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Investigation Work Plan for Technical Area 57 Aggregate Area (Fenton Hill)

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EXECUTIVE SUMMARY

The Technical Area 57 (TA-57) Aggregate Area includes TA-57 located on U.S. Forest Service property west of Los Alamos National Laboratory and consists of 10 areas of concern (AOCs). Of these sites, three were previously approved for no further action (NFA) by the U.S. Environmental Protection Agency. Five other sites were used to manage geothermal exploration wastes not subject to regulation under the Resource Conservation and Recovery Act (RCRA). These sites were approved for NFA by the New Mexico Oil Conservation Division. These eight sites are not discussed in this investigation work plan. The remaining two sites were used to manage RCRA-regulated waste, and this work plan describes the operational history, evaluates existing analytical data, and proposes additional sampling and analyses. Details of previous investigations and analytical results for these sites are provided in the historical investigation report for the TA-57 Aggregate Area. The sites consist of a waste storage drum and a leach field.

The objective of this work plan is to evaluate the historical data and, based on that evaluation, propose additional sampling as necessary to define the nature and extent of contamination associated with the AOCs within the TA-57 Aggregate Area and assess the potential human health and ecological risks associated with this contamination.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. 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 fingerlike 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 above mean sea level (amsl).

The Laboratory is participating in a national effort by DOE to clean up contaminated sites and facilities. The goal of the Laboratory's efforts is to ensure past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the Laboratory is currently investigating sites potentially contaminated by past Laboratory operations. These sites are designated as either solid waste management units or areas of concern (AOCs).

The Technical Area 57 (TA-57) Aggregate Area is located at Fenton Hill, which lies on the western side of the Jemez Mountains, approximately 12 mi west of the Laboratory, at an elevation of approximately 8700 ft amsl (Figure 1.0-1). TA-57 is located on property owned by the U.S. Forest Service and is used by DOE under an Interagency Agreement with the Forest Service. Laboratory operations have been conducted in the aggregate area since 1974.

The AOCs addressed in this investigation work plan are potentially contaminated with both hazardous and radioactive components. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 435.1, "Radioactive Waste Management," and DOE Order 458.1, Administrative Change 2, "Radiation Protection of the Public and the Environment." Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with DOE policy.

Corrective actions at the Laboratory are subject to a Compliance Order on Consent (the Consent Order). The TA-57 site, which is located in Sandoval County, is not part of the Laboratory facility, as defined in Sections II.A.2 and III.B of the Consent Order; therefore, releases from the TA-57 sites are not subject to the Consent Order. However, the Laboratory is voluntarily implementing the Consent Order corrective action process for those sites at TA-57 that managed Resource Conservation and Recovery Act–(RCRA-) regulated waste and that have not previously been approved for no further action (NFA) under other regulatory programs.

1.1 Investigation Work Plan Overview

The TA-57 Aggregate Area includes 10 AOCs, 8 of which have previously been approved for NFA. Three sites were approved for NFA by the U.S. Environmental Protection Agency (EPA). Five sites were used to manage geothermal exploration wastes not subject to regulation under RCRA. These sites were approved for NFA by the New Mexico Oil Conservation Division (NMOCD). The remaining two sites require additional characterization.

Historical details of previous investigations and data for the two sites under investigation are provided in the historical investigation report (HIR) for the TA-57 Aggregate Area (LANL 2012, 214549). This work plan proposes investigation activities for the two sites using information from previous field investigations to evaluate current conditions at each site.

Table 1.1-1 provides a summary of the 10 sites within the TA-57 Aggregate Area. For the eight sites approved for NFA, brief descriptions, and the references for the approval documents are provided in Table 1.1-1.

Section 2 of this work plan presents general site information, operational history, the conceptual site model, and a data overview. General site conditions are presented in section 3. Specific site descriptions and proposed investigation activities are presented in section 4. The investigation methods are described in section 5. Ongoing monitoring and sampling programs in the TA-57 Aggregate Area are discussed in section 6, and an anticipated schedule is presented in section 7. Section 8 lists the references cited in this work plan and the map data sources. Appendix A contains the list of acronyms and abbreviations used in this investigation work plan and a metric conversion table. Appendix B describes the management of investigation-derived waste (IDW).

