 was collected at the soil/tuff interface adjacent to TA-33-39 in an area suspected to be contaminated with PAHs.

5.10.5 Evaluation of Inorganic Chemicals

No samples were analyzed for inorganic chemicals.

5.10.6 Evaluation of Radionuclides

No samples were analyzed for radionuclides.

5.10.7 Evaluation of Organic Chemicals

Low levels of PAHs were detected in 16 of the 18 samples collected from the unimproved road and from the brush-covered slope east of TA-33-39. Twelve of these samples contained carcinogenic PAHs above their SALs (Table 5.10.7-1).

TABLE 5.10.4-1

SUMMARY OF SAMPLES TAKEN FOR PRS 33-017

SAMPLE ID	SITE ID	MATRIX	DEPTH (ft)	SVOCs	PCBs
AAA2031[a]	33-1086	Soil[b]	0.5-1	14587[c]	NA[d]
AAA2032[a]	33-1087	Soil[b]	1	14587	14592
AAA2033[a]	33-1088	Soil	0–0.5	14587	14592
AAA2034[a]	33-1089	Soil	0–0.5	14587	14592
0333-96-0130	33-1585	Soil	0–0.5	2339	NA
0333-96-0131	33-1586	Soil	0–0.5	2339	NA
0333-96-0132	33-1587	Soil	0–0.5	2339	NA
0333-96-0133	33-1588	Soil	0–0.5	2339	NA
0333-96-0134	33-1589	Soil	0–0.5	2339	NA
0333-96-0135	33-1590	Soil	0–0.5	2339	NA
0333-96-0136	33-1591	Soil	0–0.5	2339	NA
0333-96-0137	33-1592	Soil	0–0.5	2339	NA
0333-96-0138	33-1593	Soil	0–0.5	2339	NA
0333-96-0139	33-1594	Soil	0–0.5	2339	NA
0333-96-0140	33-1595	Soil	0–0.5	2339	NA
0333-96-0141	33-1596	Soil	0–0.5	2339	NA
0333-96-0142	33-1597	Soil	0–0.5	2339	NA
0333-96-0143	33-1598	Soil	0–0.5	2339	NA
0333-96-0144	33-1601	Soil	1–1.5	2339	NA
0333-96-0145	33-1600	Soil	0–0.5	2339	NA
0333-96-0146	33-1601	Soil	0–0.5	2339	NA
0333-96-0147	33-1602	Soil	0–0.5	2339	NA
0333-96-0149	33-1605	Soil	0–0.5	NA	2364
0333-96-0151	33-1607	Soil	0–0.5	NA	2364
0333-96-0152	33-1608	Soil	0–0.5	NA	2364
0333-96-0157	33-1613	Soil	0–0.5	NA	2364
0333-96-0159	33-1614	Soil	0–0.5	NA	2367
0333-96-0160	33-1615	Soil	0–0.5	NA	2367
0333-96-0161	33-1616	Soil	0–0.5	NA	2367

a. 1993 sample for overlapping PRS 33-012(a)
b. Sample collected under asphalt
c. ER analytical request number
d. NA = Not Analyzed

TABLE 5.10.7-1

DETECTED ORGANIC CHEMICALS FOR PRS 33-017

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
AAA2031	0.5-1	Bis(2-ethylhexyl)phthalate	1.1	32	0.33
AAA2032	1	Benzo[a]anthracene	0.51	0.61	0.33
		Benzo[b]fluoranthene	0.43	0.61	0.33
		Benzo[k]fluoranthene	0.52	6.1	0.33
		Bis(2-ethylhexyl)phthalate	1.3	32	0.33
		Chrysene	0.54	24	0.33
		Fluoranthene	0.68	2 600	0.33
		Phenanthrene	0.96	NS	0.33
		Pyrene	2.1	1 900	0.33
0333-96-0130	0–0.5	Acenaphthene	0.14 (J)[a]	2 200	0.33
		Anthracene	0.34	18 000	0.33
		Benzo[a]anthracene	0.84	0.61	0.33
		Benzo[a]pyrene	0.78	0.061	0.33
		Benzo[b]fluoranthene	0.99	0.61	0.33
		Benzo[g,h,i]perylene	0.11 (J)	NS	0.33
		Benzo[k]fluoranthene	0.25 (J)	6.1	0.33
		Chrysene	0.8	24	0.33
		Fluoranthene	1.8	2 600	0.33
		Fluorene	0.88 (J)	2 300	0.33
		Indeno[1,2,3-cd]pyrene	0.28 (J)	0.61	0.33
		Methylnapthalene [2-]	0.049 (J)	NS	0.33
		Naphthalene	0.062 (J)	1 000	0.33
		Phenanthrene	1.6	NS	0.33
		Pyrene	1.2	1 900	0.33
0333-96-0131	0–0.5	Benzo[a]anthracene	0.54	0.61	0.34
		Benzo[a]pyrene	0.25(J)	0.061	0.34
		Benzo[b]fluoranthene	0.43	0.61	0.34
		Benzo[g,h,i]perylene	0.72	NS	0.34
		Chrysene	0.48	24	0.34
		Fluoranthene	0.59	2 600	0.34
		Indeno[1,2,3-cd]pyrene	0.1 (J)	0.61	0.34
		Phenanthrene	0.46	NS	0.34
		Pyrene	0.72	1 900	0.33
0333-96-0132	0–0.5	Benzo[a]anthracene	0.41	0.61	0.35
		Chrysene	0.29 (J)	24	0.35
		Fluoranthene	0.051 (J)	2 600	0.35
		Pyrene	0.48	1 900	0.35

TABLE 5.10.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR PRS 33-017

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0133	0–0.5	Acenaphthene	0.61 (J)	2 200	0.34
		Anthracene	1 (UJ)	18 000	0.34
		Benzoic Acid	0.22 (J)	100 000	0.34
		Benzo[a]anthracene	1.4	0.61	0.34
		Benzo[a]pyrene	1.7(UJ)	0.061	0.34
		Benzo[b]fluoranthene	2.2(UJ)	0.61	0.34
		Benzo[g,h,i]perylene	0.57	NS	0.34
		Benzo[k]fluoranthene	0.94 (UJ)	6.1	0.34
		Bis(2-ethylhexyl)phthalate	0.4 (B)	32	0.34
		Chrysene	1.4	24	0.34
		Di-n-butylphthalate	0.085 (UJ)	6 500	0.34
		Dibenzofuran	0.14 (J)	250	0.34
		Fluoranthene	3.5	2 600	0.34
		Fluorene	0.43 (J)	2 300	0.34
		Indeno[1,2,3-cd]pyrene	0.71	0.61	0.34
		Naphthalene	0.22 (J)	1 000	0.34
		Methylnaphthalene [2-]	0.11 (UJ)	NS	0.34
		Phenanthrene	3.7	NS	0.34
		Pyrene	3.3	1 900	0.34
0333-96-0134	0–0.5	Benzoic Acid	0.2 (J)	100 000	0.37
		Benzo[a]anthracene	0.63	0.61	0.37
		Benzo[a]pyrene	0.38	0.061	0.37
		Benzo[b]fluoranthene	0.7	0.61	0.37
		Bis(2-ethylhexyl)phthalate	0.51 (B)	32	0.34
		Chrysene	0.56	24	0.37
		Di-n-butylphthalate	0.26 (J)	6 500	0.37
		Fluoranthene	0.68	2 600	0.37
		Phenanthrene	0.52	NS	0.37
		Pyrene	0.94	1 900	0.37
0333-96-0135	0–0.5	Benzo[a]anthracene	0.41	0.61	0.34
		Chrysene	0.3 (J)	24	0.34
		Fluoranthene	0.072 (J)	2 600	0.34
		Pyrene	0.48	1 900	0.34
0333-96-0136	0–0.5	Benzo[a]anthracene	0.5	0.61	0.34
		Bis(2-ethylhexyl)phthalate	0.44 (B)	32	0.34
		Chrysene	0.41	24	0.34
		Fluoranthene	0.34	2 600	0.34
		Phenanthrene	0.2 (J)	NS	0.34
		Pyrene	0.75	1 900	0.34

TABLE 5.10.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR PRS 33-017

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0138	0–0.5	Acenaphthene	0.26 (J)	2 000	0.34
		Anthracene	0.42	18 000	0.34
		Benzo[a]anthracene	1.2	0.61	0.34
		Benzo[a]pyrene	1.1	0.061	0.34
		Benzo[b]fluoranthene	1.4	0.61	0.34
		Benzo[g,h,i]perylene	0.4	NS	0.34
		Chrysene	1.2	24	0.34
		Dibenzofuran	0.046 (J)	250	0.34
		Dibenzo[a,h]anthracene	0.18 (J)	0.061	0.34
		Fluoranthene	2.6	2 600	0.34
		Fluorene	0.24 (J)	2 300	0.34
		Indeno[1,2,3-cd]pyrene	0.6	0.61	0.34
		Naphthalene	0.33 (J)	1 000	0.34
		Phenanthrene	2.1	NS	0.34
		Pyrene	2.1	1 900	0.34
0333-96-0139	0–0.5	Benzo[a]anthracene	0.084 (J)	0.61	0.35
		Benzo[a]pyrene	0.074 (J)	0.061	0.35
		Benzo[b]fluoranthene	0.17 (J)	0.61	0.35
		Benzo[g,h,i]perylene	0.096 (J)	NS	0.35
		Chrysene	0.094 (J)	24	0.35
		Fluoranthene	0.042 (J)	2 600	0.35
		Indeno[1,2,3-cd]pyrene	0.21 (J)	0.61	0.35
		Pyrene	0.15 (J)	1 900	0.35
0333-96-0140	0–0.5	Acenaphthene	1.3	2 200	0.36
		Anthracene	2	18 000	0.36
		Benzo[a]anthracene	3.5	0.61	0.36
		Benzo[a]pyrene	2.4	0.061	0.36
		Benzo[b]fluoranthene	2.7	0.61	0.36
		Benzo[g,h,i]perylene	0.75	NS	0.36
		Benzo[k]fluoranthene	0.97	6.1	0.36
		Chrysene	2.5	24	0.36
		Dibenzofuran	0.43	250	0.36
		Dibenzo[a,h]anthracene	0.33 (J)	0.061	0.36
		Fluoranthene	6.4	2 600	0.36
		Fluorene	0.94	2 300	0.36
		Indeno[1,2,3-cd]pyrene	1	0.61	0.36
		Methylnaphthalene [2-]	0.15 (J)	NS	0.36
		Naphthalene	0.51	1 000	0.36
		Phenanthrene	7.1	NS	0.36
		Pyrene	5.1	1 900	0.36

TABLE 5.10.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR PRS 33-017

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0141	0–0.5	Acenaphthene	0.058 (J)	2 200	0.33
		Anthracene	0.18 (J)	18 000	0.33
		Benzo[a]anthracene	0.6	0.61	0.33
		Benzo[a]pyrene	0.55	0.061	0.33
		Benzo[b]fluoranthene	0.66	0.61	0.33
		Benzo[g,h,i]perylene	0.23 (J)	NS	0.33
		Benzo[k]fluoranthene	0.084 (J)	6.1	0.33
		Chrysene	0.61	61	0.33
		Fluoranthene	1.4	2 600	0.33
		Indeno[1,2,3-cd]pyrene	0.37	0.61	0.33
		Phenanthrene	1	NS	0.33
		Pyrene	1.1	1 900	0.33
0333-96-0142	0–0.5	Benzo[g,h,i]perylene	0.76 (J)	NS	0.71
0333-96-0143	0–0.5	Acenaphthene	0.045 (J)	2 200	0.34
		Anthracene	0.18 (J)	18 000	0.34
		Benzo[a]anthracene	0.44	0.61	0.34
		Benzo[a]pyrene	0.41	0.061	0.34
		Benzo[b]fluoranthene	0.49	0.61	0.34
		Benzo[g,h,i]perylene	0.21 (J)	NS	0.34
		Chrysene	0.44	61	0.34
		Fluoranthene	0.96	2 600	0.34
		Indeno[1,2,3-cd]pyrene	0.34	0.61	0.34
		Phenanthrene	0.79	NS	0.34
		Pyrene	0.81	1 900	0.34
0333-96-0145	0–0.5	Benzo[a]pyrene	0.12 (J)	0.061	0.34
		Benzo[b]fluoranthene	0.22 (J)	0.61	0.34
		Benzo[g,h,i]perylene	0.11 (J)	NS	0.34
		Chrysene	0.14 (J)	61	0.34
		Di-n-butylphthalate	0.079 (J)	6 500	0.34
		Fluoranthene	0.17 (J)	2 600	0.34
		Indeno[1,2,3-cd]pyrene	0.22 (J)	0.61	0.34
		Phenanthrene	0.13 (J)	NS	0.34
		Pyrene	0.24 (J)	1 900	0.34
0333-96-0146	0–0.5	Benzo[a]anthracene	0.12 (J)	0.61	0.34
		Benzo[a]pyrene	0.1 (J)	0.061	0.34
		Chrysene	0.13 (J)	61	0.34
		Fluoranthene	0.13 (J)	2 600	0.34
		Indeno[1,2,3-cd]pyrene	0.21 (J)	0.61	0.34
		Pyrene	0.2 (J)	1 900	0.34

TABLE 5.10.7-1 (continued)

DETECTED ORGANIC CHEMICALS FOR PRS 33-017

SAMPLE ID	DEPTH (ft)	ANALYTE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)
0333-96-0147	0–0.5	Benzo[a]anthracene	0.2 (J)	0.61	0.33
		Benzo[a]pyrene	0.2 (J)	0.061	0.33
		Benzo[g,h,i]perylene	0.11 (J)	NS	0.33
		Chrysene	0.23 (J)	61	0.33
		Di-n-butylphthalate	0.034 (J)	6 500	0.33
		Fluoranthene	0.4	2 600	0.33
		Indeno[1,2,3-cd]pyrene	0.23 (J)	0.61	0.33
		Phenanthrene	0.14 (J)	NS	0.33
		Pyrene	0.38	1 900	0.33

a. J = Estimated value. The analyte was detected above the detection limit but below the estimated quantitation limit.

PCBs were detected in seven samples located east of shop TA-33-39. However, the two drainage samples, 0333-96-0157 and 0333-96-0161, contained only Aroclor-1260™. This contamination is attributed to PRS C-33-001, a power transformer location near laboratory TA-33-114, from which runoff enters the PRS 33-017 drainage channel. In addition, low levels of Aroclor 1254™ were found in two of three samples during the 1993 sampling campaign in overlapping PRS 33-012(a). All PCBs found in this area are listed in Table 5.10.7-2. The PCB analytical suite contains seven Aroclors; only 1254 and 1260 were detected in any sampling campaign.

During the 1996 sampling campaign, PCB contamination was discovered in PRS C-33-001, a transformer site near TA-33-114. The same PCB, Aroclor 1260™, was found in the drainage from the transformer that overlaps PRS 33-017. To assure consistency and efficiency in the investigation and cleanup of PCBs in this area, LANL proposes to address all PCBs in the cleanup of PRS C-33-001.

5.10.8 Risk-Based Screening Assessment

An MCE performed for noncarcinogenic contaminants, with a result of 0.1, indicates that these are not present at levels of concern and need not be carried forward in the screening process (Table 5.10.8-1). Benzo[g,h,i]perylene, 2-methylnapthalene, and phenanthrene were not included in the calculation because they have no SAL. (See discussion in Section 5.0 of this report.) .

TABLE 5.10.7-2

PCBs FOUND ABOVE REPORTING LIMITS AT PRS 33-017

SAMPLE ID	DEPTH (ft)	PCB	RESULT (mg/kg)	SAL[a] (mg/kg)	EQL (mg/kg)
AAA2032	0–0.5	Aroclor-1254	2.3	1	0.036
AAA2033	0–0.5	Aroclor-1254	0.034 (U) [b]	1	0.036
AAA2034	0–0.5	Aroclor-1254	0.25	1	0.036
0333-96-0149	0–0.5	Aroclor-1254	0.12	1	0.035
		Aroclor-1260	0.13	1	0.035
0333-96-0151	0–0.5	Aroclor-1254	0.083	1	0.034
		Aroclor-1260	0.099	1	0.034
0333-96-0152	0–0.5	Aroclor-1254	0.18	1	0.038
		Aroclor-1260	0.29	1	0.038
0333-96-0157[c]	0–0.5	Aroclor-1260	5.5	1	0.038
0333-96-0159	0–0.5	Aroclor-1254	1.4	1	0.21
		Aroclor-1260	0.87	1	0.21
0333-96-0160	0–0.5	Aroclor-1254	0.85	1	0.035
		Aroclor-1260	0.92	1	0.035
0333-96-0161	0–0.5	Aroclor-1260	3.7	1	0.038

a. PCB cleanup level
b. U = Undetected—value given is the detection limit
c. Drainage sample with PCBs from overlapping PRS C-33-001

TABLE 5.10.8-1

MCE FOR NONCARCINOGENIC EFFECTS AT PRS 33-017

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
Acenaphthene	33-1595	0333-96-0140	1.3	2200	0.004
Anthracene	33-1595	0333-96-0140	2	18 000	0.0001
Benzoic Acid	33-1588	0333-96-0133	0.22 (J)	100 000	0.000002
Bis(2-ethylhexyl)phthalate	33-1087	AAA2032	1.3	32	0.04
Chrysene	33-1595	0333-96-0140	2.5	61	0.04
Dibenzofuran	33-1595	0333-96-0140	0.43	250	0.002
Di-n-butylphthalate	33-1589	0333-96-0134	0.26	6 500	0.00005
Fluoranthene	33-1595	0333-96-0140	5.8	2600	0.002
Fluorene	33-1595	0333-96-0140	0.94	2300	0.0004
Naphthalene	33-1595	0333-96-0140	0.51	1000	0.0005
				Total	0.1

Carcinogenic PAHs were detected above SALs in 12 of 18 samples and will be carried forward in the screening process (Table 5.10.8-2).

TABLE 5.10.8-2

PRS 33-017 CARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALs

SAMPLE ID	LOCATION ID	DEPTH (ft)	BENZO[a] PYRENE (mg/kg)	BENZO[a] ANTHRA-CENE (mg/kg)	BENZO[b] FLUOR-ANTHENE (mg/kg)	DIBENZO[a,h]ANTHRACENE (mg/kg)	IDENO [1,2,3-cd] PYRENE (mg/kg)
SAL	N/A[a]	N/A	0.061	0.61	0.61	0.061	0.61
PRG[b]	N/A	N/A	0.26	2.6	2.6	0.26	2.6
0333-96-0130	33-1585	0–0.5	0.78	0.84	0.99	0.33(U)[c]	0.28(J)[d]
0333-96-0131	33-1586	0–0.5	0.25 (J)	0.54	0.43	0.34(U)	0.1(J)
0333-96-0133	33-1588	0–0.5	1.7 (UJ)	1.4	2.2 (UJ)	0.34(U)	0.71
0333-96-0134	33-1589	0–0.5	0.38	0.63	0.7	0.37(U)	0.33(U)
0333-96-0138	33-1593	0–0.5	1.1	1.2	1.4	0.18 (J)	0.6
0333-96-0139	33-1594	0–0.5	0.074 (J)	0.84(J)	0.17(J)	0.21(J)	0.35(U)
0333-96-0140	33-1595	0–0.5	2.4	3.5	2.7	0.36(J)	1
0333-96-0141	33-1596	0–0.5	0.55	0.6	0.66	0.33(U)	0.37
0333-96-0143	33-1598	0–0.5	0.41	0.44	0.49	0.34(U)	0.34
0333-96-0145	33-1600	0–0.5	0.12 (J)	0.33(U)	0.22(J)	0.34(U)	0.22(J)
0333-96-0146	33-1601	0–0.5	0.1 (J)	0.12(J)	0.33(U)	0.34(U)	0.21(J)
0333-96-0147	33-1602	0–0.5	0.2 (J)	0.2(J)	0.33(U)	0.33(U)	0.23(J)

a. N/A = Not Applicable
b. PRG = Preliminary Remediation Goal for industrial sites (EPA 1996, 1307)
c. U = Undetected—value listed is the detection limit of the analytical instrument
d. J = Estimated value—the analyte was detected above the detection limit but below the estimated quantitation limit

Low levels of the PCBs Aroclor-1254™ and Aroclor-1260™ were detected in the five non-drainage samples. LANL proposes that a PCB cleanup be performed in this area as part of a different PRS. (See Section 5.10.11 of this report.)

5.10.9 Human-Health Risk Assessment

PAHs identified in the screening assessment included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene. Due to the low concentrations of these compounds, a quantitative human-health risk assessment was not performed for samples collected in 1996 at PRS 33-017. However, quantitative human-health risk assessment was performed for samples collected in 1993 (Environmental Restoration Project 1995, 1265). The maximum concentration of PAHs detected above SALs in the 1993 samples are: benzo[a]pyrene, 7.5 mg/kg; benzo[b]fluoranthene, 9.8; benzo[k]fluoranthene, 7.1; and ideno[1,2,3-cd]pyrene, 4.2. Results of the risk assessment show that the estimated

risk to construction workers is 2.7 E-07 for the mean and 5.6 E-07 at the 95% UCL. Residential risk is 3.1 E-06 for the mean and 2.1 E-05 at the 95% UCL. These calculations are included in Attachment 9 of this report.

The maximum PAH concentration in the 1996 sampling campaign at this PRS was 3 mg/kg of benzo(a)anthracene. Benzo(a)pyrene was detected at a maximum concentration of 2.4 mg/kg. Most PAH concentrations were less than 1 mg/kg. The presence of these PAHs was expected because they are found in asphalt and are also products of incomplete combustion from motor vehicles. This PRS receives runoff from paving and drains from the asphalt roof of TA-33-39. Based on the risk calculations performed for 1993 data, in which PAH concentrations were higher, the presence of PAHs at these levels in surface soils does not indicate a significant contaminant release scenario or potential human health concern. At an industrial facility, using industrial cleanup levels rather than residential SAL comparisons, the shorter exposure duration and smaller exposure frequency associated with industrial land use would reduce the possibility of adverse health impacts from soil exposure. In addition, children and infants are excluded from the exposure scenario. In light of the industrial scenario, additional evaluation of PAHs for human-health risk will not be pursued at this PRS, and PAHs are eliminated as COPCs.

PCBs were found above the cleanup level of 1 mg/kg at two locations outside of the drainage receiving runoff from PRS C-33-001. LANL proposes that PCBs be addressed in conjunction with an expected cleanup of PRS 33-012(a). (See Section 5.10.11 of this report.)

5.10.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at these sites will be deferred until the sites can be assessed as part of the ecological exposure unit methodology currently being developed.

5.10.11 Conclusion and Recommendation

Sampling was performed at locations known or suspected of heavy vehicle use or actual vehicle maintenance. As expected, PAHs were detected in this area. However, levels were not elevated beyond those found at many areas at LANL where exposure to asphalt has released low levels of PAHs to nearby soils. Because PAH concentrations are low and found in areas such as heavily-vegetated bank slopes and on gravel roadways, and because the site will remain an industrial area, risk levels at PRS 33-017 are considered low.

Two samples contained Aroclor-1254™ above the industrial cleanup level of 1 mg/kg. Distribution of those Aroclors indicated that the probable source of contamination is a storage area adjacent to shop TA-33-39. The area is designated PRS 33-012(a), which was proposed for NFA in the January 1995 RFI Report for TA-33 (LANL 1995, 1212). At that time, the cleanup level for PCBs was 10 mg/kg. Because the cleanup level is now 1 mg/kg, and low levels of Aroclor 1254™ were found on the slope below the shop, LANL proposed to withdraw the NFA proposal. Further investigation of PCBs in the area will be conducted as an assessment of PRS 33-012(a).

The source of Aroclor-1260™ found in the drainage at the north end of PRS 33-017 is Area of Concern C-33-001, which is a transformer located upslope from the 33-017 area. A previous transformer is known to have contained high concentrations of PCB. PCB contamination will be further investigated as part of the assessment of that PRS. Straw bales have been put in the main drainage below Main Site to prevent contaminant runoff. A voluntary corrective action is scheduled for FY 1999.

PRS 33-017 is proposed for NFA for human health based on Criterion 5 because it has been investigated, evaluated, and shown to prevent a minimum risk to human health. LANL proposes that PCB contamination be addressed in one campaign at these overlapping PRSs under the auspices of PRSs 33-012(a) and C-33-001.

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APPENDIX A ANALYTICAL SUITES

Results of analyses can be found in the Facility for Information Management and Display (FIMAD). Hard copies of supporting information will be provided upon request.

Chemicals that are reported by analytical laboratories as not detected have not been included in the tables of this RFI report. Nonetheless, undetected analytes are often part of the decision-making process and it is important to note that these chemicals were analyzed for. This appendix lists the target analytes in each analytical suite included in the tables of Section 5.

Inorganic Suite

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

Volatile Organic Compound (VOC) Suite

Acetone
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
n-Butylbenzene
sec-Butylbenzene
tert-Butylbenzene
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
2-Chlorotoluene
4-Chlorotoluene
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
Dibromomethane
Dibromochloromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethylbenzene
Hexachlorobutadiene
2-Hexanone
Iodomethane
Isopropylbenzene
p-Isopropyltoluene
Methyl iodide
4-Methyl-2-pentanone
Methylene chloride
Naphthalene
n-Propylbenzene
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2,-Tetrachloroethane
Tetrachloroethene
Toluene
Trichlorotrifluoroethane
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
1,2,3-Trichloropropane
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
Vinyl chloride
o,m-Xylene
p-Xylene

Semivolatile Organic Compound (SVOC) Suite

Acenaphthene
Acenaphthylene
Aniline
Anthracene
Azobenzene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Benzoic acid
Benzyl alcohol
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenylphenyl ether
Butylbenzylphthalate
Carbazole
4-Chloroaniline
4-Chloro-3-methylphenol
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenylphenyl ether
Chrysene
Dibenzo(a,h)anthracene
Dibenzofuran
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
2,4-Dimethylphenol
2,4-Dinitrophenol
4,6-Dinitro-2-methylphenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol
4-Methylphenol
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitroso-di-n-propylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
Pyridine
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

Pesticide and Polychlorinated Biphenyl Suites

Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

Radiological Suite

Plutonium-238
Plutonium-239/240
Uranium-234
Uranium-235
Uranium-238
Tritium

High Explosives Suite

2-Amino-4,6-DNT
4-Amino-2,6-DNT
1,3-Dinitrobenzene (1,3-DNB)
2,4-Dinitrotoluene (2,4-DNT)
2,6-Dinitrotoluene (2,6-DNT)
HMX
Nitrobenzene (NB)
o-Nitrotoluene (2-NT)
m-Nitrotoluene (3-NT)
p-Nitrotoluene (4-NT)
RDX
Tetryl
1,3,5-Trinitrobenzene (1,3,5-TNB)
2,4,6-Trinitrotoluene (2,4,6-TNT)

APPENDIX B DATA QUALITY EVALUATION TABLES

The following tables summarize the results of quality assurance/quality control (QA/QC) data validation for all analytical results used to support recommendations in this report. The tables list the request number associated with each sample delivery group submitted for analyses. The request numbers are referenced in Section 5 of this report in the table entitled *Summary of Samples Taken* provided with the description of the field investigation for each PRS.

Summaries are included for inorganic analyses (Table B-1), radiological analyses (Table B-2), volatile organic analyses (Table B-3), semivolatile organic analyses (Table B-4); PCB analyses (Table B-5), and high explosives analyses (Table B-6).

TABLE B-1

DATA QUALITY EVALUATION FOR INORGANIC ANALYSES AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
Inorganics	2111	Because antimony recovery from the spiked sample was 70.5%, all results were qualified as estimated undetected. Many elements were found in the blank. All results less than 5 times the blank were qualified as undetected. Interference check samples and duplicates were in control. Antimony is not identified as a potential contaminant at PRS 33-008(a). The remaining elements in this data package are accepted as relevant for the purposes of this RFI.
Inorganics	2117	Recoveries of 10 elements from the spiked sample were below 75%, all results were qualified as estimated with a low bias. Because no antimony was recovered from the spiked sample, all results were rejected. Many elements were found in the blank. All results less than 5 times the blank and were qualified as undetected. Nine duplicate results were beyond relative percent deviations, generally attributed to the inhomogeneous nature of the samples. Interference check samples were in control. Antimony is not identified as a potential contaminant at PRS 33-008(b). The remaining elements in this data package are accepted as relevant for the purposes of this RFI.
Inorganics	2135	Because antimony recovery from the spiked sample was 70.7%, all results were qualified as estimated undetected or estimated with a low bias. Many elements were found in the blank. All results less than 5 times the blank were qualified as undetected. Interference check samples were in control except for nickel, which did not agree within 10% of the undiluted sample. This anomaly was ascribed to the low concentration (near detection limit) of nickel in the original sample. Duplicate analyses were in control except for lead, which differed by 21%. This anomaly is ascribed to sample inhomogeneity. Because antimony is not identified as a potential contaminant at PRS 33-008(a), and the other anomalies are not severe, this data package is accepted as relevant for the purposes of this RFI.
Inorganics	2144	All method blanks, interference check samples, and spike recoveries were in control with the exception of manganese, for which spike recovery was high. All manganese results were qualified as estimated high. No other results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Inorganics	2177	Because antimony had no recovery from the spiked sample, all results were rejected. Blanks, interference check samples and duplicates were in control. Antimony is not identified as a potential contaminant at MDA-K. The remaining elements in this data package are accepted as relevant for the purposes of this RFI.

TABLE B-1(continued)

DATA QUALITY EVALUATION FOR INORGANIC ANALYSES AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
Inorganics	2189	Because antimony had less than 30% recovery from the spiked sample, all results were rejected. Thallium spike recovery was low and results were qualified as estimated undetected. Out-of-control aluminum duplicates are ascribed to sample inhomogeneity . Blanks and interference check samples were in control. Antimony and thallium are not identified as potential contaminants at MDA-K. The remaining elements in this data package are accepted as relevant for the purposes of this RFI.
Inorganics	2365	All method blanks and interference check samples were in control. Spike recoveries were out-of-control low for antimony and selenium and out-of-control high for barium and zinc. Because these analytes are not considered contaminants of concern at PRS 33-011(d), the results are accepted as reasonable estimates. No other results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Inorganics	2376	Arsenic, cobalt, nickel, thallium, and zinc were detected in the blanks. Sample results less than five times the worst-case detection were qualified as undetected. Arsenic, manganese, and selenium spikes were out of control low. Sample results were qualified as estimated undetected or estimated low. Duplicate results for aluminum were beyond control limits. All other analytical parameters were in control. This data package is accepted as relevant for the purposes of this RFI.
Inorganics	2423	All method blanks and interference check samples were in control. Spike recoveries were out-of-control low for antimony, selenium, and zinc. Duplicate results for aluminum were beyond control limits .Because these analytes are not considered contaminants of concern at PRS 33-013, the results are accepted as reasonable estimates. No other results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Inorganics	2758	Mercury was found in the blank at a concentration between the instrument detection limit and the estimated detection limit. The matrix spike and duplicate QC analysis was performed on a sample from a different request number. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.

TABLE B-2

DATA QUALITY EVALUATION FOR RADIOCHEMISTRY ANALYSIS AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
Total uranium	2112	Blank, matrix spike, and duplicate analyses were in control for uranium. No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Total uranium	2118	Blank, matrix spike, and duplicate analyses were in control for uranium. No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Total uranium	2136	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Tritium, uranium	2178	Matrix spike and duplicate analyses were in control for all analytes. Tritium found in blanks was attributed to high tritium in the samples. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Uranium, plutonium	2190	Matrix spike and duplicate analyses were in control for uranium. Tritium duplicates differed by 2.16%. Plutonium matrix spike were reported from another request. Plutonium results were reported below minimum detection limit and were qualified as undetected. No other anomalies were noted. This data package is accepted as relevant for the purposes of this RFI.
Tritium	2195	Matrix spike, blanks, and duplicate analyses were in control for all analytes. Estimated quantitation limit for tritium was greater than the minimum detection limit due to high tritium activities in the samples. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Tritium	2232	Blanks, and duplicate analyses were in control for all analytes. No matrix spike was analyzed. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Isotopic uranium	2366	The reporting limit for the three isotopes was raised due to blank contamination. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Total uranium	2366	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Isotopic uranium	2377	The reporting limit for the three isotopes was raised due to blank contamination. No interference check sample was provided for uranium-235 and -238. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Total uranium	2377	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Total uranium	2424	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
Total uranium	2759	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.

TABLE B-3

DATA QUALITY EVALUATION FOR VOLATILE ORGANICS AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
VOCs	2176	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
VOCs	2188	No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.

TABLE B-4

DATA QUALITY EVALUATION FOR SEMI-VOLATILE ORGANICS AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
SVOCs	2110	Because these samples were judged to have possible interferences, they were processed by EPA Method 3640 using a cleanup technique. Although internal standards were in control, five samples had no surrogates recoveries; a sixth had low recoveries. These were reextracted and reanalyzed up to three times. The reextracted samples missed holding times. All results were qualified as rejected or undetected. Data package from this package is being reported with qualifiers.
SVOCs	2116	Holding times were met. Surrogate recoveries were in control. Bis(2-ethylhexyl)phthalate and di-n-butylphthalate were detected in the blank. All results were qualified as undetected in the samples. The detection limit for 4-nitroaniline was above the contract required estimated quantitation limit. Neither of these compounds are of concern at 33-008(b). No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
SVOCs	2134	Holding times were met. Surrogate recoveries were in control. All internal stand recoveries were in control. The samples were extracted three times. Results from the first two extractions were not reported because of problems with cleanup and surrogate and spike recoveries. Results from the third extractions were reported. For the third extraction, insufficient sample remained to perform matrix spike and matrix spike duplicate analyses, so blanks were spiked instead. One spike recovery was slightly high (110% vs. the limit of 109%). Three samples produced dark colored extracts that disabled the instruments. These samples were reanalyzed at a 1:5 dilution. Because no results were qualified by data validation, this data package is accepted as relevant for the purposes of this RFI.
SVOCs	2176	Bis(2-ethylhexyl)phthalate was detected in the blank. All results were qualified as undetected in the samples. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
SVOCs	2188	Bis(2-ethylhexyl)phthalate was detected in the blank. All results were qualified as undetected in the samples. The detection limit for 4-nitroaniline was above the contract required estimated quantitation limit. Neither of these compounds are of concern at MDA-K. No other anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
SVOCs	2339	Internal standard recovery was low in five samples, their reruns, duplicates, matrix spikes, or matrix spike duplicates. Various analytes were qualified as noted in the tables in Section 5.6 for PRS 33-017. Surrogates recoveries were in control except in sample 0333-96-0142, in which the surrogates were diluted. Bis(2-ethylhexylphthalate was found in the blank and was qualified as undetected in relevant samples. All other parameters were in control. Because most SVOCs detected were derived from asphalt, these data are considered acceptable for the purposes of this report.

TABLE B-5

DATA QUALITY EVALUATION FOR PCBs AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
PCBs	2143	Extraction times were met. All method blanks and surrogate recoveries were in control. Retention time for all samples were in control. No data were qualified. This data package is accepted as relevant for the purposes of this RFI.
PCBs	2364	Extraction times were met. All method blanks and surrogates were in control. Retention time windows for surrogates were not provided by the analytical laboratory, and a retention time shift of 0.4 minute was noted for 2,4,5,6-tetrachloro-m-xylene. Although all sample results were qualified, results were accepted by the field unit decision team because all surrogate recoveries were in control and retention times for surrogate decachlorobiphenyl were not compromised. This data package is accepted as relevant for the purposes of this RFI.
PCBs	2367	Because no retention time window was given for the surrogates, the results were qualified with professional judgment required. Matrix spikes and matrix spike duplicates could not be quantified because the spiked sample had relatively high levels of Aroclor 1248 and 1260. Because surrogate recovery was in control and ranged between 73% and 107%, results were accepted as valid.
PCBs	2393	Extraction times were met. All method blanks and surrogates were in control, although surrogates in four of eight samples were diluted. Retention times for all samples were in control. No data were qualified. This data package is accepted as relevant for the purposes of this RFI.

TABLE B-6

DATA QUALITY EVALUATION FOR HIGH EXPLOSIVES AT TA-33

SUITE	REQUEST NUMBER	COMMENTS
High explosives	2113	Blanks, laboratory control samples, and surrogates were in control. Holding times were met. No anomalies were noted. No results were qualified. This data package is accepted as relevant for the purposes of this RFI.
High explosives	2401	Extraction times were met. All method blanks and surrogate recoveries were in control. No data were qualified. This data package is accepted as relevant for the purposes of this RFI.

