LA-UR-07-2581
April 2007
EP2007-0226

Phase II Investigation Work Plan for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

LA-UR-07-2581
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EXECUTIVE SUMMARY

This investigation work plan presents proposed Phase II investigation activities at Material Disposal Area (MDA) C at Los Alamos National Laboratory (the Laboratory) in Technical Area 50.

The objective of the proposed investigation activities is to define the extent of contamination identified by previous investigation activities. Contaminants previously identified include volatile organic compounds (VOCs) in pore gas, radionuclides, including tritium in pore gas, and inorganic chemicals in tuff. Previous investigations collected subsurface tuff and pore-gas samples from 40 boreholes in 2004–2007. Data from subsurface pore-gas and tuff samples indicated that contaminant concentrations decreased markedly below approximately 325 ft. Only one borehole extended beyond a depth of 325 ft and into the Otowi Member of the Bandelier Tuff. The VOCs, particularly trichloroethene (TCE) and tetrachloroethene (PCE), were detected in the deepest pore-gas samples from some boreholes. Tritium was also detected in pore-gas samples, including the deepest pore-gas samples at some locations. Surface data did not indicate sufficient contamination to result in an unacceptable risk to human health or the environment. However, only screening-level data were available for inorganic chemicals in surface soil.

The activities proposed in this Phase II work plan are designed to provide the additional data needed to define the nature and extent of contamination for MDA C by collecting subsurface tuff and pore-gas samples at greater depths and at additional locations. Surface soil samples will be collected to confirm the results of previous screening-level sample analyses. Specific activities include

- drilling three new boreholes outside the boundary of MDA C to further define the lateral and vertical extent of contamination,
- extending six existing boreholes to greater depths to further define the vertical extent of contamination,
- collecting surface soil samples at multiple locations across MDA C to be analyzed for inorganic chemicals,
- installing vapor monitoring wells using the three new boreholes and six extended boreholes, and
- collecting fracture-density and orientation data to evaluate the potential role of fractures in contaminant transport.

At minimum, the nine proposed boreholes will be drilled into the Otowi Member of the Bandelier Tuff. Data from MDA C and other sites indicate that contaminant concentrations below MDAs are related to the bedrock lithology, with concentrations decreasing dramatically below the Tshirege Member. The total depth of each borehole will be determined by submitting pore-gas samples to an analytical laboratory for rapid analysis of TCE and PCE. A FLUTe flexible membrane system will be installed with sampling ports that correspond to the depth intervals at which core samples were previously collected. These vapor-monitoring wells will be sampled for VOCs and tritium upon completion of each borehole and on a quarterly basis for 1 yr, after which the pore-gas data will be reviewed by the New Mexico Environment Department and the Laboratory to determine subsequent frequency of sampling.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the United States Department of Energy (DOE) and managed by Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft.

The Laboratory's Environmental Programs (EP) Directorate (the Directorate), formerly the Environmental Restoration Project, is participating in a national effort by DOE to clean up sites and facilities previously involved in weapons research and development. The goal of the Directorate is to ensure that past operations do not threaten human health and safety or the environmental in and around Los Alamos County, New Mexico. To achieve this goal, the Directorate is currently investigating sites potentially contaminated by past Laboratory operations. The sites under investigation are designated as either solid waste management units (SWMUs) or areas of concern.

This investigation work plan addresses SWMU 50-009, also known as Material Disposal Area (MDA) C, which is potentially contaminated with both hazardous and radioactive chemicals. Corrective actions at the Laboratory are subject to the March 1, 2005, Compliance Order on Consent (the Consent Order). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to the New Mexico Environment Department (NMED) in accordance with DOE policy.

1.1 General Site Information

MDA C is located in Technical Area (TA) 50 at the head of Ten Site Canyon. TA-50 is bound on the north by Effluent and Mortandad Canyons, on the east by the upper reaches of Ten Site Canyon, on the south by Two Mile Canyon, and on the west by TA-55. Facilities at TA-50 include a radioactive liquid waste treatment facility (RLWTF), a waste reduction characterization facility, offices, several storage areas, other SWMUs, and MDA C. Figure 1.1-1 shows the location of MDA C and the surrounding technical areas.

MDA C is an inactive 11.8-acre landfill consisting of six disposal pits, a chemical disposal pit, and 108 shafts (Figure 1.1-2). Solid low-level radioactive wastes and chemical wastes were disposed of in the landfill between 1948 and 1974. The depths of the seven pits at MDA C range from 12 to 25 ft below the original ground surface. The depths of the 108 shafts range from 10 to 25 ft below the original ground surface. The original ground surface is defined as beneath the cover that was placed over the site in 1984. The pits and shafts are constructed in the Tshirege Member of the Bandelier Tuff. The regional aquifer is estimated to be approximately 1300 ft deep (LANL 1998, 059599). The topography of MDA C is relatively flat, although the slope steepens to the north where the northeast corner of MDA C abuts the south wall of Ten Site Canyon.

1.2 Investigation Objectives

The primary objective of the Phase II investigation is to define the vertical and lateral extent of volatile organic compound (VOC) contamination at MDA C. The data collected will be used to determine the potential for migration of subsurface VOCs to groundwater. The data will also provide a context for evaluating potential remedies for MDA C.

The specific objectives of the investigation are (1) to collect samples to characterize subsurface pore-gas VOC concentrations, with boreholes extending into the Otowi Member of the Bandelier Tuff and (2) to collect surface soil samples to confirm previous screening-level sample results for inorganic chemicals and to define the nature and extent of potential soil contamination. The target concentrations for trichloroethene (TCE) and tetrachloroethene (PCE) in pore-gas samples are 2100 $\mu g/m^3$ and 3800 $\mu g/m^3$, respectively (LANL 2006, 094688; LANL 2007, 095404; NMED 2007, 095437).

2.0 BACKGROUND

MDA C is a decommissioned material disposal area established to replace MDA B at TA-21 as a disposal area for Laboratory-derived waste. MDA C operated from May 1948 to April 1974 but received waste only intermittently from 1968 until it was decommissioned in 1974. Wastes disposed of at MDA C consisted of liquids, solids, and containerized gases generated from a broad range of nuclear energy research and development activities conducted at the Laboratory. These wastes include uncontaminated classified materials, metals, hazardous materials, and radioactively contaminated materials. A summary of the estimated waste inventory was included in Appendix J of the 2006 MDA C investigation report (LANL 2006, 094688).

Wastes were disposed of in 7 pits and 108 shafts at MDA C (Figure 1.1-2). The pits and shafts were subsequently covered with varying amounts of fill material.

2.1 Previous Investigations

Previous Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) fieldwork was conducted at MDA C from 1993 to 2007. Fieldwork included the following activities:

- three geophysical surveys (1994, 2001, and 2002);
- biota screening and sampling (2003);
- surface investigations that included surface soil and fill sampling (1993) and VOC surface flux measurements (2000);
- subsurface investigations that included core sampling (1995), borehole air-flow velocity measurements (1995–1996); pore-gas sampling (2001), and tritium-probe sampling (2003);
- a geophysical survey to identify boundaries of waste disposal pits (2006); and
- borehole drilling and sampling of subsurface tuff and pore gas, and a radiological field survey and surface soil sampling (2004–2007).

Figure 2.1-1 shows the locations of all boreholes drilled during previous investigation activities. Both vertical and angled boreholes are shown, with dashed lines depicting the surface projection of the direction and extent of angled boreholes.

2.2 Results of Previous Investigations

The results of previous investigations were presented in the approved investigation work plan (LANL 2005, 091493) and in the investigation report (LANL 2006, 094688). Data from previous sampling activities indicate that the extent of subsurface contamination at MDA C has not been completely defined, particularly for VOCs in subsurface vapor (pore gas).

TCE and PCE were detected in all boreholes and were detected above their screening levels based on protection of groundwater (2100 µg/m^3 and 3800 µg/m^3, respectively), in some cases at the deepest sampled interval of individual boreholes. The maximum detected concentration of TCE in pore-gas samples (77,000 µg/m^3) was at a depth of 150 ft below ground surface (bgs) in borehole location 50-24771 between Pit 4 and Pit 5 (LANL 2006, 094688). TCE and PCE concentrations are highest in boreholes in the vicinity of Pits 1–5. Data from the single borehole location deeper than 300 ft bgs (borehole location 50-24818) indicate that the concentrations of VOCs in pore gas decrease substantially below a depth of 325 ft bgs, corresponding to changes in lithology from the Tshirege Member to the Otowi Member of the Bandelier Tuff. However, no other boreholes at other locations at MDA C were deep enough to confirm this decreasing vertical trend.

VOCs were detected in pore gas in all boreholes installed on or near the perimeter of MDA C. Therefore, additional data are needed to define the lateral extent of vapor-phase contamination. Data from the step-out boreholes installed during the Phase I investigation indicate the magnitude of reduction in VOC concentration with distance from the MDA boundary. Boreholes 50-24820 and 50-24821 were installed approximately 170 ft south of the MDA C boundary. Pore-gas samples from these boreholes showed TCE and PCE concentrations 30% to 85% lower than samples collected from equivalent depths in boreholes along the southern boundary of MDA C. Samples from borehole 50-25451, located approximately 400 ft from the southern MDA C boundary had concentrations of TCE and PCE approximately 2 orders of magnitude less than samples collected from equivalent depths along the boundary. These results suggest a sampling distance on the order of 200 to 400 ft from the MDA C boundary to establish definite decreasing trends in concentration with distance.

Inorganic chemicals were generally detected at concentrations only slightly above background levels in a small percentage of subsurface tuff samples. Because only screening-level inorganic chemical data were available for surface soil samples, the nature and extent of potential inorganic chemical contamination at the surface were not defined. Additional surface soil samples are required to confirm the results of screening-level data and define nature and extent for inorganic chemicals at the surface (NMED 2007, 095437).

The results of the previous investigations at MDA C indicate that the vertical extent of inorganic contamination has been determined. During the 1995 and 2004–2007 investigations, inorganic chemical samples were collected from 40 boreholes. Of these, a total of 13 boreholes had one or more inorganic chemicals detected above the background value (BV) and the maximum value of the background data set in the sample collected at total depth (TD). A total of 13 inorganic chemicals (aluminum, arsenic, barium, beryllium, calcium, copper, chromium, iron, magnesium, manganese, lead, selenium, and zinc) were detected above BV and the maximum value of the background data set, with each of these chemicals being detected above BV and the maximum value of the background data set in one to four boreholes. Thus, a total of 32 TD sample results were above BV and the maximum value of the background data set out of a total of approximately 1000 TD sample results. The TD sample detections above BV and the maximum value of the background data set are summarized in Table 2.2-1. As shown in Table 2.2-1, the detections above background in TD samples were generally only slightly above background and were generally not accompanied by detections above background in higher lithologic units. The results appear to indicate that the detections above background in TD samples are associated with natural variability of the tuff rather than indicative of unbounded releases.

Several radionuclides were detected in subsurface tuff, and tritium was detected in numerous subsurface pore-gas samples. The extent of tritium contamination is defined by previous pore-gas sample data. Because tritium may be relatively mobile in either the liquid or the vapor phase, tritium samples will be collected along with the proposed VOC pore-gas samples.

3.0 SCOPE OF ACTIVITIES

3.1 Surface Soil Sampling

Surface soil samples will be collected from 30 locations shown in Figure 3.1-1. Each location will be sampled at two depths. The first depth at each location will be 0–0.5 ft bgs. The second depth may vary depending on site conditions observed at the time of sampling, but the default depth will be 1.0–1.5 ft bgs. Table 3.1-1 lists all proposed samples and analytical suites.

3.2 Subsurface Sampling

Subsurface tuff and vapor samples will be collected from three new boreholes located outside the boundary of MDA C and from six existing boreholes that will be extended to greater depths. The three new boreholes and an existing borehole located to the south of MDA C will be used to define the lateral extent of contamination. The five existing boreholes within the MDA C boundary will be used define the vertical extent of contamination.

3.2.1 Number, Locations, and Depths of Boreholes

Three new boreholes will be drilled outside the MDA C boundary, and six previously drilled boreholes (LANL 2006, 094688) will be extended to greater depths. The locations of the proposed Phase II boreholes are shown in Figure 3.2-1.

Existing borehole locations to be extended include

- 50-25451, south of MDA C across Pajarito Road
- 50-24784, at the far west end of MDA C, near the Chemical Pit
- 50-24783, near the northwest corner of Pit 4
- 50-24771, between Pits 4 and 5
- 50-24769, near the east end of MDA C, between Pits 4 and 5
- 50-24813, near the southeast end of MDA C, south of Pit 1

As discussed in section 2.2, the existing pore-gas data from borehole 50-24818 show that VOC concentrations in pore gas decrease significantly below the Tshirege Member and that advancing the boreholes into the Otowi Member should be sufficient to define vertical extent. Because VOC vapors are transported by diffusion through the tuff, they should migrate laterally as well as vertically away from source areas. Therefore, VOC concentrations are expected to have less spatial variability as depth increases (i.e., the vapor plume will spread laterally as it moves downward and there is less chance of having a “hot spot” at depth). The target borehole depth in the Otowi Member (approximately 450 ft) was used as a general guideline for well spacing to select the five existing boreholes within the boundary of MDA C and one existing and three new boreholes outside the boundary of MDA C. These nine locations should provide sufficient coverage to confirm that VOC concentrations decrease in the Otowi Member to levels that do not pose a threat of groundwater contamination.