1.2 Work Plan Objectives

The first objective of this work plan is to propose sampling and analyses that will define the nature and extent of contamination associated with the two sites within the TA-57 Aggregate Area that managed RCRA-regulated waste and that have not been approved for NFA. The second objective is to obtain data to support decisions regarding the need to remediate or remove contamination at these sites, where appropriate. To accomplish this objective, this work plan

- presents historical and background information on the sites;
- describes the rationale for proposed data collection activities; and
- identifies and proposes appropriate methods and protocols for collecting, analyzing, and evaluating data to finalize characterization at these sites.

As discussed in the individual sections for each site, the nature and extent of contamination are not currently defined for either of the sites under investigation. Additional investigation is required to define the nature and extent of contamination for each site and to allow potential human health and ecological risks to be evaluated. The proposed investigation is based on a biased sampling approach developed by using available information on site operational history and current site configurations.

2.0 BACKGROUND

2.1 General Site Information

The TA-57 Aggregate Area is on the western side of the Jemez Mountains, west of the Valles Caldera, on land owned by the U.S. Forest Service. The TA-57 location is northwest of the township of La Cueva, New Mexico, approximately 37 road miles west of the Laboratory (Figure 1.0-1). TA-57, also known as the Fenton Hill Site, occupies approximately 20 acres and is located on Lake Fork Mesa, which is bordered to the south by Lake Fork Canyon and to the north by Barley Canyon and Rio Cebolla. The Laboratory has conducted operations at TA-57 since 1974 under an Interagency Agreement with the U.S. Forest Service.

2.2 Operational History

TA-57 was established at the Fenton Hill site in 1974 to support the Laboratory's Hot Dry Rock (HDR) program. HDR was an experimental geothermal energy program designed to test the feasibility of extracting heat from deep geologic units near the Valles Caldera. The first location chosen for HDR was in Barley Canyon north of the current TA-57 site. After one test well had been drilled, this location was abandoned because of poor winter access and topographic limitations. Operations were moved to the current TA-57 location, which offered a large flat area with easier access. Operations at the TA-57 site began in 1974.

The HDR energy recovery concept was based on drilling two deep (i.e., 10,000 to 15,000 ft) wells into the low-permeability, hot crystalline rock beneath TA-57. Hydraulic fracturing was then used to create a permeable fractured zone between the two wells. During operation, pressurized water was injected into one well and extracted from the other after it flowed through the fractured zone and became heated. Heat exchangers on the surface were used to extract heat from the water, which was then reinjected.

The first geothermal well drilled at TA-57 was well GT-2, which was started in 1974 and completed in 1975. Upon completion of hydraulic fracturing of well GT-2, drilling began on well EE-1, which was to be the extraction well used with GT-2. After completion of fracturing and additional drilling, testing of the two-well system began in 1978. Work on a larger Phase II system began in 1979 with the drilling of well EE-2, the injection well for the Phase II system. Well EE-2 was completed in 1980, and drilling began on extraction well EE-3, which was completed in 1981. Testing of the Phase II system began in 1985 and continued until 1992, when operations were reduced substantially because of funding limitations.

When the extraction wells were drilled, drilling muds were discharged to mud pits and settling ponds near the drill sites. Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of geothermal energy are specifically excluded from management as hazardous wastes under RCRA (40 Code of Federal Regulations 261.4[b][5]). These waste management sites were regulated by NMOCD and were closed in accordance with NMOCD requirements (NMOCD 2003, 101265).

After the HDR project ended, the 5-million-gal. covered pond originally constructed for the HDR program was converted to a gamma-ray observatory for a project known as Milagro. To construct the observatory, liquid was removed from the pond, the interior of the pond was cleaned, over 700 photomultiplier tubes were placed in the pond, and the pond was refilled with treated water. This water was obtained from an on-site supply well and off-site sources and treated with ion-exchange, granular activated carbon, and ultraviolet light. The Milagro observatory began operating in 1996, and it was decommissioned in June 2008.

TA-57 is currently used to operate a fully automated observatory in support of the Thinking Telescopes project overseen by the Laboratory's International, Space, and Response Division. This project combines automated telescope observation, feature extraction from image data, change and anomaly detection, and automated response. An automated measurement program continuously scans the sky to detect optical transients.