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APPENDIX C RISK ASSESSMENT CALCULATIONS FOR PRS 33-002(b)

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RESRAD, Version 5.61     T½ Limit = 0.5 year        09/18/97  09:18    Page   1
 Summary : 33-002(b) Sump Dose                                 File: 33002B.DAT

                           Table of Contents
                           -----------------
      Part I: Mixture Sums and Single Radionuclide Guidelines
      =======================================================

 Dose Conversion Factor (and Related) Parameter Summary ...    2
 Site-Specific Parameter Summary .........................    3
 Summary of Pathway Selections ...........................    6
 Contaminated Zone and Total Dose Summary ................    7
 Total Dose Components
      Time = 0.000E+00 ...................................    8
      Time = 1.000E-01 ...................................    9
      Time = 1.000E+00 ...................................   10
      Time = 1.000E+01 ...................................   11
      Time = 1.000E+02 ...................................   12
      Time = 1.000E+03 ...................................   13
 Dose/Source Ratios Summed Over All Pathways .............   14
 Single Radionuclide Soil Guidelines .....................   14
 Dose Per Nuclide Summed Over All Pathways ...............   15
 Soil Concentration Per Nuclide ..........................   15
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RESRAD, Version 5.61    T½ Limit = 0.5 year       09/18/97  09:18    Page   2
 Summary : 33-002(b) Sump Dose                                  File: 33002B.DAT

                         Dose Conversion Factor (and Related) Parameter Summary
                                           File: DOSFAC.BIN
0     |                                                         | Current   |           | Parameter
 Menu |                        Parameter                        |  Value    |  Default  |   Name
 -----+---------------------------------------------------------+-----------+-----------+--------------
 B-1  | Dose conversion factors for inhalation, mrem/pCi:       |           |           |
 B-1  | H-3                                                     | 6.400E-08 | 6.400E-08 | DCF2( 1)
      |                                                         |           |           |
 D-1  | Dose conversion factors for ingestion, mrem/pCi:        |           |           |
 D-1  | H-3                                                     | 6.400E-08 | 6.400E-08 | DCF3( 1)
      |                                                         |           |           |
 D-34 | Food transfer factors:                                  |           |           |
 D-34 | H-3      , plant/soil concentration ratio, dimensionless | 4.800E+00 | 4.800E+00 | RTF( 1,1)
 D-34 | H-3      , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.200E-02 | 1.200E-02 | RTF( 1,2)
 D-34 | H-3      , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-02 | 1.000E-02 | RTF( 1,3)
      |                                                         |           |           |
 D-5  | Bioaccumulation factors, fresh water, L/kg:             |           |           |
 D-5  | H-3      , fish                                         | 1.000E+00 | 1.000E+00 | BIOFAC( 1,1)
 D-5  | H-3      , crustacea and mollusks                       | 1.000E+00 | 1.000E+00 | BIOFAC( 1,2)
 ==========================================================================================
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RESRAD, Version 5.61     T' Limit = 0.5 year          09/18/97  09:18    Page   3
 Summary : 33-002(b) Sump Dose                                    File: 33002B.DAT

                                            Site-Specific Parameter Summary
0      |                                                  |   User    |            |        Used by RESRAD              | Parameter
 Menu  |                 Parameter                        |   Input   |  Default   | (If different from user input)  |   Name
-------+--------------------------------------------------+-----------+------------+---------------------------------+------------
 R011  | Area of contaminated zone (m**2)                 | 9.000E+00 | 1.000E+04  |              ---                | AREA
 R011  | Thickness of contaminated zone (m)               | 8.000E+00 | 2.000E+00  |              ---                | THICK0
 R011  | Length parallel to aquifer flow (m)              | not used  | 1.000E+02  |              ---                | LCZPAQ
 R011  | Basic radiation dose limit (mrem/yr)             | 3.000E+01 | 3.000E+01  |              ---                | BRDL
 R011  | Time since placement of material (yr)            | 0.000E+00 | 0.000E+00  |              ---                | TI
 R011  | Times for calculations (yr)                      | 1.000E-01 | 1.000E+00  |              ---                | T( 2)
 R011  | Times for calculations (yr)                      | 1.000E+00 | 3.000E+00  |              ---                | T( 3)
 R011  | Times for calculations (yr)                      | 1.000E+01 | 1.000E+01  |              ---                | T( 4)
 R011  | Times for calculations (yr)                      | 1.000E+02 | 3.000E+01  |              ---                | T( 5)
 R011  | Times for calculations (yr)                      | 1.000E+03 | 1.000E+02  |              ---                | T( 6)
 R011  | Times for calculations (yr)                      | not used  | 3.000E+02  |              ---                | T( 7)
 R011  | Times for calculations (yr)                      | not used  | 1.000E+03  |              ---                | T( 8)
 R011  | Times for calculations (yr)                      | not used  | 0.000E+00  |              ---                | T( 9)
 R011  | Times for calculations (yr)                      | not used  | 0.000E+00  |              ---                | T(10)
       |                                                  |           |            |                                 |
 R012  | Initial principal radionuclide (pCi/g):  H-3     | 1.010E+05 | 0.000E+00  |              ---                | S1( 1)
 R012  | Concentration in groundwater   (pCi/L):  H-3     | not used  | 0.000E+00  |              ---                | W1( 1)
       |                                                  |           |            |                                 |
 R013  | Cover depth (m)                                  | 0.000E+00 | 0.000E+00  |              ---                | COVER0
 R013  | Density of cover material (g/cm**3)              | not used  | 1.500E+00  |              ---                | DENSCV
 R013  | Cover depth erosion rate (m/yr)                  | not used  | 1.000E-03  |              ---                | VCV
 R013  | Density of contaminated zone (g/cm**3)           | 1.600E+00 | 1.500E+00  |              ---                | DENSCZ
 R013  | Contaminated zone erosion rate (m/yr)            | 1.000E-03 | 1.000E-03  |              ---                | VCZ
 R013  | Contaminated zone total porosity                 | 4.000E-01 | 4.000E-01  |              ---                | TPCZ
 R013  | Contaminated zone effective porosity             | 2.000E-01 | 2.000E-01  |              ---                | EPCZ
 R013  | Contaminated zone hydraulic conductivity (m/yr)  | 4.400E+02 | 1.000E+01  |              ---                | HCCZ
 R013  | Contaminated zone b parameter                    | 4.050E+00 | 5.300E+00  |              ---                | BCZ
 R013  | Humidity in air (g/cm**3)                        | 8.000E+00 | 8.000E+00  |              ---                | HUMID
 R013  | Evapotranspiration coefficient                   | 9.990E-01 | 5.000E-01  |              ---                | EVAPTR
 R013  | Precipitation (m/yr)                             | 4.800E-01 | 1.000E+00  |              ---                | PRECIP
 R013  | Irrigation (m/yr)                                | 0.000E+00 | 2.000E-01  |              ---                | RI
 R013  | Irrigation mode                                  | overhead  | overhead   |              ---                | IDITCH
 R013  | Runoff coefficient                               | 5.200E-01 | 2.000E-01  |              ---                | RUNOFF
 R013  | Watershed area for nearby stream or pond (m**2)  | not used  | 1.000E+06  |              ---                | WAREA
 R013  | Accuracy for water/soil computations             | not used  | 1.000E-03  |   Zero shows Simpson's rule.    | EPS
       |                                                  |           |            |                                 |
 R014  | Density of saturated zone (g/cm**3)              | 1.500E+00 | 1.500E+00  |              ---                | DENSAQ
 R014  | Saturated zone total porosity                    | 4.000E-01 | 4.000E-01  |              ---                | TPSZ
 R014  | Saturated zone effective porosity                | 2.000E-01 | 2.000E-01  |              ---                | EPSZ
 R014  | Saturated zone hydraulic conductivity (m/yr)     | 1.000E+02 | 1.000E+02  |              ---                | HCSZ
 R014  | Saturated zone hydraulic gradient                | 2.000E-02 | 2.000E-02  |              ---                | HGWT
 R014  | Saturated zone b parameter                       | 5.300E+00 | 5.300E+00  |              ---                | BSZ
 R014  | Water table drop rate (m/yr)                     | 1.000E-03 | 1.000E-03  |              ---                | VWT
 R014  | Well pump intake depth (m below water table)     | 1.000E+01 | 1.000E+01  |              ---                | DWIBWT
 R014  | Model: Nondispersion (ND) or Mass-Balance (MB)   | ND        | ND         |              ---                | MODEL
 R014  | Well pumping rate (m**3/yr)                      | 2.500E+02 | 2.500E+02  |              ---                | UW
       |                                                  |           |            |                                 |
 R015  | Number of unsaturated zone strata                | not used  | 1          |              ---                | NS
```

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RESRAD, Version 5.61     T' Limit = 0.5 year        09/18/97  09:18    Page   4
 Summary : 33-002(b) Sump Dose                                       File: 33002B.DAT

                                     Site-Specific Parameter Summary (continued)
0      |                                                  |   User     |            |        Used by RESRAD            |  Parameter
 Menu  |                  Parameter                       |   Input    |  Default   | (If different from user input)   |    Name
=======+==================================================+============+============+==================================+================
 R015  | Unsat. zone 1, thickness (m)                     |  not used  | 4.000E+00  |               ---                | H(1)
 R015  | Unsat. zone 1, soil density (g/cm**3)            |  not used  | 1.500E+00  |               ---                | DENSUZ(1)
 R015  | Unsat. zone 1, total porosity                    |  not used  | 4.000E-01  |               ---                | TPUZ(1)
 R015  | Unsat. zone 1, effective porosity                |  not used  | 2.000E-01  |               ---                | EPUZ(1)
 R015  | Unsat. zone 1, soil-specific b parameter         |  not used  | 5.300E+00  |               ---                | BUZ(1)
 R015  | Unsat. zone 1, hydraulic conductivity (m/yr)     |  not used  | 1.000E+01  |               ---                | HCUZ(1)
       |                                                  |            |            |                                  |
 R016  | Distribution coefficients for H-3                |            |            |                                  |
 R016  |   Contaminated zone (cm**3/g)                    |  0.000E+00 | 0.000E+00  |               ---                | DCNUCC( 1)
 R016  |   Unsaturated zone 1 (cm**3/g)                   |  not used  | 0.000E+00  |               ---                | DCNUCU( 1,1)
 R016  |   Saturated zone (cm**3/g)                       |  not used  | 0.000E+00  |               ---                | DCNUCS( 1)
 R016  |   Leach rate (/yr)                               |  0.000E+00 | 0.000E+00  |            2.650E-04             | ALEACH( 1)
 R016  |   Solubility constant                            |  0.000E+00 | 0.000E+00  |            not used              | SOLUBK( 1)
       |                                                  |            |            |                                  |
 R017  | Inhalation rate (m**3/yr)                        |  1.490E+04 | 8.400E+03  |               ---                | INHALR
 R017  | Mass loading for inhalation (g/m**3)             |  9.000E-05 | 2.000E-04  |               ---                | MLINH
 R017  | Dilution length for airborne dust, inhalation (m)|  3.000E+00 | 3.000E+00  |               ---                | LM
 R017  | Exposure duration                                |  2.500E+01 | 3.000E+01  |               ---                | ED
 R017  | Shielding factor, inhalation                     |  4.000E-01 | 4.000E-01  |               ---                | SHF3
 R017  | Shielding factor, external gamma                 |  not used  | 7.000E-01  |               ---                | SHF1
 R017  | Fraction of time spent indoors                   |  1.840E-01 | 5.000E-01  |               ---                | FIND
 R017  | Fraction of time spent outdoors (on site)        |  4.600E-02 | 2.500E-01  |               ---                | FOTD
 R017  | Shape factor flag, external gamma                |  not used  | 1.000E+00  |   1 shows circular AREA.         | FS
 R017  | Radii of shape factor array (used if FS = -1):   |            |            |                                  |
 R017  |   Outer annular radius (m), ring  1:             |  not used  | 5.000E+01  |               ---                | RAD_SHAPE( 1)
 R017  |   Outer annular radius (m), ring  2:             |  not used  | 7.071E+01  |               ---                | RAD_SHAPE( 2)
 R017  |   Outer annular radius (m), ring  3:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 3)
 R017  |   Outer annular radius (m), ring  4:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 4)
 R017  |   Outer annular radius (m), ring  5:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 5)
 R017  |   Outer annular radius (m), ring  6:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 6)
 R017  |   Outer annular radius (m), ring  7:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 7)
 R017  |   Outer annular radius (m), ring  8:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 8)
 R017  |   Outer annular radius (m), ring  9:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE( 9)
 R017  |   Outer annular radius (m), ring 10:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE(10)
 R017  |   Outer annular radius (m), ring 11:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE(11)
 R017  |   Outer annular radius (m), ring 12:             |  not used  | 0.000E+00  |               ---                | RAD_SHAPE(12)
       |                                                  |            |            |                                  |
 R017  | Fractions of annular areas within AREA:          |            |            |                                  |
 R017  |   Ring  1                                        |  not used  | 1.000E+00  |               ---                | FRACA( 1)
 R017  |   Ring  2                                        |  not used  | 2.732E-01  |               ---                | FRACA( 2)
 R017  |   Ring  3                                        |  not used  | 0.000E+00  |               ---                | FRACA( 3)
 R017  |   Ring  4                                        |  not used  | 0.000E+00  |               ---                | FRACA( 4)
 R017  |   Ring  5                                        |  not used  | 0.000E+00  |               ---                | FRACA( 5)
 R017  |   Ring  6                                        |  not used  | 0.000E+00  |               ---                | FRACA( 6)
 R017  |   Ring  7                                        |  not used  | 0.000E+00  |               ---                | FRACA( 7)
 R017  |   Ring  8                                        |  not used  | 0.000E+00  |               ---                | FRACA( 8)
 R017  |   Ring  9                                        |  not used  | 0.000E+00  |               ---                | FRACA( 9)
 R017  |   Ring 10                                        |  not used  | 0.000E+00  |               ---                | FRACA(10)
 R017  |   Ring 11                                        |  not used  | 0.000E+00  |               ---                | FRACA(11)
 R017  |   Ring 12                                        |  not used  | 0.000E+00  |               ---                | FRACA(12)
       |                                                  |            |            |                                  |
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RESRAD, Version 5.61    T½ Limit = 0.5 year       09/18/97  09:18   Page   5
 Summary : 33-002(b) Sump Dose                              File: 33002B.DAT

                                  Site-Specific Parameter Summary (continued)
 0    |                                                 | User      |            |      Used by RESRAD              | Parameter
 Menu |                    Parameter                    | Input     |  Default   | (If different from user input)   |   Name
======+=================================================+===========+============+==================================+=============
 R018 | Fruits, vegetables and grain consumption (kg/yr) | not used  | 1.600E+02  |               ---                | DIET(1)
 R018 | Leafy vegetable consumption (kg/yr)              | not used  | 1.400E+01  |               ---                | DIET(2)
 R018 | Milk consumption (L/yr)                          | not used  | 9.200E+01  |               ---                | DIET(3)
 R018 | Meat and poultry consumption (kg/yr)             | not used  | 6.300E+01  |               ---                | DIET(4)
 R018 | Fish consumption (kg/yr)                         | not used  | 5.400E+00  |               ---                | DIET(5)
 R018 | Other seafood consumption (kg/yr)                | not used  | 9.000E-01  |               ---                | DIET(6)
 R018 | Soil ingestion rate (g/yr)                       | 3.650E+01 | 3.650E+01  |               ---                | SOIL
 R018 | Drinking water intake (L/yr)                     | not used  | 5.100E+02  |               ---                | DWI
 R018 | Contamination fraction of drinking water         | not used  | 1.000E+00  |               ---                | FDW
 R018 | Contamination fraction of household water        | not used  | 1.000E+00  |               ---                | FHHW
 R018 | Contamination fraction of livestock water        | not used  | 1.000E+00  |               ---                | FLW
 R018 | Contamination fraction of irrigation water       | not used  | 1.000E+00  |               ---                | FIRW
 R018 | Contamination fraction of aquatic food           | not used  | 5.000E-01  |               ---                | FR9
 R018 | Contamination fraction of plant food             | not used  |-1          |               ---                | FPLANT
 R018 | Contamination fraction of meat                   | not used  |-1          |               ---                | FMEAT
 R018 | Contamination fraction of milk                   | not used  |-1          |               ---                | FMILK
      |                                                  |           |            |                                  |
 R019 | Livestock fodder intake for meat (kg/day)        | not used  | 6.800E+01  |               ---                | LFI5
 R019 | Livestock fodder intake for milk (kg/day)        | not used  | 5.500E+01  |               ---                | LFI6
 R019 | Livestock water intake for meat (L/day)          | not used  | 5.000E+01  |               ---                | LWI5
 R019 | Livestock water intake for milk (L/day)          | not used  | 1.600E+02  |               ---                | LWI6
 R019 | Livestock soil intake (kg/day)                   | not used  | 5.000E-01  |               ---                | LSI
 R019 | Mass loading for foliar deposition (g/m**3)      | not used  | 1.000E-04  |               ---                | MLFD
 R019 | Depth of soil mixing layer (m)                   | 1.500E-01 | 1.500E-01  |               ---                | DM
 R019 | Depth of roots (m)                               | not used  | 9.000E-01  |               ---                | DROOT
 R019 | Drinking water fraction from ground water        | 1.000E+00 | 1.000E+00  |               ---                | FGWDW
 R019 | Household water fraction from ground water       | not used  | 1.000E+00  |               ---                | FGWHH
 R019 | Livestock water fraction from ground water       | not used  | 1.000E+00  |               ---                | FGWLW
 R019 | Irrigation fraction from ground water            | not used  | 1.000E+00  |               ---                | FGWIR
      |                                                  |           |            |                                  |
 C14  | C-12 concentration in water (g/cm**3)            | not used  | 2.000E-05  |               ---                | C12WTR
 C14  | C-12 concentration in contaminated soil (g/g)    | not used  | 3.000E-02  |               ---                | C12CZ
 C14  | Fraction of vegetation carbon from soil          | not used  | 2.000E-02  |               ---                | CSOIL
 C14  | Fraction of vegetation carbon from air           | not used  | 9.800E-01  |               ---                | CAIR
 C14  | C-14 evasion layer thickness in soil (m)         | not used  | 3.000E-01  |               ---                | DMC
 C14  | C-14 evasion flux rate from soil (1/sec)         | not used  | 7.000E-07  |               ---                | EVSN
 C14  | C-12 evasion flux rate from soil (1/sec)         | not used  | 1.000E-10  |               ---                | REVSN
 C14  | Fraction of grain in beef cattle feed            | not used  | 8.000E-01  |               ---                | AVFG4
 C14  | Fraction of grain in milk cow feed               | not used  | 2.000E-01  |               ---                | AVFG5
      |                                                  |           |            |                                  |
 STOR | Storage times of contaminated foodstuffs (days): |           |            |                                  |
 STOR |   Fruits, non-leafy vegetables, and grain        | not used  | 1.400E+01  |               ---                | STOR_T(1)
 STOR |   Leafy vegetables                               | not used  | 1.000E+00  |               ---                | STOR_T(2)
 STOR |   Milk                                           | not used  | 1.000E+00  |               ---                | STOR_T(3)
 STOR |   Meat and poultry                               | not used  | 2.000E+01  |               ---                | STOR_T(4)
 STOR |   Fish                                           | not used  | 7.000E+00  |               ---                | STOR_T(5)
 STOR |   Crustacea and mollusks                         | not used  | 7.000E+00  |               ---                | STOR_T(6)
 STOR |   Well water                                     | not used  | 1.000E+00  |               ---                | STOR_T(7)
 STOR |   Surface water                                  | not used  | 1.000E+00  |               ---                | STOR_T(8)
 STOR |   Livestock fodder                               | not used  | 4.500E+01  |               ---                | STOR_T(9)
      |                                                  |           |            |                                  |
```

```
RESRAD, Version 5.61     T½ Limit = 0.5 year          09/18/97  09:18    Page   6
 Summary : 33-002(b) Sump Dose                                    File: 33002B.DAT

                                     Site-Specific Parameter Summary (continued)
0     |                                                 User   |           |        Used by RESRAD          | Parameter
 Menu |                    Parameter                    Input  |  Default  | (If different from user input) |   Name
======+=================================================+======+===========+================================+==============
 R021 | Thickness of building foundation (m)            | not used |  1.500E-01 |             ---                | FLOOR
 R021 | Bulk density of building foundation (g/cm**3)   | not used |  2.400E+00 |             ---                | DENSFL
 R021 | Total porosity of the cover material            | not used |  4.000E-01 |             ---                | TPCV
 R021 | Total porosity of the building foundation       | not used |  1.000E-01 |             ---                | TPFL
 R021 | Volumetric water content of the cover material  | not used |  5.000E-02 |             ---                | PH2OCV
 R021 | Volumetric water content of the foundation      | not used |  3.000E-02 |             ---                | PH2OFL
 R021 | Diffusion coefficient for radon gas (m/sec):    |          |            |                                |
 R021 |   in cover material                             | not used |  2.000E-06 |             ---                | DIFCV
 R021 |   in foundation material                        | not used |  3.000E-07 |             ---                | DIFFL
 R021 |   in contaminated zone soil                     | not used |  2.000E-06 |             ---                | DIFCZ
 R021 | Radon vertical dimension of mixing (m)          | not used |  2.000E+00 |             ---                | HMIX
 R021 | Average annual wind speed (m/sec)               | not used |  2.000E+00 |             ---                | WIND
 R021 | Average building air exchange rate (1/hr)       | not used |  5.000E-01 |             ---                | REXG
 R021 | Height of the building (room) (m)               | not used |  2.500E+00 |             ---                | HRM
 R021 | Building interior area factor                   | not used |  0.000E+00 |             ---                | FAI
 R021 | Building depth below ground surface (m)         | not used | -1.000E+00 |             ---                | DMFL
 R021 | Emanating power of Rn-222 gas                   | not used |  2.500E-01 |             ---                | EMANA(1)
 R021 | Emanating power of Rn-220 gas                   | not used |  1.500E-01 |             ---                | EMANA(2)
=========================================================================================================================


                  Summary of Pathway Selections

               Pathway             |  User Selection
===================================+=================
   1 -- external gamma             |   suppressed
   2 -- inhalation (w/o radon)     |     active
   3 -- plant ingestion            |   suppressed
   4 -- meat ingestion             |   suppressed
   5 -- milk ingestion             |   suppressed
   6 -- aquatic foods              |   suppressed
   7 -- drinking water             |   suppressed
   8 -- soil ingestion             |     active
   9 -- radon                      |   suppressed
=====================================================
```

```
RESRAD, Version 5.61     T' Limit = 0.5 year        09/18/97  09:18    Page  7
 Summary : 33-002(b) Sump Dose                                  File: 33002B.DAT

      Contaminated Zone Dimensions           Initial Soil Concentrations, pCi/g
      ----------------------------           ----------------------------------
        Area:       9.00 square meters               H-3        1.010E+05
   Thickness:       8.00 meters
 Cover Depth:       0.00 meters
0
                             Total Dose TDOSE(t), mrem/yr
                        Basic Radiation Dose Limit =  30 mrem/yr
    Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
    --------------------------------------------------------------------------
     t (years):  0.000E+00  1.000E-01  1.000E+00  1.000E+01  1.000E+02  1.000E+03
      TDOSE(t):  5.820E+00  5.636E+00  4.220E+00  2.328E-01  4.515E-14  0.000E+00
          M(t):  1.940E-01  1.879E-01  1.407E-01  7.761E-03  1.505E-15  0.000E+00
0Maximum TDOSE(t):  5.820E+00 mrem/yr   at t = 0.000E+00 years
```

```
RESRAD, Version 5.61     T' Limit = 0.5 year        09/18/97  09:18    Page   8
 Summary : 33-002(b) Sump Dose                                File: 33002B.DAT

                         Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                        As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0                                         Water Independent Pathways (Inhalation excludes radon)
0              Ground            Inhalation            Radon              Plant              Meat               Milk               Soil
 Radio-  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  5.820E+00 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.884E-04 0.0001
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  5.820E+00 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.884E-04 0.0001
0
                         Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                        As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0                                                     Water Dependent Pathways
0              Water               Fish              Radon              Plant              Meat               Milk          All Pathways*
 Radio-  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.820E+00 1.0000
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.820E+00 1.0000
0*Sum of all water independent and dependent pathways.
```

```
RESRAD, Version 5.61     T½ Limit = 0.5 year        09/18/97  09:18    Page   9
 Summary : 33-002(b) Sump Dose                                     File: 33002B.DAT

                       Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                     As mrem/yr and Fraction of Total Dose At t = 1.000E-01 years
0                                      Water Independent Pathways (Inhalation excludes radon)
0            Ground           Inhalation          Radon             Plant              Meat              Milk              Soil
 Radio-  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 -------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  5.635E+00 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.729E-04 0.0001
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  5.635E+00 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.729E-04 0.0001
0
                       Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                     As mrem/yr and Fraction of Total Dose At t = 1.000E-01 years
0                                               Water Dependent Pathways
0            Water              Fish              Radon             Plant              Meat              Milk          All Pathways*
 Radio-  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 -------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.636E+00 1.0000
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.636E+00 1.0000
0*Sum of all water independent and dependent pathways.
```

```
RESRAD, Version 5.61     T½ Limit = 0.5 year       09/18/97  09:10    Page  10
 Summary : 33-002(b) Sump Dose                                File: 33002B.DAT

                        Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                  As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground            Inhalation          Radon              Plant              Meat               Milk               Soil
 Radio-  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------
 Nuclide  mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  4.219E+00 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.541E-04 0.0001
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  4.219E+00 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.541E-04 0.0001
0
                        Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                  As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0                                            Water Dependent Pathways
0            Water               Fish              Radon              Plant              Meat               Milk          All Pathways*
 Radio-  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------  ----------------
 Nuclide  mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.    mrem/yr  fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.220E+00 1.0000
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.220E+00 1.0000
0*Sum of all water independent and dependent pathways.
```

```
RESRAD, Version 5.61     T' Limit = 0.5 year        09/18/97  09:18    Page  11
 Summary : 33-002(b) Sump Dose                                        File: 33002B.DAT

                                Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                            As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0                                               Water Independent Pathways (Inhalation excludes radon)
0                 Ground            Inhalation            Radon              Plant               Meat               Milk               Soil
 Radio-   ----------------- ----------------- ----------------- ----------------- ----------------- ----------------- -----------------
 Nuclide  mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.
 -------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3      0.000E+00 0.0000  2.328E-01 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.954E-05 0.0001
 =======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total    0.000E+00 0.0000  2.328E-01 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.954E-05 0.0001
0
                                Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                            As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0                                                         Water Dependent Pathways
0                 Water               Fish              Radon              Plant               Meat               Milk          All Pathways*
 Radio-   ----------------- ----------------- ----------------- ----------------- ----------------- ----------------- -----------------
 Nuclide  mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.   mrem/yr   fract.
 -------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3      0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.328E-01 1.0000
 =======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total    0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  2.328E-01 1.0000
0*Sum of all water independent and dependent pathways.
```

```
RESRAD, Version 5.61      T½ Limit = 0.5 year        09/18/97  09:18    Page  12
 Summary : 33-002(b) Sump Dose                                   File: 33002B.DAT

                             Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                                As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0                                                     Water Independent Pathways (Inhalation excludes radon)
0             Ground            Inhalation          Radon              Plant              Meat               Milk               Soil
 Radio-  ----------------- ----------------- ----------------- ----------------- ----------------- ----------------- -----------------
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  4.515E-14 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.789E-18 0.0001
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  4.515E-14 0.9999  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  3.789E-18 0.0001
0
                             Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                                As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0                                                               Water Dependent Pathways
0             Water              Fish              Radon              Plant              Meat               Milk          All Pathways*
 Radio-  ----------------- ----------------- ----------------- ----------------- ----------------- ----------------- -----------------
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.515E-14 1.0000
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  4.515E-14 1.0000
0*Sum of all water independent and dependent pathways.
```

```
RESRAD, Version 5.61     T' Limit = 0.5 year          09/18/97  09:18    Page  13
 Summary : 33-002(b) Sump Dose                                   File: 33002B.DAT

                        Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                    As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0                                     Water Independent Pathways (Inhalation excludes radon)
0              Ground          Inhalation           Radon             Plant             Meat              Milk              Soil
 Radio-  ----------------- ----------------- ----------------- ----------------- ----------------- ----------------- -----------------
 Nuclide mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000
0
                        Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                    As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0                                              Water Dependent Pathways
0              Water             Fish              Radon             Plant             Meat              Milk         All Pathways*
 Radio-  ----------------- ----------------- ----------------- ----------------- ----------------- ----------------- -----------------
 Nuclide mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.  mrem/yr   fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 H-3     0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000
 ======= ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======  ========= ======
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000
0*Sum of all water independent and dependent pathways.
```

```
                      Dose/Source Ratios Summed Over All Pathways
              Parent and Progeny Principal Radionuclide Contributions Indicated
0Parent  Product  Branch                        DSR(j,t)  (mrem/yr)/(pCi/g)
  (i)      (j)    Fraction  t= 0.000E+00 1.000E-01 1.000E+00 1.000E+01 1.000E+02 1.000E+03
 ------- ------- ---------     --------- --------- --------- --------- --------- ---------
 H-3     H-3     1.000E+00     5.762E-05 5.580E-05 4.178E-05 2.305E-06 4.470E-19 0.000E+00
 ======= ======= =========     ========= ========= ========= ========= ========= =========
 Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter:  CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
 The DSR includes contributions from associated (half-life 0 0.5 yr) daughters.
0
                  Single Radionuclide Soil Guidelines G(i,t) in pCi/g
                       Basic Radiation Dose Limit =  30 mrem/yr
0Nuclide
  (i)     t= 0.000E+00   1.000E-01   1.000E+00   1.000E+01   1.000E+02   1.000E+03
 -------     ---------   ---------   ---------   ---------   ---------   ---------
 H-3         5.206E+05   5.376E+05   7.181E+05   1.301E+07  *9.594E+15  *9.594E+15
 =======     =========   =========   =========   =========   =========   =========
 *At specific activity limit
0
                Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
                and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
             at tmin = time of minimum single radionuclide soil guideline
          and at tmax = time of maximum total dose = 0.000E+00 years
0Nuclide  Initial        tmin        DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)
  (i)     pCi/g        (years)                   (pCi/g)               (pCi/g)
 ------- ---------  ---------------- ---------  ---------  ---------  ---------
 H-3     1.010E+05     0.000E+00     5.762E-05  5.206E+05  5.762E-05  5.206E+05
 ======= =========  ================ =========  =========  =========  =========
```

```
                              Individual Nuclide Dose Summed Over All Pathways
                                Parent Nuclide and Branch Fraction Indicated
ONuclide Parent   BRF(i)                              DOSE(j,t), mrem/yr
   (j)     (i)                t= 0.000E+00 1.000E-01 1.000E+00 1.000E+01 1.000E+02 1.000E+03
 ======= ======= =========       ========= ========= ========= ========= ========= =========
 H-3  .  H-3     1.000E+00       5.820E+00 5.636E+00 4.220E+00 2.328E-01 4.515E-14 0.000E+00
 ======= ======= =========       ========= ========= ========= ========= ========= =========
 BRF(i) is the branch fraction of the parent nuclide.


                                   Individual Nuclide Soil Concentration
                                Parent Nuclide and Branch Fraction Indicated
ONuclide Parent   BRF(i)                              S(j,t), pCi/g
   (j)     (i)                t= 0.000E+00 1.000E-01 1.000E+00 1.000E+01 1.000E+02 1.000E+03
 ======= ======= =========       ========= ========= ========= ========= ========= =========
 H-3     H-3     1.000E+00       1.010E+05 9.780E+04 7.323E+04 4.040E+03 7.836E-10 0.000E+00
 ======= ======= =========       ========= ========= ========= ========= ========= =========
 BRF(i) is the branch fraction of the parent nuclide.
```

ATTACHMENT 1 PHASE I REPORT FOR PRS 33-002(b)

Reference: Environmental Restoration Project, September 29, 1995. "RFI Report for MDA K, PRSs 33-002 (a,b,c,d,e), Field Unit 3," Los Alamos National Laboratory Report LA-UR-95-3624, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1263)**

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4.2 SWMU 33-002(b) Sump TA-33-134

SWMU 33-002(b) is sump TA-33-134 at MDA K. It is discussed in the RFI Work Plan for OU 1122 in Subsections 3.2.2.1, 4.1.4, and 4.2.3.1 (LANL 1992,0784). It is proposed for Phase II sampling based on one high tritium result and questions concerning sampling location.

The sump, constructed in 1955, is a rubble-filled, unlined seepage pit alleged to be 6 ft in diameter and 8 ft deep. It might better be described as a dry well. A 3-in. concrete cover overlaid by 1 in. of soil originally covered the sump. The cover was broken during sampling by Weston personnel in 1989. A sink and floor drain in the south part of TA-33-86 are connected to the sump. Archival information indicates that sump TA-33-134 received organic contaminants such as ethanol and methanol (less than 5 gal./year), trichloroethene, and tritium-contaminated benzene and acetone (about 5 gal./year). The sump may also have received beryllium, mercury, and depleted uranium (LANL 1992, 0784).

The sump lies on a level area about 20 ft south of septic tank TA-33-93. Broken pieces of concrete mark the site. The entire area is greatly disturbed and the vegetation consists of weeds. Soil is dry, dusty, and sandy with small pumice pebbles at the surface. Subsurface soil is sandy with tuff and no organic material at 2.5 ft.

4.2.1 Previous Investigations

Weston personnel collected a surface sample at sump TA-33-134 in 1989. Samples were analyzed for inorganics, radionuclides, pesticides, and polychlorinated biphenyls (PCBs). Only tritium, at 190 000 pCi/ml in soil moisture, was detected. No moisture analysis was performed so no activity per gram of soil can be calculated.

4.2.2 Field Investigation

The RFI work plan specified fluid and sludge samples be collected from the sump. The plan also directed that a borehole be drilled next to the sump and three subsurface samples (plus a duplicate) be taken from the core to determine if possible contamination was migrating from the sump to the environment. During the ER sampling campaign in 1993, the fluid and sludge samples were not collected because these components were not present in the sump. Drilling adjacent to the sump encountered the soil/tuff interface at 30 in. Because of the shallow depth of the hole, only a surface sample and a soil/tuff interface sample were collected. A third sample was taken at a depth of 5 ft from within the sump at the point of auger refusal (Fig. 4-9). All samples were analyzed for uranium, tritium, plutonium, gamma emitters, inorganics, and SVOCs. The two subsurface samples were analyzed for VOCs.

4.2.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-002(b).

4.2.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-002(b).

4.2.3 Screening Assessment

4.2.3.1 Comparison to Background/SALs

Weston results for a surface sample indicated that no inorganic, pesticides, PCBs, uranium, or gamma emitters were detected above LANL and TA-33 background UTLs. Tritium was detected at 190 000 pCi/ml of soil moisture. No moisture content was determined,.so this value can not be converted to pCi/g. The surface sample AAA1931 collected at this same point in 1993 contained 3 370.5 pCi/ml of soil moisture; the subsurface sample AAA1934 taken at 30 in. contained 10 529 pCi/ml of soil moisture.

The ER 1993 results indicate that only tritium was detected above SAL. Table 4-10 lists inorganics and radionuclides detected above LANL and TA-33 background UTLs. Note that the value of 610 485 pCi/g is a mobile radiation laboratory measurement. (Table 4-6 provides a comparison of mobile radiation laboratory vs. fixed laboratory results). Of the 319 organic compounds for which analyses were performed, none was detected.

Sampling points are shown in Fig. 4-9.

TABLE 4-10

INORGANIC AND RADIONUCLIDE ANALYTES FOUND AT SWMU 33-002(b) WITH VALUES GREATER THAN LANL AND TA-33 BACKGROUND UTLS

ANALYTE	SAMPLE ID	CONCENTRATION	LANL UTL[a]	TA-33 UTL	SAL[b]	DEPTH (in.)
Cadmium	AAA3900	4 mg/kg	2.7 mg/kg	2.7 mg/kg	80 mg/kg	60
Plutonium-238	AAA3900	0.057 pCi/g	0.01 pCi/g	0.01 pCi/g	27 pCi/g	60
Plutonium-239	AAA1931	0.95 pCi/g	0.025 pCi/g	0.058 pCi/g	24 pCi/g	0-6
	AAA3900	0.078 pCi/g	0.025 pCi/g	0.058 pCi/g	24 pCi/g	60
Tritium	AAA1931	539.5 pCi/g	none	23.2 pCi/g	810 pCi/g	0-6
	AAA1934	1 728 pCi/g	none	23.2 pCi/g	810 pCi/g	30
	AAA3900	610 485 pCi/g[c]	none	23.2 pCi/g	810 pCi/g	60

[a] UTL = Upper tolerance limit.
[b] SAL = Screening action level.
[c] Mobile radiation laboratory measurement.

4.2.3.2 Data Interpretation

Comparison of the Weston 1989 surface tritium activity in soil moisture (190 000 pCi/ml) with the tritium activity of soil moisture in the ER 1993 surface sample (3 370.5 pCi/ml) indicates natural dilution of surface tritium by a factor of 55 over a 4-year period. The vertical extent of a possible subsurface tritium plume from the sump is not determined. Subsurface trace levels of plutonium detected this sump and in sump TA-33-133 [(SWMU 33-002(c)] may indicate past discharge from the building.

4.2.3.3 Risk Assessment

Three samples were collected from sump TA-33-134, SWMU 33-002(b), at MDA K. Results showed a measured tritium concentration of 610 485 pCi/g at a depth of 5 ft in the sump. A second sample collected at a depth of 2.5 ft showed a tritium concentration of 1 728 pCi/g, and a sample collected at the surface had a measured tritium concentration less than SAL.

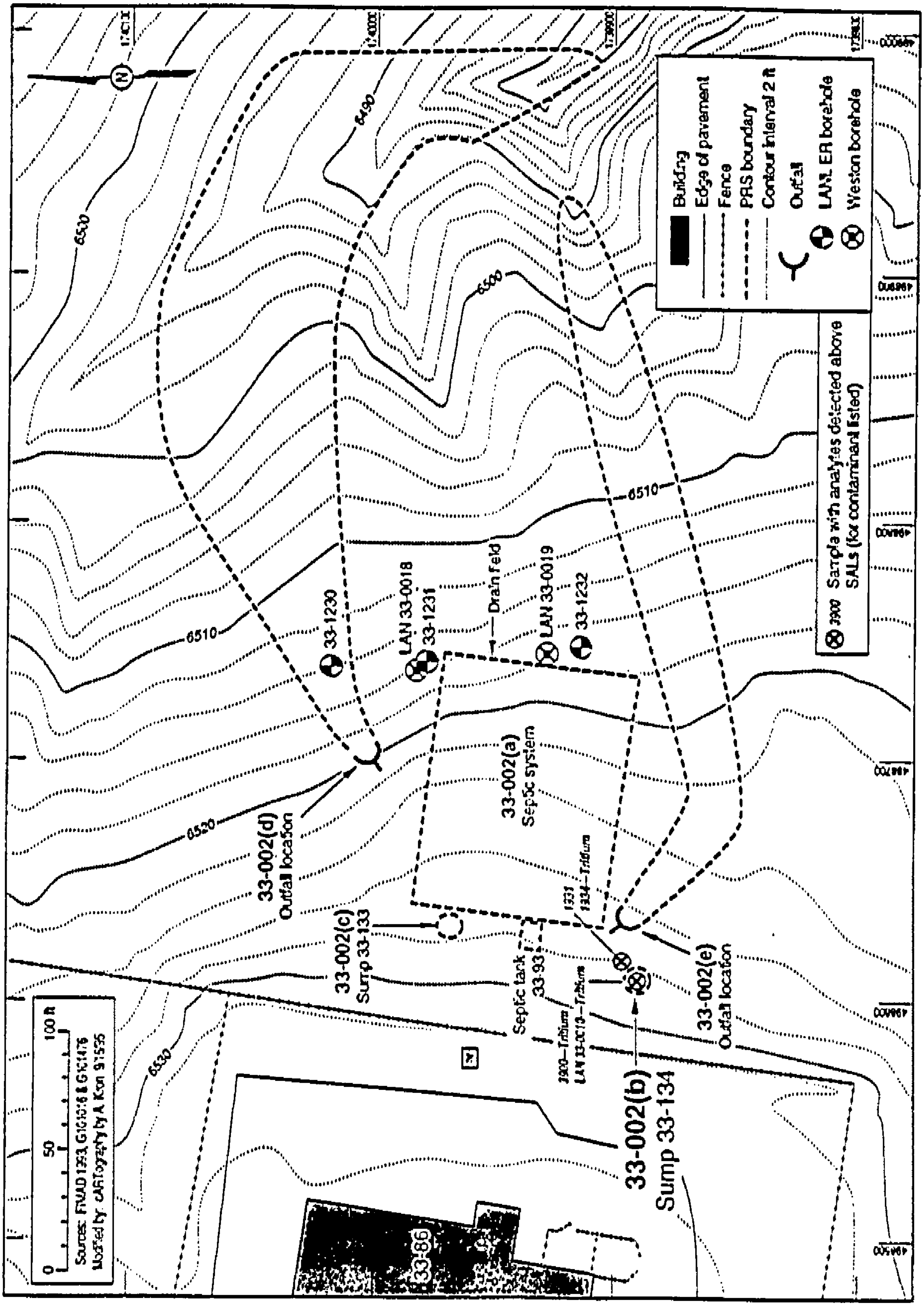

Fig. 4-9. SWMU 33-002(b) sump TA-33-134.

Because of the extent to which the tritium concentration in the 5-ft sample exceeded SAL, an assessment of risk was performed using the tritium plume subroutine of RESRAD, ver. 5.6, and the Argonne National Laboratory mesa top and industrial worker exposure parameters described in Subsection 4.1.3.3 of this RFI report. The site-specific parameters used in running the model are in Table 4-11.

TABLE 4-11

PARAMETERS USED IN RESRAD MODEL FOR SUMP TA-33-134

PARAMETER	VALUE	COMMENT
Contaminated area	4 m^2	6 ft diameter of sump
Contamination depth	27 m	80 ft[a]
Tritium soil activity	610 000 pCi/g	Highest activity detected

[a] Based on a worst-case assumption that an 80-ft-deep tritium plume exists below the sump as a result of a possible hydraulic head to the sump that existed until 1990, when operations at the building ceased.

The only exposure pathway deemed credible is inhalation resulting from tritium flux from the soil. Because the depth to groundwater is constrained to depths between 315 ft and 830 ft and because there is no surface water nearby, ingestion from water is not considered. Exposure to tritium through plants is not credible because MDA K is slated used for industrial use for the foreseeable future.

Using the parameters described above, RESRAD results show that the effective dose equivalent EDE to an individual working at the site of the sump in 1993 (when the tritium samples were collected) was 11.3 mrem/year. This EDE is well below the federally allowable EDE of 100 mrem/year (10 CFR 834, Radiological Protection of the Public and Environment). The DOE recommended EDE is 30 mrem/year, which is consistent with the guidance of the International Commission on Radiation Protection (DOE 1990, 0277). RESRAD calculations are provided in Appendix D of the RFI report.

4.2.3.4 Ecotoxicological Screening Assessment

Ecotoxicological assessment for MDA K is discussed in Subsection 4.1.3.4 of this report.

4.2.4 Conclusion and Recommendation

Sampling personnel and field notes verify that sample AAA3900 was taken where the hand auger hit refusal in the sump at 5 ft. Archival information indicates that the sump is 8 ft deep. Because of these uncertainties, a Phase II sampling plan is proposed in Appendix B of this RFI report. Results indicate that tritium is the most significant contaminant at SWMU 33-002(b).

SWMU 33-002(b) tritium activities at the surface and at a depth of 30 in. are included in the risk assessment for SWMU 33-002(a) in Subsection 4.1.3.3 of this report. Migration of subsurface tritium will be suppressed under the subsurface scenario for MDA K as described for SWMU 33-002(a). The sump has been posted for subsurface tritium contamination in accordance with the LANL RADCON manual (LANL 1994, 1235).

4.3 SWMU 33-002(c) Sump TA-33-133

SWMU 33-002(c) is sump TA-33-133 at MDA K. It is discussed in the RFI work plan for OU 1122 in Subsections 3.2.2.1, 4.1.4, and 4.2.4 (LANL 1992, 0784). Because of questions concerning 1993 sampling locations, the SWMU is proposed for Phase II sampling.

The sump, constructed in 1955, was originally connected to four sinks and four floor drains in the north part of TA-33-86. The sump is an unlined seepage pit allegedly 6 ft in diameter and 8-ft deep. It might better be called a dry well. The sump originally had a 3-in. concrete cover overlaid by 1 in. of soil. The cover was destroyed during Weston sampling in 1989; pieces of broken concrete are strewn about the site. Sump TA-33-133 was disconnected in 1959 and the drain line from the building extended approximately 90 ft past the sump to create the noncontact cooling water outfall, SWMU 33-002(d). Archival evidence indicates that the sump TA-33-133 may have received tritium and small quantities of solvents such as trichloroethene, methanol, ethanol, acetone, and propanol. It has been inactive since 1959.

The area is level and highly disturbed with a growth of chamisa and weeds. A few juniper trees are nearby. The sump is overlaid by piles of dirt mixed with broken tuff. On the surface, the soil is fine sand intermixed with silt and clay, with abundant tuff gravel, and little organic material. At 2.5 ft, the soil is a fine sand and clay, mixed with pulverized tuff presumed to be bedrock.