Three new boreholes will be drilled in the following locations: one location to the southwest of MDA C, across Pajarito Road; one location approximately 300 ft to the east of MDA C; and one location approximately 200 ft to the north (in TA-35) (Figure 3.2-1). The three new boreholes are being installed outside the boundary of MDA C to determine the lateral extent of VOC contamination. As described in section 2.2, based on previous investigations, a location approximately 200 to 400 ft from the MDA boundary was desired to see a substantial decrease in VOC concentrations. This setback distance was possible for the boreholes to the east and southwest of MDA C. The borehole to the north was placed approximately 350 ft from Pit 5 to allow for access constraints from ongoing operations and to provide data to define the lateral extent of contamination. Although a borehole location to the west of Pit 6 was desired, a borehole could not be drilled because of current construction activities and future access constraints associated with the Chemical Metallurgical Research Replacement (CMRR) facility in TA-55. A security barrier will be installed along the western side of Pecos Road and will limit access for vapor monitoring. An alternate location sited outside the planned security perimeter was considered but was not feasible because a large number of utilities are located in the area and it was less than 75 ft from existing boreholes at MDA C (Figure 3.2-2). An existing borehole (50-25451), located approximately 400 ft to the south of MDA C, will be extended and will help to define the lateral extent of contamination.

Previous results at MDA C and at other Laboratory sites indicate that contaminant concentrations, particularly for VOCs, are closely linked to site lithology. VOC pore-gas concentrations at MDAs C, G, and L (LANL 2005, 090513; LANL 2005, 092591) decrease markedly below the Tshirege Member of the Bandelier Tuff. For this reason, the proposed boreholes will be drilled to depths determined by the geologic units. At minimum, the three new boreholes and the six existing boreholes will be drilled to final depths sufficient to penetrate the upper portion of the Otowi Member of the Bandelier Tuff. When the Otowi Member has been reached, a screening sample will be collected and submitted to an analytical laboratory to rapidly and accurately determine the concentrations of selected VOCs. Before this sample is collected, the sample interval will be purged to remove any air injected during drilling to ensure the sample is representative of formation pore gas. Drilling will continue until TCE and PCE concentrations are below the target concentrations of 2100 $\mu g/m^3$ for TCE and 3800 $\mu g/m^3$ for PCE (LANL 2006, 094688; NMED 2007, 095437). Once the TD for each borehole has been reached, additional drilling may be performed, as needed, to provide sufficient depth below the deepest target sample interval to place and install borehole liners with sample ports.

NMED proposed that the Laboratory drill five new boreholes and extend nine existing boreholes (NMED 2007, 095437).The proposed new location to the southeast of MDA C corresponds to one of the new locations that NMED proposed. The NMED-proposed borehole located to the west of MDA C across Pecos Road cannot be drilled, as discussed above. The two NMED-proposed locations to the north of Pit 5 and outside the MDA C boundary are replaced by a proposed single borehole to the northeast of building 50-0176. This location is sited 300 ft north of Pit 5 and is intended to define the lateral extent of contamination to the north of MDA C. The NMED-proposed new location to the east of MDA C has been modified by moving the location approximately 150 ft farther east to maximize the chances of defining the lateral extent of contamination to the east of the site.

The Laboratory proposes extending five of the nine boreholes NMED proposed for extension (50-24769, 50-24771, 50-24783, 50-24784, and 50-24813). These five boreholes are located within the MDA C boundary, with four distributed on an approximate east-west line through the center of the site (Figure 3.2-1). These five boreholes will be sufficient to define the vertical extent of contamination by confirming the vertical decreasing trend in concentrations relative to bedrock lithology. In lieu of extending NMED-proposed borehole locations 50-24820 and 50-24821, borehole location 50-25451 will be extended to define the lateral extent of contamination to the south of MDA C. The NMED-proposed extension of borehole 50-24822, located to the east of MDA C, is replaced with a new borehole located farther to the east, as discussed above. The NMED-proposed borehole location 50-24817, north of Pit 6, was not considered for extension because the five boreholes located within MDA C are sufficient to define the vertical extent of contamination. No accessible locations exist farther north of Pit 6 where an additional new borehole can be sited (Figure 3.2-1).

3.2.2 Field Screening

Traditional field-screening techniques (e.g., headspace vapor screening, x-ray fluorescence [XRF] metals screening, radiation screening of core) are ineffective tools for determining sample intervals or the TD of boreholes (LANL 2005, 091493; LANL 2006, 094688). Therefore, field-screening techniques will not be used to determine sample intervals or borehole TD. Field screening will be performed only to protect the health and safety of workers.

To determine TD of the boreholes, pore-gas screening samples will be collected once the target lithologic unit has been reached. These samples will be submitted to an analytical laboratory for screening analysis of VOCs by standard gas chromatographic methods. Quick-turnaround analyses will be requested for a limited set of target VOCs, including TCE and PCE. The results from these analyses will guide decisions regarding the TD of each borehole.

3.2.3 Subsurface Tuff Sampling

Tuff samples will be collected from core at 50-ft intervals as each borehole is advanced. New boreholes will be sampled beginning at 50 ft bgs. In existing boreholes, core samples will be collected beginning at the first 50-ft interval below the previous TD of the borehole (e.g., at 200 ft bgs if the previous TD was 150 ft bgs). Continuous core will not be collected, but core barrels will be inserted at planned sample intervals to allow core to be collected. Table 3.2-1 lists the proposed sample depths for all boreholes, and Table 3.1-1 lists all proposed samples and analytical suites.

3.2.4 Subsurface Vapor Sampling

In each borehole, pore-gas samples will be collected at each depth interval where core samples were collected for off-site laboratory analyses. Pore-gas samples will be collected after TD is reached in each borehole by installing sample ports at the required depths, matching the depths at which core samples were collected. Table 3.1-1 lists all proposed samples and analytical suites, and Table 3.2-1 lists the proposed sample depths for all boreholes.

3.3 Analytical Suites

Surface soil samples will be submitted through the Laboratory’s Sample Management Office (SMO) to an off-site analytical laboratory for analysis of target analyte list (TAL) metals.

Subsurface tuff samples will be submitted through the SMO to an off-site analytical laboratory for analyses of radionuclides (gamma-emitting radionuclides, americium-241, strontium-90, isotopic uranium, and isotopic plutonium), TAL metals, perchlorate, nitrate, cyanide, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), pH, and moisture content. Based on the results of previous investigations, pore-gas VOC analyses will be performed in lieu of VOC analyses of core samples.

Subsurface pore-gas samples will be submitted through the SMO to an off-site analytical laboratory for analysis of VOCs by U.S. Environmental Protection Agency (EPA) Method TO-15.

Pore-gas tritium samples will be submitted through the SMO to an off-site analytical laboratory for tritium analysis by EPA Method 906.0.

3.4 Investigation-Derived Waste

Investigation-derived waste (IDW) is waste generated as a result of field investigation activities and may include, but is not limited to, drill cuttings; potentially contaminated personal protective equipment (PPE); sampling supplies; fluids from the decontamination of sampling equipment; returned samples; and all other waste potentially coming in contact with contaminants. IDW generated during the Phase II investigation at MDA C will be managed to protect human health and the environment, comply with applicable EPA and NMED regulations, DOE orders, and Laboratory implementation requirements, and adhere to Laboratory waste-minimization goals. The management of IDW is described in Appendix B of this work plan.

3.5 Fracture Analysis

In its notice of disapproval of the investigation report dated February 19, 2007 (NMED 2007, 095437), NMED stated that all potential migration pathways must be evaluated, in particular fracture density and orientation, to determine whether fracture flow creates migration pathways for contamination at MDA C. Fractures intersected in boreholes during the proposed activities will be described to the degree possible, and any significant fractures encountered will be sampled according to the method described in the 2005 investigation work plan and in the 2006 investigation report (LANL 2005, 091493; LANL 2006, 094688). Because boreholes provide only limited information regarding the location and orientation of fractures in the subsurface, borehole data will be supplemented by fracture data obtained from a seismic survey currently being conducted immediately west of MDA C at TA-55. This study will provide information regarding the numbers, size, spacing, fill material, and orientation of fractures in the immediate vicinity of MDA C.

4.0 INVESTIGATION METHODS

The following sections describe the primary field methods to be used in implementing this work plan. A list of applicable standard operating procedures (SOPs) for field activities is provided in Table 4.0-1. A summary of each of the investigation methods associated with these procedures is presented in Table 4.0-2.

4.1 Collection of Surface Soil Samples

Samples will be collected using a hand auger according to SOP-6.10, "Hand Auger and Thin-Wall Tube Sampler." Soil samples will be collected from two depths at each location from 0–0.5 ft bgs and 1.0-1.5 ft bgs. The second depth interval may be adjusted based on field conditions observed at the time of sampling. The reasons for any adjustments to the depth of the second sample interval will be documented in the sample collection log. Additional field quality assurance/quality control (QA/QC) samples (e.g., field duplicates) will be collected according to SOP-01.05, "Field Quality Control Samples," at a minimum frequency of 10% of total samples collected.

4.2 Drilling Methods

All boreholes will be advanced using an air-rotary drilling method, which uses a drill pipe or drill stem coupled to a drill bit that rotates and cuts through soil and rock. The cuttings produced from the rotation of the drill bit are transported to the surface by compressed air, which is forced down the borehole through the drill pipe and returns to the surface through the annular space between the drill pipe and the borehole wall. The circulation of the compressed air not only removes the cuttings from the borehole but also helps to cool the drill bit. Air-rotary drilling is best suited for hard rock formations. During drilling, the air compressor will have an in-line organic filter system to filter the air coming from the compressor and to avoid possible contamination of the formation. The organic filter system will be inspected regularly to ensure that the system is functioning properly. In addition, a cyclone-velocity dissipater or similar air-containment/dust-suppression system will be used to direct the cuttings to one location rather than allowing the cuttings to discharge uncontrolled from the borehole.

All boreholes will be drilled using a casing-advance method to maintain the integrity of the borehole. Casing will be advanced as the drill bit advances and will prevent sloughing of any material from soft, unconsolidated intervals into the borehole during drilling and after drilling is completed. Casing-advance techniques and air rotary drilling may be required to complete the existing deep borehole (borehole location 50-24818) as a vapor-monitoring borehole, because sloughing of material has occurred during previous drilling activities in that borehole.

4.3 Collection of Subsurface Tuff Samples

Subsurface tuff samples will be collected using 4-in.-outside-diameter stainless-steel split-spoon core barrels or nonstainless barrels with Lexan liners. Material will be collected from the split-spoon core barrel into sealed containers to preserve core moisture following SOP-06.26, “Core-Barrel Sampling for Subsurface Earth Materials.” A minimum of one tuff sample for every 50 ft of boring will be submitted for analyses to an off-site contract laboratory.

Field documentation of samples collected from fractures (if fractures are encountered) will include a detailed physical description of the fracture-fill material and rock matrix sampled following SOP-12.01, “Field Logging, Handling, and Documentation of Borehole Materials,” and in general accordance with American Society for Testing and Materials (ASTM) or American Geological Institute (AGI) methods. The relative volumes of fracture-fill and rock-matrix material included in the sample will be estimated from field measurements. An additional sample will be collected from the rock matrix adjacent to the fracture sample material for comparison. The fracture and matrix samples will be assigned unique identifiers. Characteristics of fractures and surrounding matrix material will be recorded in the field in the borehole logs.

QA/QC samples, including field duplicates, rinsates, and trip blanks, will be collected following SOP-01.05, “Field Quality Control Samples,” at a minimum frequency of 10% of total samples collected.

4.4 Collection of Subsurface Vapor Samples

Pore-gas samples will be collected using a FLUTe flexible membrane system to isolate discrete depths in the boreholes. Figure 4.4-1 shows the proposed configuration of the FLUTe system. Casing-advance drilling techniques will be used to minimize sloughing of material into the borehole and to allow pore-gas sampling at TD in each borehole. Pore-gas samples will be collected according to SOP-6.31, “Sampling of Subatmospheric Air.” Each interval will be purged before sampling until the measurements of carbon dioxide and oxygen are stable and representative of subsurface conditions. A purge pump will be used to withdraw borehole and formation vapors through the borehole or constructed sampling port. Concentrations of purge indicator gases (carbon dioxide and oxygen) will be monitored continuously during this presampling cycle, and static subsurface pressure will be measured. Once indicator-gas concentrations are stable, formation vapor sampling can proceed. Subsurface pore-gas samples will be collected in SUMMA canisters for VOCs and in silica gel samplers for tritium.