2.3 Conceptual Site Model

The sampling and analyses proposed in this work plan are based on a conceptual site model that identifies likely areas of potential contamination. A conceptual site model describes potential contaminant sources, transport mechanisms, and receptors. The conceptual site model is applied to individual sites to select sampling locations most likely to define the nature and extent of contamination. Analytical results from the samples collected may lead to changes or refinement of the conceptual site model and to a need for additional characterization sampling in a later phase of the investigation.

2.3.1 Potential Contaminant Sources

Releases at TA-57 Aggregate Area sites may have occurred as a result of normal site operations or spills/leaks. Potential contaminant sources include a waste storage drum (AOC 57-006) and a leach field (AOC 57-007).

2.3.2 Potential Contaminant Transport Mechanisms

Current potential transport mechanisms that may lead to exposure include the following:

- dissolution and particulate transport of surface contaminants during precipitation and runoff events
- disturbance of contaminants in shallow soil and subsurface tuff
- infiltration and advective/dispersive transport of contaminants contained in subsurface soil and tuff
- disturbance and uptake of contaminants in shallow soil by plants and animals

2.3.2.1 Surface Processes

Laboratory operations, disturbance and uptake by plants and animals, and surface water runoff can mobilize contaminants present in shallow soil. During summer thunderstorms and spring snowmelt, runoff may flow down drainages from the TA-57 Aggregate Area site towards Lake Fork Canyon. Surface water runoff and erosion of contaminated surface soil could lead to contamination of the surface water off-site. Surface water may also access subsurface contaminants exposed by soil erosion. Soil erosion can vary significantly depending on factors that include soil properties, the amount of vegetative cover, the slope of the contaminated area, and the intensity and frequency of precipitation. Surface transport of contaminants represents the dominant transport pathway in the TA-57 Aggregate Area.

2.3.2.2 Subsurface Processes

The vadose zone underlying TA-57 consists of thin surficial soil deposits and underlying volcanic tuff. Flow and transport of moisture in the vadose zone will be mainly downward to the perched water at the base of the volcanic rocks (section 3.2.2.1). Infiltration is expected to occur only when the short-term infiltration rate exceeds the evapotranspiration rate, such as during summer thunderstorms and spring snowmelt. Because of low infiltration, groundwater transport of contaminants through the unsaturated zone to perched aquifers or the regional aquifer does not represent a significant pathway for contaminant transport in the TA-57 Aggregate Area.

2.3.3 Potential Receptors

Site workers are the primary potential human receptors for on-site contaminants. Access to TA-57 is restricted so members of the public are not and would not be potential receptors for on-site contaminants. Ecological receptors, such as plants and animals, may be exposed to contaminants from the sites.

2.3.4 Cleanup Standards

As specified in Section VIII.B.1 of the Consent Order, NMED soil screening levels (SSLs) (NMED 2009, 108070) will be used as soil cleanup levels for inorganic and organic chemicals unless they are determined to be impractical or unless values do not exist for the current and reasonably foreseeable future land use scenarios. In some cases where NMED SSLs do not exist, EPA regional screening values (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm) are used. The Laboratory screening action levels (SALs) (LANL 2009, 107655) will be used as soil cleanup levels for radionuclides.

2.4 Data Overview

Data evaluated in this report include historical data collected in 1994 as part of a RCRA facility investigation (RFI) and a voluntary corrective action (VCA). All data records include a vintage code field denoting how and where samples were submitted for analyses. Before 1995, the samples were submitted to the Laboratory's Chemical Science and Technology (CST) Division and either were analyzed at a CST laboratory (on-site) or were submitted to one of several off-site contract analytical laboratories. Samples analyzed at a CST laboratory are identified by the vintage code "CST Onsite." Two vintage codes identify samples CST Division submitted to off-site contract analytical laboratories—"CST Offsite" if validation was not performed and "CSTROUT03" if validation was performed.

From late 1995 to the present, samples have been submitted through the Sample Management Office (SMO) to off-site contract analytical laboratories. Two vintage codes identify samples the SMO submitted to off-site contract analytical laboratories—"AN95" if validation was not performed and "SMO" if validation was performed.

All the data collected during the 1994 RFI are screening-level data. These screening-level data are not presented in this work plan but are summarized in section 4. Screening-level data are used to identify areas of potential contamination and to guide sample collection and analyses proposed in this investigation work plan but will not be used in defining the nature and extent of contamination or in risk-screening evaluations.