4.3.1 Previous Investigations

Weston personnel collected two surface samples at sump TA-33-133 in 1989. Samples were analyzed for inorganics, radionuclides, VOCs, SVOCs, pesticides, and PCBs. Tritium was detected at 90 and 890 pCi/g. Trace levels of SVOCs were detected.

4.3.2 Field Investigation

The RFI work plan specified fluid and sludge samples be collected from the sump. The plan also directed that a borehole be drilled next to the sump. Three subsurface samples (plus a duplicate) were taken to determine if possible contamination was migrating from the sump to the environment. During the ER sampling campaign in 1993, the fluid and sludge samples were

not collected because those components were not present in the sump. Drilling adjacent to the sump encountered the soil/tuff interface at 30 in. Because of the shallow depth of the borehole, only a surface sample and a soil/tuff interface sample (plus duplicate) were collected. A third sample was taken at auger refusal at a depth of 4 ft. All samples were analyzed for uranium, tritium, plutonium, gamma emitters, inorganics, and SVOCs. The two subsurface samples were analyzed for VOCs.

4.3.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-002(c). The sump was located by repeated drilling with a hand auger.

4.3.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-002(c).

4.3.3 Screening Assessment

4.3.3.1 Comparison to Background/SALs

Tritium was found in the 1989 Weston samples at 90 and 890 pCi/g. In the 1993 ER samples, no measurements were recorded above SAL. Analytes found above LANL and TA-33 background UTLs are listed in Table 4-12. Of the 465 organic compounds for which analyses were performed, only the solvent 2-hexanone was detected in trace amounts (0.059 mg/kg) in sample AAA1939. No other organics were detected. Sampling points are shown in Fig. 4-10.

TABLE 4-12

RADIONUCLIDE ANALYTES FOUND AT SWMU 33-002(c) WITH VALUES GREATER THAN LANL OR TA-33 BACKGROUND UTLs

ANALYTE	SAMPLE ID	CONCENTRATION (pCi/g)	LANL UTL[a] (pCi/g)	TA-33 UTL (pCi/g)	SAL[b] (pCi/g)	DEPTH (in.)
Plutonium-238	AAA1938	0.013	0.01	0.0074	27	30
	AAA3901	0.328	0.01	0.0074	27	48
Plutonium-239	AAA1937	0.182	0.025	0.058	24	0-6
	AAA3901	0.342	0.025	0.058	24	48
Tritium	AAA1939	52.5	none	23.2	810	30
	AAA3901	34	none	23.2	810	48

[a] UTL = Upper tolerance limit.
[b] SAL = Screening action level.

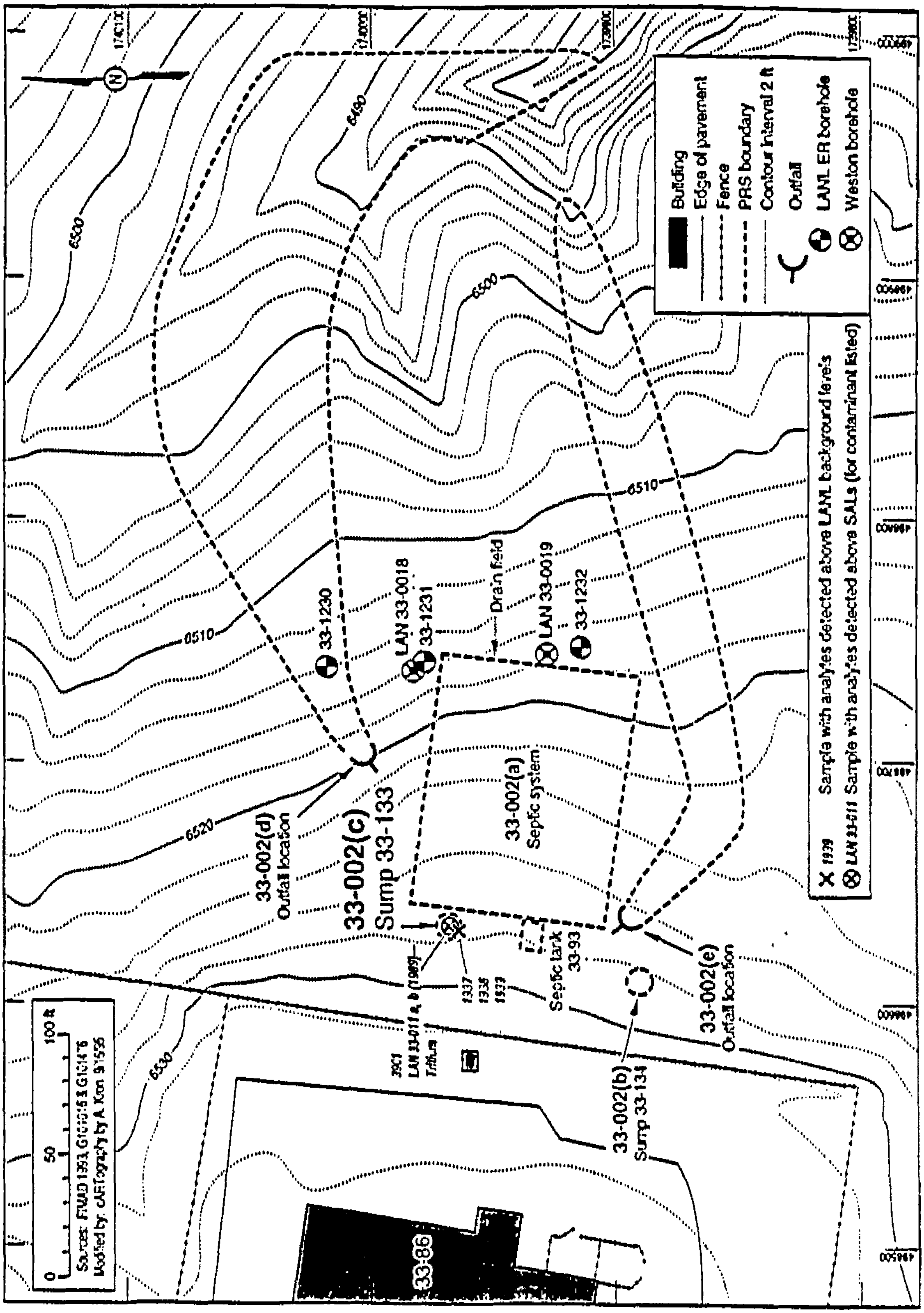

Fig. 4-10. SWMU 33-002(c) sump TA-33-133.

4.3.3.2 Data Interpretation

Trace levels of plutonium found in the sump may indicate past contamination. For tritium, comparison of the Weston 1989 surface tritium activity in soil moisture (15 000 and 3 000 pCi/ml) with the ER 1993 surface sample (69 pCi/ml in soil moisture) indicates a minimum natural dilution of surface tritium by a factor of approximately 45 over a period of 4 years.

4.3.3.3 Risk Assessment

No risk assessment was performed specifically for SWMU 33-002(c). Tritium results from SWMU 33-002(c) samples were considered in the MDA K risk assessment in Subsection 4.1.3.3 of this report.

4.3.3.4 Ecotoxicological Screening Assessment

Ecotoxicological assessment of MDA K is discussed in Subsection 4.1.3.4 of this report.

4.3.4 Conclusion and Recommendation

Field notes and interviews with sampling personnel indicate that sample AAA3901 was taken at the point of refusal of the hand auger at 4 ft. Archival information indicates that the sump is 8 ft deep. Because of these uncertainties, a Phase II sampling plan is proposed in Appendix B of this RFI report. Surface tritium is addressed under the risk assessment discussed for SWMU 33-002(a). The low levels of subsurface tritium will be constrained in place under the subsurface scenario for MDA K as described for SWMU 33-002(a).

4.4 SWMU 33-002(d) Noncontact Cooling Water Outfall

SWMU 33-002(d) is National Pollutant Discharge Elimination System (NPDES) permitted outfall EPA 04A147. It is discussed in the RFI Work Plan for OU 1122 in Subsections 3.2.2.1, 4.1.4, and 4.2.3.1 (LANL 1992, 0784). Tritium detected at the outfall was considered in the overall MDA K risk assessment. The SWMU is proposed for NFA based on sampling data collected in May and June 1993. Three additional surface samples were collected in December 1994.

SWMU 33-002(d) was the outfall for noncontact cooling water from a heat exchanger in the tritium facility. Water from the heat exchanger was directed into one of the floor drains leading to sump TA-33-133. The outfall was created when the sump was disconnected in 1959 and its drain line from TA-33-86 was extended approximately 90 ft past the sump. The outfall has not been disconnected nor has the water supply to TA-33-86 been shut off. The outfall is scheduled

2.0 FURTHER INVESTIGATION OF SWMU 33-002(B) SUMP 33-134

2.1 Phase II Sampling Objectives

The existing Phase I sampling data did not bound the vertical extent of contamination in SWMU 33-002(b). The deepest sample taken in sump TA-33-134 at a depth of five feet exhibited the highest tritium value, and this high-activity value is a mobile radiological laboratory result of unknown quality. The location representing the highest level of tritium contamination may not have been located.

The objectives of the Phase II sampling are to:

1) Determine the highest tritium concentration within or beneath the sump.
2) Confirm the high tritium activity obtained using the mobile radiological laboratory.
3) Define the vertical extent of contamination at this SWMU.
4) Determine whether contaminants other than tritium are located in or beneath the sump.

Investigations during the 1995 field campaign have demonstrated the utility of ground-penetrating radar (GPR) for locating buried vitrified clay pipe. GPR will be used to locate the inlet pipe to the sump and hence to verify the sump's location. Rapid-turnaround tritium analyses will be used to determine the depth of maximum tritium concentration in or beneath the sump and the depth at which tritium exceeds SAL. Laboratory analyses will be used to determine levels of other subsurface contaminants and levels of tritium in the zone of maximum tritium concentration. All samples will be analyzed for tritium in the mobile radiological van; at least one in three of these samples will be sent for confirmatory laboratory analysis. All samples from depths less than 15 ft will be analyzed in the laboratory for tritium, radionuclides, VOCs, SVOCs, and inorganics.

The data collected in Phase II will be used to:

1) Refine the preliminary RESRAD calculations for tritium presented in this report.
2) Confirm or deny the existence of other contaminants at SWMU 33-002(b).
3) Perform a risk assessment for any additional contaminants.

Results of these risk assessments will be used to determine the nature of further actions at this SWMU. Further actions could include:

1) Wait for tritium to decay in place, if risks to current receptors are below DOE-mandated levels.
2) Fence the SWMU and allow tritium to decay, if doses to current receptors are above DOE-mandated doses.
3) Excavate contaminated soil from shallow portions of SWMU 33-002(c), if calculated exposures due to contaminants other than tritium fail a risk assessment using an appropriate scenario.

2.2 Sampling and Analysis at SWMU 33-002(b) Sump TA-33-134

All samples will be field screened for radioactivity and organic vapors to identify gross concentrations of contaminants. Appropriate health and safety precautions will be undertaken according to the current version of the ER Project health and safety plans (LANL 1993, 0875).

A GPR survey of the region west of the sump will be undertaken to locate the vitrified clay pipe that feeds the sump. This survey will cover an area of approximately 5 ft x 30 ft due west of the broken concrete that was assumed to represent the location of the sump during Phase I sampling. Results of the GPR survey will be used to verify the location of the sump and thereby site the proposed drill hole within the sump. If the vitrified clay pipe is not detected by the GPR survey, then the field team will manually probe the area west of the sump until the vitrified clay pipe is located. The pipe will be traced to the sump.

Sampling Techniques The center of the sump will be drilled using a hollow stem auger drill rig. The sampling location is shown in Fig. B-1. All shallow borehole drilling activities will conform to LANL-ER-SOP-04.01, Drilling Methods and Drill Site Management. Samples will be collected from the borehole using a stainless steel split-spoon sampler according to LANL-ER-SOP-06.24, Sample Collection from Split Spoon and Shelby Tube Samplers.

Sampling Summary Core will be continuously screened for radionuclides and screened for organic vapors immediately after opening the split spoon. VOC and tritium samples will be taken immediately upon opening the core barrel. Laboratory samples will be taken at:

1) a depth of 5 ft,
2) a depth of 8 ft or the fill/tuff interface, and
3) a depth of 15 ft.

Any core interval within this depth range that is anomalous (two times background or more) based on the radiological or organic screening may also be sent for laboratory analysis. If the tritium level at 15 ft is above SAL, based on mobile radiological van analysis, then starting at a depth of 15 ft, sample splits at each five ft interval will be sent to the mobile radiological laboratory for tritium analysis. Sampling will continue until three consecutive sample analyses exhibit activities below the tritium SAL based on the mobile radiological laboratory results. At a minimum, every third interval (15 ft spacing) between 15 ft and the bottom of the core hole will be sent for fixed-laboratory analysis for tritium. In addition, the three samples in the core exhibiting the highest tritium levels and the three deepest samples will be sent for laboratory analysis of tritium. Maximum borehole depth will be the maximum depth achievable with the hollow-stem auger drill rig.

Laboratory Analysis All laboratory analytical samples will be analyzed for tritium. Samples from depths less than 15 ft will be analyzed for radionuclides (including plutonium), VOCs, SVOCs, and inorganics. Anomalous samples (two times background or more) from a depth greater than 15 ft will also be analyzed for radionuclides and VOCs. Quality assurance samples will be selected at a rate consistent with current LANL/ER guidance.

3.0 Further Investigations of SWMU 33-002(c) Sump TA-33-133

3.1 Phase II Sampling Objectives

The existing Phase I sampling data may not have bounded the vertical extent of contamination in SWMU 33-002(c), sump TA-33-133. The objectives of the Phase II sampling are to:

1) Determine the highest tritium concentration within or beneath the sump.
2) Determine whether contaminants other than tritium are located at depths greater than four feet in the SWMU.

Additional Phase II sampling objectives and uses of data are identical to those described for SWMU 33-002(b) in Section 2.0 of this report.

B.3.2 Sampling and Analysis for SWMU 33-002(c) Sump TA-33-133

The sampling and analysis plan for SWMU 33-002(c) is identical to that described for SWMU 33-002(b) in Section 2 of this report.

ATTACHMENT 2 PHASE I REPORT FOR PRS 33-002(c)

Reference: Environmental Restoration Project, September 29, 1995. "RFI Report for MDA K, PRSs 33-002 (a,b,c,d,e), Field Unit 3," Los Alamos National Laboratory Report LA-UR-95-3624, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1263)**

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SWMU 33-002(b) tritium activities at the surface and at a depth of 30 in. are included in the risk assessment for SWMU 33-002(a) in Subsection 4.1.3.3 of this report. Migration of subsurface tritium will be suppressed under the subsurface scenario for MDA K as described for SWMU 33-002(a). The sump has been posted for subsurface tritium contamination in accordance with the LANL RADCON manual (LANL 1994, 1235).

4.3 SWMU 33-002(c) Sump TA-33-133

SWMU 33-002(c) is sump TA-33-133 at MDA K. It is discussed in the RFI work plan for OU 1122 in Subsections 3.2.2.1, 4.1.4, and 4.2.4 (LANL 1992, 0784). Because of questions concerning 1993 sampling locations, the SWMU is proposed for Phase II sampling.

The sump, constructed in 1955, was originally connected to four sinks and four floor drains in the north part of TA-33-86. The sump is an unlined seepage pit allegedly 6 ft in diameter and 8-ft deep. It might better be called a dry well. The sump originally had a 3-in. concrete cover overlaid by 1 in. of soil. The cover was destroyed during Weston sampling in 1989; pieces of broken concrete are strewn about the site. Sump TA-33-133 was disconnected in 1959 and the drain line from the building extended approximately 90 ft past the sump to create the noncontact cooling water outfall, SWMU 33-002(d). Archival evidence indicates that the sump TA-33-133 may have received tritium and small quantities of solvents such as trichloroethene, methanol, ethanol, acetone, and propanol. It has been inactive since 1959.

The area is level and highly disturbed with a growth of chamisa and weeds. A few juniper trees are nearby. The sump is overlaid by piles of dirt mixed with broken tuff. On the surface, the soil is fine sand intermixed with silt and clay, with abundant tuff gravel, and little organic material. At 2.5 ft, the soil is a fine sand and clay, mixed with pulverized tuff presumed to be bedrock.

4.3.1 Previous Investigations

Weston personnel collected two surface samples at sump TA-33-133 in 1989. Samples were analyzed for inorganics, radionuclides, VOCs, SVOCs, pesticides, and PCBs. Tritium was detected at 90 and 890 pCi/g. Trace levels of SVOCs were detected.

4.3.2 Field Investigation

The RFI work plan specified fluid and sludge samples be collected from the sump. The plan also directed that a borehole be drilled next to the sump. Three subsurface samples (plus a duplicate) were taken to determine if possible contamination was migrating from the sump to the environment. During the ER sampling campaign in 1993, the fluid and sludge samples were

not collected because those components were not present in the sump. Drilling adjacent to the sump encountered the soil/tuff interface at 30 in. Because of the shallow depth of the borehole, only a surface sample and a soil/tuff interface sample (plus duplicate) were collected. A third sample was taken at auger refusal at a depth of 4 ft. All samples were analyzed for uranium, tritium, plutonium, gamma emitters, inorganics, and SVOCs. The two subsurface samples were analyzed for VOCs.

4.3.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-002(c). The sump was located by repeated drilling with a hand auger.

4.3.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-002(c).

4.3.3 Screening Assessment

4.3.3.1 Comparison to Background/SALs

Tritium was found in the 1989 Weston samples at 90 and 890 pCi/g. In the 1993 ER samples, no measurements were recorded above SAL. Analytes found above LANL and TA-33 background UTLs are listed in Table 4-12. Of the 465 organic compounds for which analyses were performed, only the solvent 2-hexanone was detected in trace amounts (0.059 mg/kg) in sample AAA1939. No other organics were detected. Sampling points are shown in Fig. 4-10.

TABLE 4-12

RADIONUCLIDE ANALYTES FOUND AT SWMU 33-002(c) WITH VALUES GREATER THAN LANL OR TA-33 BACKGROUND UTLs

ANALYTE	SAMPLE ID	CONCENTRATION (pCi/g)	LANL UTL[a] (pCi/g)	TA-33 UTL (pCi/g)	SAL[b] (pCi/g)	DEPTH (in.)
Plutonium-238	AAA1938	0.013	0.01	0.0074	27	30
	AAA3901	0.328	0.01	0.0074	27	48
Plutonium-239	AAA1937	0.182	0.025	0.058	24	0-6
	AAA3901	0.342	0.025	0.058	24	48
Tritium	AAA1939	52.5	none	23.2	810	30
	AAA3901	34	none	23.2	810	48

[a] UTL = Upper tolerance limit.
[b] SAL = Screening action level.

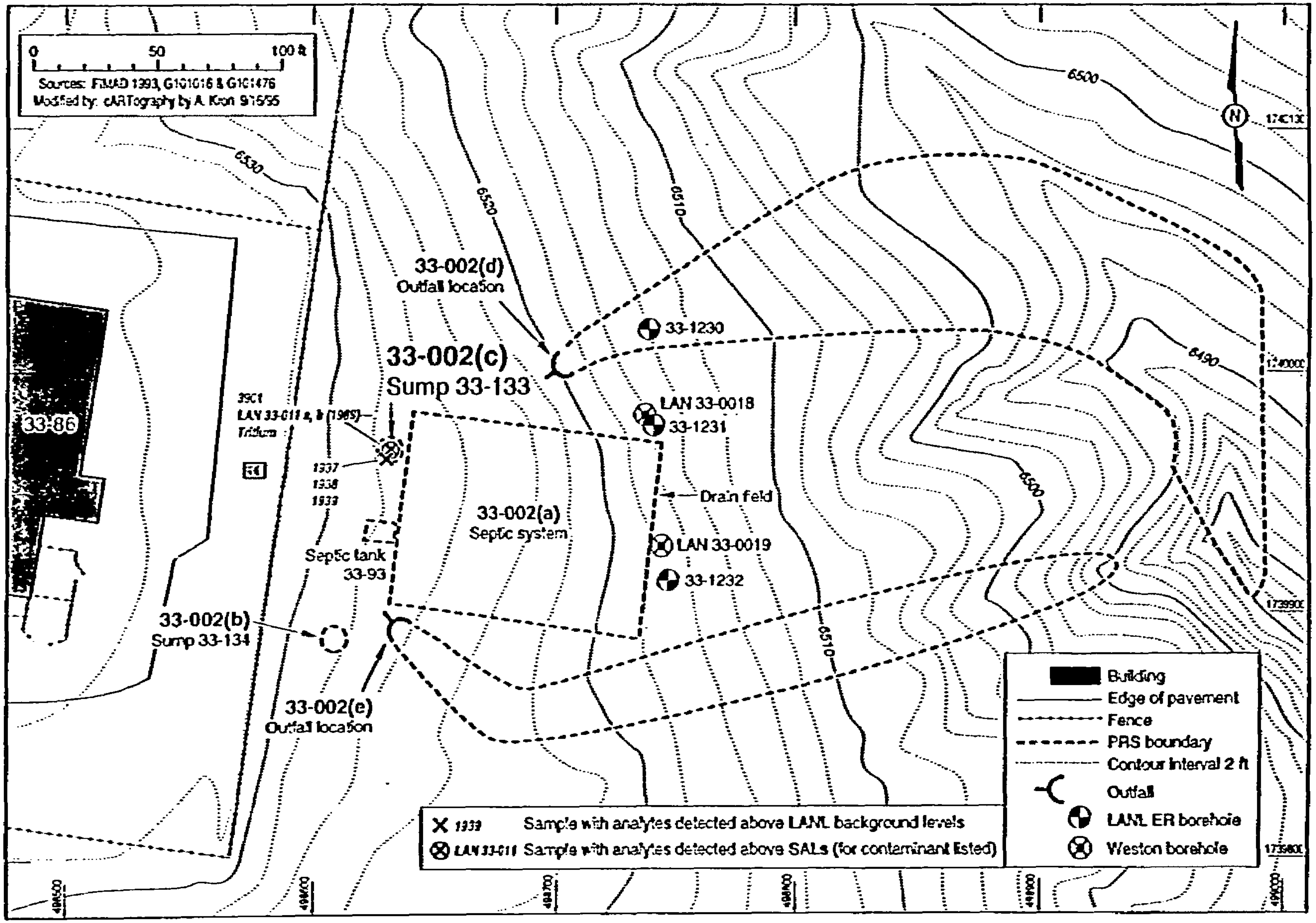

Fig. 4-10. SWMU 33-002(c) sump TA-33-133.

4.3.3.2 Data Interpretation

Trace levels of plutonium found in the sump may indicate past contamination. For tritium, comparison of the Weston 1989 surface tritium activity in soil moisture (15 000 and 3 000 pCi/ml) with the ER 1993 surface sample (69 pCi/ml in soil moisture) indicates a minimum natural dilution of surface tritium by a factor of approximately 45 over a period of 4 years.

4.3.3.3 Risk Assessment

No risk assessment was performed specifically for SWMU 33-002(c). Tritium results from SWMU 33-002(c) samples were considered in the MDA K risk assessment in Subsection 4.1.3.3 of this report.

4.3.3.4 Ecotoxicological Screening Assessment

Ecotoxicological assessment of MDA K is discussed in Subsection 4.1.3.4 of this report.

4.3.4 Conclusion and Recommendation

Field notes and interviews with sampling personnel indicate that sample AAA3901 was taken at the point of refusal of the hand auger at 4 ft. Archival information indicates that the sump is 8 ft deep. Because of these uncertainties, a Phase II sampling plan is proposed in Appendix B of this RFI report. Surface tritium is addressed under the risk assessment discussed for SWMU 33-002(a). The low levels of subsurface tritium will be constrained in place under the subsurface scenario for MDA K as described for SWMU 33-002(a).

4.4 SWMU 33-002(d) Noncontact Cooling Water Outfall

SWMU 33-002(d) is National Pollutant Discharge Elimination System (NPDES) permitted outfall EPA 04A147. It is discussed in the RFI Work Plan for OU 1122 in Subsections 3.2.2.1, 4.1.4, and 4.2.3.1 (LANL 1992, 0784). Tritium detected at the outfall was considered in the overall MDA K risk assessment. The SWMU is proposed for NFA based on sampling data collected in May and June 1993. Three additional surface samples were collected in December 1994.

SWMU 33-002(d) was the outfall for noncontact cooling water from a heat exchanger in the tritium facility. Water from the heat exchanger was directed into one of the floor drains leading to sump TA-33-133. The outfall was created when the sump was disconnected in 1959 and its drain line from TA-33-86 was extended approximately 90 ft past the sump. The outfall has not been disconnected nor has the water supply to TA-33-86 been shut off. The outfall is scheduled

Sampling Summary Core will be continuously screened for radionuclides and screened for organic vapors immediately after opening the split spoon. VOC and tritium samples will be taken immediately upon opening the core barrel. Laboratory samples will be taken at:

1) a depth of 5 ft,
2) a depth of 8 ft or the fill/tuff interface, and
3) a depth of 15 ft.

Any core interval within this depth range that is anomalous (two times background or more) based on the radiological or organic screening may also be sent for laboratory analysis. If the tritium level at 15 ft is above SAL, based on mobile radiological van analysis, then starting at a depth of 15 ft, sample splits at each five ft interval will be sent to the mobile radiological laboratory for tritium analysis. Sampling will continue until three consecutive sample analyses exhibit activities below the tritium SAL based on the mobile radiological laboratory results. At a minimum, every third interval (15 ft spacing) between 15 ft and the bottom of the core hole will be sent for fixed-laboratory analysis for tritium. In addition, the three samples in the core exhibiting the highest tritium levels and the three deepest samples will be sent for laboratory analysis of tritium. Maximum borehole depth will be the maximum depth achievable with the hollow-stem auger drill rig.

Laboratory Analysis All laboratory analytical samples will be analyzed for tritium. Samples from depths less than 15 ft will be analyzed for radionuclides (including plutonium), VOCs, SVOCs, and inorganics. Anomalous samples (two times background or more) from a depth greater than 15 ft will also be analyzed for radionuclides and VOCs. Quality assurance samples will be selected at a rate consistent with current LANL/ER guidance.

3.0 Further Investigations of SWMU 33-002(c) Sump TA-33-133

3.1 Phase II Sampling Objectives

The existing Phase I sampling data may not have bounded the vertical extent of contamination in SWMU 33-002(c), sump TA-33-133. The objectives of the Phase II sampling are to:

1) Determine the highest tritium concentration within or beneath the sump.
2) Determine whether contaminants other than tritium are located at depths greater than four feet in the SWMU.

Additional Phase II sampling objectives and uses of data are identical to those described for SWMU 33-002(b) in Section 2.0 of this report.

B.3.2 Sampling and Analysis for SWMU 33-002(c) Sump TA-33-133

The sampling and analysis plan for SWMU 33-002(c) is identical to that described for SWMU 33-002(b) in Section 2 of this report.

ATTACHMENT 3 PHASE I REPORT FOR PRS 33-003(b)

Reference: Environmental Restoration Project, September 29, 1995, "RFI Report for MDA K, PRSs 33-002 (a,b,c,d,e), Field Unit 3," Los Alamos National Laboratory Report LA-UR-95-3624, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1263)**

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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.

The same exposure unit used for lead, approximately 0.15 acres east of TA-33-39, was used for a preliminary risk assessment for the PAHs (Fig. 4-9). Risk assessment calculations for SWMU 33-017 are presented in Appendix D of this RFI report. Results show that the estimated carcinogenic risk to construction workers is low at both the mean and the 95% UCL concentrations: 2.7E-07 and 5.6E-07, respectively. Estimated risk to future residents based on the mean PAH concentration is 3.1E-06 and when based on all seven 95% UCLs, estimated risk rises to 2.1E-05.

4.8.3.4 Ecotoxicological Screening Assessment

A global ecotoxicological assessment is presented in Subsection 3.2.3 of this RFI report.

4.8.4 Conclusion and Recommendation

Based on results of this preliminary risk assessment for SVOCs, further study will be taken in this exposure unit, which includes the area extending approximately 130 ft east of shop TA-33-39. Phase II sampling will collect additional samples in the vicinity of the elevated SVOCs to refine level and extent of contamination (Appendix B).

5.0 REVISED PHASE I SAMPLING AND ANALYSIS PLANS

Information gathered since the RFI work plan LA-UR-92-925 was submitted in May 1992 indicates that six sampling plans are inadequate or inappropriate. Therefore, revised sampling plans for the PRSs listed in Table 5-1 are submitted in Section 5.0.

5.1 SWMU 33-003(b) MDA-D, East Site

SWMU 33-003(b) is underground experimental chamber TA-33-6 at MDA D. It is discussed in the RFI Work Plan for OU 1122, Subsections 3.5.2.1 and 4.5.3.1 (LANL 1992, 0784). No action is proposed for the chamber based on an assessment of exposure pathways. A Phase II sampling plan is presented for the surface and subsurface soil component of SWMU 33-003(b).

TABLE 5-1

PRSs WITH REVISED SAMPLING PLANS

PRS[a]	DESCRIPTION	REASON FOR REVISION
33-003(b)	MDA D subsurface	Possible PCB[b] contamination
33-004(k)	Outfall from TA-33-87	Outfall not located in 1994 campaign.
33-008(a)	Landfill at East Site	New information on contents
33-008(b)	Landfill at South Site	New information on contents
C-33-001	Transformer at Main Site	Phase I sampling plan for PCBs
C-33-002	Transformer at East Site	Phase I sampling plan for PCBs

[a] PRS = Potential release site.
[b] PCB = Polychlorinated biphenyl.

The chamber was constructed in 1948. It is an 18 ft by 18 ft octagonal, vault-like structure 11 ft high, buried with the roof approximately 30 ft below grade. Access was through a 4 ft by 6 ft elevator shaft at the side of the chamber. The elevator shaft, now filled, was approximately 46 ft deep. Remaining surface indications of the chamber include only an 8 ft by 12 ft concrete pad broken at the east end where the shaft was located. A 6 ft by 10 ft depression remains in the area of the shaft.

The chamber was used for initiator tests involving milligram quantities of beryllium. Polonium-210 (half-life 138 days) was used as a source of alpha particles. Chamber TA-33-6 was used twice, once in December 1948 and again in April 1952. The second test destroyed the chamber. Debris from the test was ejected through the elevator shaft and spread over the mesa. A 10-ft deep crater formed around the chamber (Blackwell 1952, 02-034). The crater was later filled with the ejected debris and covered with uncontaminated soil (Blackwell 1953, 02-035). In 1963 the depression was refilled (Zia Company 1963, 02-030).

MDA D is located at East Site. The mesa is level enough so that drainage patterns are not evident. The area is covered with weeds interspersed with a few chamisa shrubs. The chamber TA-33-6 concrete pad lies approximately 50 ft north of the East Site Road near septic tank TA-33-36 and approximately 350 ft south of the rim of Ancho Canyon.

5.1.1 Previous Investigation

Existing surface data for SWMU 33-003(b) at East Site includes 16 surface soil samples collected by LANL's Environmental Surveillance Program in 1977. The surveillance samples were analyzed for tritium, uranium, and cesium-137; all results were within background ranges. These data are summarized in the RFI Work Plan for OU 1122 (LANL 1992, 0784).

In 1989 Weston personnel conducted sampling at three boreholes at TA-33-6. Nine subsurface samples were collected. Seven were analyzed for uranium, six for inorganics, and seven for HE. Three samples were analyzed for VOCs. Results are discussed in Subsection 5.1.3.1 of this RFI report. Weston borehole logs indicate the following subsurface materials were encountered:

- LAN33-0023: This borehole was drilled into the elevator shaft to a total depth of 47 ft. Matrix consisted of fill material with gravel, sand, and tuff fragments. Wood was encountered between 8 and 23 ft. Gravel persisted to 28 ft. Rusty wire, metal clips, and chain fragments were encountered at 43 ft. Three samples were taken from the shaft.
- LAN33-0024: This borehole was drilled atop the chamber to a depth of 29 ft. Matrix consisted of tuff fill. The surface sample had numerous small, glass fragments. At 18 ft, the drill encountered a void. Below the void, sand and gravel were intermixed with tuff material. The concrete roof of the chamber was encountered at 29 ft. Two samples were taken from the borehole.
- LAN33-0025: This borehole was drilled adjacent to the chamber to a depth of 58 ft. The matrix consisted of fill material (sand and gravel) mixed with tuff. The upper 1.5 ft consisted of native soil. Four samples were taken from the borehole.

5.1.2 Field Investigation

In 1994 LANL ER Project sampling at East Site included five surface samples taken north of the chamber. Additional surface samples were taken in the drain field of SWMU 33-004(c). All samples were analyzed for inorganics, gamma emitters, and HE.

In 1994 an archival search was conducted to determine the probable contents of the chambers, with emphasis on the composition of the neutron counters. The search revealed the following: steel, copper, and aluminum were present in kilogram amounts; lead from solder was probably present in gram amounts. Capacitors used in the chamber may have contained less than 5 lb total of PCBs. No shielding material (lead, cadmium, paraffin) was used, nor were scintillation fluids or uranium (Morgan 1994, 02-088). Beryllium was present in milligram amounts. Polonium-210 (half-life 138 days) has decayed to undetectable levels.

5.1.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-003(b).

5.1.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-003(b).

5.1.3 Screening Assessment

5.1.3.1 Comparison to Background/SALs

Chamber Analytes above background UTLs were detected only in Weston samples from the LAN33-0023 borehole drilled into the elevator shaft. No analytes were detected above background UTLs in Weston boreholes LAN33-0024 and LAN33-0025. Results from borehole LAN33-0023 are presented in Table 5-2. Weston results have not received LANL ER QA/QC data validation and are presented for information purposes only.

TABLE 5-2

ANALYTES DETECTED ABOVE LANL AND TA-33 BACKGROUND UTLS IN THE TA-33-6 ELEVATOR SHAFT

ANALYTE	SAMPLE ID	DEPTH (ft)	MEDIUM	CONCENTRATION (mg/kg)	LANL UTL[a] (mg/kg)	TA-33 UTL (mg/kg)	SAL[b] (mg/kg)
Cadmium	33-0023-2	38-43	Fill	7.1	2.7	2.7	80
	33-0023-3	43-47	Fill	4.9	2.7	2.7	80
Mercury	33-0023-2	38-43	Fill	2.1	0.1	NA[c]	24
	33-0023-3	43-47	Fill	1.1	0.1	NA	24
Lead	33-0023-2	38-43	Fill	79	39	39	400
Zinc	33-0023-2	38-43	Fill	852	101	62.3	24 000
	33-0023-3	43-47	Fill	652	101	62.3	24 000

[a] Upper tolerance limit.
[b] Screening action level.

Surface Area In 1994 LANL ER personnel conducted surface sampling in the vicinity of the chamber. Analyses for gamma emitters and inorganics did not detect concentrations above LANL and TA-33 background UTLs, with the exception of a possibly anomalous mercury concentration of 0.02 mg/kg in sample AAA9608. A laboratory reanalysis of sample AAA9608 did not detect mercury. Location of Weston and ER sampling points is shown in Fig. 5-1.

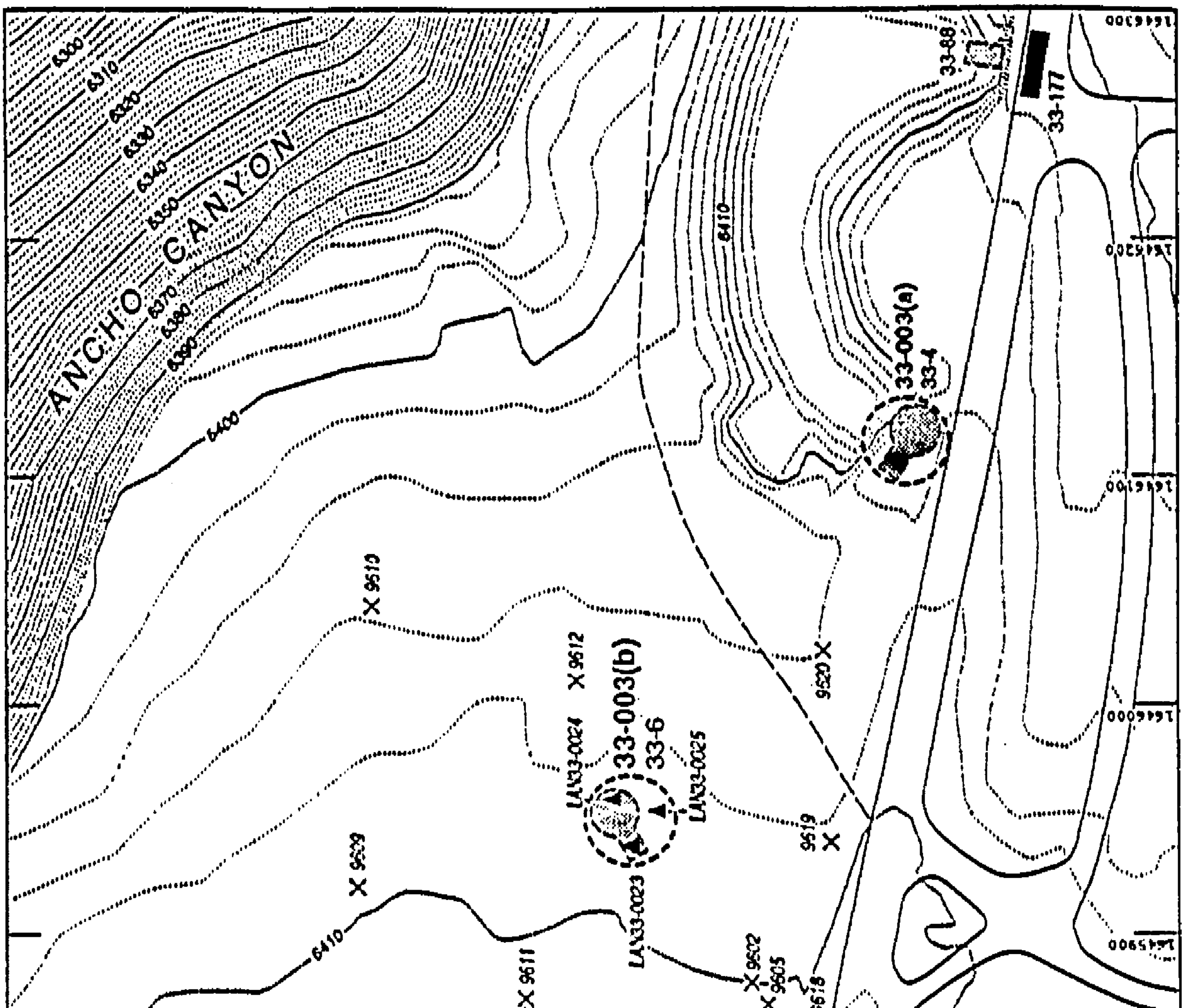

Fig. 5-1. East Site: SWMU 33-003(b) Weston boreholes and ER 1994 sampling campaign.

5.1.3.2 Data Interpretation

Results of sampling and analysis indicate that no inorganics or radionuclides are present at hazardous levels in the area surrounding the chamber. At the time of sampling, PCBs were not recognized as a potential contaminant.

5.1.3.3 Risk Assessment

No risk assessment was performed for SWMU 33-003(b). The following is a discussion of the pathway from the chamber to receptors. It does not address surface or subsurface contamination.

No remediation is recommended for chamber TA-33-6. This chamber is identical to chamber TA-33-4, described in Subsection 4.1. The rationale against further action is described in detail in Subsection 4.1.3.3 of this RFI report and is summarized here.

The source of contamination at the MDA D chambers is material within the underground chambers and possibly the elevator shafts. Based upon documentation of experiments conducted at MDA D, materials that may be present in the underground chambers include steel, copper, aluminum, PCBs, zinc, and milligram or gram amounts of beryllium and lead. The HE trinitrotoluene and its detonation products may also be present. Some electrical components of the tests may have contained PCBs and the chambers may contain PCBs in amounts estimated to be less than 5 lb (Morgan 1994, 02-088). No research data on the fate of PCBs under explosive conditions similar to those within the chamber can be found. It is not known what percentage of the PCBs remained intact and what percentage are present as combustion products.

For chamber TA-33-6, SWMU 33-003(b), the immediate transport mechanism was atmospheric dispersion. This mechanism potentially brought contaminants to the surface. This mechanism will be investigated in accordance with the sampling plan presented in Subsection 5.1.5 of this RFI report. The only current transport medium for any contaminants that remained in the chamber after detonation would be through soil sifting through cracks in the chamber or through the material used to backfill the elevator shaft. Migration is unlikely because these contaminants are most likely to bind to the subsurface fill material, the tuff walls of the shaft, and the concrete walls of the chamber. Any remaining PCBs, especially the more heavily chlorinated PCBs, will bind to organic material in the soil or to tuff rubble that may have entered the chamber.