QA/QC samples, including equipment blanks and field duplicates, will be collected following SOP-01.05, at a frequency of 10% of total samples collected. After sampling and purge decontamination, the equipment blank will be collected by pulling zero gas (99.9% ultrahigh-purity nitrogen) through the packer sampling apparatus. A field duplicate sample will also be collected for tritium using the same purge method.

4.5 Screening of Subsurface Vapor Samples

Subsurface vapor (pore-gas) samples will be collected for screening beginning in the Otowi Member of the Bandelier Tuff. Screening results will be used to determine the TD of all proposed boreholes. Subsurface vapor samples will be collected using Tedlar bags and submitted to an analytical laboratory for analysis of VOCs rather than by field screening instruments such as a photoionization detector (PID). Because air will be injected into the formation during drilling, the sample interval will be adequately purged before the screening sample is collected. The sample interval will be purged as described in section 4.4 until indicator gases are stable and indicative of formation air rather than atmospheric air.

4.6 Borehole Abandonment

All new boreholes, all existing boreholes to be extended, and the single existing deep borehole (borehole location 50-24818) will be completed as vapor-monitoring boreholes. All existing boreholes that are not being extended or completed as vapor-monitoring boreholes will be abandoned in accordance with Section X.D of the Consent Order and SOP-05.03, “Monitoring Well and RFI Borehole Abandonment,” by filling the boreholes with a bentonite/concrete mixture. A tremie pipe will be used to fill the boreholes upward from the bottom of the boreholes to the surface. All cuttings will be managed as IDW, as specified in Appendix B. All information regarding borehole abandonment will be provided in the MDA C Phase II investigation report.

4.7 Equipment Decontamination

Following drilling and sampling activities, all equipment used in drilling and sampling activities will be decontaminated. Residual material adhering to equipment will be removed using dry decontamination methods such as the use of wire brushes and scrapers (SOP-01.08, “Field Decontamination of Drilling and Sampling Equipment”). If equipment cannot be free-released using dry decontamination methods, wet decontamination methods will be used. If wet decontamination is required, the equipment will be pressure-washed on a temporary decontamination pad covered with a high-density polyethylene liner. Cleaning solutions and wash water will be collected and contained for proper disposal. Decontamination solutions will be sampled and analyzed to determine the final disposition of the wastewater and the effectiveness of the decontamination procedures. Equipment ready for demobilization will be surveyed by a Health and Safety Radiation Control Division technician before it is released from the site.

5.0 SUBSURFACE VAPOR MONITORING

5.1 Number, Locations, and Depths of Vapor-Monitoring Boreholes

Ten boreholes will be used as vapor-monitoring boreholes: three proposed new boreholes and seven existing boreholes (six to be extended, one already at sufficient depth [borehole location 50-24818]). The proposed monitoring boreholes include locations surrounding MDA C and locations within MDA C. The final depths of vapor-monitoring boreholes will be determined as described in section 3.2.1. All monitoring boreholes will extend into the Otowi Member of the Bandelier Tuff. Borehole locations to be used as vapor monitoring boreholes are listed below and are shown in Figure 5.1-1:

- 50-24783
- 50-24771
- 50-24784
- 50-24813
- 50-24769
- 50-25451
- 50-24818—current TD is 620 ft bgs in the Otowi Member
- New location 50-A—south of the intersection of Pajarito Road and Pecos Drive
- New location 50-B—approximately 300 ft northeast of location 50-24818
- New location 50-C—approximately 300 ft east-by-northeast of location 50-24769

5.2 Vapor-Monitoring Borehole Installation and Configuration

Vapor-monitoring wells will be installed with FLUTe positive-pressure sampling membranes, which will each maintain up to 10 sampling ports at discrete depths. Sampling ports will be installed at the same 50-ft intervals at which tuff samples were collected in each borehole or at other depths determined by lithologic contacts or fractures identified in each borehole during drilling.

Boreholes will be protected from sloughing during drilling by using a casing-advance method. Once TD is reached, the FLUTe system will be inserted to TD inside the casing. The casing will be extracted while sand is injected to pack the FLUTe membrane in place. A surface casing will be installed with a lockable cap to provide access to the sampling ports.

Currently, existing deep borehole (location 50-24818) is partially lined (from 0–446 ft bgs) with a steel liner that was used to prevent sloughing during previous investigation activities. If possible, the liner will be removed to install the FLUTe membrane and sampling ports at the depths where core samples were previously collected. Sloughing may occur as the liner is removed, requiring the borehole to be cleared using air-rotary drilling and casing-advance techniques. If the steel liner cannot be removed from the borehole, the FLUTe membrane will be installed through the liner, and the only available vapor sampling ports will be in approximately the bottom 150 ft of the borehole.

5.3 Vapor-Monitoring Sample Collection

5.3.1 Sampling Methods and Analytical Suites

Samples of subsurface vapors will be collected from ports at the sample depth intervals identified previously (section 4.2 and Table 4.2-1). After purging of each port, a SUMMA canister sample will be collected for VOCs from the ports in each borehole. In addition, tritium samples will be collected from the same depth intervals in all boreholes during the same sampling event that VOC samples are collected.

During the purge, measurements of percent oxygen, percent carbon dioxide, and percent methane will be collected from the sample train exhaust every several minutes to ensure that all ambient air is evacuated from the system. Static subsurface pressure will also be measured. Once these gas concentrations are stable, vapor sampling will proceed. The samples from each borehole will be collected in accordance with SOP-6.31, “Sampling of Subatmospheric Air.” Subsurface pore-gas samples will be collected in SUMMA canisters and submitted to the SMO for shipment to the analytical laboratory for VOC analysis by EPA Method TO-15. Pore-gas samples will also be collected in silica gel sample tubes for analysis of tritium by EPA Method 906.0.

5.3.2 Sample Collection Interval/Schedule

Initial vapor-monitoring samples will be collected within 30 days of completion of each vapor-monitoring borehole. After the initial samples are collected, a schedule will be established to collect vapor-monitoring samples from all the monitoring boreholes. The interval between sampling events will be determined by NMED. The vapor-monitoring sample results will be provided to NMED in periodic monitoring reports in the format described in Section XI.D of the Consent Order.

6.0 SCHEDULE

The notice date for this Phase II investigation work plan is September 30, 2007. Implementation of the field activities proposed herein is expected to require a minimum of 4 months from the start of field work. Additional time will be required for completing readiness activities before field work begins, receiving sample data, and preparing the Phase II investigation report. It is anticipated that the Phase II investigation report will be submitted to NMED by September 30, 2008.

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate’s Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the DOE–Los Alamos Site Office; the EPA, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

LANL (Los Alamos National Laboratory), May 22, 1998. “Hydrogeologic Workplan,” Los Alamos National Laboratory document LA-UR-01-6511, Los Alamos, New Mexico. (LANL 1998, 059599)

LANL (Los Alamos National Laboratory), October 2005. “Investigation Work Plan for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50, Revision 2,” Los Alamos National Laboratory document LA-UR-05-7363, Los Alamos, New Mexico. (LANL 2005, 091493)

LANL (Los Alamos National Laboratory), September 2005. “Investigation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54,” Los Alamos National Laboratory document LA-UR-05-6398, Los Alamos, New Mexico. (LANL 2005, 090513)

LANL (Los Alamos National Laboratory), September 2005. "Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54," Los Alamos National Laboratory document LA-UR-05-5777, Los Alamos, New Mexico. (LANL 2005, 092591)

LANL (Los Alamos National Laboratory), December 2006. "Investigation Report for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50," Los Alamos National Laboratory document LA-UR-06-8096, Los Alamos, New Mexico. (LANL 2006, 094688)

LANL (Los Alamos National Laboratory), March 23, 2007. "Response to Notice of Disapproval for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50," Los Alamos National Laboratory document LA-UR-07-1838, Los Alamos, New Mexico. (LANL 2007, 095404)

NMED (New Mexico Environment Department), February 19, 2007. "Notice of Disapproval (NOD) for Material Disposal Area (MDA) C, Solid Waste Management Unit 50-009, at Technical Area 50," New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Los Alamos, New Mexico. (NMED 2007, 095437)

7.2 Map Data Sources

EEP-ERSS-GS, Geotechnical Solutions er_location_ids_pnt, Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory. Environment and Remediation Support Services Division, EP2006-1002; 09 November 2006.

EP-ERSS-GS Geotechnical Solutions er_mda_ply, Material Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.

EP-ERSS-GS Geotechnical Solutions er_nuclear_envsites_ply, Nuclear Environmental Sites; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2005-0366; 1:2,500 Scale Data; 13 June 2005.

EP-ERSS-GS Geotechnical Solutions lanl_contour1991_002_arc, Hypsography, 2 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

EP-ERSS-GS Geotechnical Solutions lanl_contour1991_010_arc, Hypsography, 10 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

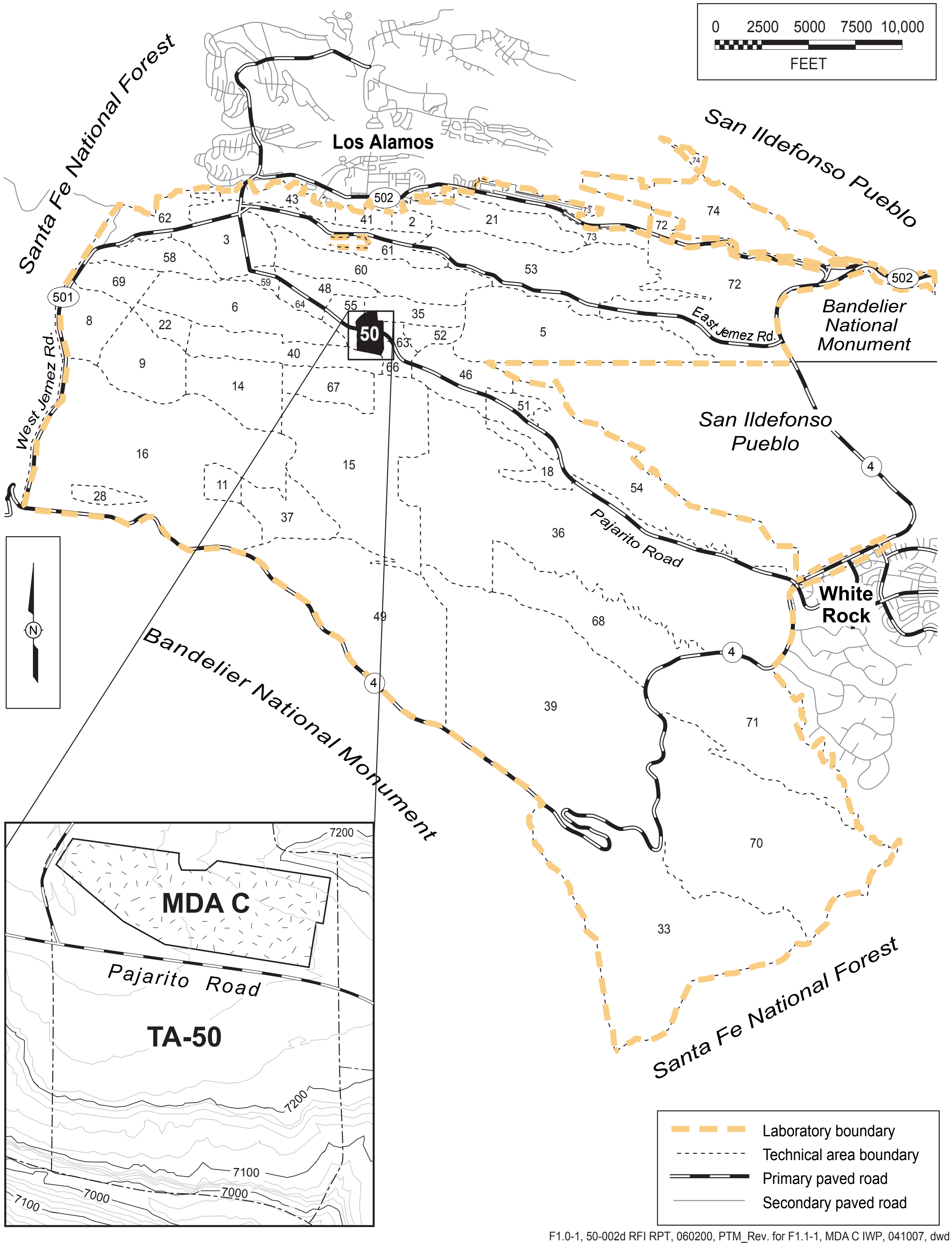

Figure 1.1-1 Location of MDA C with respect to Laboratory TAs and surrounding land holdings