3.0 SITE CONDITIONS

3.1 Surface Conditions

3.1.1 Topography

The TA-57 site is located on Lake Fork Mesa at an elevation of approximately 8700 ft amsl. The site is relatively flat and generally slopes to the south. The southern edge of the mesa is just south of the TA-57 boundary, and the topography to the south steepens toward Lake Fork Canyon.

3.1.2 Vegetation

Typical vegetation in the vicinity of TA-57 is mixed conifer forest with spruce, fir, and ponderosa pine. The TA-57 site and surrounding area were burned by wildfire in 1971, however, and most of the vegetation at the site was destroyed. Following the fire, the area was aerially reseeded with pasture grasses and legumes, and ponderosa pine seedlings were planted. Currently, the dominant trees at the site are aspen, ponderosa pine, Douglas fir, and white fir. Most of the area within the TA-57 fence is vegetated with grasses and brush.

3.1.3 Soil

No site-specific soil surveys have been performed at TA-57. Undisturbed soil at TA-57 is probably typical of the soil described by Nyhan and others (1978, 005702) for the plateau tops and edges in the Los Alamos area (LANL 1994, 034757, p. 3-17). The parent material is the Bandelier Tuff and the processes forming soil are expected to be very similar to the processes forming soils in the Los Alamos area. For most of TA-57, no undisturbed soil remains because of site development activities. Much of the TA-57 site has been filled and regraded. The depth to bedrock noted during previous investigations at TA-57 ranged from 3.5 ft to 16 ft.

A thin veneer of physically weathered bedrock colluvium is the only surficial material left in the few undisturbed areas of TA-57. The residual material is thicker on the top of the plateau and thins along the edges to bedrock outcrops on the steep portions of the canyon walls. Some fine-grained to coarser material was observed in the two small alluvial channels draining the site to the southeast and northwest; however, these channels have been considerably altered by activities related to site construction and operations.

3.1.4 Surface Water

The major surface water drainage near TA-57 is the Jemez River and its tributaries. The East Fork of the Jemez River drains the Valle Grande. Base flow is from discharge of groundwater to the stream from the near-surface water table in the Valle Grande and from the relatively large amount of precipitation that occurs in the high mountains around the Valles Caldera. San Antonio Creek drains the Valle Toledo to the north of the Valle Grande as well as an area along the west side of the Valles Caldera and is a tributary to the Jemez River at the confluence with the East Fork of the Jemez River. Several thermal springs discharge into the creek. Base flow in San Antonio Creek is from the discharge of groundwater from the near-surface water table in Valle Toledo and from precipitation. At the confluence of the East Fork of the Jemez River and San Antonio Creek, approximately 10 mi south of TA-57, the combined streams become the Jemez River.

The Rio Guadalupe drains the area west of TA-57 and includes the tributaries Rio de las Vacas and Rio Cebolla. The Rio de las Vacas drains an area west of the Valles Caldera. Base flow to the Rio Cebolla is from groundwater discharge from the shallow alluvial aquifers along numerous tributaries and from springs on the canyon wails.

The TA-57 site slopes gently south so the major part of the run-off is into Lake Fork Creek, a tributary to the Rio Cebolla below Fenton Lake. The land immediately northwest of TA-57 drains into an unnamed tributary, which joins the Rio Cebolla at Fenton Lake. The land immediately northeast of TA-57 drains toward San Antonio Creek but is diverted by a low divide into Lake Fork Creek.

3.1.5 Land Use

Currently, land use at TA-57 is industrial. The TA-57 site is fenced and locked and is accessible only to authorized workers. A portion of the area immediately adjacent to TA-57 is used by the U.S. Forest Service as a seasonal support area for firefighters. The remaining area around TA-57 is within the Santa Fe National Forest and used recreationally. Current land uses are not expected to change in the foreseeable future.

3.2 Subsurface Conditions

3.2.1 Stratigraphic Units

The stratigraphy of the bedrock beneath the TA-57 Aggregate Area is summarized in this section. The stratigraphy includes, in descending order, the Bandelier Tuff, the Paliza Canyon Formation, the Abiquiu Tuff, the Abo Formation, the Madera limestone, the Sandia Formation, and Precambrian granite (LANL 1994, 034757, pp. 3-12–3-14).