The potential for future migration of PCBs and other contaminants from the chamber is negligible because of the minimum potential for migration discussed in the preceding paragraph and the inaccessibility of contaminated material in the chamber to potential receptors. Because the floor of the chamber is approximately 50 ft below grade, contaminants are not accessible to LANL workers or visitors. A potential future construction scenario is unlikely to expose workers to chamber contamination because a typical excavation would not occur at depths greater than 12 ft, the average depth of a basement. A residential scenario would not expose homeowners to contamination. For these reasons no remediation is recommended for the chamber.

The risk to groundwater is considered negligible. MDA D is located 660 ft above the nearest spring on the floor of Ancho Canyon. No springs have been located on the side of the canyon. No driving force exists in the chambers to force contaminants through cracks in both tuff and basalt layers to groundwater.

5.1.4 Conclusion and Recommendation

Based on the argument in Subsection 5.1.3.2 that no pathway exists for contamination to reach a receptor, no further investigation of chamber TA-33-6 will be carried out. However, sampling prescribed by the RFI work plan was not sufficient to characterize material bulldozed into the crater created by the 1952 test, nor were PCBs considered a potential contaminant. Therefore, additional Phase I surface and subsurface sampling are proposed for SWMU 33-003(b).

5.1.5 Phase I Revised Sampling and Analysis Plan

5.1.5.1 Phase I Sampling Objectives

Existing surface data for SWMU 33-003(b) at East Site includes 16 surface soil samples collected by LANL's Environmental Surveillance program, and 9 samples collected from 3 boreholes for the 1989 Weston investigation. The surveillance samples were analyzed for tritium, uranium, and cesium-137, and all results were within background ranges. The Weston borehole samples were analyzed for inorganics, HE, and radionuclides. Results were below detection limits or background UTLs. Surface sampling in 1994 did not detect inorganics above background UTLs.

Concerns that are inadequately addressed by the existing data are:

- Previous surface data are primarily from locations within approximately 50 ft of TA-33-6. However, following destruction of the chamber by a large experiment that ejected debris from the shaft, debris and soil were bulldozed back into the crater. It is possible that the area sampled in 1977 either had been scraped off, or consisted of uncontaminated soil used to cover the bulldozed material, while contaminants above background and possibly even above levels of concern may remain at greater distances from the elevator shaft.

- The Weston survey provided two samples from the refilled volume of the crater; that is, the debris and material for which above background field radioactivity measurements were reported in 1953.

Phase I sampling at PRS 33-003(b) is intended to address these concerns, to provide data for risk assessment, and (if appropriate) to provide information on the mobility of buried contaminants (Fig 5-2).

- **Surface samples** A 100 ft by 100 ft grid-stratified random sampling scheme will provide 9 surface samples out to a distance of 150 to 200 ft from the elevator shaft. One sample will be taken from each square, with the sample location randomly selected within each square. Sampling will be conducted north of the East Site road and will avoid other SWMUs when possible.

- **Subsurface samples** Two holes drilled near the shaft will provide six samples from depths of 2 ft to a minimum of 15 ft within the bulldozed debris.

All 15 samples will be field screened for PCBs using the PCB D TECH™ kit. PCB-screened samples exceeding 1 mg/kg will be submitted for fixed laboratory analysis. Subsurface samples will also be analyzed for inorganics. Results of inorganic analyses from the ER 1994 surface sampling points are adequate to address surface inorganic concerns. Toxicity characteristic leaching procedure (TCLP) analyses will be performed on subsurface samples if the total inorganics results (in mg/kg) exceed twenty times the TCLP limit (in mg/L). TCLP analyses will determine if buried constituents are leachable.

5.1.5.2 Sampling and Analysis

Phase I sampling will focus on determining the presence of inorganics and PCBs at SWMU 33-003(b). All samples will be field screened for radioactivity to identify gross concentrations of contaminants. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan.

Sampling Techniques Surface soil samples will be collected with the spade and scoop technique (LANL-ER-SOP-06.09) to a depth of 6 in. Subsurface samples will be collected with a hollow-stem auger drill rig outfitted with a continuous sample collection system (LANL-ER-SOP-04.01) and will be advanced to a depth of 15 ft. The 15 ft depth is designed to ensure detection of contamination below the clean fill and/or scraped surface horizon.

The SWMU includes two target areas

- **Elevator shaft** Nine surface soil samples (0 to 6 in.) will be collected. The 9 grid-stratified random samples taken from a 100 ft by 100 ft grid will result in sampling to a distance of approximately 150 to 200 ft from the shaft (Fig. 5-2). These random samples will be field screened for PCBs.
- **Borehole samples** Two hollow-stem auger boreholes adjacent to the shaft will be drilled to a nominal depth of 15 ft. If soil texture or color indicates that the boreholes are not below the bottom of the former depression , the boreholes will be advanced below 15 ft until that interface is reached. These boreholes will be located within 8 ft of the shaft and will provide 3 analytical samples each. Analytical samples will be collected below the cover fill layer and above the bottom of the former depression. Selection of analytical sample intervals will be based upon observed changes in soil color and texture. Analytical samples will be a minimum depth interval of 6 in. each. See Fig. 5-2 for planned sample locations.

Laboratory Analysis Subsurface analytical samples will be field screened by X-ray fluorescence (XRF) or laser-induced breakdown spectroscopy (LIBS) for inorganics. All samples for which the inorganic concentration exceeds 20 times the TCLP limits will be submitted to the laboratory for TCLP analyses. Any sample measuring 1 mg/kg PCBs or above by field screening will be submitted for fixed-laboratory analysis.

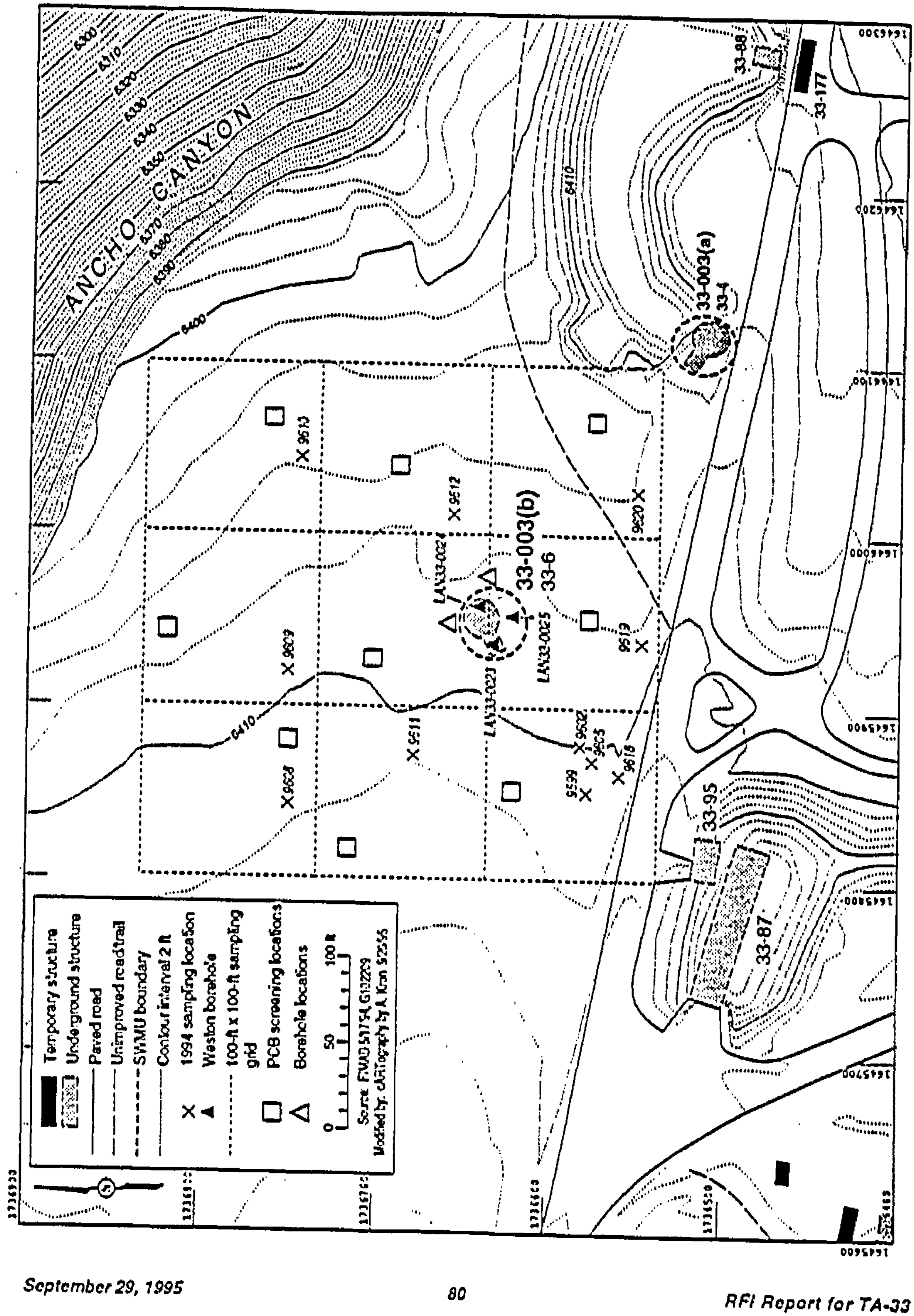

Fig. 5-2. East Site: SWMU 33-003(b) sampling locations.

ATTACHMENT 4 PHASE I and INTERIM ACTION REPORTS FOR PRS 33-006(a)

Reference: Environmental Restoration Project, December 1995 "RFI Report for Potential Release Sites 33-004(b), 33-004(c), 33-004(j), 33-004(m), 33-006(a), 33-006(b), 33-007(a), 33-007(b), 33-010(a), 33-010(b), 33-010(c), 33-010(d), 33-010(g), 33-010(h), 33-011(b), 33-011(c), 33-014, Field Unit 3," Los Alamos National Laboratory Report LA-UR-95-4439, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1288)**

Reference: Environmental Restoration Project, March, 1997. Interim Action Report for Potential Release Site 33-006(a), LA-UR-97-641 **(Environmental Restoration Project 1997, 02-122).**

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5.4.7.2 Risk Assessment

No risk assessment was performed for this PRS.

5.4.8 Ecological Assessment

5.4.8.1 Ecotoxicological Screening Assessment

This PRS will be included in EEUs defined for both ecological screening and ecological risk assessments. A site inspection of this PRS indicates that it will be adequately addressed in the EEUs.

5.4.8.2 Ecological Risk Assessment

No ecological risk assessment has been performed for this PRS. An ecological risk assessment will be evaluated when an approach is approved by regulators.

5.4.9 Extent of Contamination

Contamination was confined to the septic tank at this PRS. Biased sampling was performed in the drain field to support a screening decision. No attempt was made to determine the extent of contamination at this PRS.

5.4.10 Conclusion and Recommendation

Based on NFA Criterion 4, a Class III permit modification is requested to remove PRS 33-004(m) from the HSWA Module of LANL's RCRA operating permit.

- Sampling was performed at locations most likely to be contaminated.
- No chemicals were detected at hazardous levels. The expected solvent contamination at PRS 33-004(m) was detected at low levels only in the septic tank. No chemicals were detected in the drain field.
- The system is active.

5.5 PRS 33-006(a) South Site Shot Pad

PRS 33-006(a) is the shot pad at South Site where implosion studies were conducted. Uranium and copper are widespread in soils, but a risk assessment indicates that no unacceptable risk is present (Section 5.5.7.2 of this RFI report). All surface uranium analyses at South Site were included in the risk assessment regardless of the PRS to which it was originally assigned.

Because of widespread shrapnel distribution and documented evidence that approximately 30% of shrapnel may be contaminated with radioactive material, the PRS may be considered for VCA. HE analyses at South Site were compromised by missed holding times. Because PRS 33-006(a) covers all of South Site, all surface HE analyses collected under Phase I sampling plans for other PRSs at South Site have been reassigned to PRS 33-006(a). Limited resampling for HE is proposed in a Phase II sampling plan.

5.5.1 History

The South Site shot pad is discussed in the RFI Work Plan for OU 1122, Subsections 3.4.2.4 and 4.4.3.3. PRS 33-006(a) was initially described as a shot pad at South Site. Because shrapnel from detonations is widespread, the extent of the PRS has been redefined to cover an area with radius of approximately 1.1 mile.

The buildings at South Site were completed and testing began in June 1950. The X-unit vault contained electronic control equipment used to detonate implosion test apparatus. Uranium shells holding the initiators were used in implosion tests involving from 275 to 5 000 lb of HE. The apparatus and neutron detectors were put into large copper shells for electrical shielding, then the entire assemblage was covered by a wooden shack prior to detonation (Hoard 1990, 02-022). The detonations spread debris, shrapnel, and wood fragments over the entire South Site valley and beyond. After the implosion test program was transferred to other LANL groups in 1955 or 1956, implosion tests were discontinued at TA-33. The shot pad has been inactive since that time.

Potential contaminants were listed as uranium and inorganics.

5.5.2 Description

South Site lies in a small valley about 600 ft in diameter. The entire area drains to Chaquehui Canyon through a short arroyo. The shot pad atop TA-33-26 is located in the middle of this valley. Much of the valley was scraped to bedrock during site construction. The pad itself is located directly above X-unit vault TA-33-26 and is approximately 40 ft in diameter. The pad is covered with sand a foot or more deep. Runoff from the pad enters the main drainage arroyo serving the whole of South Site. Soils are thin and bedrock outcrops prevalent in undisturbed areas. Chamisa covers large areas of the site.

Implosion shots spread shrapnel over a wide area at TA-33 and into Bandelier National Monument. For that reason, the boundaries of PRS 33-006(a) have been expanded to cover a radius 1.1 miles, centered at the shot pad.

5.5.3 Previous Investigations

No previous investigations were conducted at this PRS.

5.5.4 Field Investigation

Sampling at PRS 33-006(a) was designed to determine mean contamination and contaminant distribution by employing random sampling over a wide area. The work plan specified 38 surface samples collected at random locations around the shot pad and 11 samples from the drainage. Forty-six samples were taken over a wide area at South Site (Table 5.5.4-1) (Figure 5.5.4-1). Eleven samples were taken in the main drainage (Table 5.5.4-2) (Figure 5.4.4-2). All samples were analyzed for inorganics, uranium, gamma emitters, and HE.

Because PRS 33-006(a) covers the entire developed area at South Site, results of sampling and analysis attributed to other PRSs are used in subsequent assessment of contaminant distribution. In addition to the samples listed in Tables 5.5.4-1 and 5.5.4-2, surface samples from nearby PRSs were evaluated for possible contamination from the PRS 33-006(a) implosion tests. These included eight surface samples from the tower area of PRS 33-007(b), four samples from the burn area PRS 33-014, and four samples from disposal area PRS 33-010(c).

TABLE 5.5.4-1

SUMMARY OF SURFACE SAMPLES TAKEN FOR PRS 33-006(a)

LOCATION ID	SAMPLE ID	DEPTH (ft)	MATRIX	INORGANICS	RADIO-NUCLIDES	HE[a]
33-1321	AAA9769	0-0.5	Soil	19405	19414	17786
33-1332	AAA9770	0-0.5	Soil	19405	19414	17786
33-1343	AAA9771	0-0.5	Soil	19405	19414	17786
33-1354	AAA9772	0-0.5	Soil	19405	19414	17786
33-1460	AAA9773	0-0.5	Soil	19405	19414	17786
33-1355	AAA9774	0-0.5	Soil	19405	19414	17786
33-1356	AAA9775	0-0.5	Soil	19405	19414	17786
33-1357	AAA9776	0-0.5	Soil	19405	19414	17786
33-1358	AAA9777	0-0.5	Soil	19405	19414	17786
33-1464	AAA9778	0-0.5	Soil	19405	19414	17786
33-1359	AAA9779	0-0.5	Soil	19405	19414	17786
33-1322	AAA9780	0-0.5	Soil	19405	19414	17786
33-1323	AAA9781	0-0.5	Soil	19405	19414	17786
33-1324	AAA9782	0-0.5	Soil	19405	19414	17786
33-1325	AAA9783	0-0.5	Soil	19405	19414	17786
33-1326	AAA9784	0-0.5	Soil	19405	19414	17786

TABLE 5.5.4-1 (CONTINUED)

SUMMARY OF SURFACE SAMPLES TAKEN FOR PRS 33-006(a)

LOCATION ID	SAMPLE ID	DEPTH (ft)	MATRIX	INORGANICS	RADIO-NUCLIDES	HE[a]
33-1327	AAA9785	0-0.5	Soil	19403	19360	17791
33-1328	AAA9786	0-0.5	Soil	19403	19360	17791
33-1329	AAA9787	0-0.5	Soil	19403	19360	17791
33-1465	AAA9788	0-0.5	Soil	19403	19360	17791
33-1330	AAA9789	0-0.5	Soil	19403	19360	17791
33-1466	AAA9790	0-0.5	Soil	19403	19360	17791
33-1331	AAA9791	0-0.5	Soil	19403	19360	17791
33-1333	AAA9792	0-0.5	Soil	19403	19360	17791
33-1334	AAA9793	0-0.5	Soil	19403	19360	17791
33-1335	AAA9794	0-0.5	Soil	19396	19462	17732
33-1336	AAA9795	0-0.5	Soil	19403	19360	17791
33-1337	AAA9796	0-0.5	Soil	19396	19462	17732
33-1338	AAA9797	0-0.5	Soil	19396	19462	17732
33-1339	AAA9798	0-0.5	Soil	19396	19462	17732
33-1340	AAA9799	0-0.5	Soil	19396	19462	17732
33-1341	AAA9800	0-0.5	Soil	19396	19462	17732
33-1342	AAA9801	0-0.5	Soil	19396	19462	17732
33-1467	AAA9802	0-0.5	Soil	19396	19462	17732
33-1344	AAA9803	0-0.5	Soil	19396	19462	17732
33-1345	AAA9804	0-0.5	Soil	19396	19462	17732
33-1346	AAA9805	0-0.5	Soil	19396	19462	17732
33-1347	AAA9806	0-0.5	Soil	19396	19462	17732
33-1348	AAA9807	0-0.5	Soil	19396	19462	17732
33-1349	AAA9808	0-0.5	Soil	19396	19462	17732
33-1475	AAA9809	0-0.5	Soil	19396	19462	17732
33-1350	AAA9810	0-0.5	Soil	19283	19471	17831
33-1351	AAA9811	0-0.5	Soil	19283	19471	17831
33-1352	AAA9812	0-0.5	Soil	19283	19471	17831
33-1353	AAA9813	0-0.5	Soil	19283	19471	17831
33-1473	AAA9891	0-0.5	Soil	19403	19360	17791

[a] HE = High explosives.

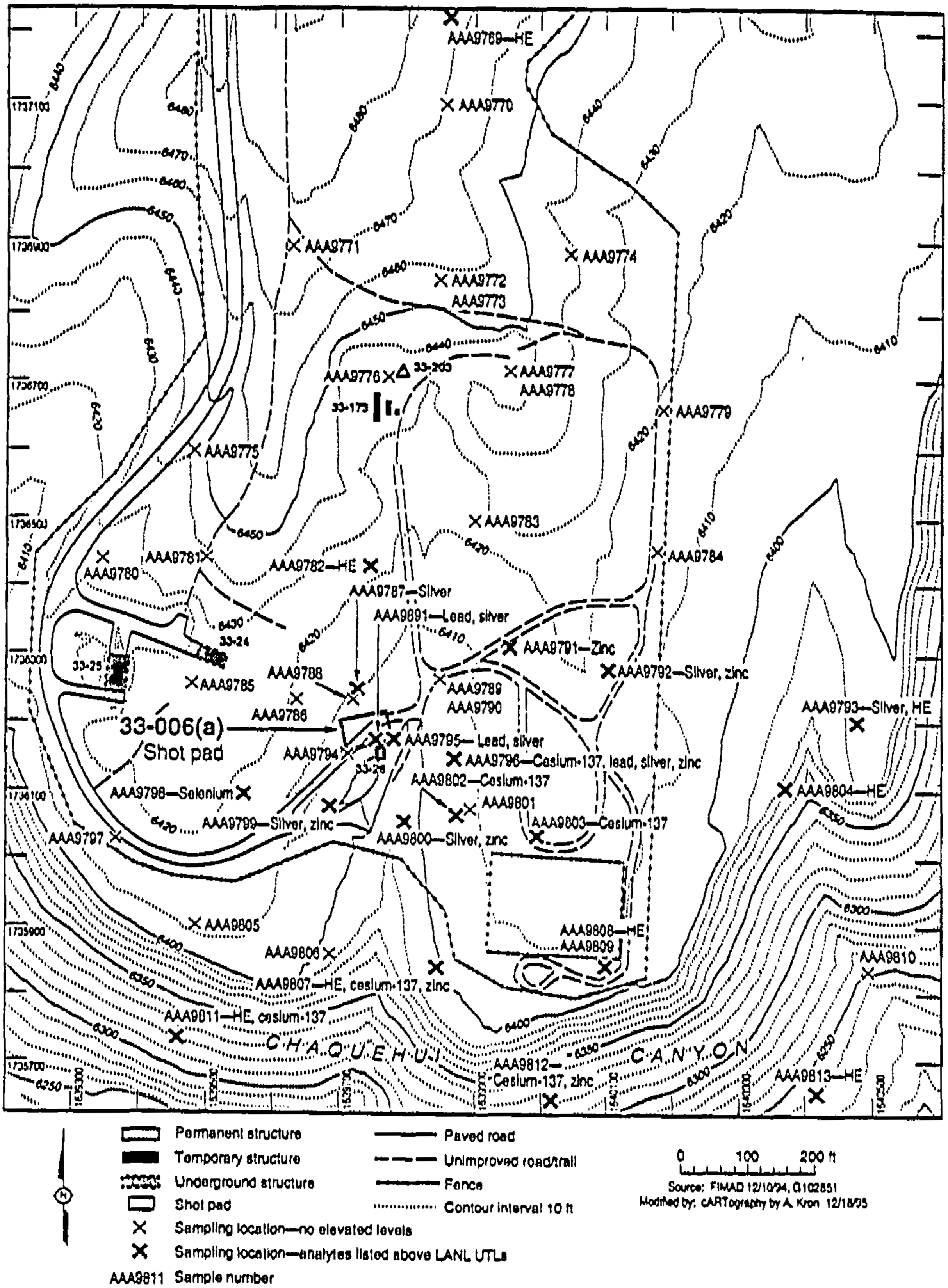
TABLE 5.5.4-2

SUMMARY OF DRAINAGE SAMPLES TAKEN FOR PRS 33-006(a)

LOCATION ID	SAMPLE ID	DEPTH (ft)	MATRIX	INORGANICS	RADIO-NUCLIDES	HE[a]	PESTI-CIDES	HERBI-CIDES
33-1363	AAA9743	0-0.5	Sediment	20384	19433	17789	NA[b]	NA
33-1364	AAA9744	0-0.5	Sediment	19264	19357	17733	NA	NA
33-1463	AAA9745	0-0.5	Sediment	19264	19357	17733	NA	NA
33-1365	AAA9746	0-0.5	Sediment	19264	19357	17733	NA	NA
33-1366	AAA9747	0-0.5	Sediment	19264	19357	17733	NA	NA
33-1367	AAA9748	0-0.5	Sediment	19264	19357	17733	17728	17728
33-1368	AAA9749	0-0.5	Sediment	19264	19357	17733	NA	NA
33-1369	AAA9750	0-0.5	Sediment	19264	19357	17733	NA	NA
33-1361	AAA9751	0-0.5	Sediment	19264	19357	17733	17728	17728
33-1311	AAA9752	0-0.5	Sediment	20384	19433	NA	NA	NA
33-1312	AAA9753	0-0.5	Sediment	20384	19433	NA	NA	NA

[a] HE = High explosives.

[b] NA = Not analyzed.



Source: FIMAD 12/10/94, G102851
Modified by: cARTography by A. Kron 12/18/95

Fig. 5.5.4-1. South Site: PRS 33-006(a), shot pad. Uranium and copper locations not indicated.

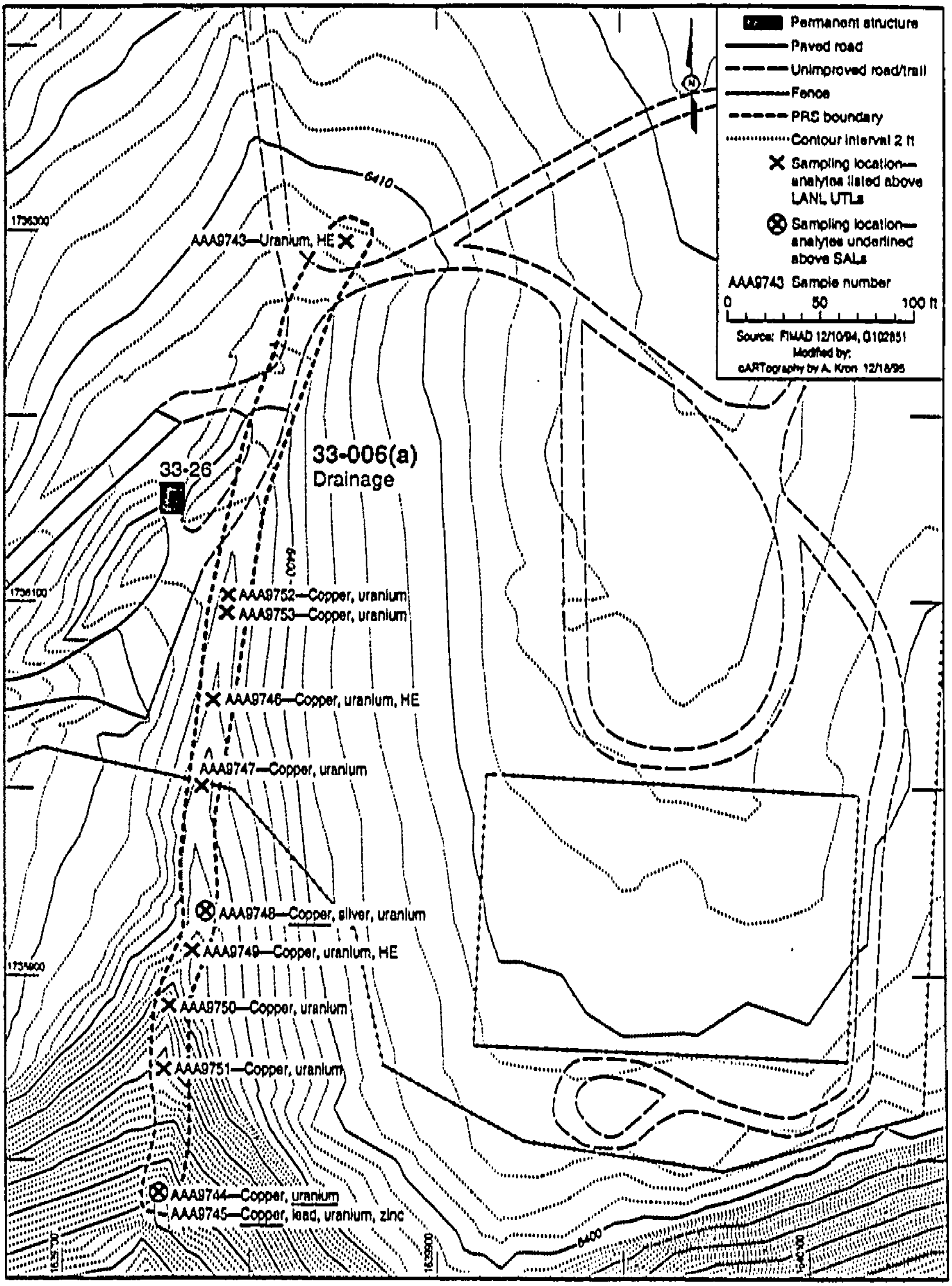


Fig. 5.5.4-2. South Site: PRS 33-006(a), drainage.

5.5.5 Background Comparison

Uranium and copper were detected in most PRS 33-006(a) samples. Results for both these chemicals are included in the discussion of sitewide distribution of uranium and copper presented in Section 5.5.9 of this RFI report. All other inorganic concentrations were below SALs in both random surface samples and drainage samples. Table 5.5.5-1 lists inorganics,.. except copper, detected above LANL UTLs in the random surface samples. Table 5.5.5-2 lists inorganics, except copper, detected above LANL UTLs in the drainage samples.

TABLE 5.5.5-1

INORGANICS[a] WITH CONCENTRATIONS GREATER THAN BACKGROUND UPPER TOLERANCE LIMIT FOR PRS 33-006(a) SURFACE SAMPLES

SAMPLE ID	DEPTH (ft)	LEAD (mg/kg)	SELENIUM (mg/kg)	SILVER (mg/kg)	ZINC (mg/kg)
LANL UTL[b]	N/A[c]	23.3	1.7	NA[d]	50.8
TA-33 UTL	N/A	25.2	0.921	ND[e]	57.3
SAL[f]	N/A	400	380	380	23 000
AAA9787	0-0.5	11.2	<0.56	2.3	39.1
AAA9791	0-0.5	8.5	<0.54	<2.2	54.2
AAA9792	0-0.5	17.5	<0.54	2.3	113
AAA9793	0-0.5	12.1	<0.54	0.81	45.8
AAA9795	0-0.5	41.4	<0.52	1.2	40.8
AAA9796	0-0.5	32.3	<0.53	4	56.1
AAA9798	0-0.5	8.8	4.4	<0.78	30.2
AAA9799	0-0.5	12.5	<0.54	2.2	87.8
AAA9800	0-0.5	14.5	<0.52	9.7	86.8
AAA9807	0-0.5	18.8	<0.54	<0.8	54.2
AAA9807R[g]	0-0.5	17.7	<0.54	<0.98	51.3
AAA9812	0-0.5	21.0	<.52	<.77	54
AAA9891	0-0.5	51.6	<0.55	0.81	51.8

[a] Copper results are listed in Section 5.5.9.
[b] UTL = Upper tolerance limit.
[c] N/A = Not applicable.
[d] NA = Not analyzed.
[e] ND = Not detected.
[f] SAL = Screening action level.
[g] R = Reanalyzed.

Cesium-137 was detected above LANL UTL in seven samples; levels are above TA-33 background UTL only in two of these samples. Table 5.5.5-3 lists cesium-137 detected above LANL UTLs in the random surface samples.

TABLE 5.5.5-2

INORGANICS[a] WITH CONCENTRATIONS GREATER THAN BACKGROUND UTLs FOR PRS 33-006(a)

SAMPLE ID	DEPTH (ft)	LEAD (mg/kg)	SILVER (mg/kg)	ZINC (mg/kg)
LANL UTL[b]	N/A[c]	23.3	NA[d]	50.8
TA-33 UTL	N/A	25.2	NA	57.3
SAL[e]	N/A	400	380	23 000
AAA9745	0-0.5	31.5	<0.75	1 160
AAA9748	0-0.5	5.7	0.8	43.1

[a] Copper results are listed in section 5.5.9
[b] UTL = Upper tolerance limit.
[c] N/A = Not applicable.
[d] NA = Not analyzed.
[e] SAL = Screening action level.

TABLE 5.5.5-3

RADIONUCLIDES[a] WITH CONCENTRATIONS GREATER THAN BACKGROUND CONCENTRATIONS FOR PRS 33-006(a) DRAINAGE SAMPLES

SAMPLE ID	DEPTH (ft)	CESIUM-137 (pCi/g)
LANL UTL[b]	N/A[c]	1.4
TA-33 UTL	N/A	2.068
SAL[d]	N/A	5.1
AAA9796	0-0.5	1.612
AAA9802	0-0.5	2.979
AAA9803	0-0.5	2.678
AAA9807	0-0.5	1.505
AAA9811	0-0.5	1.506
AAA9811R[e]	0-0.5	1.416
AAA9812	0-0.5	2.085

[a] Uranium results are listed in section 5.5.9.
[b] UTL = Upper tolerance limit.
[c] N/A = Not applicable.
[d] SAL = Screening action level.
[e] R = Reanalyzed.

5.5.6 Evaluation of Organics

About 80% of the data used to assess the level and extent of HE contamination in areas affected by the South Site shot pad, PRS 33-006(a), were rejected during data validation. These data include samples listed in Tables 5.5.4-1 and 5.5.4-2, and data from surface samples taken for PRSs 33-007(b), 33-010(g), and 33-014, all of which are within boundary of PRS 33-006(a) (Fig. 5.0-1). Low levels of HE for half a dozen samples were reported with qualifiers due to missed holding times. The detailed review of the HPLC scans described in Section 4.2.2 increased the number of samples in this group in which low levels of HE could be identified. Original estimated results are listed in Table 5.5.6-1.

Data are sufficiently complete to determine that while there are trace amounts of explosives in surface samples at South Site, they are not at levels of concern. Table 5.5.6-1 lists all surface HE results (as reported) detected at South Site, including both results that were originally reported and those that were added as a result of reevaluation of the raw data, described in Section 4.2. The first qualifier is that provided during the reevaluation; the second is that applied by the data validators to the original result, which in many cases was reported as below the CRQL.

In general, HE results in these samples are below levels of concern, even if the estimated results are multiplied by a factor of 5 to 10 to compensate for missed holding times. A few RDX data points would be above the SAL of 4 if the results were multiplied by 5 to 10. One questionable RDX result is above SAL. However, a limited resampling campaign is proposed in Section 5.5.11 to confirm this assessment.

TABLE 5.5.6-1

HIGH EXPLOSIVES DETECTED IN SOUTH SITE SURFACE SAMPLES

PRS	DESCRIPTION	DEPTH (ft)	SAMPLE	HE[a]	RESULT (mg/kg)	SAL[b] (mg/kg)	EQL[c] (mg/kg)	QUALIFIERS	
33-006(a)	Drainage	0-0.5	AAA9743	HMX	0.15	3 259	1.1	N/A[d]	R[e]
33-006(a)	Drainage	0-0.5	AAA9740	RDX	0.59	4.0	0.5	J+[f]	R
				TNT	0.07	48.4	0.13	J+	R
33-006(a)	Drainage	0-0.5	AAA9749	RDX	0.56	4.0	0.5	J+	R
33-006(a)	Operational release	0-0.5	AAA9769	HMX	0.30	3 259	1.1	J,g	R
33-006(a)	Operational release	0-0.5	AAA9782	HMX	0.30	3 259	1.1	J-	R
				RDX	0.20	4.0	0.5	J-	R
				TNT	0.27	48.4	0.13	R	R
33-006(a)	Operational release	0-0.5	AAA9793	TIC[h]	N/A	N/A	N/A	N/A	N/A
33-006(a)	Operational release	0-0.5	AAA9804	Tetryl	0.69	650	0.33	J[i]	J
33-006(a)	Operational release	0-0.5	AAA9807	A-DNT	0.50	NC[j]	0.13	J+	R
33-006(a)	Operational release	0-0.5	AAA9808	A-DNT	0.66	NC	0.13	J+	J

TABLE 5.5.6-1 (CONTINUED)

HIGH EXPLOSIVES DETECTED IN SOUTH SITE SURFACE SAMPLES

PRS	DESCRIPTION	DEPTH (m)	SAMPLE	HE	RESULT (mg/kg)	SAL (mg/kg)	EQL (mg/kg)	QUALIFIERS	
33-006(a)	Operational release	0-0.5	AAA9811	A-DNT	5.35	NC	0.13	J+	J
				NB	0.51	33	0.13	J+	J
				2-NT	0.16	NC	0.13	J+	J
				3-NT	0.51	650	0.13	J+	J
				4-NT	0.51	650	0.13	J+	J
				RDX	0.54	4.0	0.5	J+	J
				TIC	N/A	N/A	N/A	N/A	N/A
33-006(a)	Operational release	0-0.5	AAA9813	A-DNT	0.36	NC	0.13		J
				TIC	N/A	N/A	N/A	N/A	N/A
33-007(b)	Drainage	0-0.5	AAA9741	HMX	0.30	3 259	1.1	J+	R
				RDX	0.50	4.0	0.5	N/A	J
				TNB	0.17	3.3	0.13	N/A	J
33-007(b)	Drainage	0-0.5	AAA9742	HMX	0.20	3 259	1.1	J+	R
33-007(b)	Gun mount	0-0.5	AAA9761	HMX	0.83	3 259	1.1	N/A	R
33-010(h)	Surface disposal	0-0.5	AAA9724	HMX	0.20	3 259	1.1	J+	UJ[k]
33-014	Burn area	0-0.5	AAA9758	HMX	0.53	3 259	1.1	J-	R
33-014	Burn area	0-0.5	AAA9759	A-DNT	1.20	NC	0.13	J2[l]	R
				HMX	0.36	3 259	1.1	J2	R
				RDX	8.20	4.0	0.5	J2	R
				TNT	0.81	48.4	0.13	J2	R
				Tetryl	1.85	650	0.33	J2	R

[a] HE = High explosives.
[b] J+ = Estimated quantity, biased high based on surrogate recovery.
[c] R = Rejected.
[d] J = Estimated quantity.
[e] J- = Estimated quantity, biased low based on surrogate recovery.
[f] UJ = Not detected, quantitative limit reported is estimated.
[g] J2 = Estimated from confirmation column data.

5.5.7 Human Health Assessment

5.5.7.1 Screening Assessment

Uranium and copper were detected above SAL in the soil samples collected for this PRS, and will therefore be carried forward through the screening assessment. Based on Phase I random sampling, copper and uranium distributions were determined for the area surrounding the pad, discussed in Section 5.5.9 of this RFI report.

Other chemicals identified to be greater than LANL background UTLs were submitted for an MCE for noncarcinogenic effects. HE data are used as reported in Table 5.5.6-1, recognizing that much of this data is of uncertain quality. The sum of the maxima for the noncarcinogenic group is 0.40. The sum of the maxima for the carcinogenic group is 0.13. These results are well

below the target value of 1, which indicates a low potential for adverse effects due to exposure to these multiple groupings. Therefore, these chemicals are not identified as potentially hazardous. The data from Phase II resampling for HE may require us to revisit this MCE in a Phase II report. Only one radionuclide (cesium-137) was detected above UTL, but below SAL; therefore, no MCE was performed for this grouping. The results of the MCE for this PRS are summarized in Table 5.5.7-1.

TABLE 5.5.7.1-1

MULTIPLE CONSTITUENT EVALUATION FOR PRS 33-006(a)

ANALYTE	MAXIMUM SOIL CONCENTRATION (mg/kg)	SOIL SAL[a] (mg/kg)	CONCENTRATION NORMALIZED TO SAL
NONCARCINOGENIC EFFECTS			
Lead	51.6	400	0.129
Selenium	4.4	380	0.012
Silver	9.7	380	0.026
Zinc	1160	23 000	0.050
1,3,5-Trinitrobenzene	0.17	3.3	0.052
m-Nitrotoluene	0.51	650	0.001
Nitrobenzene	0.51	33	0.002
p-Nitrotoluene	0.51	650	0.001
RDX	0.5	4	0.12
HMX	0.30	3 259	0.001
Tetryl	0.69	650	0.001
Total			0.400
CARCINOGENIC EFFECTS			
RDX	0.5	4	0.125
2,4,6-TNT	0.27	48	0.006
Total			0.131

[a] SAL = Screening action level.

5.5.7.2 Risk Assessment

No risk assessment was performed for this PRS because the risk assessment for PRS 33-010(c) indicated elevated uranium and copper posed no unacceptable risk. These two contaminants are evaluated in detail in Section 5.11.8 of this RFI report for PRS 33-010(c), which is in close proximity to this PRS. Because the upper confidence level (UCL) calculated for uranium (68.4 mg/kg) is lower than that evaluated as the source term in the 33-010(c)

analysis (81.5 mg/kg), it is concluded that potential exposure to uranium and copper in soil at this site should not result in adverse noncarcinogenic health effects or an unacceptable radiation dose to trail users. See Appendix C of this RFI report for risk calculations for PRS 33-010(c).

5.5.8 Ecological Assessment

5.5.8.1 Ecotoxicological Screening Assessment

This PRS will be included in EEUs defined for both ecological screening and ecological risk assessments. A site inspection of this PRS indicates that it will be adequately addressed in the EEUs.

5.5.8.2 Ecological Risk Assessment

No ecological risk assessment has been performed for this PRS. An ecological risk assessment will be evaluated when an approach is approved by regulators.

5.5.9 Extent of Contamination

As expected, uranium and copper are widespread around the shot pad. A total of 46 surface soil samples and 11 drainage samples were collected in PRS 33-006(a) to assess the spatial distribution of contaminants around the shot pad. Sampling at South Site also included eight surface soil samples from the tower area [PRS 33-007(b)], four surface samples from the burn pit (PRS 33-014), and four surface samples from a canyonside disposal area [PRS 33-010(g)]. Because PRS 33-006(a) overlaps these PRSs, the 16 additional samples from these PRSs can be used to extend the area included in this assessment to the north, east, and south, for a total of 73 samples. Data for these samples are listed in Table 5.5.9-1, including collocated (CO) samples and duplicate laboratory analyses of single samples.