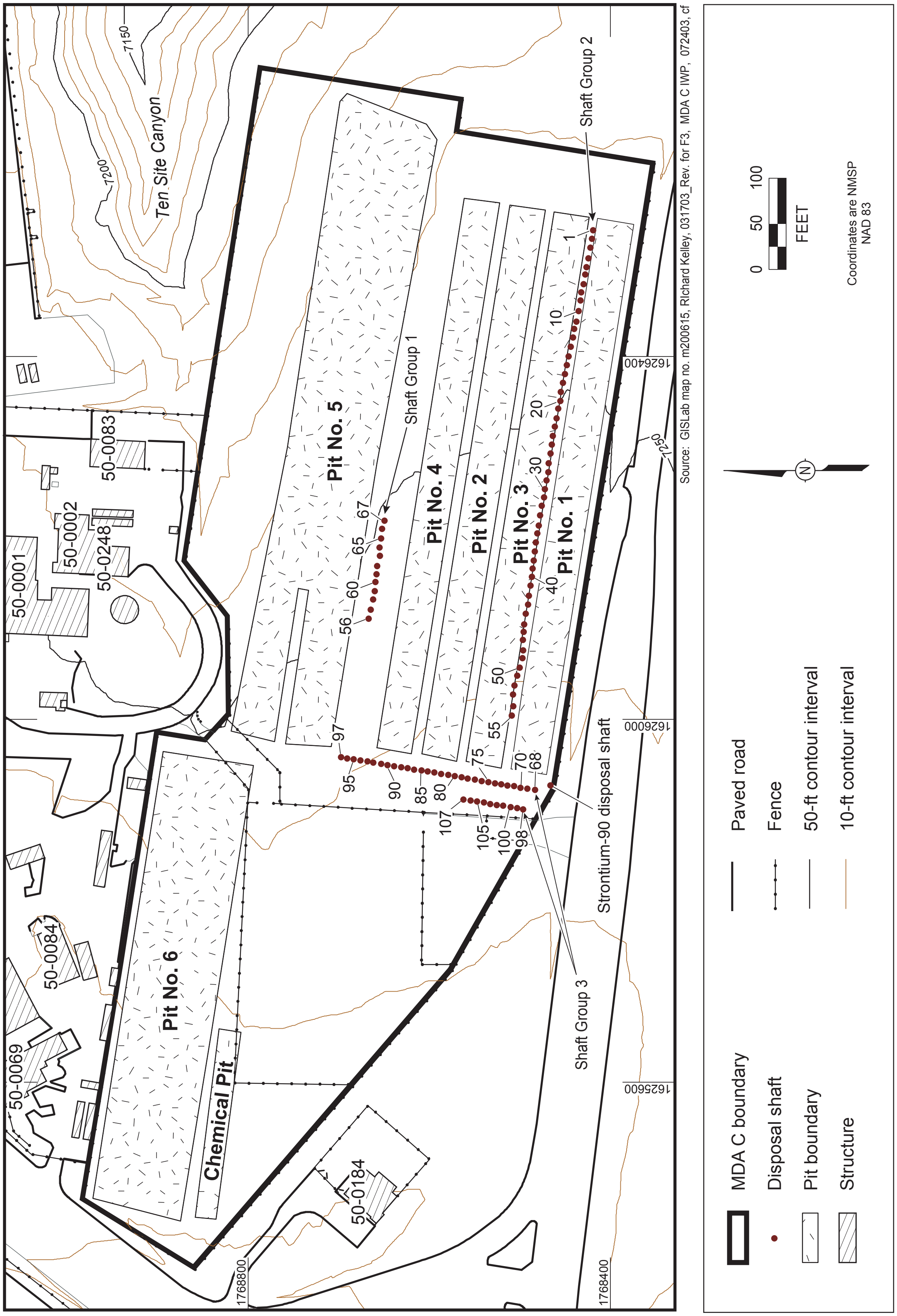

Figure 1.1-2 Locations of pits and shafts at MDA C

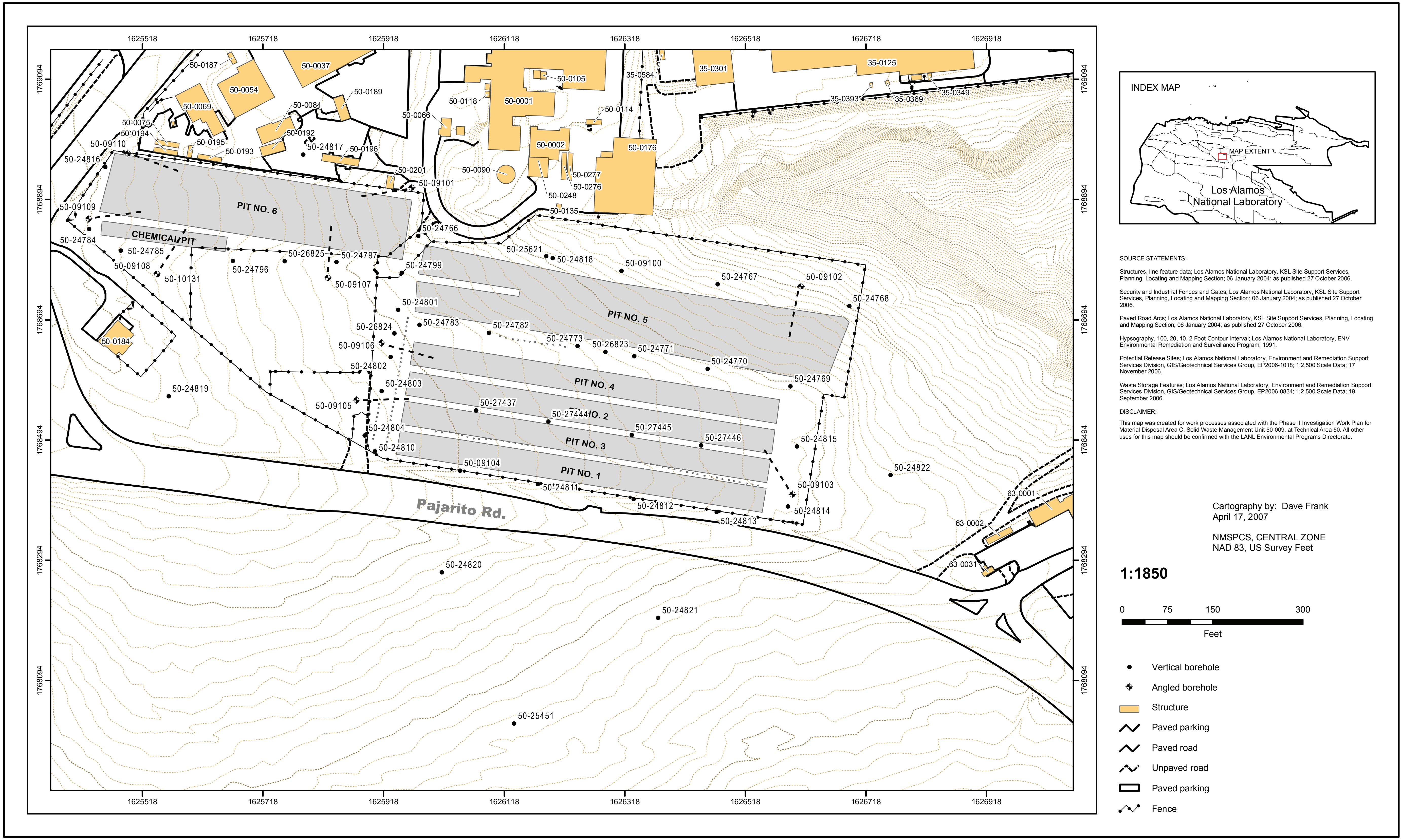

Figure 2.1-1 Locations of existing angled and vertical boreholes at MDA C

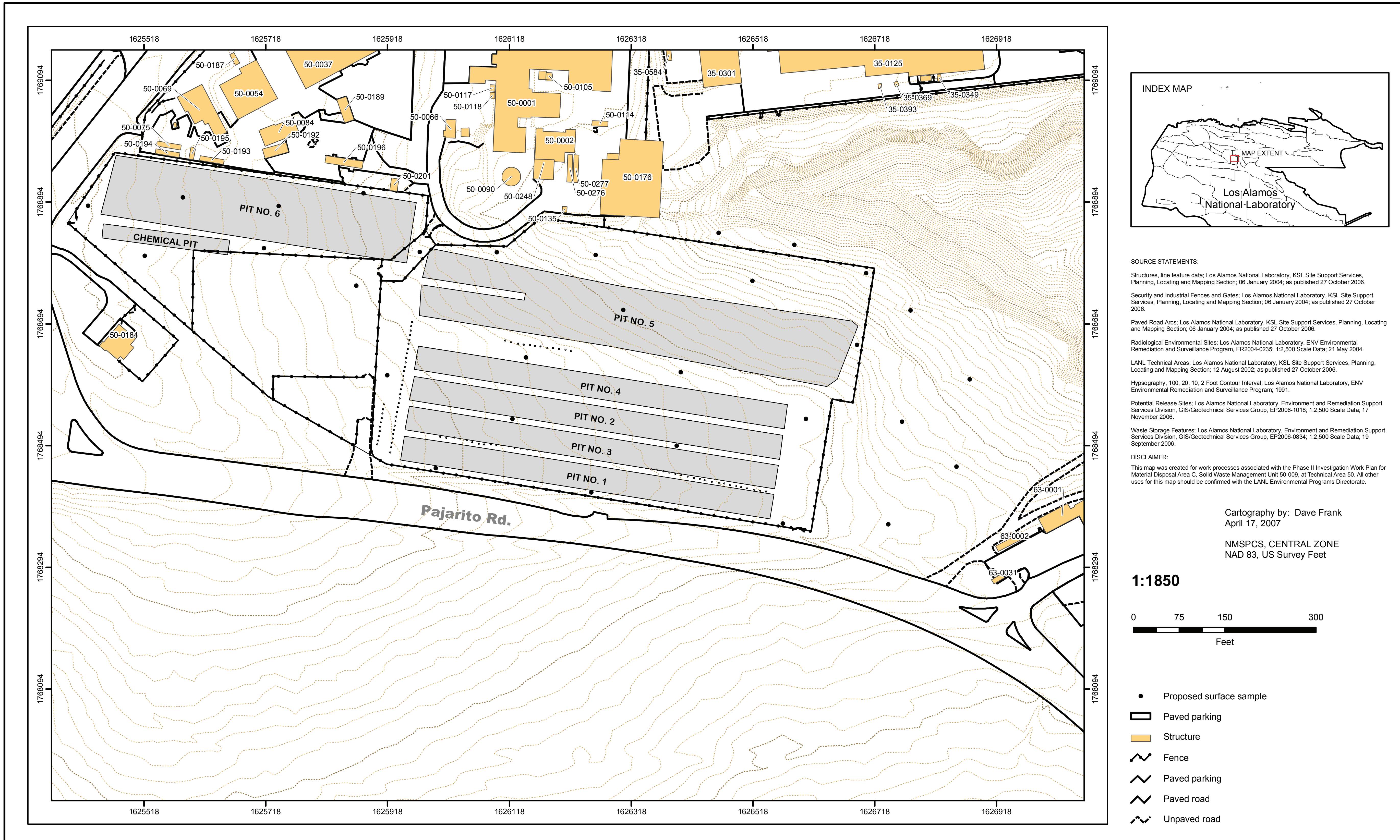

Figure 3.1-1 Locations of proposed surface soil samples at MDA C

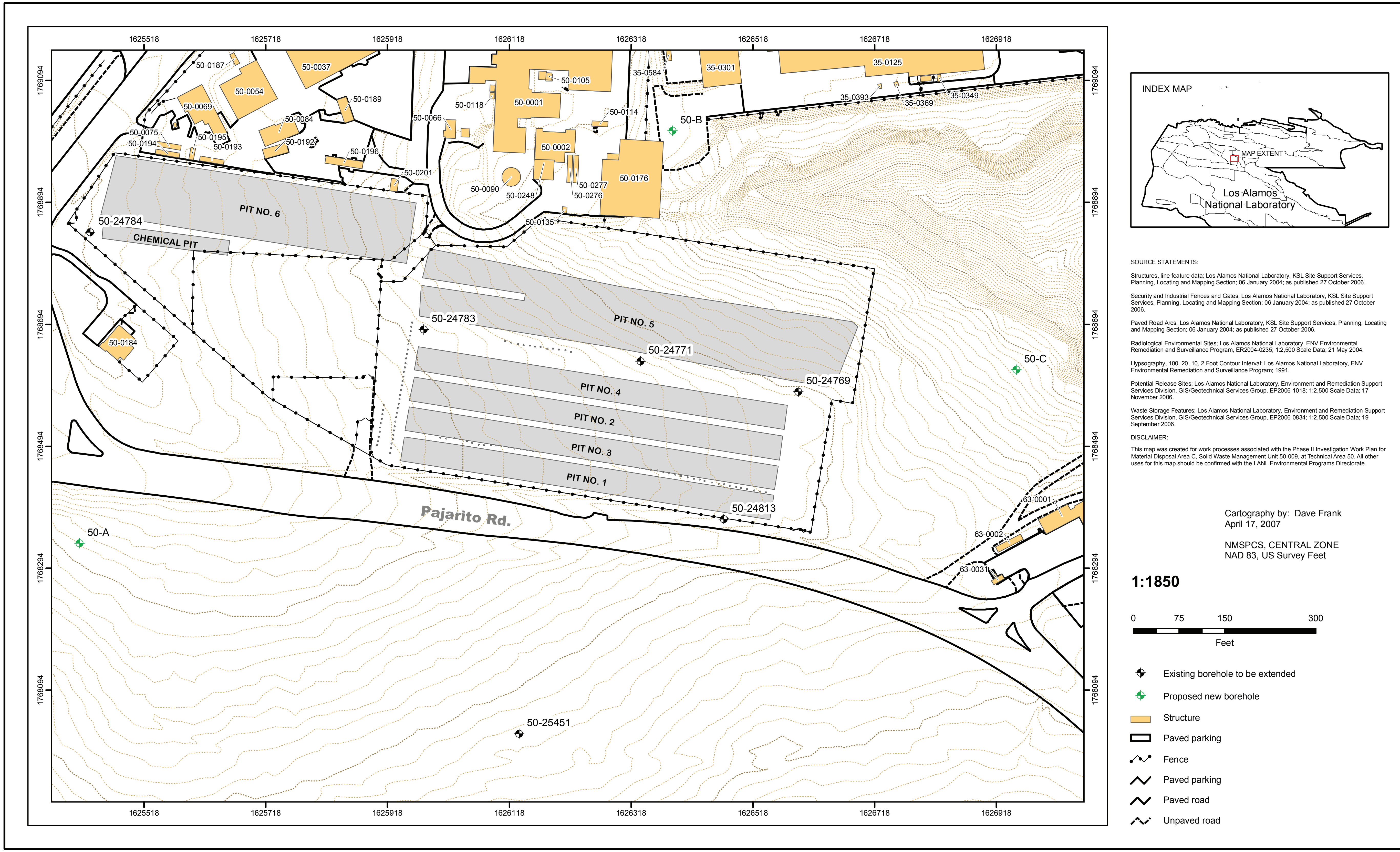

Figure 3.2-1 Locations of proposed Phase II boreholes at MDA C