The Bandelier Tuff is a nonwelded to densely welded rhyolite tuff that ranges from light to dark gray. It is composed of quartz and sanadine crystals, lithic fragments of latite and rhyolite, and fragments of glass shards and rare mafic minerals in a fine-grained ash matrix. This tuff layer thins to the west and southwest away from its source at the Valles Caldera (Rea 1977, 005713; Kaufman and Siciliano 1979, 005941). The Bandelier Tuff is about 350 ft thick under the Fenton Hill site (Purtymun et al. 1974, 005483).

The Paliza Canyon Formation underlies the Bandelier Tuff and is composed of andesite and basaltic andesite breccias interbedded with sand and gravels. The Paliza Canyon Formation is about 50 ft thick under the site (Purtymun et al. 1974, 005483).

Under the Paliza Canyon is the Abiquiu Tuff, a light gray, friable tuffaceous sandstone. It is about 50 ft thick under the TA-57 site (Purtymun et al. 1974, 005483).

Beneath the Abiquiu Tuff are the Permian redbeds of the Abo Formation. The lithologies are typically arkosic siltstone, sandstone, and shale with small inclusions of calcareous gray clay. Particles include granules of quartz and feldspar and pieces of igneous rock. The thickness is highly variable because of erosion before Cenozoic volcanism (Rea 1977, 005713; Kaufman and Siciliano 1979, 005941).

Beneath the Abo Formation are Pennsylvanian limestones, shales, and arkoses of the Magdalena group. The group consists of Madera limestone over the Sandia Formation. The Madera limestone is an arkosic limestone containing both gray and red arkosic shale overlying a dark gray limestone with insets of gray shale and beds of sandstone. The Sandia Formation has an upper clastic member of sandstone, shale, and limestone. The lower part is a discontinuous dark gray siliceous limestone (Rea 1977, 005713; Kaufman and Siciliano 1979, 005941).

The basement rock beneath the Sandia Formation is a coarse Precambrian granite with large microcline crystals, quartz-feldspar lenticular gneiss, schists, amphibolites, and pegmatites. Veins include quartz and hornblendite. Minerals include quartz and microcline, oligoclase-andesine, hornblende, biotite, epidote, sphene, apatite, zircon, and magnetite (Rea 1977, 005713; Kaufman and Siciliano 1979, 005941).

3.2.2 Hydrogeology

3.2.2.1 Groundwater

Groundwater in the area of TA-57 occurs as (1) water in saturated alluvium, (2) perched aquifers, and (3) the regional aquifer.

Saturated Alluvium

Burns Swale, a dry tributary of Lake Fork Canyon at the south side of TA-57, has a 2.0- to 6.0-ft depth of alluvium in its upper reaches and more than a 40-ft depth of alluvium at the confluence with Lake Fork

Canyon. In May 1979, water was encountered in four holes bored in the alluvium. Later that year, these holes were dry (Kaufman and Siciliano 1979, 005941). After a release of water into Bums Swale in September 1979, the two holes closest to the site again contained water. Releases to Bums Swale were observed to infiltrate the alluvium and then either moved downstream along the interface of the alluvium and the Cenozoic volcanics or infiltrated into the volcanics.

Perched Aquifers

The water supply for TA-57 is furnished by a well completed in a perched aquifer at a depth of about 450 ft below ground surface (bgs). The aquifer is in the Abiquiu Tuff and is perched on the clays and siltstones of the Abo Formation. The aquifer is of limited extent, terminating to the east along the canyon cut by San Antonio Creek. Water movement in the aquifer is to the southwest, where a part is discharged through springs and seeps in the lower part of Lake Fork Canyon and along the Rio Cebolla.

Other perched aquifers were identified beneath the site as part of an evaluation of alternate water supplies. Four saturated zones were identified in the Abo Formation at depths of 780 to 800 ft, 970 to 995 ft, 1005 to 1015 ft, and 1100 to 1120 ft bgs. These zones were described as fine-grained sandstones underlain by shales. Six perched zones were also identified in the Madera limestone.

Regional Aquifer

The regional aquifer is at the base of the Madera formation. Many of the hot springs in the region appear at outcrops of this horizon. These are generally hot mineral springs. The regional aquifer is encountered at a depth of 1750 ft bgs below TA-57. All the aquifers above this depth are perched. Within the regional aquifer, a permeable horizon was found in the depth interval 1770 to 1800 ft bgs. It consisted of 30 ft of arkosic sandstone or granite wash. Geophysical log data indicate the zone is “only fair” as an aquifer (LANL 1994, 034757). Water in the granitic basement is primarily contained in fracture porosity.