Total uranium results are available for all 73 samples. Thirty-one, or 42%, of these results exceed the LANL background UTL. These are concentrated in the central valley, as shown in Figure 5.5.9-1. The shaded area in Figure 5.5.9-1 estimates the boundary of above-background uranium contamination. Occasional above-background observations are found outside this contour. Within-background observations are found inside this contour. Collocated pairs can differ significantly (compare AAA9772 and AAA9773 at the south end of the drainage, for example). The overall trend, however, is well defined by the existing samples, except that the extent of contamination in the central drainage has not been bounded at the southern end. All samples but the northernmost drainage sample are above background. Ten observations exceed the uranium SAL of 29 mg/kg.

Copper analyses are available for 65 of the samples. Thirty-three, or 46%, of these results exceed the background UTL, and six (including the duplicate but not the original analysis of AAA9748) exceed the SAL of 3 000 mg/kg. There is a high degree of overlap between the sets of samples that exceed background for uranium and for copper, and on a logarithmic scale, the correlation between the two measurements is 0.67.

TABLE 5.5.9-1

URANIUM AND COPPER IN SOUTH SITE SURFACE SOIL SAMPLES

SAMPLE ID	TYPE	PRS	LOCATION	COPPER (mg/kg)	URANIUM (mg/kg)
LANL UTL[a]	N/A[b]	N/A	N/A	30.7	5.1
TA-33 UTL	N/A	N/A	N/A	NC[c]	4.1
SAL[d]	N/A	N/A	N/A	2 800	29
AAA9741	Field	33-006(a)	Drainage	13.2 (J)[e]	4.23 (J)[f]
AAA9741	Duplicate	33-006(a)	Drainage	13.9	NA[g]
AAA9742	Field	33-006(a)	Drainage	27.5 (J)	407.12[h]
AAA9743	Field	33-006(a)	Drainage	22.1 (J)	7.01 (J)[f]
AAA9744	Field	33-006(a)	Drainage	847.0[f]	21.48 (J)[f]
AAA9744	Duplicate	33-006(a)	Drainage	NA	31.78 (J)[h]
AAA9745	CO(AAA9744)	33-006(a)	Drainage	5 760.0[h]	16.68 (J)[f]
AAA9746	Field	33-006(a)	Drainage	817.0[f]	13.51 (J)[f]
AAA9747	Field	33-006(a)	Drainage	291.0[f]	6.63 (J)[f]
AAA9748	Field	33-006(a)	Drainage	1 380.0[f]	22.74 (J)[f]
AAA9748	Duplicate	33-006(a)	Drainage	4 010.0[h]	NA
AAA9749	Field	33-006(a)	Drainage	494.0[f]	20.93 (J)[f]
AAA9750	Field	33-006(a)	Drainage	60.1[f]	7.55 (J)[f]
AAA9750	Duplicate	33-006(a)	Drainage	NA	6.24 (J)[f]
AAA9751	Field	33-006(a)	Drainage	1 270.0[f]	21.43 (J)[f]
AAA9763	Field	33-007(b)	Operational release	13.2	0.74
AAA9764	CO(AAA9763)	33-007(b)	Operational release	13.6	0.91
AAA9765	Field	33-007(b)	Gun mount	23.1	1.96
AAA9766	Field	33-007(b)	Operational release	10.6	0.94
AAA9767	Field	33-007(b)	Operational release	31.8[f]	19.27[f]
AAA9768	Field	33-007(b)	Operational release	10.2	2.45
AAA9769	Field	33-006(a)	Operational release	6	0.54
AAA9770	Field	33-006(a)	Operational release	5.7	0.71
AAA9771	Field	33-006(a)	Operational release	27.6	1.61
AAA9772	Field	33-006(a)	Operational release	183[f]	11.54[f]

TABLE 5.5.9-1 (CONTINUED)

URANIUM AND COPPER IN SOUTH SITE SURFACE SOIL SAMPLES

SAMPLE ID	TYPE	PRS	LOCATION	COPPER (mg/kg)	URANIUM (mg/kg)
AAA9773	CO(AAA9772)	33-006(a)	Operational release	11.1	3.76
AAA9774	Field	33-006(a)	Operational release	<5.7	0.47
AAA9775	Field	33-006(a)	Operational release	5.7	1.02
AAA9776	Field	33-006(a)	Operational release	8.8	2.74
AAA9777	Field	33-006(a)	Operational release	5.4	1.58
AAA9778	Field	33-006(a)	Operational release	<5.2	0.66
AAA9779	Field	33-006(a)	Operational release	10.5	3.35
AAA9780	Field	33-006(a)	Operational release	7.3	1.48
AAA9780	Duplicate	33-006(a)	Operational release	6.1	1.17
AAA9781	Field	33-006(a)	Operational release	<10.5	4.15[f]
AAA9782	Field	33-006(a)	Operational release	39.2[f]	14.14[f]
AAA9783	Field	33-006(a)	Operational release	10	1.18
AAA9783	Duplicate	33-006(a)	Operational release	NA	1.75
AAA9784	Field	33-006(a)	Operational release	12.7	2.34
AAA9785	Field	33-006(a)	Operational release	16.4	0.85
AAA9785	Duplicate	33-006(a)	Operational release	18.5	0.90
AAA9786	Field	33-006(a)	Operational release	539[f]	8.25[f]
AAA9787	Field	33-006(a)	Operational release	2 500[f]	52.41[h]
AAA9788	Field	33-006(a)	Operational release	300[f]	30.44[h]
AAA9789	Field	33-006(a)	Operational release	1320[f]	4.20[f]
AAA9790	CO(AAA9789)	33-006(a)	Operational release	25.6	3.12
AAA9791	Field	33-006(a)	Operational release	23 300[h]	23.34[f]
AAA9792	Field	33-006(a)	Operational release	18 100[h]	7.88[f]
AAA9793	Field	33-006(a)	Operational release	22.3	1.10
AAA9794	Field	33-006(a)	Operational release	409[f]	35.24[h]
AAA9795	Field	33-006(a)	Operational release	1 140[f]	90.94[h]
AAA9796	Field	33-006(a)	Operational release	3 180[h]	208.85[h]
AAA9797	Field	33-006(a)	Operational release	8.7	0.45
AAA9798	Field	33-006(a)	Operational release	58.7[f]	6.05[f]
AAA9799	Field	33-006(a)	Operational release	3 340[h]	58.50[h]
AAA9800	Field	33-006(a)	Operational release	1210[f]	84.33[h]
AAA9801	Field	33-006(a)	Operational release	41[f]	26.66[f]
AAA9802	Field	33-006(a)	Operational release	40.2[f]	9.69[f]
AAA9803	Field	33-006(a)	Operational release	33[f]	1.20
AAA9804	Field	33-006(a)	Operational release	9	2.12
AAA9804	Duplicate	33-006(a)	Operational release	NA	2.33

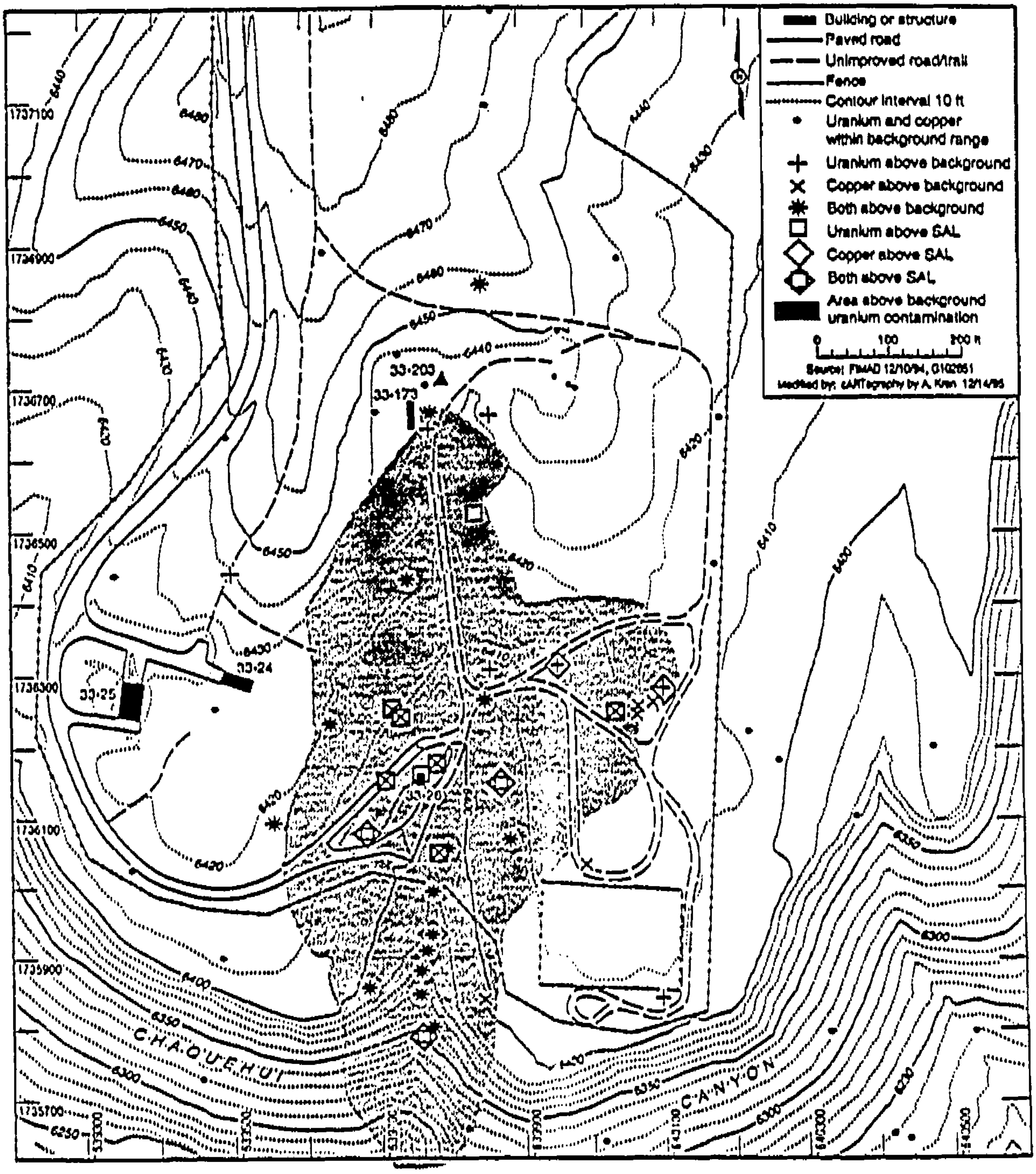
TABLE 5.5.9-1 (CONTINUED)

URANIUM AND COPPER IN SOUTH SITE SURFACE SOIL SAMPLES

SAMPLE ID	TYPE	PRS	LOCATION	COPPER (mg/kg)	URANIUM (mg/kg)
AAA9805	Field	33-006(a)	Operational release	23.9	3.40
AAA9806	Field	33-006(a)	Operational release	91.5[f]	6.05[f]
AAA9807	Field	33-006(a)	Operational release	69.8[f]	3.93
AAA9807	Duplicate	33-006(a)	Operational release	76.3[f]	NA
AAA9808	Field	33-006(a)	Operational release	11.5	1.27
AAA9809	Field	33-006(a)	Operational release	5.5	15.05[f]
AAA9810	Field	33-006(a)	Operational release	NA	0.62
AAA9811	Field	33-006(a)	Operational release	NA	0.87
AAA9812	Field	33-006(a)	Operational release	NA	1.35
AAA9813	Field	33-006(a)	Operational release	NA	0.62
AAA9891	Field	33-006(a)	Operational release	1 330[f]	678.30[h]
AAA9761	Field	33-007(b)	Gun mount	27.1	12.19[f]
AAA9761	Duplicate	33-007(b)	Gun mount	25.2	NA
AAA9762	Field	33-007(b)	Gun mount	23.6	3.80
AAA9762	Duplicate	33-007(b)	Gun mount	NA	3.77
AAA9814	Field	33-010(g)	Canyonside disposal	NA	0.55
AAA9815	Field	33-010(g)	Canyonside disposal	NA	0.18
AAA9816	Field	33-010(g)	Canyonside disposal	NA	1.57
AAA9817	Field	33-010(g)	Canyonside disposal	NA	1.16
AAA9817	Duplicate	33-010(g)	Canyonside disposal	NA	1.27
AAA9757	Field	33-014	Burn area	147[f]	2.32
AAA9758	Field	33-014	Burn area	31.6[f]	1.14
AAA9759	Field	33-014	Burn area	302[f]	72.39[h]
AAA9760	Field	33-014	Burn area	1450[f]	3.86

[a] UTL = Upper tolerance limit.
[b] N/A = Not applicable.
[c] NC = Not calculated.
[d] SAL = Screening action level.
[e] J = Estimate quantity.
[f] Above background UTL.
[g] NA = Not analyzed.
[h] Above SAL.

Low levels of silver were detected near the shot pad and at least 700 ft to the east (Figure 5.5.4-1). This distribution implies that silver was a component of the implosion experiments. Because of its high SAL (383 mg/kg) and spotty distribution, silver is not considered a potential concern (Section 5.5.7.1 of this RFI report).



Source: FIMAD 12/10/94, G102651
Modified by: cARTography by A. Kron 12/14/95

Fig. 5.5.9-1. South Site: distribution of uranium and copper.

Lead was detected at locations near the shot pad, but not at levels of concern (Section 5.5.7.1 of this RFI report). Lead bricks and plates were commonly used for shielding against radioactivity and anchoring experimental apparatus. Because pieces of lead have been found on the surface at South Site, identification of lead is specified in the shrapnel sampling plan in Section 5.5.11 of this RFI report.

5.5.10 Conclusion and Recommendation

PRS 33-006(a) is recommended for limited HE Phase II resampling because HE results at South Site were compromised by missed holding times. While focused validation indicates that contamination may be low, a limited resampling effort is recommended to verify the assessment that HE is not a concern at South Site. The resampling plan is presented in Section 5.5.11.1 of this RFI report.

Shrapnel is widespread at South Site, in Chaquehui Canyon, and on adjacent mesa tops. During an investigation in 1989, approximately 20% of the shrapnel was found to be radioactively contaminated (Buckland 1989, 02-059). A shrapnel pickup VCA will be evaluated and performed if appropriate.

5.5.11 Resampling and Analysis Plan for PRS 33-006(a)

Approximately 80% of the data to assess the distribution of HE in areas affected by the shot pad [surface samples from PRS 33-006(a), PRS 33-007(b), PRS 33-010(g), and PRS 33-014] were rejected by data validation. Review of the HPLC scans for these samples, as described in Section 4.2, almost tripled the number of samples in which low levels of HE could be identified. In general, HE results in these samples are below levels of concern, even when adjusted to compensate for missed holding times. However, a limited resampling campaign is proposed to confirm this assessment. Eight South Site surface sampling locations, listed in Table 5.5.11-1, will be resampled for HE analysis only. At six locations, the original sampling suggests the presence of HE. Two locations are selected to confirm negative results. These locations are shown on Figure 5.5.11-1.

TABLE 5.5.11-1

SOUTH SITE HIGH EXPLOSIVES RESAMPLING LOCATIONS

PRS	DESCRIPTION	LOCATION ID	SAMPLE	CRITERIA
33-006(a)	Drainage	33-1360	AAA9741	Drainage w/ most hits
33-006(a)	Drainage	33-1365	AAA9746	High RDX
33-006(a)	Drainage	33-1366	AAA9747	Drainage w/ no hits
33-006(a)	Operational release	33-1351	AAA9811	High A-DNT, other hits, high surrogate recovery
33-006(a)	Operational release	33-1353	AAA9813	High A-DNT, unknowns
33-006(a)	Operational release	33-1324	AAA9782	Dirty sample, analytical problems
33-007(b)	Gun mount	33-1402	AAA9761	High HMX
33-014	Burn area	33-1446	AAA9759	RDX>8, several hits >1, analytical problems

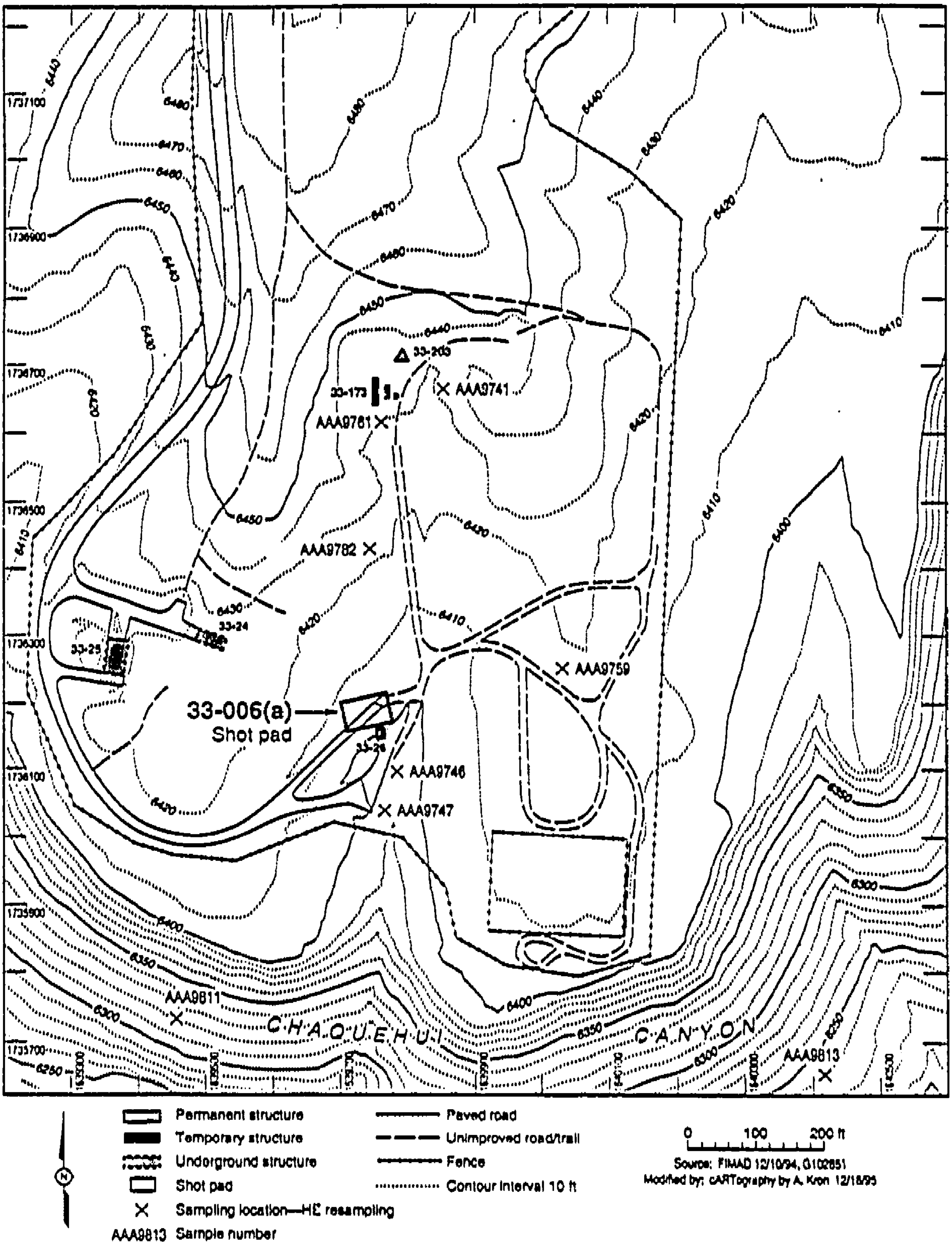


Fig. 5.5.11-1. South Site: PRS 33-006(a), shot pad. Resampling locations for high explosives.

5.2 Waste Volumes

Actual volumes of waste generated during the IA, compared with the estimated waste volumes, are shown in Table 5-1. Weights of the waste are also listed in the table.

TABLE 5-1

ESTIMATED AND ACTUAL WASTE VOLUMES

SITE LOCATION	WASTE TYPE	ESTIMATED VOLUME	ACTUAL VOLUME	ACTUAL WEIGHT
TA-33	Nonhazardous/ nonradioactive	1 yd^3	1 yd^3	450 lb
	Radioactive	1 yd^3	1.5 yd^3	770 lb
	Hazardous	0 yd^3	<0.25 yd^3	20 lb
	Mixed	0 yd^3	<0.25 yd^3	20 lb
Bandelier National Monument	Nonhazardous/ nonradioactive	<0.1 yd^3	<0.01 yd^3	1 lb
	Radioactive	<0.1 yd^3	0 yd^3	-0-

5.3 Waste Disposal

Waste streams were disposed of as follows:

- Radioactive waste was stored in four 55-gal drums and one King bag within RWHAs. On February 12, 1997, the waste was sent to Area G, TA-54.
- Nonhazardous/nonradioactive waste is being stored in two 55-gal drums and one King bag in posted areas adjacent to the RWHAs. The material is held pending accumulation from other TA-33 activities of a sufficient quantity for collection by a commercial recycler.
- Hazardous and potentially-mixed waste remain in a satellite accumulation area at Main Site.
- Mixed waste may be used in treatability studies to evaluate techniques to separate radioactive from hazardous components.

6.0 COST AND SCHEDULE

Estimated and actual costs are given in Table 6-1. Estimated and actual schedules are given in Table 6-2.

TABLE 6-1

ESTIMATED AND ACTUAL COSTS

TYPE ACTION	TASK	ESTIMATED COSTS	ACTUAL COSTS
Chaquehui pickup	Administrative	Not estimated	$7 700
	Field removal work	$7 200	$26 465
	Report writing	$1 200	$2 520
	Waste management	$675	$675
	Radioactive waste disposal fees	$300	$300
	Mixed-waste disposal fees	Not estimated	$5 000*
		Subtotal	$42 660
Bandelier pickup	Administrative	Not estimated	$330
	Field removal work	$3 600	$6 620
	Report writing	$600	$800
	Waste management	$450	$450
		Subtotal	$8 200
		TOTAL	$50 860

* Costs are unknown if the mixed waste is incorporated into a technology demonstration project. Cost shown is for waste disposal to a mixed-waste permitted facility (Envirocare).

TABLE 6-2

ESTIMATED AND ACTUAL SCHEDULE

TYPE ACTION	TASK	SCHEDULE	ESTIMATED TIME	ACTUAL TIME
Chaquehui Canyon pickup	Field removal work	10/9/96-11/11/96	96 man hours	192 man hours
	Report writing	2/28/97	16 man hours	50 man hours
	Waste management	8/30/96-2/28/97	9 man hours	9 man hours
	Radioactive waste disposal	3/97	N/A	N/A
Bandelier pickup	Field removal work	8/30/96-8/31/96	48 man hours	48 man hours
	Report writing	2/28/97	8 man hours	16 man hours
	Waste management	8/30/96-2/28/97	6 man hours	6 man hours

REFERENCES

Environmental Restoration Project, July 1996. "Interim Action Plan for Shrapnel Pickup at PRS 33-006(a), Field Unit 3, Los Alamos National Laboratory, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 02-119)**

LANL, (Los Alamos National Laboratory), January 6, 1994. Cultural Resources Management Team Survey Procedure Draft. ESH-20, Los Alamos, New Mexico. **(LANL 1994, 02-116)**

ATTACHMENT 5 PHASE I REPORT FOR PRS 33-008(a)

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

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5.2.4 Conclusion and Recommendation

To adequately assess release of potential contamination by this outfall, a second try at Phase I sampling is proposed in conjunction with sampling in landfill SWMU 33-008(b).

5.2.5 Sampling and Analysis Plan

During the Phase I sampling of landfill SWMU 33-008(b), described in Subsection 5.3 of this RFI report, an attempt will be made to locate the pipe. If the pipe is located, samples will be collected as follows: if the outfall lies within the boundaries of the landfill, a sample will be taken at the soil/tuff interface in the landfill at the point indicated on the engineering drawing as the location of the outfall (Fig. 5-3). If the outfall is located outside the boundaries of the landfill, a sample will be taken at that point. This sampling will be considered Phase I reconnaissance sampling. The sample will be analyzed in the laboratory for inorganics, VOCs, and SVOCs.

5.3 SWMU 33-008(a,b) Landfills at South Site and East Site

SWMUs 33-008(a,b) are landfills created at TA-33 during a 1984 cleanup of South and East Sites. SWMU 33-008(a) is discussed in the RFI Work Plan for OU 1122, Subsections 3.4.2.10 and 4.4.7 (LANL 1992, 0784). SWMU 33-008(b) is discussed in work plan Subsections 3.5.2.6 and 4.5.6. After the RFI work plan was submitted, evidence was discovered that the contents of the landfill made the proposed trenching sampling plan inappropriate to perform. A revised plan is presented here.

The SWMU 33-008(a) landfill was created in 1984 at South Site when many structures and experimental objects were dismantled. The cleanup was intended as an interim action pending stricter regulation of LANL cleanup activities. During cleanup, radioactive and salvageable material were removed; however, no sampling was done to identify RCRA hazardous wastes. Remaining material was buried in the landfill (Buhl 1984, 02-038).

The SWMU 33-008(b) landfill was created at East Site during the 1984 cleanup. Radioactive and salvageable material were removed. Remaining material was buried. The surface was leveled and the corners of the landfill marked with metal posts.

The RFI work plan for OU 1122, approved by EPA in 1993, proposed trenching through each landfill to determine if the contents include hazardous material (LANL 1992, 0784). Subsequent to submittal of the work plan, photos were discovered that were taken during the cleanup. Photos indicate that the buried debris included massive items such as telephone poles and railroad ties and that the material is tightly packed within the landfill. It became clear that trenching with a backhoe as described in the work plan could not produce the desired samples. This section presents an alternate sampling plan.

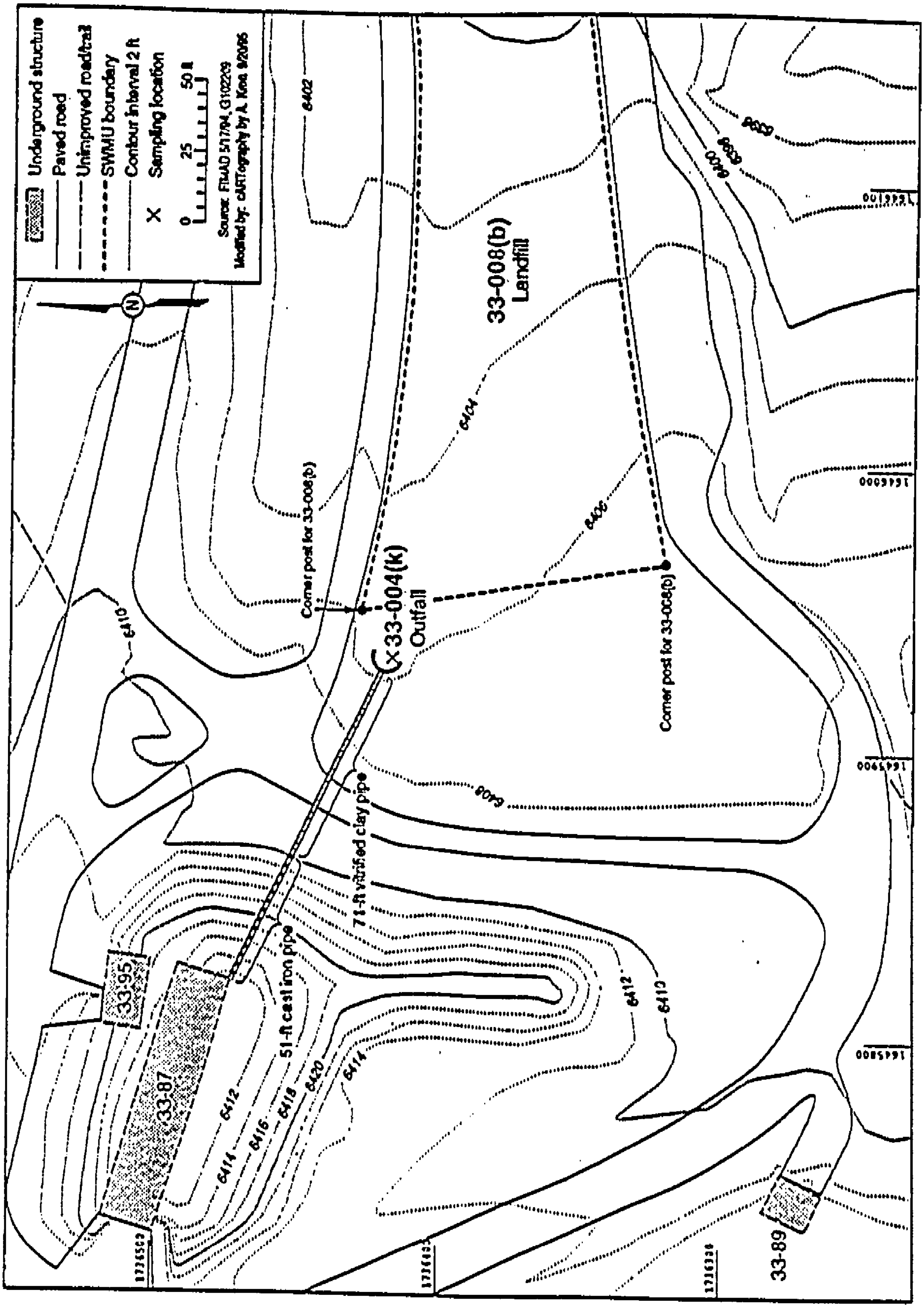

Fig. 5-3. East Site: SWMU 33-004(k), outfall from TA-33-87, shown in relation to SWMU 33-008(b), landfill.

SWMU 33-008(a) This landfill lies within a horseshoe-shaped berm, TA-33-43, at South Site. The floor of the berm appears to be on bedrock. At its highest point, the berm is about 15 ft high. The landfill grades from the floor to the inside curve of the berm and may be 8 ft at its deepest point. The four corners of the landfill are marked with metal pipe. Over the years, a thick stand of chamisa has grown on the landfill. Some of the buried material has been exposed through erosion.

SWMU 33-008(b) The landfill at East Site occupies the space between the firing pads east of bunker TA-33-87 and shack TA-33-151. According to LANL engineering drawing ENG-C 3304, this area may have originally been excavated to provide material for the nearby berms. The fill is well compacted and covered; there is no longer any surface indication of its existence. The four corners are marked with metal poles. The surface is level and covered with a sparse growth of weeds and grasses. Thick stands of chamisa grow along most of the perimeter.

5.3.1 Previous Investigations

Prior to 1994 ER sampling, no investigations had been performed for these landfills.

5.3.2 Field Investigations

SWMU 33-008(a) During the 1994 sampling campaign, four surface samples were collected at the South Site landfill. Three were taken at the lower edge of the landfill. The fourth was taken in the drainage leading from the bermed area (Fig. 5-4). All four samples were analyzed for inorganics, uranium, gamma emitters and HE. Two samples were analyzed for uranium.

SWMU 33-008(b) No samples were taken within the East Site landfill boundaries during the 1994 sampling campaign. Fig. 5-5 shows the extent of the landfill.

5.3.2.1 Results of Field Surveys

No field surveys were associated with SWMUs 33-008(a) or 33-008(b).

5.3.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-008(a).

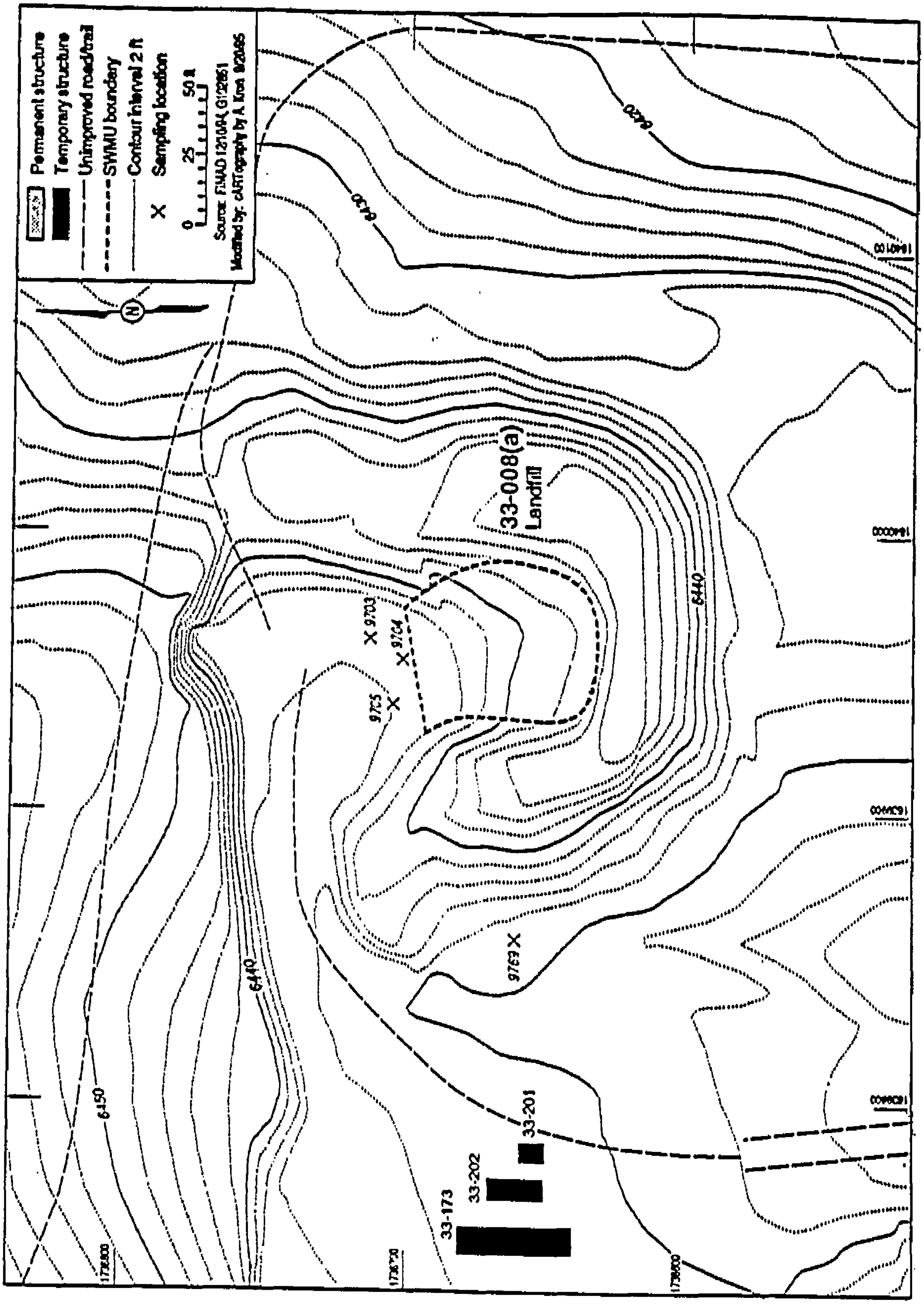

Fig. 5-4. South Site: SWMU 33-008(a), landfill, 1994 sampling campaign.

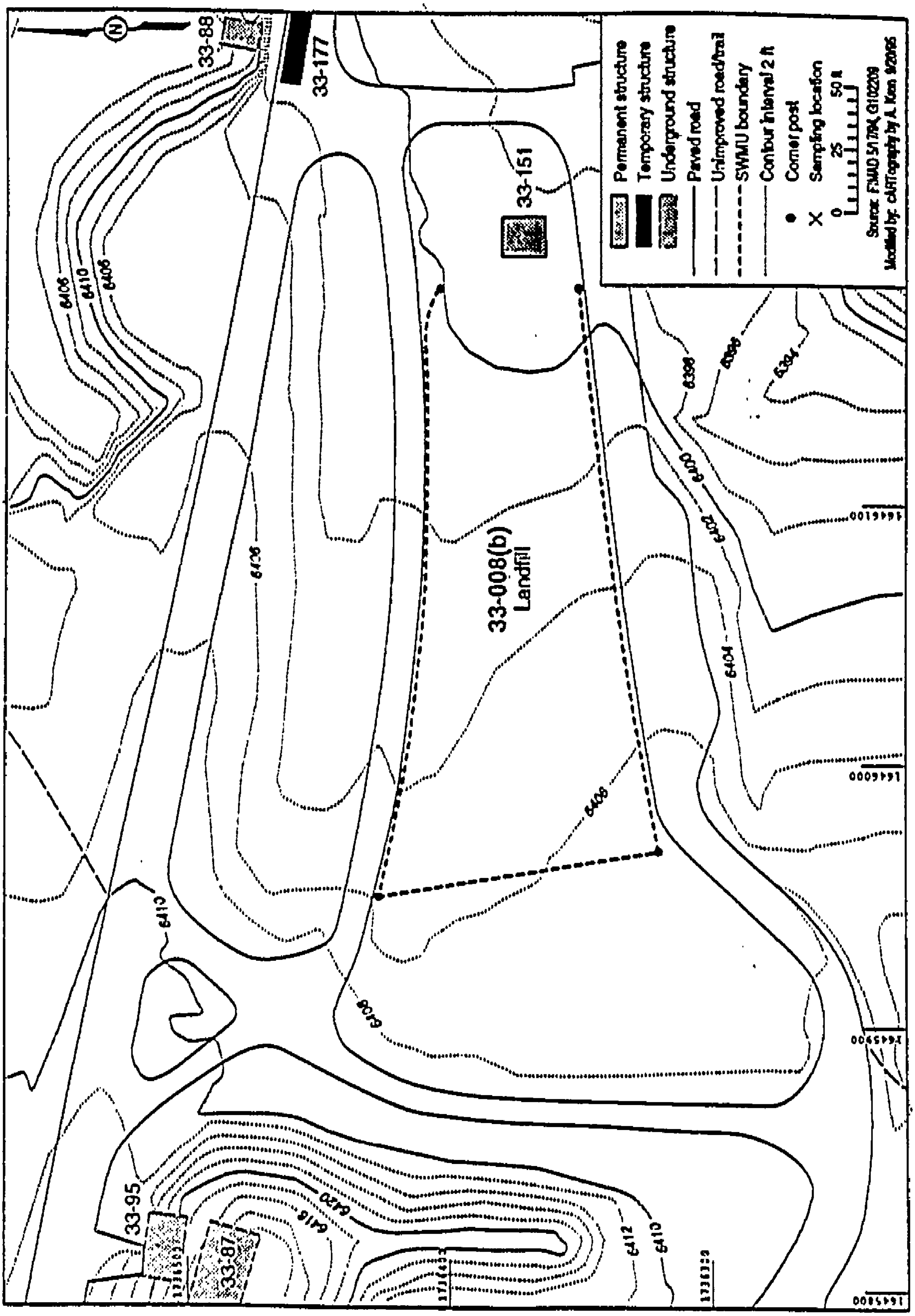

Fig. 5-5. East Site: SWMU 33-008(b), landfill.

5.3.3 Screening Assessment

5.3.3.1 Comparison to Background/SALs

SWMU 33-008(a) Two SVOCs were detected in one sample (Table 5-3). No inorganics, gamma emitters, or uranium were detected above LANL and TA-33 background UTLs.

TABLE 5-3

SVOCs DETECTED AT LANDFILL SWMU 33-008(a)

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	SAL[a] (mg/kg)
Di-n-butylphthalate	AAA9675	0-6	Soil	4.1	8 000
Dinitrotoluene	AAA9675	0-6	Soil	2	1

[a] SAL = Screening action level.

5.3.3.2 Data Interpretation

The question of contamination within the landfills has not been addressed. Di-n-butylphthalate, a plasticizer, is a common analytical laboratory contaminant and may not be present. Dinitrotoluene is a propellant plasticizer.

5.3.4 Conclusions and Recommendations

Additional Phase I sampling is recommended for these landfills to assess the possibility of contamination. Based on sampling and analyses, recommendations will be developed for the disposition of the landfills.

5.3.5 Further Investigations

5.3.5.1 Sampling Objectives for SWMU 33-008(a,b)

Based on anecdotal evidence and reports of the 1984 activities that created these landfills, uranium, beryllium, and lead are likely to be present in small quantities in both landfills. HE or their byproducts may be present at the South Site landfill, SWMU 33-008(a). Field and/or laboratory analysis will characterize levels of radioactivity, inorganic hazardous constituents (both total and recoverable by TCLP), and HE.

The landfills are expected to be heterogeneous. Field information will provide information about this heterogeneity, including estimates of the volumes of metallic material such as cables, of wood material such as telephone poles and railroad ties, and of fill material, as well

as identify other types of buried material. Field investigations of the two shallow landfills will provide estimates of several parameters associated with these sites: the volumes of each landfill, the nature of the landfill contents, levels of radioactive and hazardous constituents, and whether or not such constituents, if present, are migrating into the underlying tuff. The depth of the fill/tuff interface will be observed in each borehole placed during Phase I sampling. The lateral extent of the landfills is known, and the depth will provide sufficient information to establish the total volume of the landfills.