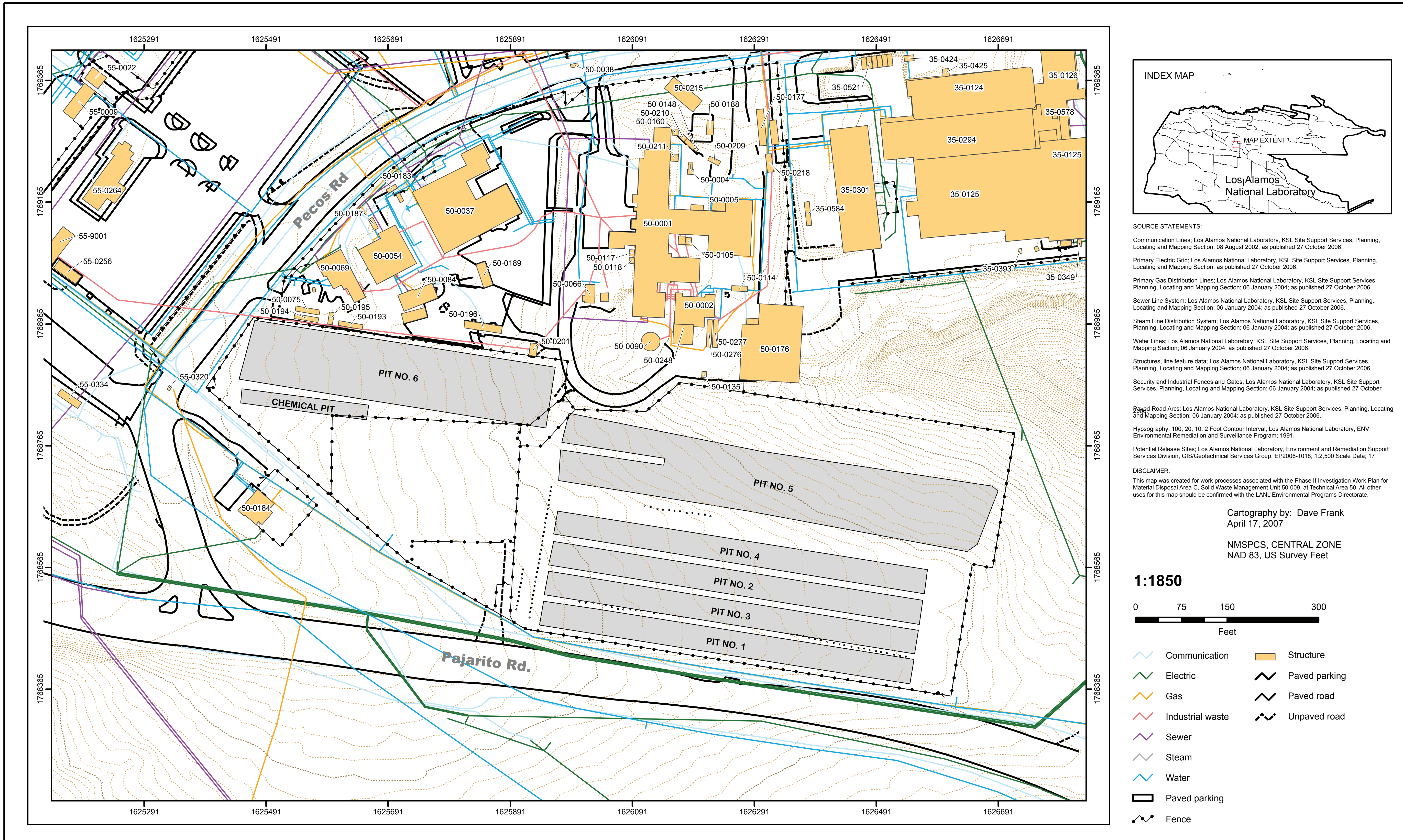

Figure 3.2-2 Locations of surface and subsurface utilities at MDA C

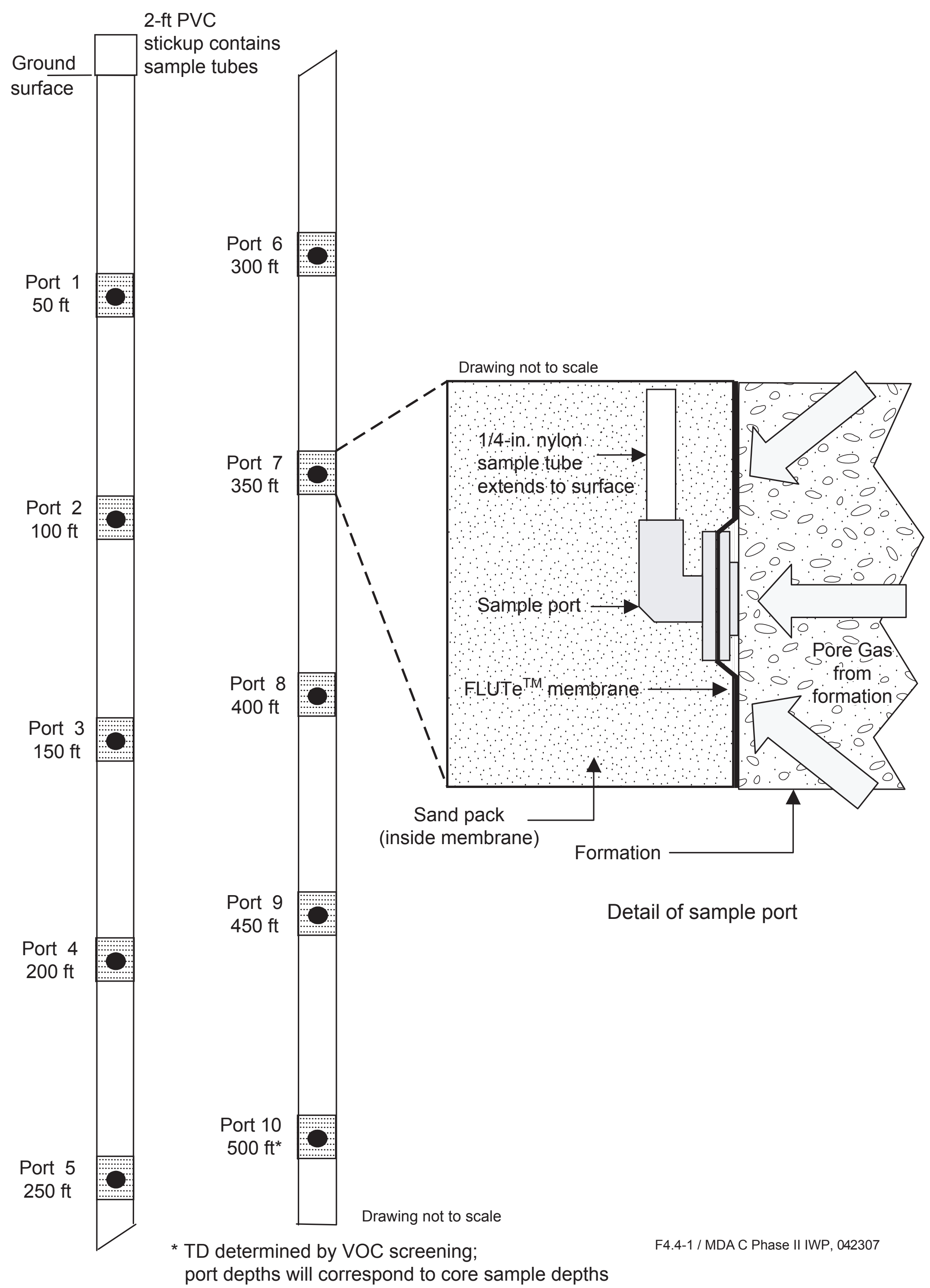

Figure 4.4-1 Schematic configuration of vapor monitoring borehole with FLUTe membrane and sampling ports

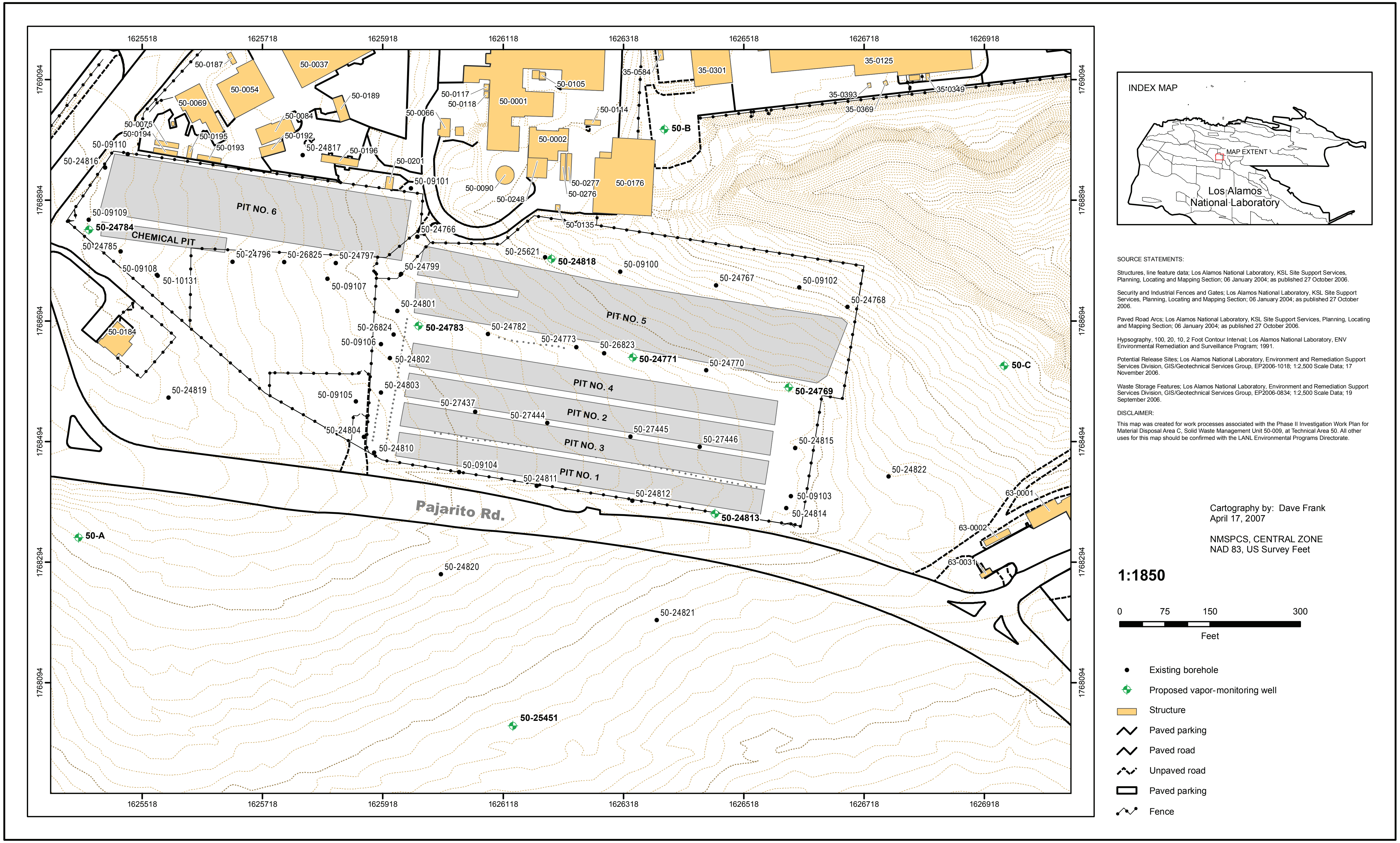

Figure 5.1-1 Locations of proposed vapor monitoring boreholes at MDA C

Table 2.2-1
Summary of Inorganic Chemicals Detected Above Background in TD Samples