3.2.2.2 Vadose Zone

The unsaturated zone from the mesa surface to the top of the regional aquifer is referred to as the vadose zone. The vadose zone underlying TA-57 is in thin surficial soil deposits and in the underlying volcanic tuff. Flow and transport in the vadose zone will be mainly downward to the perched water at the base of the volcanics. The source of moisture for the vadose zone is precipitation, but much of it runs off, evaporates, or is absorbed by plants. The subsurface vertical movement of water is influenced by properties and conditions of the materials that make up the vadose zone.

The Bandelier Tuff is generally dry and does not readily transmit moisture. Most of the pore spaces in the tuff are of capillary size and have a strong tendency to hold water against gravity by surface-tension forces. Vegetation is very effective at removing moisture near the surface. During the summer rainy season, when rainfall is highest, near-surface moisture content is variable because of higher rates of evaporation and transpiration by vegetation, which flourishes at this time.

The various units of the Bandelier Tuff tend to have relatively high porosities. Porosity ranges between 30% and 60% by volume, generally decreasing for more highly welded tuff. Permeability varies for each cooling unit of the Bandelier Tuff. The moisture content of tuff beneath the mesa tops is low, generally less than 5% by volume throughout the profile (Kearl et al. 1986, 015368; Purtymun and Stoker 1990, 007508).

4.0 PROPOSED INVESTIGATION ACTIVITIES

The TA-57 Aggregate Area contains 10 sites, 8 of which have been approved for NFA. These sites are identified in Table 1.1-1. The remaining two sites are described below.

4.1 AOC 57-006, Former Waste Storage Drum

AOC 57-006 is the former location of a plastic-lined 55-gal. drum that was buried in the ground at TA-57 beneath a trailer (structure 57-23) that served as an analytical chemistry laboratory (Figure 4.1-1). The chemistry trailer was used from about 1976 to 1989 to provide real-time analytical services for the geothermal project. A sink in the trailer was used to dispose of wastewater associated with chemical analyses. The sink drained to a leach field (AOC 57-007) near the trailer. Chemicals that could not be discharged to the leach field because of their toxicity were poured into a special drain connected to the polyethylene drum. When the drum was full, its contents were transported to the Laboratory for disposal. In 1994, the drum was removed as part of a VCA. The chemistry trailer was removed from the site in March 1994.

The site of the former waste drum is currently vegetated with grasses. The ground surface where the trailer was located is level, and then slopes to the southeast toward a drainage swale.

4.1.1 Summary of Previous Investigations for AOC 57-006

A VCA was conducted in 1994 to remove the waste collection drum (LANL 1995, 054336). The contents of the drum had previously been removed in January 1994 (LANL 1995, 054336, p. 1). Sampling of the contents indicated elevated levels of lead and mercury as well as various organic solvents, and the waste was classified as hazardous waste (LANL 1995, 054336, p. 1). During the VCA, the 55-gal. drum was removed. No evidence of leakage was observed during the removal. After the drum was removed, a sample was collected from the bottom of the excavation at a depth of 0.0 to 0.5 ft below the bottom of the excavation and submitted for laboratory analysis of target analyte list (TAL) metals, total cyanide, total uranium, and volatile organic compounds (VOCs).

4.1.2 Summary of Data for AOC 57-006

The data collected during the 1994 VCA do not meet current data validation standards and are not decision-level data. The results of the analyses of samples collected during the 1994 VCA are described in section 2.1.3 of the HIR (LANL 2012, 214549) and are summarized below.

- Lead and mercury were detected above background values (BVs).
- No VOCs were detected.

4.1.3 Proposed Scope of Activities for AOC 57-006

The results of the 1994 VCA, although screening-level data, indicated inorganic chemical concentrations above BVs beneath the former waste storage drum. Sampling will be performed within and around this area to determine the nature and extent of potential contamination. Screening-level data from the VCA did not indicate concentrations above SSLs so soil removal is not anticipated, although further characterization is needed to confirm this.

Samples will be collected at the previously sampled location of the former waste storage drum (location 6-1 in Figure 4.1-1) and at three step-out locations (locations 6-2 through 6-4 in Figure 4.1-1).