Field crews will categorize all excavated material into at least three categories (metal, wood, soil/tuff fill), and more if desirable. Additional categories might be established for glass, rubber, or other materials if they are encountered. The volume of each type of material in the landfill will be estimated based on the relative amounts of each category encountered during drilling. This information will also be used to stratify the collection of samples for analysis.

Samples will be collected from the cored material, both within the landfill (i.e., above the fill/tuff interface), at the interface, and in undisturbed tuff or material beneath the landfill. Analysis will determine whether hazardous constituents are present in any stratum at each landfill. The TCLP will be performed on one-half the randomly selected soil samples in preparation for possible removal of landfilled materials.

5.3.5.2 Phase I Sampling and Analysis

Phase I sampling will focus on determining: the volume of the landfills, the nature of the landfill contents, the levels of hazardous constituents within the landfills, and possible migration of hazardous constituents into underlying soil/tuff.

All samples will be field screened for radioactivity and organic vapors to identify gross concentrations of contaminants. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan.

Sampling Techniques Subsurface core samples will be collected with an auger drill rig outfitted with a tungsten-carbide tipped core barrel. Although this drill rig would normally drive a hollow-stem auger drill string, in this case no augers will be used, only a specially-built tungsten carbide-tipped core barrel. This drill string will be cooled and lubricated with compressed air and is designed to slowly mill through the various types of landfill debris expected to be encountered. The boreholes will be advanced 2-ft into the underlying tuff to a nominal depth of 10 ft to ensure the detection of contaminants that may have leached from the landfill and migrated to the fill/tuff interface or below.

Sampling Summary, SWMU 33-008(a) Four cored boreholes will be drilled at the South Site landfill at random locations within a stratified 2 by 2 grid (four cells approximately 30 ft by 35 ft each) laid over the site as defined by the four posts. Alternate borehole locations will be selected within the same grid square if drilling into the underlying tuff is not possible because of bit refusal.

The boreholes will be cored through the landfill surface cover layer, the debris layer, and 2 ft into the tuff below. Four analytical samples will be collected from each borehole. Two borehole samples will consist of actual debris material, one soil sample at the bottom of the landfill material immediately above the tuff, and one tuff sample from between 12 in. to 24 in. beneath the fill/tuff interface. Debris samples will be selected from the entire landfill in the following proportions; one-third fill, one-third wood, one-third other material. Depth intervals of analytical samples will be 6 in. the case of tuff or soil and the thickness of the debris when the debris samples are being collected.

Sampling Summary, SWMU 33-008(b) Six cored boreholes will be drilled at the East Site landfill at random within a stratified grid of 2 by 3 (six cells approximately 40 ft by 60 ft each) laid over the site within the four corner posts. Alternate borehole locations will be selected within the same grid square if drilling into the underlying tuff is not possible because of bit refusal.

The boreholes will be cored through the landfill surface cover layer, the debris layer, and 2 ft into the tuff below. Four analytical samples will be collected from each borehole. Two samples will consist of actual debris materials, one soil sample at the bottom of the landfill material immediately above the tuff, and one tuff sample from between 12 in. to 24 in. beneath the fill/tuff interface. Debris samples will be selected from the entire landfill in the following proportions; one-third fill, one-third wood, one-third other material. Depth intervals of analytical samples will be 6 in. the case of tuff or soil and the thickness of the debris when the debris samples are being collected.

Laboratory Analysis Debris samples of landfill material will be field screened for inorganics using XRF or LIBS. All soil samples will be analyzed in the laboratory for total inorganics and total uranium. TCLP analyses will be performed on samples exceeding 20 times SAL. HE analyses will be performed on all samples collected from the South Site landfill. Analysis for SVOCs will be performed on all fill samples, tuff/fill interface samples, and the samples taken 12 to 24 in. beneath the tuff/fill interface.

ATTACHMENT 6 PHASE I REPORT FOR PRS 33-008(b)

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

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5.2.4 Conclusion and Recommendation

To adequately assess release of potential contamination by this outfall, a second try at Phase I sampling is proposed in conjunction with sampling in landfill SWMU 33-008(b).

5.2.5 Sampling and Analysis Plan

During the Phase I sampling of landfill SWMU 33-008(b), described in Subsection 5.3 of this RFI report, an attempt will be made to locate the pipe. If the pipe is located, samples will be collected as follows: if the outfall lies within the boundaries of the landfill, a sample will be taken at the soil/tuff interface in the landfill at the point indicated on the engineering drawing as the location of the outfall (Fig. 5-3). If the outfall is located outside the boundaries of the landfill, a sample will be taken at that point. This sampling will be considered Phase I reconnaissance sampling. The sample will be analyzed in the laboratory for inorganics, VOCs, and SVOCs.

5.3 SWMU 33-008(a,b) Landfills at South Site and East Site

SWMUs 33-008(a,b) are landfills created at TA-33 during a 1984 cleanup of South and East Sites. SWMU 33-008(a) is discussed in the RFI Work Plan for OU 1122, Subsections 3.4.2.10 and 4.4.7 (LANL 1992, 0784). SWMU 33-008(b) is discussed in work plan Subsections 3.5.2.6 and 4.5.6. After the RFI work plan was submitted, evidence was discovered that the contents of the landfill made the proposed trenching sampling plan inappropriate to perform. A revised plan is presented here.

The SWMU 33-008(a) landfill was created in 1984 at South Site when many structures and experimental objects were dismantled. The cleanup was intended as an interim action pending stricter regulation of LANL cleanup activities. During cleanup, radioactive and salvageable material were removed; however, no sampling was done to identify RCRA hazardous wastes. Remaining material was buried in the landfill (Buhl 1984, 02-038).

The SWMU 33-008(b) landfill was created at East Site during the 1984 cleanup. Radioactive and salvageable material were removed. Remaining material was buried. The surface was leveled and the corners of the landfill marked with metal posts.

The RFI work plan for OU 1122, approved by EPA in 1993, proposed trenching through each landfill to determine if the contents include hazardous material (LANL 1992, 0784). Subsequent to submittal of the work plan, photos were discovered that were taken during the cleanup. Photos indicate that the buried debris included massive items such as telephone poles and railroad ties and that the material is tightly packed within the landfill. It became clear that trenching with a backhoe as described in the work plan could not produce the desired samples. This section presents an alternate sampling plan.

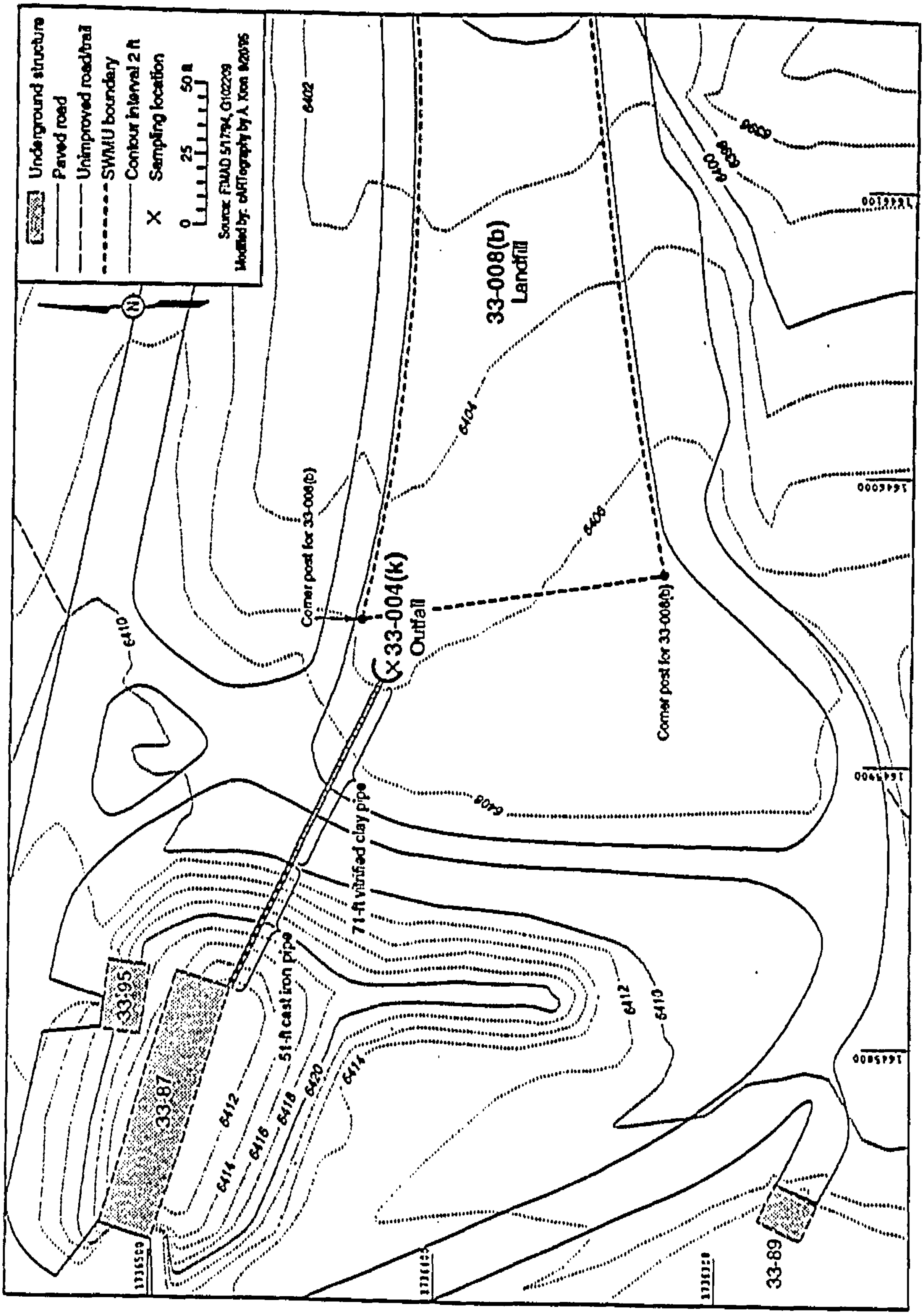

Fig. 5-3. East Site: SWMU 33-004(k), outfall from TA-33-87, shown in relation to SWMU 33-008(b), landfill.

SWMU 33-008(a) This landfill lies within a horseshoe-shaped berm, TA-33-43, at South Site. The floor of the berm appears to be on bedrock. At its highest point, the berm is about 15 ft high. The landfill grades from the floor to the inside curve of the berm and may be 8 ft at its deepest point. The four corners of the landfill are marked with metal pipe. Over the years, a thick stand of chamisa has grown on the landfill. Some of the buried material has been exposed through erosion.

SWMU 33-008(b) The landfill at East Site occupies the space between the firing pads east of bunker TA-33-87 and shack TA-33-151. According to LANL engineering drawing ENG-C 3304, this area may have originally been excavated to provide material for the nearby berms. The fill is well compacted and covered; there is no longer any surface indication of its existence. The four corners are marked with metal poles. The surface is level and covered with a sparse growth of weeds and grasses. Thick stands of chamisa grow along most of the perimeter.

5.3.1 Previous Investigations

Prior to 1994 ER sampling, no investigations had been performed for these landfills.

5.3.2 Field Investigations

SWMU 33-008(a) During the 1994 sampling campaign, four surface samples were collected at the South Site landfill. Three were taken at the lower edge of the landfill. The fourth was taken in the drainage leading from the bermed area (Fig. 5-4). All four samples were analyzed for inorganics, uranium, gamma emitters and HE. Two samples were analyzed for uranium.

SWMU 33-008(b) No samples were taken within the East Site landfill boundaries during the 1994 sampling campaign. Fig. 5-5 shows the extent of the landfill.

5.3.2.1 Results of Field Surveys

No field surveys were associated with SWMUs 33-008(a) or 33-008(b).

5.3.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-008(a).

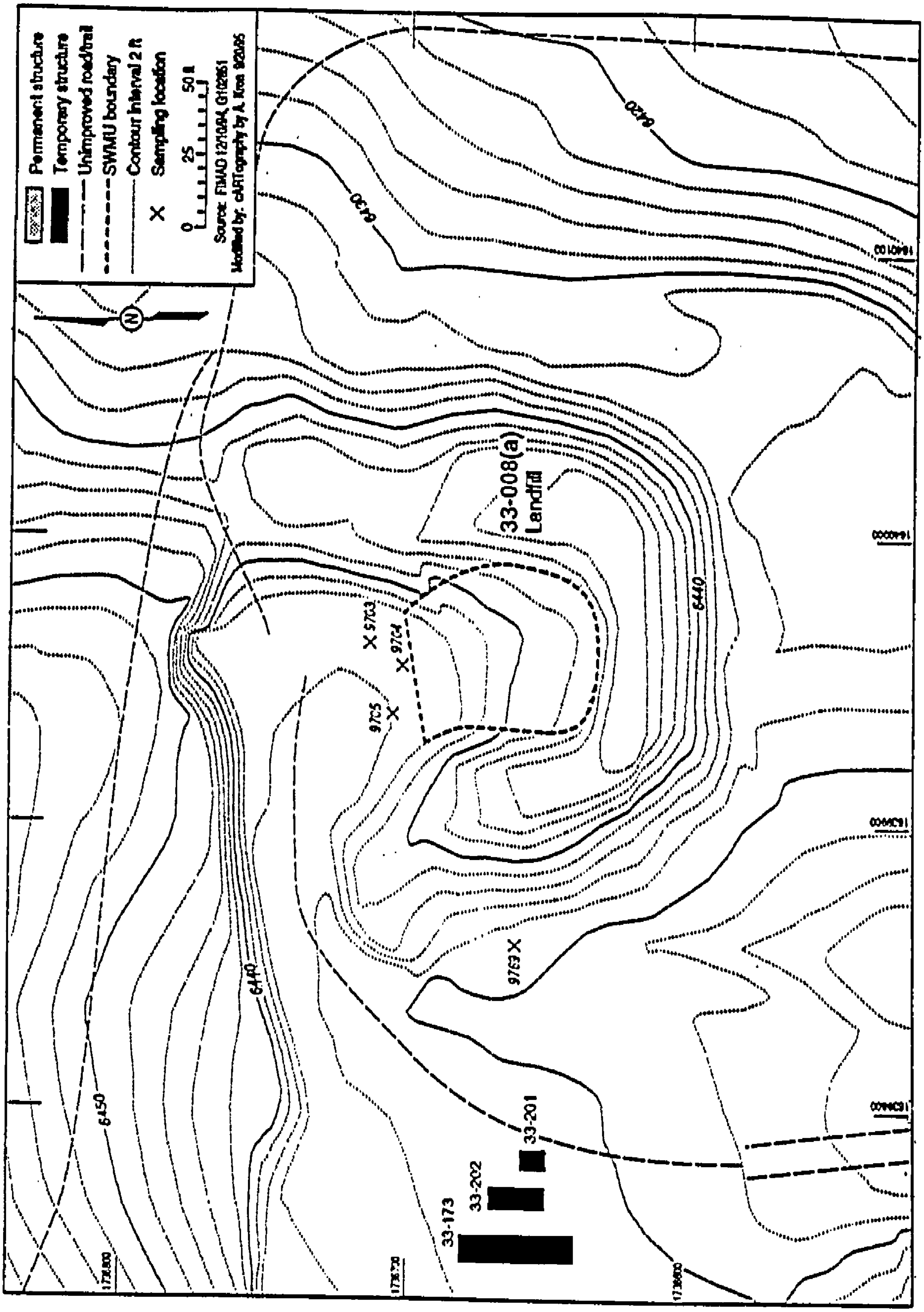

Fig. 5-4. South Site: SWMU 33-008(a), landfill, 1994 sampling campaign.

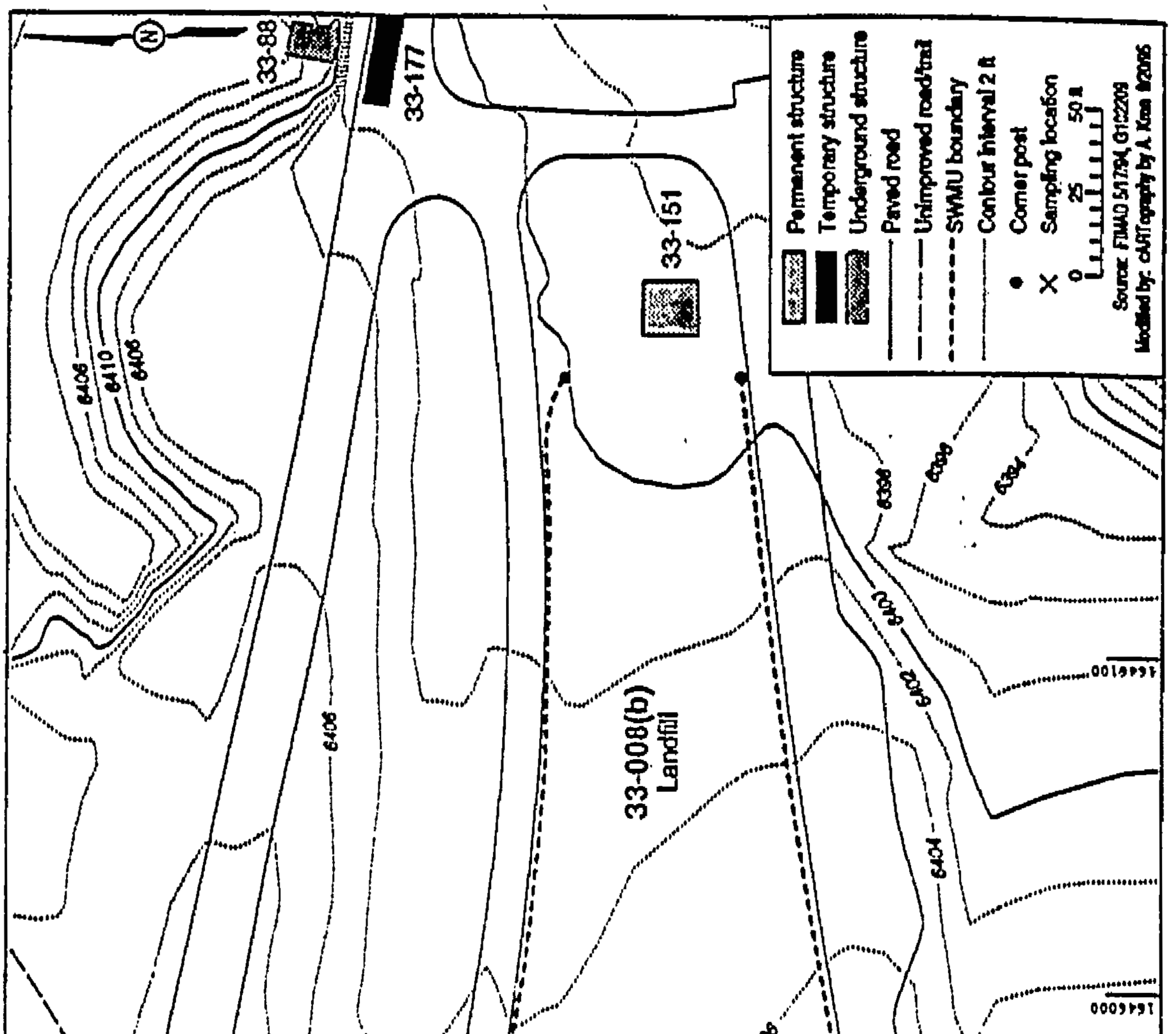

Fig. 5-5. East Site: SWMU 33-008(b), landfill.

5.3.3 Screening Assessment

5.3.3.1 Comparison to Background/SALs

SWMU 33-008(a)   Two SVOCs were detected in one sample (Table 5-3). No inorganics, gamma emitters, or uranium were detected above LANL and TA-33 background UTLs.

TABLE 5-3

SVOCs DETECTED AT LANDFILL SWMU 33-008(a)

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	SAL* (mg/kg)
Di-n-butylphthalate	AAA9675	0-6	Soil	4.1	8 000
Dinitrotoluene	AAA9675	0-6	Soil	2	1

* SAL = Screening action level.

5.3.3.2 Data Interpretation

The question of contamination within the landfills has not been addressed. Di-n-butylphthalate, a plasticizer, is a common analytical laboratory contaminant and may not be present. Dinitrotoluene is a propellant plasticizer.

5.3.4 Conclusions and Recommendations

Additional Phase I sampling is recommended for these landfills to assess the possibility of contamination. Based on sampling and analyses, recommendations will be developed for the disposition of the landfills.

5.3.5 Further Investigations

5.3.5.1 Sampling Objectives for SWMU 33-008(a,b)

Based on anecdotal evidence and reports of the 1984 activities that created these landfills, uranium, beryllium, and lead are likely to be present in small quantities in both landfills. HE or their byproducts may be present at the South Site landfill, SWMU 33-008(a). Field and/or laboratory analysis will characterize levels of radioactivity, inorganic hazardous constituents (both total and recoverable by TCLP), and HE.

The landfills are expected to be heterogeneous. Field information will provide information about this heterogeneity, including estimates of the volumes of metallic material such as cables, of wood material such as telephone poles and railroad ties, and of fill material, as well

as identify other types of buried material. Field investigations of the two shallow landfills will provide estimates of several parameters associated with these sites: the volumes of each landfill, the nature of the landfill contents, levels of radioactive and hazardous constituents, and whether or not such constituents, if present, are migrating into the underlying tuff. The depth of the fill/tuff interface will be observed in each borehole placed during Phase I sampling. The lateral extent of the landfills is known, and the depth will provide sufficient information to establish the total volume of the landfills.

Field crews will categorize all excavated material into at least three categories (metal, wood, soil/tuff fill), and more if desirable. Additional categories might be established for glass, rubber, or other materials if they are encountered. The volume of each type of material in the landfill will be estimated based on the relative amounts of each category encountered during drilling. This information will also be used to stratify the collection of samples for analysis.

Samples will be collected from the cored material, both within the landfill (i.e., above the fill/tuff interface), at the interface, and in undisturbed tuff or material beneath the landfill. Analysis will determine whether hazardous constituents are present in any stratum at each landfill. The TCLP will be performed on one-half the randomly selected soil samples in preparation for possible removal of landfilled materials.

5.3.5.2 Phase I Sampling and Analysis

Phase I sampling will focus on determining: the volume of the landfills, the nature of the landfill contents, the levels of hazardous constituents within the landfills, and possible migration of hazardous constituents into underlying soil/tuff.

All samples will be field screened for radioactivity and organic vapors to identify gross concentrations of contaminants. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan.

Sampling Techniques Subsurface core samples will be collected with an auger drill rig outfitted with a tungsten-carbide tipped core barrel. Although this drill rig would normally drive a hollow-stem auger drill string, in this case no augers will be used, only a specially-built tungsten carbide-tipped core barrel. This drill string will be cooled and lubricated with compressed air and is designed to slowly mill through the various types of landfill debris expected to be encountered. The boreholes will be advanced 2-ft into the underlying tuff to a nominal depth of 10 ft to ensure the detection of contaminants that may have leached from the landfill and migrated to the fill/tuff interface or below.

Sampling Summary, SWMU 33-008(a) Four cored boreholes will be drilled at the South Site landfill at random locations within a stratified 2 by 2 grid (four cells approximately 30 ft by 35 ft each) laid over the site as defined by the four posts. Alternate borehole locations will be selected within the same grid square if drilling into the underlying tuff is not possible because of bit refusal.

The boreholes will be cored through the landfill surface cover layer, the debris layer, and 2 ft into the tuff below. Four analytical samples will be collected from each borehole. Two borehole samples will consist of actual debris material, one soil sample at the bottom of the landfill material immediately above the tuff, and one tuff sample from between 12 in. to 24 in. beneath the fill/tuff interface. Debris samples will be selected from the entire landfill in the following proportions; one-third fill, one-third wood, one-third other material. Depth intervals of analytical samples will be 6 in. the case of tuff or soil and the thickness of the debris when the debris samples are being collected.

Sampling Summary, SWMU 33-008(b) Six cored boreholes will be drilled at the East Site landfill at random within a stratified grid of 2 by 3 (six cells approximately 40 ft by 60 ft each) laid over the site within the four corner posts. Alternate borehole locations will be selected within the same grid square if drilling into the underlying tuff is not possible because of bit refusal.

The boreholes will be cored through the landfill surface cover layer, the debris layer, and 2 ft into the tuff below. Four analytical samples will be collected from each borehole. Two samples will consist of actual debris materials, one soil sample at the bottom of the landfill material immediately above the tuff, and one tuff sample from between 12 in. to 24 in. beneath the fill/tuff interface. Debris samples will be selected from the entire landfill in the following proportions; one-third fill, one-third wood, one-third other material. Depth intervals of analytical samples will be 6 in. the case of tuff or soil and the thickness of the debris when the debris samples are being collected.

Laboratory Analysis Debris samples of landfill material will be field screened for inorganics using XRF or LIBS. All soil samples will be analyzed in the laboratory for total inorganics and total uranium. TCLP analyses will be performed on samples exceeding 20 times SAL. HE analyses will be performed on all samples collected from the South Site landfill. Analysis for SVOCs will be performed on all fill samples, tuff/fill interface samples, and the samples taken 12 to 24 in. beneath the tuff/fill interface.

ATTACHMENT 7 PHASE I REPORT FOR PRS 33-011(d)

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

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4.5 SWMU 33-011(d) Storage at TA-33-20

SWMU 33-011(d) is the area used for storage south of warehouse TA-33-20. It is discussed in the RFI Work Plan for OU 1122 in Subsections 3.2.2.7 and 4.2.3.1 (LANL 1992, 0748). Lead, uranium, and tritium were detected above SAL in one asphalt sample and its duplicate. A radiological survey and cleanup is proposed for uranium. A Phase II sampling plan is presented to determine extent of lead contamination. The contaminated spot has been covered and posted.

SWMU 33-011(d) is located on the asphalt paving at warehouse TA-33-20. Site workers indicated that uranium and beryllium were stored in and around the warehouse until 1972. Scrap from recovered shots and material intended for recovery were also stored south of the building. All such material has been removed. The building is now used for storage and much of the surrounding paved area is used for parking. Potential contaminants included uranium, beryllium, and possibly other inorganics.

The site is within the developed area at Main Site. It is level and paved with asphalt.

4.5.1 Previous Investigations

No previous investigations were conducted at this PRS.

4.5.2 Field Investigation

Prior to sampling at TA-33, Main Site was surveyed for radiation on a grid as specified in the work plan. No radioactivity was detected. However, at the time of sample collection, radioactivity was detected on asphalt at SWMU 33-011(d). As specified in the work plan, two asphalt samples and three soil samples from below the asphalt were taken at three locations. Of these, one asphalt and one soil sample (AAA6866 and AAA6867) were taken at the radioactive point. All samples were analyzed for inorganics, uranium, and gamma emitters. Five of the samples (AAA6863, AAA6864, AAA6866, AAA6867, and AAA6868) were also analyzed for tritium and plutonium.

4.5.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-011(d).

4.5.2.2 Results of Field Screening

Radiation was detected during routine field screening. A sample was collected later by a sampler certified to collect radioactive samples. The entire area around the point was screened for radiation.

4.5.3 Screening Assessment

4.5.3.1 Comparison to Background/SALs

Samples AAA 6866 and AAA6867 taken from the radioactive spot contained uranium levels far-above SAL. Lead was above background UTLs in most samples and above soil SAL in asphalt sample AAA6866. Other inorganics were found above background UTLs in this same asphalt sample. Tritium was above background UTL in samples AAA 6864 and AAA6868 and above the soil SAL in the asphalt sample AAA6863. Plutonium above the background UTL was detected at this location (Fig. 4-5). Table 4-13 is a summary of analytes detected above background UTLs. Neither UTLs nor SALs apply to asphalt; soil UTLs and SALs are listed in the table as a point of reference only.

4.5.3.2 Data Interpretation

Phase I sampling results suggest that contamination, both radioactive and inorganic, is patchy and not extensive. The highest levels of inorganic contamination were found in the same asphalt sample that contained over 3 200 mg/kg of uranium. High uranium, lead, and nickel concentrations were also found in the soil sample collected below the pavement at the same location.

4.5.3.3 Risk Assessment

No risk assessment was performed for this PRS.

4.5.3.4 Ecotoxicological Screening Assessment

A global ecotoxicological assessment is presented in Subsection 3.2.3 of this report.

4.5.4 Conclusion and Recommendation

Because the initial TA-33 grid for radioactive screening was too coarse to detect the radioactive spot at SWMU 33-011(d), the area around the warehouse is proposed for further investigation. A Phase II sampling and analysis plan is presented to investigate lead and uranium contamination (Appendix B).

TABLE 4-13

ANALYTES ABOVE LANL AND TA-33 BACKGROUND UTLs AND SALs AT SWMU 33-011(d)

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	LANL UTL[a] (mg/kg)	TA-33 UTL (mg/kg)	SOIL SAL[b] (mg/kg)
Cadmium	AAA6866	0-6	Asphalt	4	2.7	2.7	80
Lead	AAA2028	0-6	Soil[c]	110	39	39	400
	AAA6863	0-6	Asphalt	45	39	39	400
	AAA6864	0-12	Soil	40	39	39	400
	AAA6866	0-6	Asphalt	690	39	39	400
	AAA6867	0-12	Soil	139	39	39	400
	AAA6868	0-12	Soil	40	39	39	400
Nickel	AAA6866	0-6	Asphalt	240	26.7	17	1 600
Uranium	AAA2028	0-6	Soil	6.8	2.8	4.8	95
	AAA2274	0-6	Soil	6.7	2.8	4.8	95
	AAA2275	0-6	Soil	6.3	2.8	4.8	95
	AAA6864	0-12	Soil	5.1	2.8	4.8	95
	AAA6866	0-6	Asphalt	3 200	2.8	4.8	95
	AAA6867	0-12	Soil	899	2.8	4.8	95
Zinc	AAA6866	0-6	Asphalt	470	101	62.3	24 000
	AAA6867	0-12	Soil	120	101	62.3	24 000
ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	ACTIVITY (pCi/g)	LANL UTL (pCi/g)	TA-33 UTL (pCi/g)	SAL (pCi/g)
Plutonium-238	AAA6863	0-6	Asphalt	0.055	0.01	0.01	27
	AAA6864	0-12	Soil	0.083	0.01	0.01	27
	AAA6866	0-6	Asphalt	0.405	0.01	0.01	27
	AAA6867	0-12	Soil	0.032	0.01	0.01	27
	AAA6868	0-12	Soil	0.04	0.01	0.01	27
Plutonium-239	AAA6866	0-6	Asphalt	0.083	0.01	0.058	24
	AAA6867	0-12	Soil	0.225	0.01	0.058	24
Tritium	AAA6863	0-6	Asphalt	3 028 pCi/g	ND[d]	23.2	810
	AAA6864	0-12	Soil[c]	304 pCi/g	ND	23.2	810
	AAA6868	0-12	Soil[c]	472 pCi/g	ND	23.2	810

[a] UTL = Upper tolerance limit.
[b] SAL = Screening action level.
[c] Soil depth under 3-4 in. of asphalt.
[d] ND = Not determined.

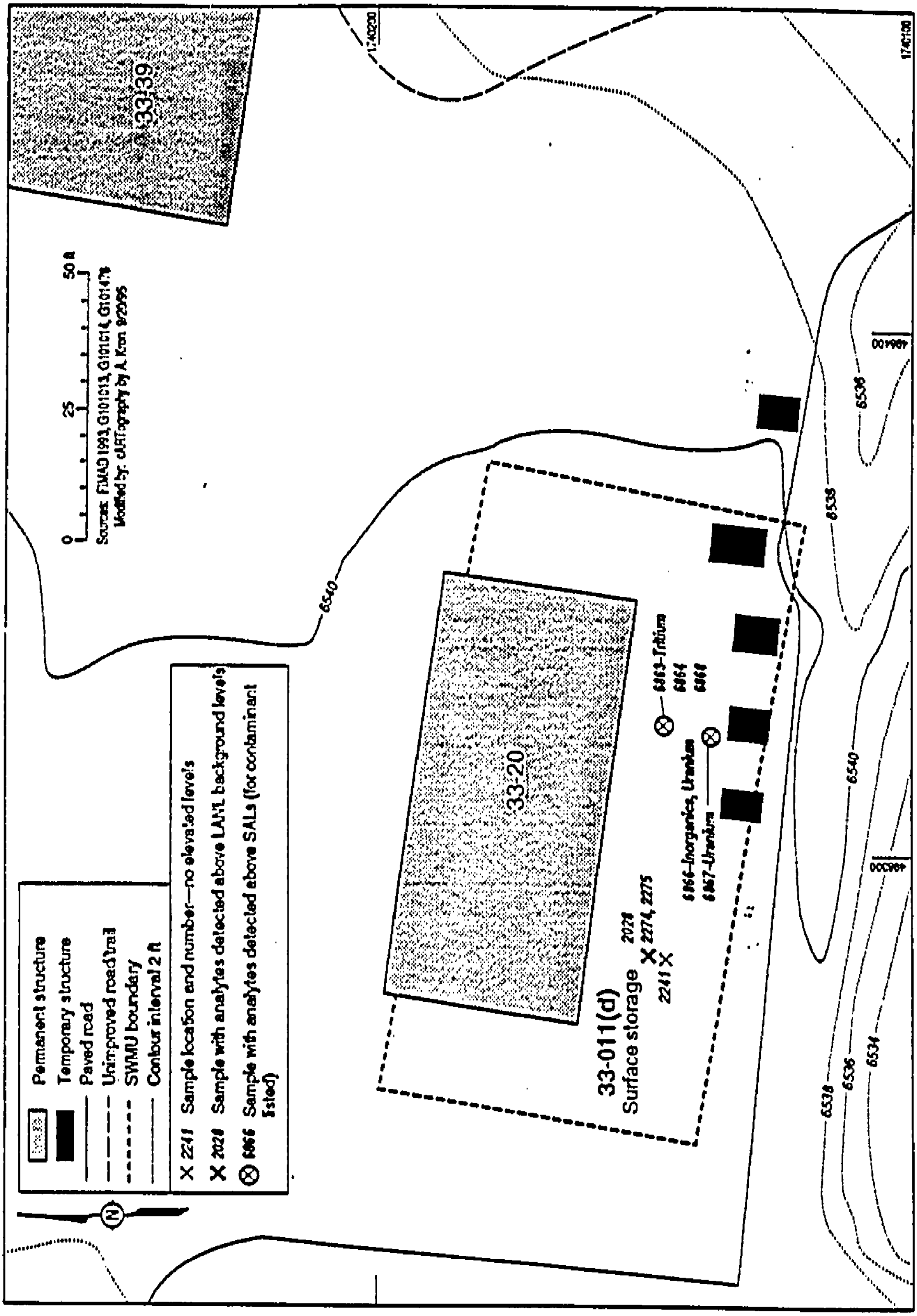

Fig. 4-5. Main Site: SWMU 33-011(d), surface storage.

ATTACHMENT 8 PHASE I REPORT FOR PRS 33-013

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

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4.6 SWMU 33-013 Liquid Waste Storage at the Tritium Facility

SWMU 33-013 is a surface disposal area on pavement east of the tritium facility TA-33-86. It is discussed in the RFI Work Plan for OU 1122, Subsections 3.2.2.8 and 4.3.4 (LANL 1992, 0784. Cadmium, chromium, and tritium were observed above SALs. Beryllium was measured above soil background levels. However, elevated inorganics were associated with problems in the QA/QC data. A Phase II sampling plan is presented to determine the extent of contamination.

SWMU 33-013 is an asphalt pad once used as a storage area for liquid waste. The SWMU is located northeast of TA-33-86 and lies within the fence surrounding the TA-33-86. Long-time employees describe the northeast section within the fence as a storage area for material awaiting disposal. Items for disposal included vacuum pumps from throughout LANL, barrels of waste oil, and dumpsters of miscellaneous wastes. No effort was made to cover the area. Many containers leaked and several containers remained in the area for years.

The area is level, about 50 ft square, paved with asphalt as an extension of the parking lot and driveway around the building. Weeds grow in the soil on three sides of the pad and in cracks in the pavement. Runoff from the area is to the east, toward the drainage leading to Chaquehui Canyon. East of the fence the ground slopes at a moderate grade without obvious channeling. There the surface material, soil with pumice, is sparsely vegetated; some of it may be fill from grading the site for building TA-33-86.

4.6.1 Previous Investigations

No previous investigations were conducted at this PRS.

4.6.2 Field Investigation

Three samples were taken at random locations 0-6 in. under the asphalt paving, which is 2 to 3 in. thick (Fig. 4-6). All SWMU 33-013 samples were analyzed for inorganics, gamma emitters and SVOCs. Two samples were analyzed for tritium and one for herbicides.

4.6.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-013.

4.6.2.2 Results of Field Screening

No radiation was detected during routine field screening of sampling locations at SWMU 33-0013.

4.6.3 Screening Assessment

4.6.3.1 Comparison to Background/SALs

One sample contained inorganics above background UTLs. Two elements, cadmium and chromium, were measured above their SALs in this sample. Both samples analyzed for tritium contained tritium above the TA-33 background UTL, with one concentration above SAL. Sample AAA2037 analyzed for SVOCs had trace levels of pyrene, benzo(b)fluoranthene, and fluoranthene. SVOC results were low enough so that a multiconstituent screening was deemed unnecessary. No herbicides were detected. Table 4-14 lists concentrations of contaminants found above LANL and TA-33 background UTLs.

TABLE 4-14

ANALYTES EXCEEDING UTLs AT SWMU 33-013

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	LANL UTL[a] (mg/kg)	TA-33 UTL (mg/kg)	SAL[b] (mg/kg)
Beryllium	AAA2035	0-6	Soil under asphalt	7.8	3.31	1.51	None
Cadmium	AAA2035	0-6	Soil under asphalt	620	2.7	2.7	80
Chromium	AAA2035	0-6	Soil under asphalt	670	34.2	20.7	400
Nickel	AAA2035	0-6	Soil under asphalt	100	26.7	17	1 600
Silver	AAA2035	0-6	Soil under asphalt	10	ND[c]	ND	400
Tritium	AAA2036	0-6	Soil under asphalt	3 342 pCi/g	ND	23.2 pCi/g	810 pCi/g
Tritium	AAA2037	0-6	Soil under asphalt	27 pCi/g	ND	23.2 pCi/g	810 pCi/g

[a] UTL = Upper tolerance limit.
[b] SAL = Screening action level.
[c] ND = Not determined.

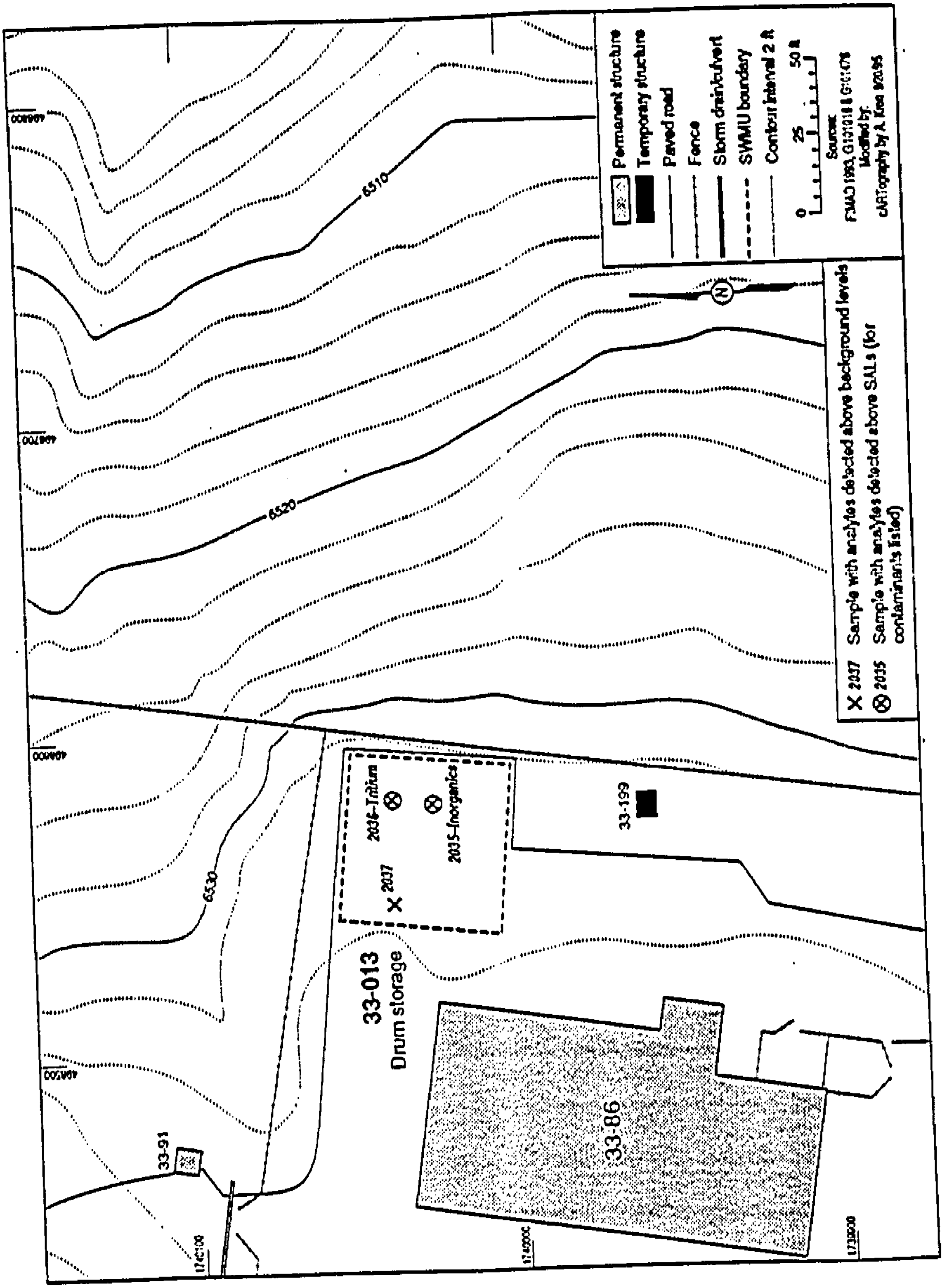

Fig. 4-6. Main Site: SWMU 33-013, drum storage.