Location	Chemical	Depth (ft)	Media	Concentration (mg/kg)	Background Value (mg/kg)	Maximum of Background Data (mg/kg)	Comments
50-24768	Lead	148.6–151.5	Qbt 2	19.7	11.2	15.5	Below BV in 3 of 4 other samples in borehole
50-24771	Selenium	148.2–150	Qbt 2	12	0.3	0.105	Detected above BV, or detection limit (DL) above BV, in 5 of 5 samples in borehole
50-24784	Chromium	298.3–299.8	Qbt 1g	19.4	2.6	2.3	Below BV in next sample above TD and in 7 of 10 other samples in borehole
50-24785	Lead	273.8–275	Qbt 1g	81.5	13.5	20	Below BV in 5 of 6 other samples in borehole
	Selenium	273.8–275	Qbt 1g	1.75	0.3	na*	Detected above BV, or DL above BV, in 7 of 7 samples in borehole
	Zinc	273.8–275	Qbt 1g	81.7 (J)	40	46	Below BV in 5 of 6 other samples in borehole
50-24799	Beryllium	158.5–160	Qbt 2	2.67	1.21	1.8	Below BV in next three samples above TD and in 7 of 8 other samples in borehole
50-24801	Selenium	148.3–150	Qbt 2	1.42 (J)	0.3	0.105	Detected above BV, or DL above BV, in 5 of 5 samples in borehole
50-24812	Aluminum	146–150	Qbt 2	24300 (J+)	7340	8370	Below BV in 4 of 4 other samples in borehole
	Beryllium	146–150	Qbt 2	5.62 (J)	1.21	1.8	Below BV in 4 of 4 other samples in borehole
	Calcium	146–150	Qbt 2	2560 (J)	2200	2230	Below BV in 4 of 4 other samples in borehole
	Copper	146–150	Qbt 2	7.75 (J)	4.66	6.2	Below BV in 3 of 4 other samples in borehole
	Magnesium	146–150	Qbt 2	3420 (J)	1690	2820	Below BV in 4 of 4 other samples in borehole
	Selenium	146–150	Qbt 2	3.33	0.3	0.105	Detected above BV, or DL above BV, in 5 of 5 samples in borehole
	Zinc	146–150	Qbt 2	69.7 (J-)	63.5	65.6	Below BV in 3 of 4 other samples in borehole

Table 2.2-1 (continued)

Location	Chemical	Depth (ft)	Media	Concentration (mg/kg)	Background Value (mg/kg)	Maximum of Background Data (mg/kg)	Comments
50-24817	Aluminum	248.1–250	Qbt 1g	7870	3560	3400	Below BV in 5 of 5 other samples in borehole
	Arsenic	248.1–250	Qbt 1g	2.88	0.56	0.7	Below BV in 5 of 5 other samples in borehole
	Barium	248.1–250	Qbt 1g	31.2	25.7	23	Below BV in 5 of 5 other samples in borehole
	Beryllium	248.1–250	Qbt 1g	2.07	1.44	1.4	Below BV in 5 of 5 other samples in borehole
	Iron	248.1–250	Qbt 1g	5740	3700	3700	Below BV in 5 of 5 other samples in borehole
	Manganese	248.1–250	Qbt 1g	243	189	210	Below BV in 5 of 5 other samples in borehole
50-24818	Copper	597–600.4	Qbo	11.3	3.96	2.6	Above BV in 5 of 5 Qbo samples; below BV in 8 of 8 other samples
50-24820	Arsenic	248.3–250	Qbt 1g	1.84	0.56	1.7	Below BV in 5 of 5 other samples in borehole
	Barium	248.3–250	Qbt 1g	33.5	25.7	23	Below BV in next 2 samples above TD and in 4 of 5 other samples in borehole
	Iron	248.3–250	Qbt 1g	4660	3700	3700	Below BV in 5 of 5 other samples in borehole
	Manganese	248.3–250	Qbt 1g	225	189	210	Below BV in 5 of 5 other samples in borehole
50-24821	Chromium	248.6–250	Qbt 1g	3.8 (J)	2.6	2.3	Below BV in 4 of 5 other samples in borehole
	Iron	248.6–250	Qbt 1g	4660	3700	3700	Below BV in 5 of 5 other samples in borehole
	Manganese	248.6–250	Qbt 1g	225	189	210	Below BV in 5 of 5 other samples in borehole
50-24822	Iron	248.7–250	Qbt 1g	4660	3700	3700	Below BV in 5 of 5 other samples in borehole
	Manganese	248.7–250	Qbt 1g	225	189	210	Below BV in 5 of 5 other samples in borehole
50-25451	Chromium	298.5–300	Qbt 1g	2.99	2.6	2.3	Below BV in 6 of 6 other samples in borehole

*na = Not available.

Table 3.1-1
Summary of Proposed Surface Soil and Borehole Sampling and Analyses

Location	Sample Type	Number of Samples	TAL Metals	Nitrate + Perchlorate	Cyanide	SVOCs	VOCs	PCBs	pH	Moisture Content	Gamma Spectroscopy	Isotopic Plutonium	Isotopic Uranium	Americium-241	Strontium-90	Tritium
30 surface locations	Soil	60[a]	✓[b]	—[c]	—	—	—	—	—	—	—	—	—	—	—	—
50-25451	Core	3[c]	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	3	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-24783	Core	6	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	6	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-24771	Core	6	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	6	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-24784	Core	3	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	3	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-24813	Core	6	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	6	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-24769	Core	6	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	6	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-A	Core	9	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	9	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-B	Core	9	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	9	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓
50-C	Core	9	✓	✓	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—
	Pore gas	9	—	—	—	—	✓	—	—	—	—	—	—	—	—	✓

[a] Two depth intervals will be sampled at each location.
[b] ✓ = To be submitted for laboratory analysis.
[c] — = Analysis not required.
[d] Numbers of samples in boreholes to be determined by TD of each borehole; samples to be collected at 50-ft intervals; additional fracture samples may be collected.

Table 3.2-1
Proposed Sample Depths for Boreholes at MDA C

Depth (ft)	Borehole Location								
	50-25451	50-24783	50-24771	50-24784	50-24813	50-24769	50-A	50-B	50-C
50	—[a]	—	—	—	—	—	✓[b]	✓	✓
100	—	—	—	—	—	—	✓	✓	✓
150	—	Current TD[c]	Current TD	—	Current TD	Current TD	✓	✓	✓
200	—	✓	✓	—	✓	✓	✓	✓	✓
250	—	✓	✓	—	✓	✓	✓	✓	✓
300	Current TD	✓	✓	Current TD	✓	✓	✓	✓	✓
350	✓	✓	✓	✓	✓	✓	✓	✓	✓
400	✓	✓	✓	✓	✓	✓	✓	✓	✓
450	✓	✓	✓	✓	✓	✓	✓	✓	✓
500	TBD[d]	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

[a] — = Previously sampled depth range (approximate; samples not necessarily collected at exact interval listed).

[b] ✓ = Both tuff (core) and pore-gas samples will be collected.

[c] Samples were collected previously at various depths between surface and current TD (LANL 2006, 094688); “Current TD” depths are approximate.

[d] TBD = To be determined; total depth of boreholes based on VOC analysis of samples beginning in Otowi Member of Bandelier Tuff.

Table 4.0-1
Field Investigation Procedures for Phase II Investigation Activities at MDA C

ENV-DO-206, Sample Containers and Preservation
ENV-DO-207, Handling, Packaging, and Transporting Field Samples
SOP-01.01, General Instructions for Field Investigations
SOP-01.04. Sample Control and Field Documentation
SOP-01.05, Field Quality Control Samples
SOP-01.06, Management of Environmental Restoration Project Waste
SOP-01.08, Field Decontamination of Drilling and Sampling Equipment
SOP-01.10, Waste Characterization
SOP-03.11, Coordinating and Evaluating Geodetic Surveys
SOP-05.03, Monitoring Well and Borehole Abandonment
SOP-6.09, Spade and Scoop Method for the Collection of Soil Samples
SOP-06.10, Hand Auger and Thin-Wall Tube Sampler
SOP-06.24, Sample Collection from Split-Spoon Samplers and Shelby-Tube Samplers
SOP-06.26, Core-Barrel Sampling for Subsurface Earth Materials
SOP-06.31, Sampling of Subatmospheric Air
SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials

Note: These procedures are available at http://int.lanl.gov/environment/all/qa.shtml.

Table 4.0-2
Brief Descriptions of Field Investigation Procedures for Phase II Investigation Activities at MDA C

Method	Summary
Sample Containers and Preservation	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and quality assurance. Specific requirements for each sample are printed on the sample collection logs provided by the SMO (size and type of container, i.e. glass, amber glass, polyethylene, preservative, etc.). All samples are preserved by placing in insulated containers with ice to maintain a temperature of 4˚C. Other requirements, such as use of nitric acid or other preservatives, may apply to different media or analytical requests.
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing and ensure that the sampling and transport containers are free of external contamination. Field team members package all samples to minimize the possibility of breakage during transportation. After all environmental samples are collected, packaged, and preserved, a field team member transports them to the SMO. A split of each sample is sent to an SMO-approved radiation screening laboratory under chain-of-custody (COC). Once the radiation screening results are received, the SMO arranges for the corresponding analytical samples to be shipped to fixed laboratories for full analyses.
Sample Control and Field Documentation	The collection, screening, and transport of samples are documented on standard forms generated by the SMO. These forms include sample collection logs, COC forms, and sample container labels. The collection logs are completed at the time the samples are collected and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. COC forms are completed and assigned to verify that the samples are not left unattended.
Field Quality Control Samples	Field quality control samples are collected as directed in the Consent Order as follows: *Field Duplicate*: At a frequency 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment Rinsate Blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water, which is collected in a sample container and submitted for laboratory analysis. *Trip Blanks*: Required for all field events that include the collection of samples for VOC analysis. Trip blanks containers of certified clean sand that are opened and kept with the other sample containers during the sampling process.
Management, Characterization, and Storage of Investigation-Derived Waste (IDW)	IDW will be managed, characterized, and stored in accordance with an approved waste characterization strategy form that documents site history, field activities, and the characterization approach for each waste stream managed. Waste characterization will comply with on-site or off-site waste acceptance criteria, as appropriate. All stored IDW will be marked with appropriate signage and labels. Drums containing IDW will be stored on pallets to prevent deterioration of containers. The means to store, control, and transport each potential waste type and classification will be determined before field operations begin. A waste storage area will be established before waste is generated. Each container of waste generated will be individually labeled with waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste will be segregated by classification and compatibility to prevent cross-contamination.