4.6.3.2 Data Interpretation

The analytical request that included the three samples from SWMU 33-013 (request number 14594, report number 21424) also included two field blank samples and several grid samples. High levels of silver, cadmium, chromium and zinc were reported in field blank sample AAA2188 and in grid sample AAA2099. In addition, results for cadmium, chromium and zinc were biased high for one of two blind liquid QC samples included with this batch of samples. The result for nickel was biased low. The observations for field blank sample AAA2188 are anomalous. All other field blanks, which were splits of a single sample collected from an offsite location near Bandelier National Monument, were within TA-33 and LANL background ranges. Results from grid sample AAA2099 may be anomalous as well; this grid point lies just south of TA-33-86 and has tritium contamination within the TA-33 background range, but is not in an area that would have been affected by site activities other than stack releases. These anomalous observations could be the result of cross contamination either in the field or in the laboratory, or of an out-of-control laboratory process. All of these samples were collected May 12, 1993. According to the field logs, the samples from SWMU 33-013 were collected in the afternoon, while the grid sample and the field blank were collected in the morning, ruling out cross-contamination due to the field sample collection process. The data validation narrative associated with report number 21424 indicates that all of the run-time QC samples were statistically acceptable, which would preclude an out-of-control laboratory process. Cross-contamination in the laboratory, either from sample AAA2035 or from some other source, remains a possibility.

The QA/QC conditions lend uncertainty to the analytical results for inorganics obtained from the three samples. However, inorganics appear to be elevated above SALs at isolated points within PRS 33-013.

4.6.3.3 Risk Assessment

No risk assessment was performed for this SWMU.

4.6.3.4 Ecotoxicological Screening Assessment

A global ecotoxicological assessment is presented in Subsection 3.2.3 of this report.

4.6.4 Conclusion and Recommendation

High tritium in sample AAA2036 is expected because this storage pad is immediately adjacent to the tritium facility and fluids stored at the site were contaminated with tritium. Tritium is addressed in an RFI report for MDA K (in preparation). A risk assessment for tritium at Main

Site, discussed in the RFI report for MDA K, indicated a 1993 tritium exposure of 11.9 mrem/year, well below the DOE effective dose equivalent of 30 mrem/year.

Because the source of high inorganic concentrations reported in one sample is uncertain, however, Phase II sampling will be conducted before further decisions are made (Appendix B).

4.7 SWMU 33-016 Sump at TA-33-23

SWMU 33-016 is a sump and outfall at bunker TA-33-23. It is discussed in the RFI Work Plan for OU 1122, Subsections 3.2.2.14 and 4.3.4 (LANL 1992, 0784). SVOCs above SALs were discovered in the sump sludge. A VCA of the sump was completed in 1995.

The sump served a sink and floor drain in TA-33-23, a trim building used in the early 1950s to prepare propellant charges for use at South Site. Until 1994 the bunker was used for storage by a LANL geological group, but is now empty. The sump is located west of the door to TA-33-23. Prior to the VCA, it was covered by a wooden lid.

At the time of construction, the area in front of TA-33-23 was graded and paved. One side of the sump is adjacent to the building. Two sides are surrounded by pavement and the fourth side is a tuff embankment, cut when the site was built. A pipe exits the sump and leads under the pavement to an outfall about 250 ft west of the building on the sloping side of Chaquehui Canyon. The slope is covered with pinyon and juniper trees and sparse grasses. Soil is thin with bedrock tuff outcrops. No drainage channel has formed at the outfall.

4.7.1 Previous Investigations

No previous investigations were conducted at this PRS.

4.7.2 Field Investigation

All sampling locations at SWMU 33-016 were selected to increase the chances of detecting contamination. Five samples were taken from the sump, two of fluid and two of sludge. A borehole adjacent to the sump yielded one surface sample, one sample at 3 to 5 ft, and one sample at 10 to 12 ft. Four surface samples were taken at the outfall (Fig. 4-7). All samples were analyzed for SVOCs and HE. Liquid and subsurface samples were also analyzed for VOCs.

4.7.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-016.

ATTACHMENT 9 PHASE I REPORT FOR PRS 33-017

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

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4.7.3.2 Data Interpretation

The sludge at the TA-33-23 sump contains cPAHs above SALs. Analytical results from the borehole beside the sump and at the outfall indicate that contaminants found in the sump are not migrating from the sump.

4.7.3.3 Risk assessment

No risk assessment was performed for this PRS.

4.7.3.4 Ecotoxicological Screening Assessment

A global ecotoxicological assessment is presented in Subsection 3.2.3 of this report.

4.7.4 Conclusion and Recommendation

Sampling and analysis indicated that contamination was confined to the sump. Because the sump is no longer active, it was decommissioned in 1995 under a VCA plan. Approximately 250 gal. of liquid was removed from the sump. Approximately 45 gal. of sludge was vacuumed from the floor of the sump. The sump was filled with 3 yd^3 of sand and gravel, then capped with 1 ft of concrete. No confirmatory samples were taken. The sludge was analyzed for RCRA waste characteristics prior to disposal. Results indicated that 1,1-dichloroethylene and lead were present. A final report was submitted to EPA by October 1, 1995. A copy is attached as Addendum 1.

4.8 SWMU 33-017 Operational Releases/Vehicle Maintenance Area

SWMU 33-017 encompasses the eastern section of the fenced area at Main Site. It is discussed in the RFI Work Plan for OU 1122, Subsections 3.2.2.2 and 4.2.3.1 through 4.2.3.3 (LANL 1992, 0784). Elevated levels of lead and SVOCs are associated with samples from the small area east of shop TA-33-39 known as the vehicle maintenance area. A risk assessment for lead in this area was addressed in Subsection 4.4.4 of RFI Report LA-UR-95-882 (LANL 1995, 1212). The vehicle maintenance area is proposed for Phase II sampling to determine concentrations and extent of SVOC contamination. A sampling and analysis plan is included in Appendix B.

SWMU 33-017 addresses diverse activities at Main Site. Historic operating activities included the fumes from the uranium cut-off shack TA-33-40; air emissions from shop TA-33-39, tritium releases from the high-pressure tritium facility TA-33-86, stack emissions from shop TA-33-119 where uranium was processed, possible atmospheric release of plutonium from the spill in TA-33-21 [SWMUs 33-005(a,b,c)], and any other operations or releases that are not associated

with other known PRSs. One specific site, located east of shop TA-33-39 and used for vehicle maintenance, is included in SWMU 33-017.

The primary potential contaminants were identified as uranium, plutonium, tritium, SVOCs, and inorganics - specifically beryllium, cadmium, and lead. Pesticides, herbicides, and PCBs may also have been used in the area encompassed by this SWMU.

Most of SWMU 33-017 lies within the security fence at Main Site, where laboratory and office buildings are surrounded by asphalt pavement. The area is level with only a slight slope to the east. All runoff from Main Site converges on the east side of the site in a shallow tributary to Chaquehui Canyon. The eastern third of the site is unimproved. Construction of Main Site resulted in a steep bank about 20 ft high at the head of the drainage. Runoff and cooling water blowdown aided vigorous vegetation growth in this area. East of the Main Site fence, native pinyon-juniper woodland covers the drainage and surrounding land.

4.8.1 Previous Investigations

No previous investigations were conducted at this PRS.

4.8.2 Field Investigation

SWMU 33-017 is described as operational releases from Main Site. In the work plan, three separate sets of samples, a total of 82 surface samples, were identified to address SWMU 33-017: vehicle maintenance, airborne operational release, and drainage (LANL 1992, 0784).

- Fifty-six grid samples were taken from a wide area around Main Site and Area 6. Samples locations were selected by random offsets from the nodes of a 100-ft grid overlying Main Site and from four extensions radiating from Main Site as described in the work plan (LANL 1992, 0784).
- Twenty drainage samples were collected.
- Six samples were taken from the vehicle maintenance area east of shop TA-33-39. In addition to these six samples, ten samples were collected from two overlapping SWMUs, SWMU 33-004(i) and SWMU 33-012(a), embedded in the vehicle maintenance area.

All 82 SWMU 33-017 samples were analyzed for inorganics, 80 for radionuclides by gamma spectroscopy and SVOCs, 75 for plutonium, 74 for uranium and tritium, 14 for herbicides, 9 for pesticides, and 4 for PCBs.

4.8.2.1 Results of Field Surveys

All sampling points were surveyed. No other field surveys were associated with SWMU 33-017.

4.8.2.2 Results of Field Screening

The Main Site radiation survey, described in Subsection 4.2.1.3 of the work plan, did not detect any radioactivity (LANL 1992, 0784). No radiation was detected during routine field screening of sampling locations at SWMU 33-017.

4.8.3 Screening Assessment

4.8.3.1 Comparison to Background/SALs

Tritium Because the source of tritium is considered to be the high-pressure tritium facility, a detailed analysis of all surface tritium at Main Site is included in the RFI Report for MDA K (in preparation). In that report, a risk assessment for tritium indicates that levels of activity detected in samples collected at Main site and MDA K present an acceptable risk. Input to the model included an industrial worker exposure unit, an inhalation exposure pathway, a contaminated volume 200 ft by 300 ft by 155 ft deep, and a 1993 activity of 11 900 pCi/g. Calculations indicated that the effective dose equivalent to a worker at the site would be 11.9 mrem/year under these extremely conservative conditions. The DOE allowable effective dose equivalent is 30 mrem/year (LANL 1995, in preparation).

Grid Samples Most grid samples were used to calculate background UTLs specific to TA-33. Results are assessed in detail in Subsection 3.2 of the TA-33 RFI Report LA-UR-95-882 (LANL 1995, 1212). The grid sample set contained some anomalous results. Plutonium-239 (0.174 pCi/g) was detected in sample AAA2089 collected about 50 ft north of the site of TA-33-21 (SWMU 33-005). Inorganic anomalies in grid samples are listed in Table 4-16. Organic analytes above detection limits are listed in Table 4-17. Location of all grid samples are shown in Fig. 4-8.

TABLE 4-16

INORGANIC CONTAMINATION ABOVE LANL AND TA-33 BACKGROUND UTLs IN SWMU 33-017 GRID SAMPLES

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	LANL UTL[a] (mg/kg)	TA-33 UTL (mg/kg)	SAL[b] (mg/kg)
Arsenic	AAA2067	0-6	Soil	13.8	11.6	4.36	None
Cadmium	AAA2099	0-6	Soil	5.2	2.7	2.7	80
Chromium	AAA2099	0-6	Soil	35	33.5	20.7	400
Nickel	AAA2061	0-6	Soil	46	26.7	17	1 600
	AAA2075	0-6	Soil	69	26.7	17	1 600
	AAA2077	0-6	Soil	460	26.7	17	1 600
Lead	AAA2067	0-6	Soil	902	39	39	400
	AAA2082	0-6	Soil	90	39	39	400
	AAA2097	0-6	Soil	61	39	39	400
	AAA2105	0-6	Soil	60	39	39	400
	AAA2053	0-6	Soil	98	39	39	400
	AAA2054	0-6	Soil	200	39	39	400
Silver	AAA2092	0-6	Soil	2.3	ND[c]	ND	400
	AAA2099	0-6	Soil	4.6	ND	ND	400
	AAA2053	0-6	Soil	8.8	ND	ND	400
	AAA2054	0-6	Soil	46	ND	ND	400
Uranium	AAA2075	0-6	Soil	41.6	2.8	4.8	95
Zinc	AAA2067	0-6	Soil	217	101	62.3	24 000

[a] Upper tolerance limit.
[b] Screening action level.
[c] Not determined.

TABLE 4-17

ORGANICS DETECTED IN SWMU 33-017 GRID SAMPLES

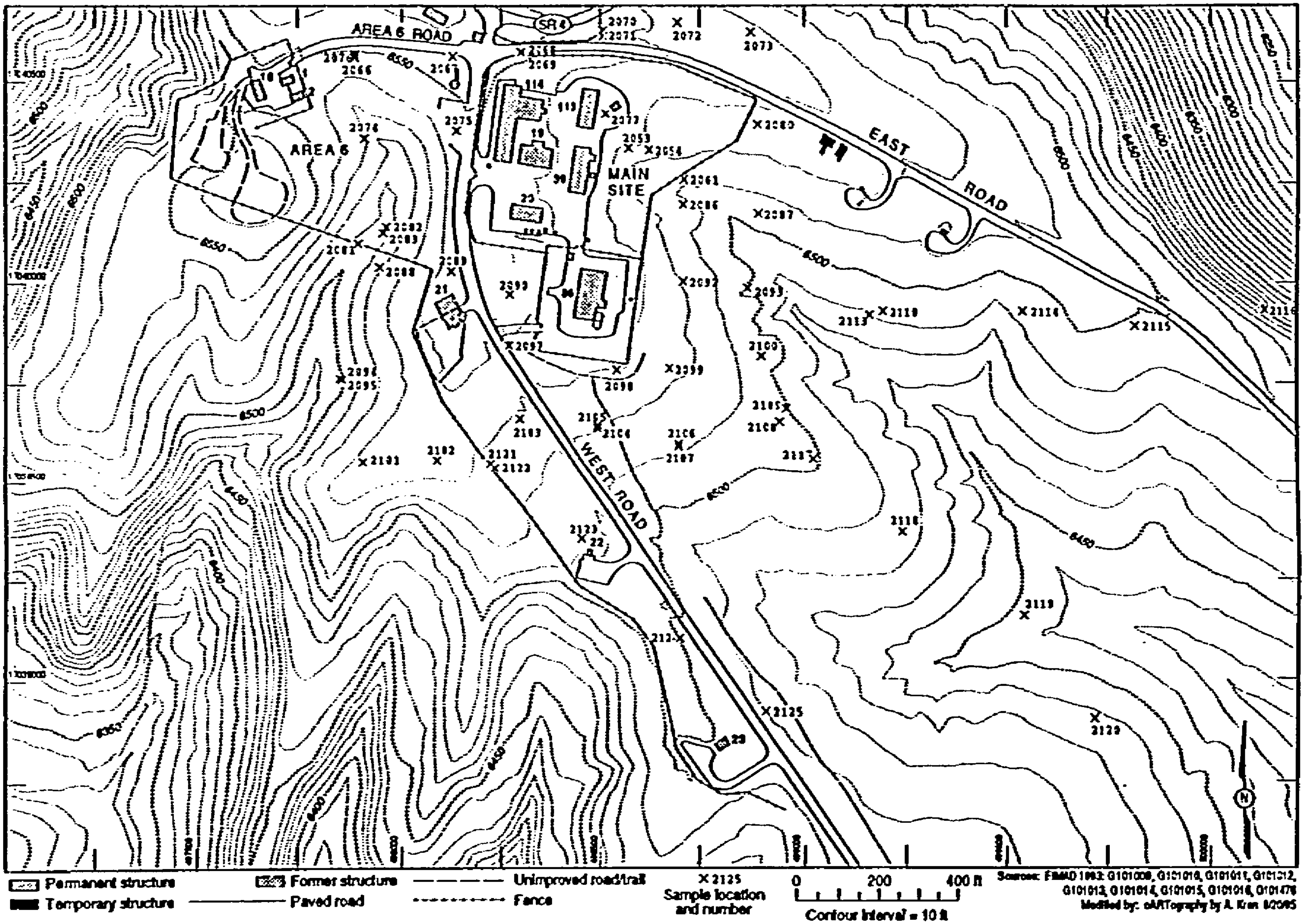
SVOCS	SAMPLE ID	DEPTH (in.)	MEDIUM	RESULT (mg/kg)	SAL[a] (mg/kg)	EQL[b] (mg/kg)
Acenaphthene	AAA2054	0-6	Soil	0.75	*4 800*	*Not listed*
Acenaphthene	AAA2097	0-6	Soil	0.69	*4 800*	*Not listed*
Aniline	AAA2123	0-6	Soil	0.41	*NC* [c]	*Not listed*
Anthracene	AAA2053	0-6	Soil	0.85	*24 000*	*0.33*
Anthracene	AAA2054	0-6	Soil	1.2	*24 000*	*0.33*
Anthracene	AAA2077	0-6	Soil	0.36	*24 000*	*0.33*
Anthracene	AAA2097	0-6	Soil	0.95	*24 000*	*0.33*
Benzo[a]anthracene	AAA2053	0-6	Soil	4.1	*1*	*0.33*
Benzo[a]anthracene	AAA2054	0-6	Soil	3.5	*1*	*0.33*
Benzo[a]anthracene	AAA2077	0-6	Soil	1.3	*1*	*0.33*
Benzo[a]anthracene	AAA2097	0-6	Soil	2.1	*1*	*0.33*
Benzo[a]pyrene	AAA2053	0-6	Soil	4.7	*0.1*	*0.33*
Benzo[a]pyrene	AAA2054	0-6	Soil	4	*0.1*	*0.33*
Benzo[a]pyrene	AAA2077	0-6	Soil	1.4	*0.1*	*0.33*
Benzo[b]fluoranthene	AAA2053	0-6	Soil	6.2	*1*	*0.33*
Benzo[b]fluoranthene	AAA2054	0-6	Soil	5.2	*1*	*0.33*
Benzo[b]fluoranthene	AAA2077	0-6	Soil	1.8	*1*	*0.33*
Benzo[b]fluoranthene	AAA2097	0-6	Soil	3.8	*1*	*0.33*
Benzo[g,h,i]perylene	AAA2053	0-6	Soil	1.7	*44*	*0.33*
Benzo[g,h,i]perylene	AAA2054	0-6	Soil	3.1	*44*	*0.33*
Benzo[g,h,i]perylene	AAA2077	0-6	Soil	0.66	*44*	*0.33*
Benzo[k]fluoranthene	AAA2053	0-6	Soil	4.3	*1*	*0.33*
Benzo[k]fluoranthene	AAA2054	0-6	Soil	3.9	*1*	*0.33*
Benzo[k]fluoranthene	AAA2077	0-6	Soil	1.1	*1*	*0.33*
Benzo[k]fluoranthene	AAA2097	0-6	Soil	1.9	*1*	*0.33*
BHC [beta-]	AAA2070	0-6	Soil	0.0023	*4*	*Not listed*
Bis(2-ethylhexyl)phthalate	AAA2053	0-6	Soil	1.1	*50*	*0.33*
Bis(2-ethylhexyl)phthalate	AAA2054	0-6	Soil	1.2	*50*	*0.33*
Bis(2-ethylhexyl)phthalate	AAA2097	0-6	Soil	1.9	*50*	*0.33*
Bis(2-ethylhexyl)phthalate	AAA2110	0-6	Soil	3.2	*50*	*0.33*
Chrysene	AAA2053	0-6	Soil	5.5	*96*	*0.33*
Chrysene	AAA2054	0-6	Soil	4.6	*96*	*0.33*
Chrysene	AAA2077	0-6	Soil	1.6	*96*	*0.33*
Chrysene	AAA2097	0-6	Soil	2.4	*96*	*0.33*
D [2,4-]	AAA2069	0-6	Soil	1.89	*NC*	*Not listed*
DDE [p,p'-]	AAA2071	0-6	Soil	0.0014	*NC*	*0.03*
Di-n-butyl phthalate	AAA2075	0-6	Soil	0.5	*8 000*	*0.33*
Dibenzofuran	AAA2097	0-6	Soil	0.44	*NC*	*0.33*
Dibenzo[a,h]anthracene	AAA2053	0-6	Soil	0.59	*0.086*	*0.33*
Dieldrin	AAA2071	0-6	Soil	0.00083	*NC*	*Not listed*
Diethylphthalate	AAA2069	0-6	Soil	30	*64 000*	*0.33*
Dinoseb	AAA2069	0-6	Soil	0.692	*NC*	*Not listed*
Endrin	AAA2070	0-6	Soil	0.0023	*NC*	*Not listed*
Endrin	AAA2071	0-6	Soil	0.0027	*NC*	*Not listed*

TABLE 4-17

ORGANICS DETECTED IN SWMU 33-017 GRID SAMPLES

SVOCS	SAMPLE ID	DEPTH (in.)	MEDIUM	RESULT (mg/kg)	SAL[a] (mg/kg)	EQL[b] (mg/kg)
Fluoranthene	AAA2053	0-6	Soil	1.6	*3 200*	*0.33*
Fluoranthene	AAA2054	0-6	Soil	5.2	*3 200*	*0.33*
Fluoranthene	AAA2077	0-6	Soil	2.5	*3 200*	*0.33*
Fluoranthene	AAA2097	0-6	Soil	2.8	*3 200*	*0.33*
Fluoranthene	AAA2098	0-6	Soil	0.61	*3 200*	*0.33*
Fluorene	AAA2054	0-6	Soil	0.59	*3 200*	*0.33*
Fluorene	AAA2097	0-6	Soil	0.58	*3 200*	*0.33*
Indeno[1,2,3-cd]pyrene	AAA2053	0-6	Soil	2.2	*1*	*0.33*
Indeno[1,2,3-cd]pyrene	AAA2054	0-6	Soil	3.3	*1*	*0.33*
Indeno[1,2,3-cd]pyrene	AAA2077	0-6	Soil	0.82	*1*	*0.33*
Naphthalene	AAA2054	0-6	Soil	0.39	*3 200*	*0.33*
Naphthalene	AAA2097	0-6	Soil	0.93	*3 200*	*0.33*
Phenanthrene	AAA2053	0-6	Soil	4.7	*NC*	*0.33*
Phenanthrene	AAA2054	0-6	Soil	5.9	*NC*	*0.33*
Phenanthrene	AAA2077	0-6	Soil	1.5	*NC*	*0.33*
Phenanthrene	AAA2097	0-6	Soil	2.8	*NC*	*0.33*
Phenanthrene	AAA2098	0-6	Soil	0.39	*NC*	*0.33*
Pyrene	AAA2053	0-6	Soil	19.6	*2 400*	*0.33*
Pyrene	AAA2054	0-6	Soil	27.4	*2 400*	*0.33*
Pyrene	AAA2068	0-6	Soil	0.49	*2 400*	*0.33*
Pyrene	AAA2070	0-6	Soil	0.38	*2 400*	*0.33*
Pyrene	AAA2077	0-6	Soil	2.6	*2 400*	*0.33*
Pyrene	AAA2097	0-6	Soil	3.3	*2 400*	*0.33*
Pyrene	AAA2098	0-6	Soil	0.53	*2 400*	*0.33*
Pyrene	AAA2221	0-6	Soil	0.69	*2 400*	*0.33*
Pyrene	AAA2222	0-6	Soil	0.44	*2 400*	*0.33*

[a] SAL = Screening action levels.
[b] EQL = Estimated quantitation limits.
[c] NC = Not calculated due to insufficient toxicity data.



Sources: FIMAD 1993: G101008, G101010, G101011, G101012, G101013, G101014, G101015, G101016, G101478
Modified by: cARTography by A. Kron 8/2095

Fig. 4-8. Locations of grid samples assigned to SWMU 33-017.

Drainage Samples Four inorganics from the drainage samples exceeded LANL and TA-33 background UTLs (Table 4-18). Trace amounts of four organics were found above detection limits (Table 4-19). No other analyte concentrations were found above TA-33 and LANL background UTLs. No figure is given for these drainage samples.

TABLE 4-18

INORGANIC ANALYTES ABOVE LANL AND TA-33 BACKGROUND UTLs AT SWMU 33-017 DRAINAGES

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	LANL UTL[a] (mg/kg)	TA-33 UTL (mg/kg)	SAL[b] (mg/kg)
Cadmium	AAA2061	0-6	Soil	3.3	2.7	2.7	80
Lead	AAA2055	0-6	Soil	40	39	39	400
	AAA2091	0-6	Soil	98	39	39	400
	AAA2195	0-6	Soil	100	39	39	400
Uranium	AAA2195	0-6	Soil	5.2	2.8	4.8	95
Zinc	AAA2056	0-6	Soil	110	101	62.3	24 000
	AAA2193	0-6	Soil	110	101	62.3	24 000
	AAA2061	0-6	Soil	750	101	62.3	24 000
	AAA2195	0-6	Soil	350	101	62.3	24 000

[a] Upper tolerance limit.
[b] Screening action level.

TABLE 4-19

ORGANIC ANALYTES ABOVE LANL AND TA-33 BACKGROUND UTLs AT SWMU 33-017 DRAINAGES

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	CONCENTRATION (mg/kg)	EQL[a] (mg/kg)	SAL[b] (mg/kg)
Benzo(b)fluoranthene	AAA2055	0-6	Soil	0.44	0.33	1
Fluoranthene	AAA2056	0-6	Soil	0.41	0.33	3 200
	AAA2064	0-6	Soil	0.72	0.33	3 200
Phenanthrene	AAA2056	0-6	Soil	0.37	0.33	ND[c]
	AAA2064	0-6	Soil	0.59	0.33	ND[c]
Pyrene	AAA2055	0-6	Soil	0.71	0.33	2 400
	AAA2056	0-6	Soil	0.36	0.33	2 400
	AAA2064	0-6	Soil	0.66	0.33	2 400

[a] Estimated quantitation limit.
[b] Screening action level.
[c] Not determined.

Vehicle Maintenance Located within the vehicle maintenance area east of shop TA-33-39 are overlapping SWMUs 33-004(i) and 33-012(a). These SWMUs were discussed in depth in RFI Report LA-UR-95-882, Subsections 4.4 and 4.9 (LANL 1995, 1212). Elevated levels of lead were detected in most samples from the area east of the shop. As a means of dealing with the overlapping PRSs, all inorganic contamination was ascribed to SWMU 33-004(i), outfalls from the shop, because the shop contained a lead melting facility. Fig. 4-9 shows the relationship of these overlapping SWMUs.

Inorganics and SVOCs were detected in 14 of the 16 samples taken in the vehicle maintenance area. Seven samples contained PAHs above SAL. Because SVOCs are logically associated with maintenance activities, this contamination is ascribed to SWMU 33-017. Table 4-20 lists inorganics detected in the vehicle maintenance area. Table 4-21 lists the SVOCs. TICs were detected in all SVOC samples.

4.8.3.2 Data Interpretation

SVOCs, specifically cPAHs, were found in the vehicle maintenance area at levels that exceeded SALs. With the exception of lead, inorganics, radionuclides, herbicides, and pesticides were below SALs. SVOCs and PCBs are discussed in the Appendix B sampling and analysis plan for SWMU 33-017.

The area east of TA-33-39, represented by six samples from SWMU 33-004(i), four samples from SWMU 33-012(a), three samples from the vehicle maintenance area, and four samples from the main drainage, appears to have widespread above-background concentrations of lead and zinc, plus a few above-background observations of nickel and chromium. These analytes are addressed in a separate RFI report LA-UR-95-882 (LANL 1995, 1212). Three samples from SWMU 33-012(a) were analyzed for PCBs. Sample AAA2032 contained 2.3 mg/kg PCBs and sample AAA2034 contained 0.25 mg/kg. PCB migration at Main Site is addressed under area of concern (AOC) C-33-001 in Subsection 5.4 of this RFI report.

4.8.3.3 Risk Assessment

Lead results were included in the SWMU 33-004(i) preliminary risk assessment described in RFI Report LA-UR-95-882, Subsection 4.4. Results indicate that although lead contamination is widespread in the area east of TA-33-39, it would not pose a risk to the most sensitive population, children under seven years (LANL 1995, 1212). Because SWMU 33-004(i) is embedded SWMU 33-017, calculations for this risk assessment are repeated in Appendix D of this RFI report for completeness in dealing with SWMU 33-017. According to EPA, an acceptable risk for lead exposure is less than 5% of the population expected to have blood lead

TABLE 4-20

INORGANICS DETECTED ABOVE LANL AND TA-33 BACKGROUND UTLs AT SWMU 33-017 VEHICLE MAINTENANCE AREA

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	RESULT (mg/kg)	LANL UTL[a] (mg/kg)	TA-33 UTL (mg/kg)	SAL[b] (mg/kg)
Chromium	AAA2051	0-6	Soil	84	34.2	20.7	*400*
Chromium	AAA1978	0-6	Soil	60	34.2	20.7	*400*
Lead	AAA2049	0-6	Soil	64	39	39	*1 600*
Lead	AAA2050	0-6	Soil	90	39	39	*400*
Lead	AAA2051	0-6	Soil	170	39	39	*400*
Lead	AAA2052	0-6	Soil	46	39	39	*400*
Lead	AAA2053	0-6	Soil	98	39	39	*400*
Lead	AAA2054	0-6	Soil	200	39	39	*400*
Lead	AAA1976	0-6	Soil	79	39	39	*400*
Lead	AAA1977	0-6	Soil	73	39	39	*400*
Lead	AAA1978	0-6	Soil	800	39	39	*400*
Lead	AAA1979	0-6	Soil	71	39	39	*400*
Lead	AAA1980	0-6	Soil	210	39	39	*400*
Lead	AAA2031	0-6	Soil	104	39	39	*400*
Lead	AAA2032	0-6	Soil	118	39	39	*400*
Lead	AAA2033	0-6	Soil	53	39	39	*400*
Nickel	AAA2051	0-6	Soil	73	26.7	17	*1 600*
Nickel	AAA2052	0-6	Soil	87	26.7	17	*1 600*
Nickel	AAA2053	0-6	Soil	35	26.7	17	*1 600*
Silver	AAA2053	0-6	Soil	8.8	NC[c]	NC	*400*
Silver	AAA2054	0-6	Soil	46	NC	NC	*400*
Uranium	AAA2052	0-6	Soil	3.6	2.82	4.84	*95*
Uranium	AAA2053	0-6	Soil	3.5	2.82	4.84	*95*
Uranium	AAA2054	0-6	Soil	4.2	2.82	4.84	*95*
Uranium	AAA1976	0-6	Soil	3.1	2.82	4.84	*95*
Uranium	AAA1977	0-6	Soil	3.9	2.82	4.84	*95*
Zinc	AAA2049	0-6	Soil	730	101	62.3	*24 000*
Zinc	AAA2050	0-6	Soil	530	101	62.3	*24 000*
Zinc	AAA2051	0-6	Soil	1 700	101	62.3	*24 000*
Zinc	AAA2053	0-6	Soil	330	101	62.3	*24 000*
Zinc	AAA2054	0-6	Soil	350	101	62.3	*24 000*
Zinc	AAA1976	0-6	Soil	210	101	62.3	*24 000*
Zinc	AAA1977	0-6	Soil	120	101	62.3	*24 000*
Zinc	AAA1980	0-6	Soil	130	101	62.3	*24 000*
Zinc	AAA2031	0-6	Soil	820	101	62.3	*24 000*
Zinc	AAA2032	0-6	Soil	610	101	62.3	*24 000*
Zinc	AAA2033	0-6	Soil	210	101	62.3	*24 000*

[a] UTL = Upper tolerance limit.

[b] SAL = Screening action level.

[c] NC = Not calculated due to insufficient data above detection limit.

TABLE 4-21

ORGANICS DETECTED AT SWMU 33-017 VEHICLE MAINTENANCE AREA

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	RESULT (mg/kg)	SAL[a] (mg/kg)	EQL[b] (mg/kg)
Acenaphthene	AAA2051	0-6	Soil	0.47	*4 800*	*Not listed*
Acenaphthene	AAA2054	0-6	Soil	0.75	*4 800*	*Not listed*
Acenaphthene	AAA1976	0-6	Soil	0.63	*4 800*	*Not listed*
Acenaphthene	AAA1979	0-6	Soil	0.47	*4 800*	*Not listed*
Anthracene	AAA2051	0-6	Soil	2.3	*24 000*	*0.33*
Anthracene	AAA2053	0-6	Soil	0.85	*24 000*	*0.33*
Anthracene	AAA2054	0-6	Soil	1.2	*24 000*	*0.33*
Anthracene	AAA1976	0-6	Soil	0.94	*24 000*	*0.33*
Anthracene	AAA1978	0-6	Soil	0.69	*24 000*	*0.33*
Anthracene	AAA1979	0-6	Soil	0.92	*24 000*	*0.33*
Benzo[a]anthracene	AAA2051	0-6	Soil	*8.2*	*1*	*0.33*
Benzo[a]anthracene	AAA2053	0-6	Soil	*4.1*	*1*	*0.33*
Benzo[a]anthracene	AAA2054	0-6	Soil	*3.5*	*1*	*0.33*
Benzo[a]anthracene	AAA2032	0-6	Soil	0.51	*1*	*0.33*
Benzo[a]anthracene	AAA1976	0-6	Soil	*1.8*	*1*	*0.33*
Benzo[a]anthracene	AAA1977	0-6	Soil	0.39	*1*	*0.33*
Benzo[a]anthracene	AAA1978	0-6	Soil	*1.3*	*1*	*0.33*
Benzo[a]anthracene	AAA1979	0-6	Soil	*1.6*	*1*	*0.33*
Benzo[a]anthracene	AAA1980	0-6	Soil	0.6	*1*	*0.33*
Benzo[a]pyrene	AAA2051	0-6	Soil	*7.5*	*0.1*	*0.33*
Benzo[a]pyrene	AAA2053	0-6	Soil	*4.7*	*0.1*	*0.33*
Benzo[a]pyrene	AAA2054	0-6	Soil	*4*	*0.1*	*0.33*
Benzo[a]pyrene	AAA1976	0-6	Soil	*0.64*	*0.1*	*0.33*
Benzo[a]pyrene	AAA1978	0-6	Soil	*0.86*	*0.1*	*0.33*
Benzo[a]pyrene	AAA1979	0-6	Soil	*1.3*	*0.1*	*0.33*
Benzo[a]pyrene	AAA1980	0-6	Soil	*0.62*	*0.1*	*0.33*
Benzo[b]fluoranthene	AAA2049	0-6	Soil	0.34	*0.7*	*0.33*
Benzo[b]fluoranthene	AAA2051	0-6	Soil	*9.8*	*1*	*0.33*
Benzo[b]fluoranthene	AAA2053	0-6	Soil	*6.2*	*1*	*0.33*
Benzo[b]fluoranthene	AAA2054	0-6	Soil	*5.2*	*1*	*0.33*
Benzo[b]fluoranthene	AAA2032	0-6	Soil	0.43	*1*	*0.33*
Benzo[b]fluoranthene	AAA1976	0-6	Soil	*1.1*	*1*	*0.33*
Benzo[b]fluoranthene	AAA1977	0-6	Soil	0.45	*1*	*0.33*
Benzo[b]fluoranthene	AAA1978	0-6	Soil	*1.5*	*1*	*0.33*
Benzo[b]fluoranthene	AAA1979	0-6	Soil	*3.1*	*1*	*0.33*
Benzo[b]fluoranthene	AAA1980	0-6	Soil	*0.8*	*1*	*0.33*
Benzo[g,h,i]perylene	AAA2051	0-6	Soil	3.1	*NC*[c]	*0.33*
Benzo[g,h,i]perylene	AAA2053	0-6	Soil	1.7	*NC*	*0.33*
Benzo[g,h,i]perylene	AAA2054	0-6	Soil	3.1	*NC*	*0.33*
Benzo[k]fluoranthene	AAA2049	0-6	Soil	0.34	*1*	*0.33*
Benzo[k]fluoranthene	AAA2051	0-6	Soil	*7.1*	*1*	*0.33*
Benzo[k]fluoranthene	AAA2053	0-6	Soil	*4.3*	*1*	*0.33*

TABLE 4-21 (CONTINUED)

ORGANICS DETECTED AT SWMU 33-017 VEHICLE MAINTENANCE AREA

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	RESULT (mg/kg)	SAL* (mg/kg)	EQL* (mg/kg)
Benzo[k]fluoranthene	AAA2054	0-6	Soil	3.9	1	0.33
Benzo[k]fluoranthene	AAA2032	0-6	Soil	0.52	1	0.33
Benzo[k]fluoranthene	AAA1978	0-6	Soil	0.36	1	0.33
Benzo[k]fluoranthene	AAA1980	0-6	Soil	0.67	1	0.33
Bis(2-ethylhexyl)phthalate	AAA2049	0-6	Soil	1.4	50	0.33
Bis(2-ethylhexyl)phthalate	AAA2051	0-6	Soil	0.92	50	0.33
Bis(2-ethylhexyl)phthalate	AAA2053	0-6	Soil	1.1	50	0.33
Bis(2-ethylhexyl)phthalate	AAA2054	0-6	Soil	1.2	50	0.33
Bis(2-ethylhexyl)phthalate	AAA2031	0-6	Soil	1.1	50	0.33
Bis(2-ethylhexyl)phthalate	AAA2032	0-6	Soil	1.3	50	0.33
Chrysene	AAA2049	0-6	Soil	0.35	96	0.33
Chrysene	AAA2051	0-6	Soil	9.2	96	0.33
Chrysene	AAA2053	0-6	Soil	5.5	96	0.33
Chrysene	AAA2054	0-6	Soil	4.6	96	0.33
Chrysene	AAA2032	0-6	Soil	0.54	96	0.33
Chrysene	AAA1976	0-6	Soil	2	96	0.33
Chrysene	AAA1977	0-6	Soil	0.54	96	0.33
Chrysene	AAA1978	0-6	Soil	1.5	96	0.33
Chrysene	AAA1979	0-6	Soil	1.5	96	0.33
Chrysene	AAA1980	0-6	Soil	0.64	96	0.33
Dibenzo[a,h]anthracene	AAA2053	0-6	Soil	0.59	0.1	0.33
Fluoranthene	AAA2049	0-6	Soil	0.65	3 200	0.33
Fluoranthene	AAA2051	0-6	Soil	20.1	3 200	0.33
Fluoranthene	AAA2053	0-6	Soil	1.6	3 200	0.33
Fluoranthene	AAA2054	0-6	Soil	5.2	3 200	0.33
Fluoranthene	AAA2032	0-6	Soil	0.68	3 200	0.33
Fluoranthene	AAA1975	0-6	Soil	0.44	3 200	0.33
Fluoranthene	AAA1976	0-6	Soil	2.7	3 200	0.33
Fluoranthene	AAA1977	0-6	Soil	0.54	3 200	0.33
Fluoranthene	AAA1978	0-6	Soil	1.4	3 200	0.33
Fluoranthene	AAA1980	0-6	Soil	1.3	3 200	0.33
Fluorene	AAA2054	0-6	Soil	0.59	3 200	0.33
Fluorene	AAA1976	0-6	Soil	0.38	3 200	0.33
Fluorene	AAA1979	0-6	Soil	0.33	3 200	0.33
Indeno[1,2,3-cd]pyrene	AAA2051	0-6	Soil	4.2	1	0.33
Indeno[1,2,3-cd]pyrene	AAA2053	0-6	Soil	2.2	1	0.33
Indeno[1,2,3-cd]pyrene	AAA2054	0-6	Soil	3.3	1	0.33
Naphthalene	AAA2054	0-6	Soil	0.39	3 200	0.33
Phenanthrene	AAA2051	0-6	Soil	12.6	None	0.33
Phenanthrene	AAA2052	0-6	Soil	0.34	None	0.33
Phenanthrene	AAA2053	0-6	Soil	4.7	None	0.33
Phenanthrene	AAA2054	0-6	Soil	5.9	None	0.33
Phenanthrene	AAA2032	0-6	Soil	0.96	None	0.33

TABLE 4-21 (CONTINUED)

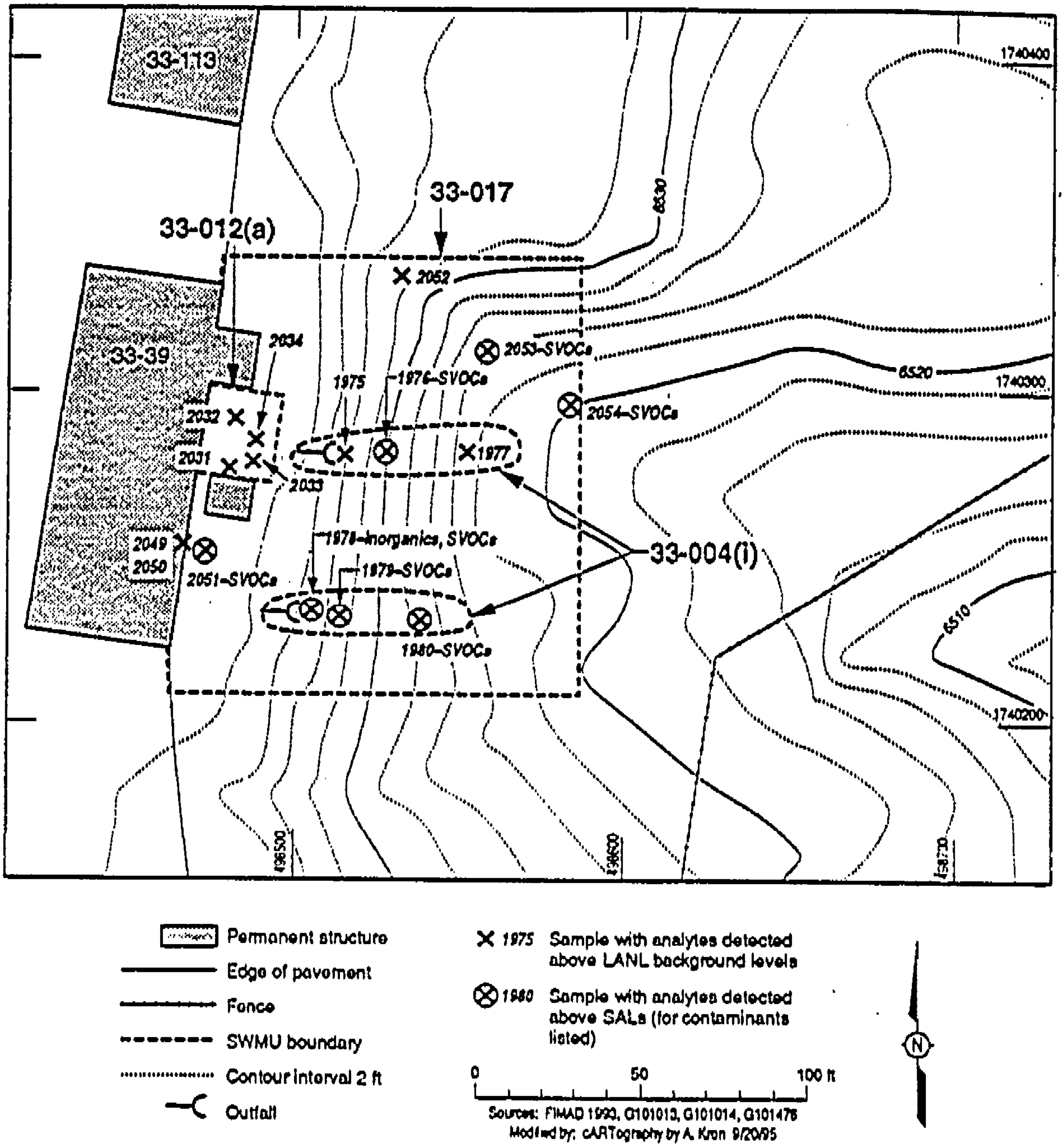
ORGANICS DETECTED AT SWMU 33-017 VEHICLE MAINTENANCE AREA

ANALYTE	SAMPLE ID	DEPTH (in.)	MEDIUM	RESULT (mg/kg)	SAL[a] (mg/kg)	EQL[b] (mg/kg)
Phenanthrene	AAA1976	0-6	Soil	3.8	*None*	*0.33*
Phenanthrene	AAA1977	0-6	Soil	0.5	*None*	*0.33*
Phenanthrene	AAA1978	0-6	Soil	2.5	*None*	*0.33*
Phenanthrene	AAA1979	0-6	Soil	2.9	*None*	*0.33*
Phenanthrene	AAA1980	0-6	Soil	1.2	*None*	*0.33*
Pyrene	AAA2049	0-6	Soil	0.92	*2 400*	*0.33*
Pyrene	AAA2050	0-6	Soil	0.35	*2 400*	*0.33*
Pyrene	AAA2051	0-6	Soil	26.7	*2 400*	*0.33*
Pyrene	AAA2052	0-6	Soil	1.7	*2 400*	*0.33*
Pyrene	AAA2053	0-6	Soil	19.6	*2 400*	*0.33*
Pyrene	AAA2054	0-6	Soil	27.4	*2 400*	*0.33*
Pyrene	AAA2032	0-6	Soil	2.1	*2 400*	*0.33*
Pyrene	AAA1975	0-6	Soil	0.51	*2 400*	*0.33*
Pyrene	AAA1976	0-6	Soil	4.5	*2 400*	*0.33*
Pyrene	AAA1977	0-6	Soil	1.4	*2 400*	*0.33*
Pyrene	AAA1978	0-6	Soil	4.2	*2 400*	*0.33*
Pyrene	AAA1979	0-6	Soil	2.3	*2 400*	*0.33*
Pyrene	AAA1980	0-6	Soil	1.6	*2 400*	*0.33*

[a] SAL = Screening action level.

[b] EQL = Estimated quantitation limit.

[c] NC = Not calculated due to insufficient toxicity data.



Sources: FIMAD 1993, G101013, G101014, G101476
Modified by: cARTography by A. Kron 9/20/95

Fig. 4-9. Main Site: SWMU 33-017, vehicle maintenance area risk assessment exposure area showing overlapping SWMUs 33-004(i) and 33-012(a).

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.

The same exposure unit used for lead, approximately 0.15 acres east of TA-33-39, was used for a preliminary risk assessment for the PAHs (Fig. 4-9). Risk assessment calculations for SWMU 33-017 are presented in Appendix D of this RFI report. Results show that the estimated carcinogenic risk to construction workers is low at both the mean and the 95% UCL concentrations: 2.7E-07 and 5.6E-07, respectively. Estimated risk to future residents based on the mean PAH concentration is 3.1E-06 and when based on all seven 95% UCLs, estimated risk rises to 2.1E-05.

4.8.3.4 Ecotoxicological Screening Assessment

A global ecotoxicological assessment is presented in Subsection 3.2.3 of this RFI report.

4.8.4 Conclusion and Recommendation

Based on results of this preliminary risk assessment for SVOCs, further study will be taken in this exposure unit, which includes the area extending approximately 130 ft east of shop TA-33-39. Phase II sampling will collect additional samples in the vicinity of the elevated SVOCs to refine level and extent of contamination (Appendix B).

5.0 REVISED PHASE I SAMPLING AND ANALYSIS PLANS

Information gathered since the RFI work plan LA-UR-92-925 was submitted in May 1992 indicates that six sampling plans are inadequate or inappropriate. Therefore, revised sampling plans for the PRSs listed in Table 5-1 are submitted in Section 5.0.

5.1 SWMU 33-003(b) MDA-D, East Site

SWMU 33-003(b) is underground experimental chamber TA-33-6 at MDA D. It is discussed in the RFI Work Plan for OU 1122, Subsections 3.5.2.1 and 4.5.3.1 (LANL 1992, 0784). No action is proposed for the chamber based on an assessment of exposure pathways. A Phase II sampling plan is presented for the surface and subsurface soil component of SWMU 33-003(b).

APPENDIX D RISK ASSESSMENT CALCULATIONS FOR SWMU 33-017

1.0 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 the risk assessments described in this report, 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 m2). The human exposure assumptions are that 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 Installation Work Plan (IWP) provides additional detail about the intake assumptions used for each exposure pathway, under each land use scenario (LANL 1993, 1017).

2.0 TOXICITY ASSESSMENT

Toxicity assessment requires identifying appropriate toxicity values for contaminants of potential concern. Slope factors, which express the potential of a contaminant to cause cancer, are obtained from the Environmental Protection Agency's (EPA) Integrated Risk Information System, EPA's Health Effects Assessment Summary Tables, or the 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., the liver or central nervous system).

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 risk in perspective. The numerical estimate of risk is calculated using methods found in EPA's Risk Assessment Guidance for Superfund (EPA 1989, 0305). 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 Environmental Restoration ER Project (LANL 1993, 1017).

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

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

TABLE D-1

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

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

* PCB = Polychlorinated biphenyls.

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

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

The MVU estimate of the mean is

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

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

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

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

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

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

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

3.2 Results of the EPA Lead Model (version 0.99d) based on 95% UCL Lead Concentration in Soil at the SWMU 33-017 Exposure Unit

Results of the EPA Lead (Pb) Model (Version 0.99d) based on 95% Upper Confidence Limit (UCL)

AIR CONCENTRATION:		0.100 µg Pb/m^3 DEFAULT	
Indoor air Pb Concentration:		40.0 percent of outdoor	
OTHER AIR PARAMETERS			
Age	Time Outdoors (hr)	Ventilation Rate (m^3/day)	Lung Absolute (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Concentration: 4.00 µg Pb/L DEFAULT
WATER Consumption: DEFAULT

SOIL AND DUST Soil: Constant concentration Dust: Multiple source analysis		
AGE	SOIL (µg Pb/g)	HOUSE DUST (µg Pb/g)
0-1	350.0	255.0
1-2	350.0	255.0
2-3	350.0	255.0
3-4	350.0	255.0
4-5	350.0	255.0
5-6	350.0	255.0
6-7	350.0	255.0
Additional dust source: None DEFAULT Soil contribution conversion factor: 0.70 Air contribution conversion factor: 100.0		

PAINT INTAKE: 0.00 µg Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Contribution: 2.50 µg Pb/dl

CALCULATED BLOOD Pb and Pb UPTAKES			
YEAR	BLOOD LEVEL (µg /dl)	TOTAL UPTAKE (µg /day)	SOIL + DUST UPTAKE (µg /day)
0.5-1	5.2	9.66	6.80
1-2	5.8	14.12	10.64
2-3	5.5	14.71	10.80
3-4	5.2	14.85	10.97
4-5	4.3	12.27	8.35
5-6	3.7	11.80	7.59
6-7	3.4	11.76	7.21

YEAR	DIET UPTAKE (µg /day)	WATER UPTAKE (µg /day)	PAINT UPTAKE (µg /day)	AIR UPTAKE (µg /day)
0.5-1	2.48	0.36	0.00	0.03
1-2	2.55	0.88	0.00	0.04
2-3	2.91	0.93	0.00	0.08
3-4	2.84	0.96	0.00	0.08
4-5	2.81	1.03	0.00	0.08
5-6	2.99	1.10	0.00	0.11
6-7	3.32	1.12	0.00	0.11

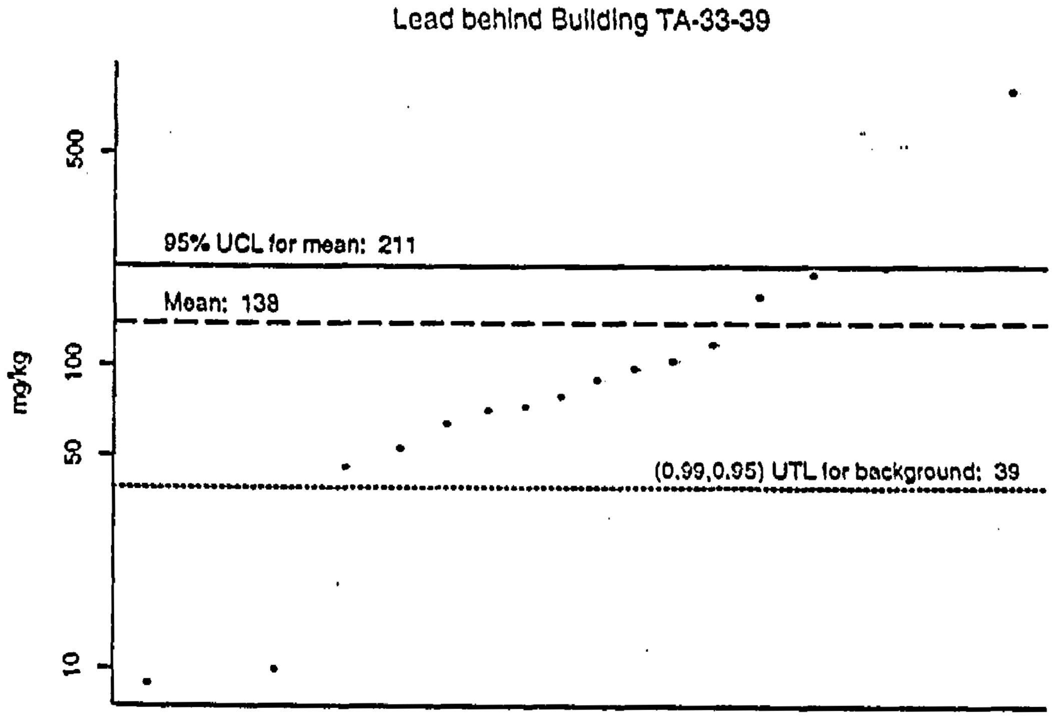


Fig. D-1. Probability plot of lead values.

4.0 RISK CALCULATION FOR PAHs AT SWMU 33-017 VEHICLE MAINTENANCE AREA

4.1 Risk Calculations for PAHs

The same formulas were used to calculate means and 95% UCLs for the seven PAHs shown in Table D-2. Below-detection-level observations were replaced by one-half the detection level. The approximate log-normality of the above-detection-level observations is illustrated in Fig. D-2 for benzo[a]anthracene, which is typical of the PAHs for which six to nine of the 16 observations are above the detection level (i.e., five of the seven constituents in Table D-2).

TABLE D-2

PAHs IN EXPOSURE UNIT EAST OF TA-33-39

	33-017: VEHICLE MAINTENANCE AREA			33-017: TOP OF MAIN DRAINAGE		
	AAA2049	AAA2050	AAA2051	AAA2052	AAA2053	AAA2054
Benzo[a]anthracene	<0.33	<0.33	8.20	<0.33	4.10	3.50
Benzo[a]pyrene	<0.33	<0.33	7.50	<0.33	4.70	4.00
Benzo[b]fluoranthene	0.34	<0.33	9.80	<0.33	6.20	5.20
Benzo[k]fluoranthene	0.34	<0.33	7.10	<0.33	4.30	3.90
Chrysene	0.35	<0.33	9.20	<0.33	5.50	4.60
Dibenzo[a,h]anthracene	<0.33	<0.33	<0.33	<0.33	0.59	<0.33
Indeno[1,2,3-cd]pyrene	<0.33	<0.33	4.20	<0.33	2.20	3.30
	33-004(I): NORTH OUTFALL			33-004(I): SOUTH OUTFALL		
	AAA1975	AAA1976	AAA1977	AAA1978	AAA1979	AAA1980
Benzo[a]anthracene	<0.33	1.80	0.39	1.30	1.60	0.60
Benzo[a]pyrene	<0.33	0.64	<0.33	0.86	1.30	0.62
Benzo[b]fluoranthene	<0.33	1.10	0.45	1.50	3.10	0.80
Benzo[k]fluoranthene	<0.33	<0.33	<0.33	0.36	<0.33	0.57
Chrysene	<0.33	2.00	0.54	1.50	1.50	0.64
Dibenzo[a,h]anthracene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
Indeno[1,2,3-cd]pyrene	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33

TABLE D-2 (CONTINUED)

PAHs IN EXPOSURE UNIT EAST OF TA-33-39

	33-012(a): STORAGE AREA			
	AAA2031	AAA2032	AAA2033	AAA2034
Benzo[a]anthracene	<0.33	0.51	<0.33	<0.33
Benzo[a]pyrene	<0.33	<0.33	<0.33	<0.33
Benzo[b]fluoranthene	<0.33	0.43	<0.33	<0.33
Benzo[k]fluoranthene	<0.33	0.52	<0.33	<0.33
Chrysene	<0.33	0.54	<0.33	<0.33
Dibenzo[a,h]anthracene	<0.33	<0.33	<0.33	<0.33
Indeno[1,2,3-cd]pyrene	<0.33	<0.33	<0.33	<0.33

Observations for seven PAHs detected in sixteen samples from this area are shown in Table D-3. Mean and 95% UCLs were computed for these seven cPAHs using the MVU lognormal estimators. Observations below detection level were replaced by one-half the detection level (EPA 1989, 0305). Calculated values are shown in Table D-3.

TABLE D-3

MEAN AND 95% UCLs FOR PAHs IN EXPOSURE UNIT EAST OF TA-33-39

PAH	MEAN (mg/kg)	95% UCL[a] (mg/kg)	SAL[b] (mg/kg)
Benzo[a]anthracene	1.35	2.28	1.0
Benzo[a]pyrene	1.11	1.89	0.10
Benzo[b]fluoranthene	1.74	3.03	1.0
Benzo[k]fluoranthene	0.88	1.45	1.0
Chrysene	1.61	2.74	22.0
Dibenzo[a,h]anthracene	0.19	0.21	0.1
Indeno[1,2,3-cd]pyrene	0.54	0.86	1.0

a UCL = Upper confidence limit.
b SAL = Screening action level.

Risks were estimated using the methodology outlined in Appendix K of the IWP for carcinogenic, nonradioactive compounds (LANL 1993, 1017). Two different exposure scenarios were considered:

- construction, which assumes that the exposure unit would continue to be used by LANL and that construction workers working in the unit would have the highest exposure potential; and
- residential, which assumes that the exposure unit would ultimately be used for housing.

Results show that the estimated carcinogenic risk to construction workers is low at both the mean and the 95% UCL concentrations: 2.7E-07 and 5.6E-07, respectively. Estimated risk to future residents based on the mean PAH concentration is 3.1E-06 and when based on all seven 95% UCLs, estimated risk rises to 2.1E-05. Printouts showing results of the calculations are included in Attachment D-1 of this appendix

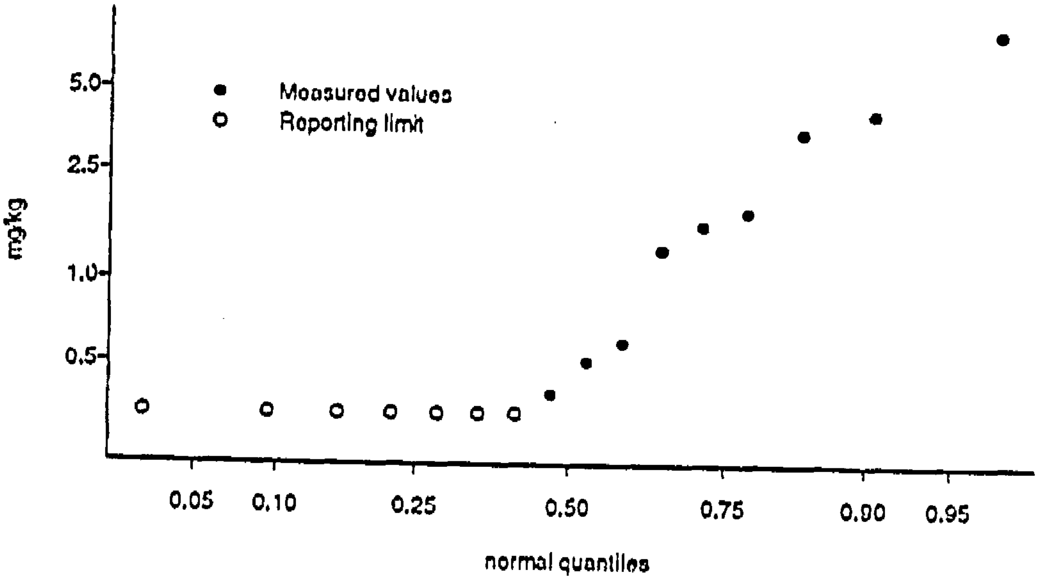


Fig. D-2. Distribution of benzo[a]anthracene in SWMU 33-017 exposure unit (lognormal plot).

5.0 REFERENCES

EPA (US Environmental Protection Agency), February 1994. "Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children," EPA 540-R-93-081, Office of Emergency and Remedial Response, Washington, DC. **(EPA 1994, 1178)**

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

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. **(LANL 1993, 1017)**

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ATTACHMENT D-1

RESULTS OF RISK CALCULATIONS FOR PAHs AT THE SWMU 33-017 VEHICLE MAINTENANCE EXPOSURE UNIT

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TABLE C-C
STATISTICAL SUMMARY OF SOIL DATA
VEHICLE MAINTENANCE AREA
LANL, LOS ALAMOS, NEW MEXICO

COPCs	FOD	Minimum Detected Conc.	Maximum Detected Conc.	Arithmetic Mean	95% UCL	Lesser of Max. or 95% UCL
Semivolatiles						
Benzo(a)anthracene	9/16	< 0.33	8.2	1.352	2.282	2.282
Benzo(a)pyrene	7/16	< 0.33	7.5	1.114	1.891	1.891
Benzo(b)fluoranthene	10/16	< 0.33	9.8	1.744	3.034	3.034
Benzo(k)fluoranthene	7/16	< 0.33	7.1	0.875	1.454	1.454
Chrysene	10/16	< 0.33	8.2	1.607	2.745	2.745
Dibenzo(a,h) anthracene	1/16	< 0.33	0.59	0.187	0.214	0.590
Indeno(1,2,3-cd)pyrene	3/16	< 0.33	4.2	0.544	0.863	0.863
Inorganics						
Antimony	13/16	0.1	0.4	0.098	0.133	0.133
Arsenic	16/16	1.26	4.14	2.113	2.392	2.392
Barium	16/16	39	220	80.668	99.885	99.885
Beryllium	16/16	0.16	0.62	0.413	0.472	0.472
Cadmium	11/16	< 0.4	2.3	1.146	1.702	1.702
Chromium	16/16	4.2	64	18.412	25.800	25.800
Lead	16/16	9	800	138.22	210.958	210.958
Nickel	14/16	< 2.0	87	24.158	38.593	38.593
Selenium	3/16	< 0.2	1.2	0.096	0.133	0.133
Silver	2/16	< 1.0	46	1.69	2.782	2.782
Zinc	16/16	37	1700	385.144	608.07	608.070

COPCs = Chemicals of potential concern
FOD = Frequency of detection
Conc. = Concentration
UCL = Upper confidence limit
Max. = Maximum detected concentration
All concentrations are in units of mg/kg.

TABLE D-1
AIR CONCENTRATIONS OF CHEMICALS ADHERED ONTO DUSTS
VEHICLE MAINTENANCE AREA
LANL, LOS ALAMOS, NEW MEXICO

COPCs	RME EPC (Cs) (mg/kg)	RME EPC (Cp) (mg/m^3)
Semivolatiles		
Benzo(a)anthracene	2.28E+00	2.05E-07
Benzo(a)pyrene	1.89E+00	1.70E-07
Benzo(b)fluoranthene	3.03E+00	2.73E-07
Benzo(k)fluoranthene	1.45E+00	1.31E-07
Chrysene	2.75E+00	2.47E-07
Dibenzo(a,h) anthracene	5.90E-01	5.31E-08
Indeno(1,2,3-cd)pyrene	8.63E-01	7.77E-08
Inorganics		
Antimony	1.33E-01	1.20E-08
Arsenic	2.39E+00	2.15E-07
Barium	9.99E+01	8.99E-06
Beryllium	4.72E-01	4.25E-08
Cadmium	1.70E+00	1.53E-07
Chromium	2.58E+01	2.32E-06
Lead	2.11E+02	1.90E-05
Nickel	3.86E+01	3.47E-06
Selenium	1.33E-01	1.20E-08
Silver	2.78E+00	2.50E-07
Zinc	6.08E+02	5.47E-06

COPCs - Chemicals of potential concern
RME EPC = Reasonable Maximum Exposure Exposure Point Concentration
Cs = Concentration in soil
Cp = Concentration in dust particles = Cs x PC
PC = Particulate Concentration in Air = 9×10^{-8} kg/m^3

TABLE T-1'
TOXICITY CRITERIA FOR CHEMICALS OF POTENTIAL CONCERN
VEHICLE MAINTENANCE AREA
LANL, LOS ALAMOS, NEW MEXICO

COPCs	Inhalation CSF (mg/kg/day)$^{-1}$	Chronic Oral CSF (mg/kg/day)$^{-1}$	Chronic Inhalation RfD (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Oral Absorption Fraction	Adjusted Dermal CSF (mg/kg/day)$^{-1}$	Adjusted Dermal RfD (mg/kg/day)
Semivolatiles							
Benzo(a)anthracene	7.30E-01	7.30E-01	NA	NA	0.84	8.69E-01	NA
Benzo(a)pyrene	7.30E+00	7.30E+00	NA	NA	0.84	8.69E+00	NA
Benzo(b)fluoranthene	7.30E-01	7.30E-01	NA	NA	0.84	8.69E-01	NA
Benzo(k)fluoranthene	7.30E-02	7.30E-02	NA	NA	0.84	8.69E-02	NA
Chrysene	7.30E-03	7.30E-03	NA	NA	0.84	8.69E-03	NA
Dibenzo(a,h) anthracene	7.30E+00	7.30E+00	NA	NA	0.84	8.69E+00	NA
Indeno(1,2,3-cd)pyrene	7.30E-01	7.30E-01	NA	NA	0.84	8.69E-01	NA
Inorganics							
Antimony	NC	NC	NA	4.00E-04	0.1	NC	4.00E-05
Arsenic	1.50E+01	1.50E+00	NA	3.00E-04	1	1.50E+00	3.00E-04
Barium	NC	NC	1.40E-04	7.00E-02	0.05	NC	3.50E-03
Beryllium	8.40E+00	4.30E+00	NA	5.00E-03	0.005	8.60E+02	2.50E-05
Cadmium	6.30E+00	NA	NA	5.00E-04	0.07	NC	3.50E-05
Chromium	4.20E+01	NA	NA	5.00E-03	0.1	NC	5.00E-04
Lead	UBM	UBM	UBM	UBM	0.5	NA	NA
Nickel	NC	NC	NA	2.00E-02	0.1	NC	2.00E-03
Selenium	NC	NC	NA	5.00E-03	0.97	NC	4.85E-03
Silver	NC	NC	NA	5.00E-03	1	NC	5.00E-03
Zinc	NC	NC	NA	3.00E-01	0.3	NC	9.00E-02

COPCs = Chemicals of potential concern
CSF = Cancer Slope Factor
RfD = Reference Dose
Adjusted Dermal CSF = Chronic Oral CSF / Oral Absorption Fraction
Adjusted Dermal RfD = Chronic Oral RfD x Oral Absorption Fraction
NA = No available data
NC = Not carcinogenic
UBM = Evaluated using the EPA Uptake Biokinetic Model

TABLE E-E
EXPOSURE PARAMETERS
VEHICLE MAINTENANCE AREA
LANL, LOS ALAMOS, NEW MEXICO

Exposure Parameter	Symbol	Units	Residents Adults	Residents Children	References
Inhalation Rate – indoor air	IRa	m³/hr	0.83	0.66	
Inhalation Rate – outdoor air	IRa	m³/hr	1.7	1.3	
Soil Ingestion Rate	IGs	mg/day	100	200	
Skin Surface Area Exposed	SA	cm²/day	5000	2000	
Soil–skin Adherence Factor	SAF	mg/cm²	1	1	
Exposure Time	ET	hr/day	20	20	
Exposure Frequency	EF	days/yr	350	350	
Exposure Duration	ED	year	30	6	
Fraction Ingested, Inhaled or Contacted from Site	FI or FC	unitless	1	1	
Conversion Factor	CF	kg/mg	1E-06	1E-06	Conversion Factor
Body Weight	BW	kg	70	15	
Averaging Time – Cancer	ATc	days	25550	25550	365 days/year x 70 years (lifetime)
Averaging Time – NonCancer	ATnc	days	10950	2190	365 days/year x ED

LADD/ADD = Lifetime Average Daily Dose/Average Daily Dose

Inhalation LADD Intake Rate Factors – outdoor air	2.00E-01	1.42E-01
Inhalation ADD Intake Rate Factors – outdoor air	4.66E-01	1.66E+00
Soil Ingestion LADD Intake Rate Factors	5.87E-07	1.10E-06
Soil Ingestion ADD Intake Rate Factors	1.37E-06	1.28E-05
Dermal Contact LADD Intake Rate Factors	2.94E-05	1.10E-05
Dermal Contact ADD Intake Rate Factors	6.85E-05	1.28E-04

TABLE I-1
CARCINOGENIC RISKS FROM SOIL INGESTION
FUTURE RESIDENT SCENARIO (CHILDREN)
VEHICLE MAINTENANCE AREA

COPCs	RME EPC (Cs) (mg/kg)	Child LADD (mg/kg/day)	Oral CSF $(mg/kg/day)^{-1}$	Child Cancer Risk
Semivolatiles				
Benzo(a)anthracene	2.28E+00	2.50E-06	7.30E-01	1.8E-06
Benzo(a)pyrene	1.88E+00	2.07E-06	7.30E+00	1.5E-05
Benzo(b)fluoranthene	3.02E+00	3.32E-06	7.30E-01	2.4E-06
Benzo(k)fluoranthene	1.45E+00	1.59E-06	7.30E-02	1.2E-07
Chrysene	2.74E+00	3.01E-06	7.30E-03	2.2E-08
Dibenzo(a,h) anthracene	5.90E-01	6.47E-07	7.30E+00	4.7E-06
Indeno(1,2,3-cd)pyrene	8.63E-01	9.48E-07	7.30E-01	6.9E-07
Inorganics				
Antimony	1.33E-01	1.46E-07	NC	NC
Arsenic	2.39E+00	2.62E-06	1.80E+00	4.7E-06
Barium	9.89E+01	1.09E-04	NC	NC
Beryllium	4.72E-01	5.17E-07	4.30E+00	2.2E-06
Cadmium	1.70E+00	1.87E-06	NA	NA
Chromium	2.56E+01	2.82E-05	NA	NA
Lead	2.11E+02	2.31E-04	NA	NA
Nickel	3.85E+01	4.23E-05	NC	NC
Selenium	1.33E-01	1.46E-07	NC	NC
Silver	2.78E+00	3.06E-06	NC	NC
Zinc	6.08E+02	6.69E-04	NC	NC
TOTAL RISK				3.2E-05

COPCs = Chemicals of potential concern
RME EPC = Reasonable Maximum Exposure Exposure Point Concentration in soil
LADD = Lifetime Average Daily Dose = Cs x LADD Factor
[Soil Ingestion Intake Rate LADD Factor = 1.10E-06]
CSF = Carcinogenic Slope Factor
NC = Noncarcinogen
NA = Not Applicable

TABLE I-2
NONCARCINOGENIC RISKS FROM SOIL INGESTION
FUTURE RESIDENT SCENARIO (CHILDREN)
VEHICLE MAINTENANCE AREA

COPCs	RME EPC (Cs) (mg/kg)	Child ADD (mg/kg/day)	Chronic Oral RfD (mg/kg/day)	Child HQ
Semivolatiles				
Benzo(a)anthracene	2.28E+00	2.92E-05	NA	NA
Benzo(a)pyrene	1.89E+00	2.42E-05	NA	NA
Benzo(b)fluoranthene	3.03E+00	3.88E-05	NA	NA
Benzo(k)fluoranthene	1.45E+00	1.86E-05	NA	NA
Chrysene	2.75E+00	3.51E-05	NA	NA
Dibenzo(a,h) anthracene	5.90E-01	7.54E-06	NA	NA
Indeno(1,2,3-cd)pyrene	8.63E-01	1.10E-05	NA	NA
Inorganics				
Antimony	1.33E-01	1.70E-06	4.00E-04	4.3E-03
Arsenic	2.39E+00	3.06E-05	3.00E-04	1.0E-01
Barium	9.99E+01	1.28E-03	7.00E-02	1.8E-02
Beryllium	4.72E-01	6.03E-06	5.00E-03	1.2E-03
Cadmium	1.70E+00	2.18E-05	5.00E-04	4.4E-02
Chromium	2.58E+01	3.30E-04	5.00E-03	6.6E-02
Lead	2.11E+02	2.70E-03	NA	NA
Nickel	3.86E+01	4.93E-04	2.00E-02	2.5E-02
Selenium	1.33E-01	1.70E-06	5.00E-03	3.4E-04
Silver	2.78E+00	3.56E-05	5.00E-03	7.1E-03
Zinc	6.08E+02	7.77E-03	3.00E-01	2.6E-02
TOTAL HAZARD INDEX				2.0E-01

RME EPC = Reasonable Maximum Exposure Exposure Point Concentration
ADD = Average Daily Dose = Cs x ADD Factor
Soil Ingestion Intake Rate ADD Factor = 1.28E-05
RfD = Reference Dose
HQ = Hazard Quotient
NC = Noncarcinogen
NA = Not Applicable

TABLE D-1
CARCINOGENIC RISKS FROM DERMAL CONTACT
FUTURE RESIDENT SCENARIO (CHILDREN)
VEHICLE MAINTENANCE AREA

COPCs	RME EPC (Cs) (mg/kg)	Dermal AF (unitless)	Child LADD (mg/kg/day)	Adjusted Dermal CSF (mg/kg/day)^-1	Child Cancer Risk
Semivolatiles					
Benzo(a)anthracene	2.28E+00	0.15	3.75E-06	6.69E-01	3.3E-06
Benzo(a)pyrene	1.80E+00	0.15	3.11E-06	6.69E+00	2.7E-05
Benzo(b)fluoranthene	3.03E+00	0.15	4.99E-06	6.69E-01	4.3E-06
Benzo(k)fluoranthene	1.45E+00	0.15	2.39E-06	6.69E-02	2.1E-07
Chrysene	2.75E+00	0.15	4.81E-06	6.69E-03	3.9E-08
Dibenzo(a,h) anthracene	5.90E-01	0.15	8.70E-07	6.69E+00	6.4E-06
Indeno(1,2,3 -cd)pyrene	8.63E-01	0.15	1.42E-06	6.69E-01	1.2E-06
Inorganics					
Antimony	1.33E-01	0.01	1.46E-08	NC	NC
Arsenic	2.39E+00	0.01	2.62E-07	1.80E+00	4.7E-07
Barium	9.99E+01	0.01	1.09E-05	NC	NC
Beryllium	4.72E-01	0.01	5.17E-08	6.60E+02	4.4E-05
Cadmium	1.70E+00	0.01	1.87E-07	NA	NA
Chromium	2.88E+01	0.01	2.63E-06	NA	NA
Lead	2.11E+02	0.01	2.31E-05	NA	NA
Nickel	3.88E+01	0.01	4.23E-06	NC	NC
Selenium	1.33E-01	0.01	1.48E-08	NC	NC
Silver	2.78E+00	0.01	3.05E-07	NC	NC
Zinc	6.08E+02	0.01	6.66E-05	NC	NC
TOTAL RISK					5.9E-05

AF = Aderence Factor
RME EPC = Reasonable Maximum Exposure Exposure Point Concentration
LADD = Lifetime Average Daily Dose = Cs x LADD Factor
[Dermal Contact Intake Rate LADD Factor = 1.10E-06]
CSF = Carcinogenic Slope Factor
NC = Noncarcinogen
NA = Not Applicable

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TABLE D-2
NONCARCINOGENIC RISKS FROM DERMAL CONTACT
FUTURE RESIDENT SCENARIO (CHILDREN)
VEHICLE MAINTENANCE AREA

COPCs	RME EPC (Cs) (mg/kg)	Dermal AF (unitless)	Child ADD (mg/kg/day)	Adjusted Dermal RfD (mg/kg/day)	Child HQ
Semivolatiles					
Benzo(a)anthracene	2.28E+00	0.15	4.38E-05	NA	NA
Benzo(a)pyrene	1.89E+00	0.15	3.63E-05	NA	NA
Benzo(b)fluoranthene	3.03E+00	0.15	5.82E-05	NA	NA
Benzo(k)fluoranthene	1.45E+00	0.15	2.79E-05	NA	NA
Chrysene	2.75E+00	0.15	5.28E-05	NA	NA
Dibenzo(a,h) anthracene	5.90E-01	0.15	1.13E-05	NA	NA
Indeno(1,2,3-cd)pyrene	5.53E-01	0.15	1.06E-05	NA	NA
Inorganics					
Antimony	1.33E-01	0.01	1.70E-07	4.00E-05	4.3E-03
Arsenic	2.39E+00	0.01	3.06E-06	3.00E-04	1.0E-02
Barium	9.99E+01	0.01	1.28E-04	3.50E-03	3.6E-02
Beryllium	4.72E-01	0.01	6.03E-07	2.50E-05	2.4E-02
Cadmium	1.70E+00	0.01	2.18E-06	3.50E-05	6.2E-02
Chromium	2.58E+01	0.01	3.30E-05	5.00E-04	6.6E-02
Lead	2.11E+02	0.01	2.70E-04	NA	NA
Nickel	3.86E+01	0.01	4.93E-05	2.00E-03	2.5E-02
Selenium	1.33E-01	0.01	1.70E-07	4.85E-03	3.5E-05
Silver	2.78E+00	0.01	3.56E-06	5.00E-03	7.1E-04
Zinc	6.08E+02	0.01	7.77E-04	9.00E-02	8.6E-03
TOTAL HAZARD INDEX					2.4E-01

RME EPC = Reasonable Maximum Exposure Exposure Point Concentration
ADD = Average Daily Dose = Cs x ADD Factor
[Dermal Contact Intake Rate ADD Factor = 1.28E-04]
RfD = Reference Dose
HQ = Hazard Quotient
NC = Noncarcinogen
NA = Not Applicable

TABLE R-R
SUMMARY OF CARCINOGENIC RISKS
FUTURE RESIDENT SCENARIO (CHILDREN)
VEHICLE MAINTENANCE AREA

COPCs	Soil Ingestion	Dermal Contact	Inhalation of Dusts	TOTAL CANCER RISK	Percent Contribution
Semivolatiles					
Benzo(a)anthracene	1.8E-06	3.3E-06	2.1E-08	5E-06	4%
Benzo(a)pyrene	1.5E-05	2.7E-05	1.8E-07	4E-05	31%
Benzo(b)fluoranthene	2.4E-06	4.3E-06	2.8E-08	7E-06	5%
Benzo(k)fluoranthene	1.2E-07	2.1E-07	1.4E-09	3E-07	0%
Chrysene	2.2E-08	3.9E-08	2.6E-10	6E-08	0%
Dibenzo(a,h) anthracene	4.7E-06	8.4E-06	6.6E-08	1E-05	10%
Indeno(1,2,3-cd)pyrene	6.9E-07	1.2E-06	8.1E-09	2E-06	1%
Inorganics					
Antimony	NC	NC	NC	NA	0%
Arsenic	4.7E-06	4.7E-07	4.6E-07	6E-06	4%
Barium	NC	NC	NC	NA	0%
Beryllium	2.2E-06	4.4E-05	5.1E-08	5E-05	34%
Cadmium	NA	NA	1.4E-07	1E-07	0%
Chromium	NA	NA	1.4E-05	1E-05	10%
Lead	NA	NA	NA	NA	0%
Nickel	NC	NC	NC	NA	0%
Selenium	NC	NC	NC	NA	0%
Silver	NC	NC	NC	NA	0%
Zinc	NC	NC	NC	NA	0%
TOTAL CANCER RISK	3E-05	9E-05	1E-05	1E-04	100%
Percent Contribution	23%	68%	11%	100%	

COPCS = Chemicals of potential concern
NC = Noncarcinogen
NA = Not Available

TABLE H-H
SUMMARY OF HAZARD INDICES
FUTURE RESIDENT SCENARIO (CHILDREN)
VEHICLE MAINTENANCE AREA

COPCs	Soil Ingestion	Dermal Contact	Inhalation of Dusts	TOTAL HAZARD INDEX	Percent Contribution
Semivolatiles					
Benzo(a)anthracene	NA	NA	NA	NA	0%
Benzo(a)pyrene	NA	NA	NA	NA	0%
Benzo(b)fluoranthene	NA	NA	NA	NA	0%
Benzo(k)fluoranthene	NA	NA	NA	NA	0%
Chrysene	NA	NA	NA	NA	0%
Dibenzo(a,h) anthracene	NA	NA	NA	NA	0%
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	0%
Inorganics					
Antimony	4.3E-03	4.3E-03	NA	9E-03	1%
Arsenic	1.0E-01	1.0E-02	NA	1E-01	18%
Barium	1.8E-02	3.6E-02	1.1E-01	2E-01	25%
Beryllium	1.2E-03	2.4E-02	NA	3E-02	4%
Cadmium	4.4E-02	6.2E-02	NA	1E-01	17%
Chromium	6.6E-02	6.6E-02	NA	1E-01	21%
Lead	NA	NA	NA	NA	0%
Nickel	2.5E-02	2.5E-02	NA	5E-02	8%
Selenium	3.4E-04	3.6E-05	NA	4E-04	0%
Silver	7.1E-03	7.1E-04	NA	8E-03	1%
Zinc	2.6E-02	8.6E-03	NA	3E-02	5%
HAZARD INDEX	3E-01	2E-01	1E-01	6E-01	100%
Percent Contribution	46%	37%	17%	100%	

COPCs = Chemicals of potential concern
NA - Not Available

308