Table 4.0-2 (continued)

Method	Summary
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination is the preferred method to minimize the generating liquid waste. Dry decontamination may include the use of a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by use of a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes. Dry decontamination may be followed by wet decontamination if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, steam cleaning may be used.
Coordinating and Evaluating Geodetic Surveys	Geodetic surveys are focused on obtaining survey data of acceptable quality for use during project investigations. Geodetic surveys will be conducted with a Trimble 5700 DGPS. The survey data will conform to Laboratory Information Architecture (IA) project standards IA-CB02, "GIS Horizontal Spatial Reference System," and IA D802, "Geospatial Positioning Accuracy Standard for A/E/C/ and Facility Management." All coordinates will be expressed as SPCS 83, NM Central, U.S. ft coordinates. All elevation data will be reported relative to the National Geodetic Vertical Datum of 1983.
Monitoring Well and Borehole Abandonment	Borehole abandonment will be performed on specific boreholes to ensure the plugging and complete sealing of a borehole with materials of low hydraulic conductivity in such a manner as to preclude migration of surface runoff or groundwater along the length of the well. The conditions and construction details of the borehole will be evaluated before it is plugged and abandoned. The borehole will be sounded (its depth measured with a weighted line or other appropriate method) immediately before it is plugged and abandoned to ensure that it contains no obstructions that could interfere with filling and sealing. In accordance with the Consent Order, sealing material will be pumped under pressure from the bottom of the hole (via the tremie pipe method) to ensure that the borehole is properly filled and sealed. The borehole will be filled to the surface with cement grout or within 2 ft of the surface with bentonite grout. After the placement of the bentonite (if used), the remaining portion of the well will be sealed with cement.
Spade and Scoop Collection of Soil Samples	This method is used for collecting shallow (i.e., 0–6 in.) soil or fill samples. The "spade-and-scoop" method involves digging a hole to the desired depth, as prescribed in the work plan, and collecting a discrete grab sample. The sample is typically homogenized and placed in a decontaminated stainless-steel bowl for transfer into appropriate sample containers.
Hand-Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but may in some cases be used for collecting samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in. inner diameter), creating a vertical hole that can be advanced to the desired sample depth. When the desired depth is reached, the auger is decontaminated before the hole is advanced through the sample depth. The sample material is transferred from the auger bucket to a stainless-steel sampling bowl before the required sample containers are filled.
Split-Spoon Core-Barrel Sampling	In this method, a stainless-steel core barrel (typically 4 in. inner diameter, 2.5 ft long) is advanced using a powered drilling rig. The core barrel extracts a continuous length of soil and/or rock that can be examined as a unit. The split-spoon core barrel is a cylindrical barrel split lengthwise so that the two halves can be separated to expose the core sample. Once extracted, the section of core is typically screened for radioactivity and organic vapors, photographed, and described in a geologic log. A portion of the core may then be collected as a discrete sample from the desired depth and submitted for fixed laboratory analysis.

Table 4.0-2 (continued)

Method	Summary
Sampling of Subatmospheric Air	Subsurface pore-gas samples are collected from discrete zones within each borehole. The process for collecting subsurface pore-gas samples is performed using an inflatable packer and a sample-train apparatus to pull subatmospheric air from the rock formation at desired sampling intervals. Leak checks on the sample train are required before every sampling or screening activity and checks are performed daily on the Teflon tubing and packer connections. The Teflon tubing used to connect the sample train to the vapor inlet is replaced for every borehole to prevent cross-contamination. The packer is lowered down the borehole and inflated with nitrogen to seal off a vapor inlet at the desired depth. The sample train is then purged to ensure formation air is being collected. Based on calculations of the packed-off borehole and tubing volume and the air flow discharged by the sample train pumps, ambient air residing in the packed-off borehole and sample tubing is evacuated after several minutes. The indicated purge time is multiplied by 2 to ensure a conservative estimate to evacuate ambient air from the system. During the purge, percent oxygen, percent carbon dioxide, and percent methane readings from the sample train exhaust are collected every several minutes using a LANDTEC GEM-500 gas extraction meter to ensure all ambient air is evacuated from the system. At the end of every purge cycle, a PID reading is collected from the air in the sample-train apparatus. Vapor samples are collected using a SUMMA canister and analyzed by EPA Method TO-15. Vapor samples will also be collected in silica gel samples tubes for tritium analysis using EPA Method 906.0. All instruments used during field screening are calibrated daily following the manufacturers' specifications.
Field Logging, Handling, and Documentation of Borehole Materials	After they reach the surface, the core barrels are immediately opened for field screening, logging, and sampling. Logging of borehole materials includes noting the run number, core recovery in feet, depth interval (in 5-ft increments), field-screening results, and lithological and structural description and taking photographs. Once the core material is logged, selected samples are taken from discrete intervals of the core. All borehole material not sampled is then disposed of as waste. No material from the boreholes will be archived.

Appendix A

Acronyms, Glossary, and
Metric Conversion and Data Qualifier Tables

A-1.0 ACRONYMS

AGI	American Geological Institute
ASTM	American Society for Testing and Materials
bgs	below ground surface
BV	background value
CMRR	Chemical Metallurgical Research Replacement facility
COC	chain of custody
DL	detection limit
DOE	Department of Energy (U.S.)
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency (U.S.)
HEPA	high-efficiency particulate air (filter)
IA	Information Architecture (Laboratory Project)
IDW	investigation-derived waste
LANL	Los Alamos National Laboratory
LIR	Laboratory implementation requirement
LLW	low-level waste
MDA	material disposal area
NMED	New Mexico Environment Department
PCB	polychlorinated biphenyl
PID	photoionization detector
PCE	tetrachloroethene
PPE	personal protective equipment
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFI	Resource Conservation and Recovery Act facility investigation
RLWTF	radioactive liquid waste treatment facility
RPF	Records Processing Facility
SMO	sample management office
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area

TAL	target analyte list
TBD	to be determined
TCE	trichloroethene
TCLP	toxicity leaching characteristic procedure
TD	total depth
VOC	volatile organic compound
WCSF	waste characterization strategy form
XRF	x-ray fluorescence

A-2.0 GLOSSARY

abandonment—The plugging of a well or borehole in a manner that precludes the migration of surface runoff or groundwater along the length of the well or borehole.

accuracy—A measure of the closeness of measurements to the true value of the parameter being measured.

analysis—A critical evaluation, usually made by breaking a subject (either material or intellectual) down into its constituent parts, then describing the parts and their relationship to the whole. Analyses may include physical analysis, chemical analysis, toxicological analysis, and knowledge-of-process determinations.

analyte—The element, nuclide, or ion a chemical analysis seeks to identify and/or quantify; the chemical constituent of interest.

analytical method—A procedure or technique for systematically performing an activity.

assessment—(1) The act of reviewing, inspecting, testing, checking, conducting surveillance, auditing, or otherwise determining and documenting whether items, processes, or services meet specified requirements. (2) An evaluation process used to measure the performance or effectiveness of a system and its elements. In this glossary, assessment is an all-inclusive term used to denote any one of the following: audit, performance evaluation, management system review, peer review, inspection, or surveillance.

basalt—A fine-grained, dark volcanic rock composed chiefly of plagioclase, augite, olivine, and magnetite.

borehole—(1) A hole drilled or bored into the ground, usually for exploratory or economic purposes. (2) A hole into which casing, screen, and other materials may be installed to construct a well.

borehole logging—The process of making remote measurements of physical, chemical, or other parameters at multiple depths in a borehole.

casing—A solid piece of pipe, typically steel, stainless steel, or polyvinyl chloride plastic, used to keep a well open in either unconsolidated material or unstable rock and as a means to contain zone-isolation materials, such as cement grout.

chemical—Any naturally occurring or human-made substance characterized by a definite molecular composition.

chemical analysis—A process used to measure one or more attributes of a sample in a clearly defined, controlled, and systematic manner. Chemical analysis often requires treating a sample chemically or physically before measurement.

Compliance Order on Consent (Consent Order)—For the Environmental Remediation and Surveillance Program, an enforcement document signed by the New Mexico Environment Department, the U.S. Department of Energy, and the Regents of the University of California on March 1, 2005, which prescribes the requirements for corrective action at Los Alamos National Laboratory. The purposes of the Consent Order are (1) to define the nature and extent of releases of contaminants at, or from, the facility; (2) to identify and evaluate, where needed, alternatives for corrective measures to clean up contaminants in the environment and prevent or mitigate the migration of contaminants at, or from, the facility; and (3) to implement such corrective measures. The Consent Order supersedes the corrective action requirements previously specified in Module VIII of the Laboratory's Hazardous Waste Facility Permit.

Consent Order—See Compliance Order on Consent.

contaminant—(1) Chemicals and radionuclides present in environmental media or on debris above background levels. (2) According to the March 1, 2005, Compliance Order on Consent (Consent Order), any hazardous waste listed or identified as characteristic in 40 Code of Federal Regulations (CFR) 261 (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]); any hazardous constituent listed in 40 CFR 261 Appendix VIII (incorporated by 20.4.1.200 NMAC) or 40 CFR 264 Appendix IX (incorporated by 20.4.1.500 NMAC); any groundwater contaminant listed in the Water Quality Control Commission (WQCC) Regulations at 20.6.3.3103 NMAC; any toxic pollutant listed in the WQCC Regulations at 20.6.2.7 NMAC; explosive compounds; nitrate; and perchlorate. (Note: Under the Consent Order, the term "contaminant" does not include radionuclides or the radioactive portion of mixed waste.)

contract analytical laboratory—An analytical laboratory under contract to the University of California to analyze samples from work performed at Los Alamos National Laboratory.

decontamination—The removal of unwanted material from the surface of, or from within, another material.

disposal—The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into, or on, any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

drill bit—The cutting tool attached to the bottom of a drill stem.

drilling string—The string of pipe (extending from the bit to the driving mechanism) that serves to carry mud down a borehole and to rotate a bit.

drill rod (drill pipe)—Special pipe used to transmit rotation and energy from the drill rig to the bit. This conduit conveys circulation fluids such as air, water, or other mixtures to cool the bit and evacuate the borehole cuttings.

Environmental Restoration (ER) Project—A Los Alamos National Laboratory project established in 1989 as part of a U.S. Department of Energy nationwide program, and precursor of today's Environmental Remediation and Surveillance (ERS) Program. This program is designed (1) to investigate hazardous and/or radioactive materials that may be present in the environment as a result of past Laboratory operations, (2) to determine if the materials currently pose an unacceptable risk to human health or the environment, and (3) to remediate (clean up, stabilize, or restore) those sites where unacceptable risk is still present.

environmental samples—Air, soil, water, or other media samples that have been collected from streams, wells, and soils, or other locations, and that are not expected to exhibit properties classified as hazardous by the U.S. Department of Transportation.

equipment blank (rinsate blank)—A sample used to rinse sample-collection equipment and expected to have negligible or unmeasurable amounts of analytes. The equipment blank is collected after the equipment decontamination is completed but before the collection of another field sample.

ER identification (ER ID) number—A unique identifier assigned by the Environmental Remediation and Surveillance Program's Records Processing Facility to each document when it is submitted as a final record.

field duplicate (replicate) samples—Two separate, independent samples taken from the same source, which are collected as collocated samples (i.e., equally representative of a sample matrix at a given location and time).

field sample—See sample.

groundwater—Interstitial water that occurs in saturated earth material and is capable of entering a well in sufficient amounts to be used as a water supply.

Hazardous and Solid Waste Amendments (HSWA)—Public Law No. 98-616, 98 Stat. 3221, enacted in 1984, which amended the Resource Conservation and Recovery Act of 1976 (42 United States Code § 6901 et seq).

hazardous constituent (hazardous waste constituent)—According to the March 1, 2005, Compliance Order of Consent (Consent Order), any constituent identified in Appendix VIII of Part 261, Title 40 Code of Federal Regulations (CFR) (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]) or any constituent identified in 40 CFR 264, Appendix IX (incorporated by 20.4.1.500 NMAC).

hazardous waste—(1) Solid waste that is listed as a hazardous waste, or exhibits any of the characteristics of hazardous waste (i.e., ignitability, corrosivity, reactivity, or toxicity, as provided in 40 CFR, Subpart C). (2) According to the March 1, 2005, Compliance Order of Consent (Consent Order), any solid waste or combination of solid wastes that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, meets the description set forth in New Mexico Statutes Annotated 1978, § 74-4-3(K) and is listed as a hazardous waste or exhibits a hazardous waste characteristic under 40 CFR 261 (incorporated by 20.4.1.200 New Mexico Administrative Code).

Hazardous Waste Facility Permit—The authorization issued to Los Alamos National Laboratory (the Laboratory) by the New Mexico Environment Department that allows the Laboratory to operate as a hazardous waste treatment, storage, and disposal facility.

HSWA module—See Module VIII.

hydrogen-ion activity (pH)—The effective concentration (activity) of dissociated hydrogen ions ($H+$); a measure of the acidity or alkalinity of a solution that is numerically equal to 7 for neutral solutions, increases with alkalinity, and decreases as acidity increases.

investigation-derived waste—Solid waste or hazardous waste that was generated as a result of corrective action investigation or remediation field activities. Investigation-derived waste may include drilling muds, cuttings, and purge water from the installation of test pits or wells; purge water, soil, and other materials from the collection of samples; residues from the testing of treatment technologies and pump-and-treat systems; contaminated personal protective equipment; and solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment.

material disposal area (MDA)—A subset of the solid waste management units at Los Alamos National Laboratory (the Laboratory) that include disposal units such as trenches, pits, and shafts. Historically, various disposal areas (but not all) were designated by the Laboratory as MDAs.

medium (environmental)—Any material capable of absorbing or transporting constituents. Examples of media include tuffs, soils and sediments derived from these tuffs, surface water, soil water, groundwater, air, structural surfaces, and debris.

migration—The movement of inorganic and organic chemical species through unsaturated or saturated materials.

mixed waste—Waste containing both hazardous and source, special nuclear, or byproduct materials subject to the Atomic Energy Act of 1954.

Module VIII—Module VIII of the Los Alamos National Laboratory (the Laboratory) Hazardous Waste Facility Permit. This permit allows the Laboratory to operate as a hazardous-waste treatment, storage, and disposal facility. From 1990 to 2005, Module VIII included requirements from the Hazardous and Solid Waste Amendments. These requirements have been superceded by the March 1, 2005, Compliance Order on Consent (Consent Order).

monitoring well—(1) A well used to obtain water-quality samples or to measure groundwater levels, (2) A well drilled at a hazardous waste management facility or Superfund site to collect groundwater samples for the purpose of physical, chemical, or biological analysis and to determine the amounts, types, and distribution of contaminants in the groundwater beneath the site.

notices of approval, of approval with modification, or of disapproval—Notices issued by the New Mexico Environment Department (NMED). Upon receipt of a work plan, schedule, report, or other deliverable document, NMED reviews the document and approves the document as submitted, modifies the document and approves it as modified, or disapproves the document. A notice of approval means that the document is approved as submitted. A notice of approval with modifications means that the document is approved but with modifications specified by NMED. A notice of disapproval means that the document is disapproved and it states the deficiencies and other reasons for disapproval.

permit—An authorization, license, or equivalent control document issued by the U.S. Environmental Protection Agency or an approved state agency to implement the requirements of an environmental regulation.

polychlorinated biphenyls (PCBs)—Any chemical substance limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination that contains such substances. PCBs are colorless, odorless compounds that are chemically, electrically, and thermally stable and have proven to be toxic to both humans and other animals.

quality assurance/quality control—A system of procedures, checks, audits, and corrective actions set up to ensure that all U.S. Environmental Protection Agency research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

quality control—See quality assurance/quality control.

radioactive waste—Waste that, by either monitoring and analysis, or acceptable knowledge, or both, has been determined to contain added (or concentrated and naturally occurring) radioactive material or activation products, or that does not meet radiological release criteria.

RCRA facility investigation (RFI)—A Resource Conservation and Recovery Act (RCRA) investigation that determines if a release has occurred and characterizes the nature and extent of contamination at a hazardous waste facility. The RFI is generally equivalent to the remedial investigation portion of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

Resource Conservation and Recovery Act—The Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976 (Public Law [PL] 94-580, as amended by PL 95-609 and PL 96-482, United States Code 6901 et seq.).

rinsate blank—See equipment blank.

sample—A portion of a material (e.g., rock, soil, water, or air), which, alone or in combination with other portions, is expected to be representative of the material or area from which it is taken. Samples are typically either sent to a laboratory for analysis or inspection or are analyzed in the field. When referring to samples of environmental media, the term field sample may be used.

sample matrix—In chemical analysis, that portion of a sample that is exclusive of the analytes of interest. Together, the matrix and the analytes of interest form the sample.

site characterization—Defining the pathways and methods of migration of hazardous waste or constituents, including the media affected; the extent, direction and speed of the contaminants; complicating factors influencing movement; or concentration profiles.

soil gas—Gaseous elements and compounds in the small spaces between particles of the earth and soil. Such gases can be moved or driven out under pressure.

soil moisture—The water contained in the pore space of the unsaturated zone.

solid waste—Any garbage, refuse, or sludge from a waste treatment plant, water-supply treatment plant, or air-pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. Solid waste does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges that are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended; or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended.

solid waste management unit (SWMU)—(1) Any discernible site at which solid wastes have been placed at any time, whether or not the site use was intended to be the management of solid or hazardous waste. SWMUs include any site at a facility at which solid wastes have been routinely and systematically released. This definition includes regulated sites (i.e., landfills, surface impoundments, waste piles, and land treatment sites), but does not include passive leakage or one-time spills from production areas and sites in which wastes have not been managed (e.g., product storage areas). (2) According to the March 1, 2005, Compliance Order on Consent (Consent Order), any discernible site at which solid waste has been placed at any time, and from which the New Mexico Environment Department determines there may be a risk of a release of hazardous waste or hazardous waste constituents (hazardous constituents), whether or not the site use was intended to be the management of solid or hazardous waste. Such sites include any area in Los Alamos National Laboratory at which solid wastes have been routinely and systematically released; they do not include one-time spills.

standard operating procedure—A document that details the officially approved method(s) for an operation, analysis, or action, with thoroughly prescribed techniques and steps.

surface sample—A sample taken at a collection depth that is (or was) representative of the medium's surface during the period of investigative interest. A typical depth interval for a surface sample is 0 to 6 in. for mesa-top locations, but may be up to several feet in sediment-deposition areas within canyons.

target analyte—A chemical or parameter, the concentration, mass, or magnitude of which is designed to be quantified by a particular test method.

technical area (TA)—At Los Alamos National Laboratory, an administrative unit of operational organization (e.g., TA-21).

tremie pipe—A small-diameter pipe used to carry sand pack, bentonite, or grouting materials to a borehole's bottom. Materials are pumped under pressure or poured to the hole bottom through the pipe. The pipe is retracted as the annular space is filled.

trip blank—A sample of analyte-free medium taken from a sampling site and returned to an analytical laboratory unopened, along with samples taken in the field; used to monitor cross contamination of samples during handling and storage both in the field and in the analytical laboratory.

tuff—Consolidated volcanic ash, composed largely of fragments produced by volcanic eruptions.

U.S. Department of Energy—The federal agency that sponsors energy research and regulates nuclear materials for weapons production.

U.S. Environmental Protection Agency (EPA)—The federal agency responsible for enforcing environmental laws. Although state regulatory agencies may be authorized to administer some of this responsibility, EPA retains oversight authority to ensure the protection of human health and the environment.

well casing—A solid piece of pipe, typically steel or polyvinyl chloride (PVC) plastic, used to keep a well open in either unconsolidated materials or unstable rock and as a means to contain zone-isolation materials such as cement grout or bentonite.

work plan—A document that specifies the activities to be performed when implementing an investigation or remedy. At a minimum, the work plan should identify the scope of the work to be performed, specify the procedures to be used to perform the work, and present a schedule for performing the work. The work plan may also present the technical basis for performing the work.

A-3.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain US Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-4.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and 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 detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

Appendix B

Investigation-Derived Waste Management

This appendix to the Phase II investigation work plan describes how investigation-derived waste (IDW) generated during the investigation of Material Disposal Area (MDA) C at Los Alamos National Laboratory (the Laboratory) will be managed. IDW is solid waste generated as a result of field-investigation activities and may include, but is not limited to, drill cuttings; purge water; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from the decontamination of PPE and sampling equipment; and all other wastes potentially coming into contact with contaminants. IDW generated during the investigation of MDA C will be managed to protect human health and the environment, comply with applicable regulatory requirements, and adhere to Laboratory waste-minimization goals.

All IDW generated during field-investigation activities will be managed in accordance with applicable standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) regulations, Department of Energy (DOE) orders, and Laboratory implementation requirements (LIRs). The SOPs applicable to the characterization and management of IDW are

- SOP-1.06, Management of Environmental Restoration Project Waste and
- SOP-1.10, Waste Characterization.

These SOPs are among those applicable to the investigation at MDA C and are available at the following URL: http://int.lanl.gov/environment/all/qa.shtml. Before the start of field investigation activities, a waste characterization strategy form (WCSF) will be prepared and approved per the requirements of SOP-01.10. The WCSF will provide detailed information on IDW characterization, management, containerization, and possible volumes. IDW characterization will be completed by reviewing existing data and/or documentation, by direct sampling of the IDW, and/or by sampling the media being investigated (i.e., surface soil, subsurface soil, etc.). If direct waste-characterization sampling is necessary, it will be described in the WCSF.

The guidance described in the Laboratory's 2006 Waste Minimization Report will be implemented during field investigations at MDA C to minimize waste generation. The IDW waste streams associated with the investigation of MDA C are identified in Table B-1 and are summarized below. Table B-1 also summarizes the waste type, estimated volume, method of on-site management, and expected disposition for each of these waste streams.

Drill cuttings. The drill cuttings waste stream will consist of cuttings from all boreholes drilled during field activities. Drill cuttings will be collected and containerized at the point of generation (i.e., at the drill rig). The drill cutting waste stream will be characterized with analytical results by direct sampling of the containerized waste. The maximum detected concentrations of radionuclides will be compared with background/fallout values. If the maximum concentrations are above background/fallout values, the waste cuttings will be designated as low-level radioactive waste (LLW). The total concentrations of toxicity characteristic leaching procedure (TCLP) constituents will be compared with 20 times the TCLP regulatory level. If the total concentrations are less than 20 times the TCLP regulatory level, the waste cuttings will be designated nonhazardous by characteristic. If total concentrations exceed 20 times the TCLP regulatory level, the waste cuttings will be sampled and analyzed using TCLP to determine if they are hazardous by characteristic. If potential EPA-listed hazardous waste constituents are detected, the Laboratory will conduct a review of historical records and data in an effort to determine whether the source of each constituent was a listed hazardous waste at its point of generation. If the source is determined to be a listed hazardous waste, the cuttings will be managed as hazardous or mixed waste (depending on the levels of radioactivity). Otherwise, the cuttings will be managed as nonhazardous solid waste or LLW (depending on the levels of radioactivity). Based on the results of previous investigations at

MDA C, the Laboratory expects these wastes to be designated as LLW to be disposed of at Technical Area (TA) 54 or at an off-site disposal facility.

Spent PPE. The spent PPE waste stream will consist of PPE that has potentially contacted contaminated environmental media (i.e., core and/or drill cuttings) and that cannot be decontaminated. The bulk of this waste stream will consist of protective clothing such as coveralls, gloves, and shoe covers. Spent PPE will be collected in containers at personnel decontamination stations. Characterization of this waste stream will be performed through acceptable knowledge of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contact. The Laboratory expects these wastes to be designated as LLW that will be disposed of at TA-54 or at an off-site disposal facility.

Disposable sampling supplies. The disposable sampling supplies waste stream will consist of all equipment and materials necessary for collecting samples that come into direct contact with contaminated environmental media and that cannot be decontaminated. This waste stream will consist primarily of paper and plastic items collected in bags at the sampling location and transferred to accumulation drums. This waste stream also includes wastes associated with dry decontamination activities. Characterization of this waste stream will be performed through acceptable knowledge of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contact. The Laboratory expects these wastes to be designated as LLW to be disposed of at TA-54 or at an off-site disposal facility.

Decontamination fluids. The decontamination fluids waste stream will consist of liquid wastes from decontamination activities (i.e., decontamination solutions and rinse waters). Consistent with waste minimization practices, the Laboratory employs dry decontamination methods to the extent possible. If dry decontamination cannot be performed, liquid decontamination wastes will be collected in containers at the point of generation and characterized with analytical results from direct sampling of the containerized waste. The Laboratory expects these wastes to be designated as liquid LLW to be sent to the radioactive liquid waste treatment facility (RLWTF) at TA-50 for disposal.

Spent filters. This waste stream consists of spent filters generated during dust-suppression activities while air coring is performed. The spent filter characteristics will be determined using the data collected during the characterization of the borehole cuttings. The spent filters will be managed as LLW until data from the borehole cuttings are obtained. The spent filters will be stored on-site within a 55-gal. drum until final characterization. The spent filters will be disposed of at TA-54 or at an off-site disposal facility.

The selection of waste containers will be based on the appropriate U.S. Department of Transportation requirements, waste types, and estimated volumes of IDW to be generated. Immediately following containerization, each waste container will be individually labeled with a unique identification number and with information regarding waste classification, item(s), radioactivity (if applicable), and date generated. If wastes are pending analytical results to make a final characterization determination, the containers will be labeled as such until analytical results are available. The wastes will be contained in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on the type of IDW and its classification. Container and storage requirements will be detailed in the WCSF and approved before the waste is generated.

Table B-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Estimated Volume	On-Site Management	Expected Disposition
Drill cuttings	LLW	80 yd^3	B-25 boxes	Disposal at TA-54 or off-site disposal facility
Spent PPE	LLW	1 x 55-gal.	Accumulation in 55-gal. drum	Disposal at TA-54 or off-site disposal facility
Disposable sampling supplies	LLW	1 x 55-gal.	Accumulation in 55-gal. drum	Disposal at TA-54 or off-site disposal facility
Decontamination fluids	LLW	<55-gal.*	Accumulation in 55-gal. drums	Treatment at the RLWTF at TA-50
Spent filters	LLW	<55-gal.	Accumulation in 55-gal. drums	Disposal at TA-54 or off-site disposal facility

* Dry decontamination methods will be used to the maximum extent possible, and only minimal amounts of decontamination fluids are expected to be generated.