Samples will be collected 3.0 to 4.0 ft bgs (approximately 0.0 to 1.0 ft below the bottom of the former drum), 5.0 to 6.0 ft bgs, and 8.0 to 9.0 ft bgs at all locations.

Based on the history of operations at this site, all samples will be submitted for laboratory analysis of TAL metals, total cyanide, nitrate, perchlorate, VOCs, semivolatile organic compounds (SVOCs), and isotopic uranium. Table 4.1-1 summarizes the proposed sampling locations, depths, and analytical suites.

4.2 AOC 57-007, Leach Field

AOC 57-007 is a leach field at TA-57 that served a former trailer (structure 57-23) used as an analytical chemistry laboratory (Figure 4.1-1). The chemistry trailer was used from about 1976 to 1989 to provide real-time analytical services for the geothermal project. A sink in the trailer drained to the leach field and was used to dispose of wastewater associated with chemical analyses. Chemicals that could not be discharged to the leach field because of their toxicity were poured into a special drain connected to a polyethylene-lined 55-gal. drum (AOC 57-006). The chemistry trailer was removed from the site in March 1994.

The RFI Work Plan for Operable Unit 1154 (LANL 1994, 034757) described the leach field as located approximately 20 ft southeast of the trailer 8 to 10 ft bgs. During the 1994 Phase I RFI at this site, the leach field was discovered to be northeast of the trailer and at a depth of 1 to 2 ft bgs.

The site of the leach field is currently vegetated with grasses, shrubs, and small trees. The ground surface slopes to the southeast toward a drainage swale. An elevated electrical conduit rack runs across the site roughly parallel to the road.

4.2.1 Summary of Previous Investigations for AOC 57-007

The Laboratory conducted a Phase I RFI at AOC 57-007 in 1994 (LANL 1996, 053801). The drainline from the trailer to the leach field was found to be in place, uncovered, and used to locate the leach field. One sample was collected from the location where the drainline discharged to the leach field. The sample was collected from a depth 0.0 ft to 1.0 ft below the bottom of the drainline and was submitted for laboratory analysis of TAL metals, total cyanide, total uranium, and SVOCs.

4.2.2 Summary of Data for AOC 57-007

The data collected during the 1994 RFI do not meet current data validation standards and are not decision-level data. The results of the analyses of samples collected during the 1994 RFI are described in section 2.2.3 of the HIR (LANL 2012, 214549) and are summarized below.

- Mercury, uranium, and zinc were detected above soil BVs
- No SVOCs were detected.

4.2.3 Scope of Activities for AOC 57-007

The results of the 1994 VCA, although screening-level data, indicated inorganic chemical concentrations above BVs where the drainline entered the leach field. Sampling will be performed along the drainline, within and around the leach field, and downgradient of the leach field to determine the nature and extent of potential contamination. Screening-level data from the VCA did not indicate concentrations above SSLs so corrective actions are not anticipated, although further characterization is needed to confirm this.

Samples will be collected where the drainline exited the former trailer and at the previously sampled location where the drainline entered the leach field (locations 7-1 and 7-2 in Figure 4.1-1, respectively). Samples will also be collected from beneath the midpoint of the drainline (location 7-3 in Figure 4.1-1), two locations within the leach field (locations 7-4 and 7-5 in Figure 4.1-1), three step-out locations (7-6 through 7-8 in Figure 4.1-1), and three locations in the drainage downgradient of the leach field (locations 7-9 through 7-11 in Figure 4.1-1). Samples from locations 7-1 through 7-8 will be collected 0.0 to 1.0 below the drainline/leach field, 1.0 ft above tuff, and 2.0 to 3.0 ft into tuff. Samples from locations 7-9 through 7-11 will be collected at 0.0 to 1.0 ft bgs, 1.0 ft above top of tuff, and 2.0 to 3.0 ft into tuff.

All samples will be submitted for laboratory analysis of TAL metals, total cyanide, nitrate, perchlorate, VOCs, SVOCs, and isotopic uranium. Table 4.2-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

5.0 INVESTIGATION METHODS

A summary of investigation methods to be implemented is presented in Table 5.0-1. The standard operating procedures (SOPs) used to implement these methods are available at http://www.lanl.gov/environment/all/qa.shtml.

Summaries of the field-investigation methods are provided below. Additional procedures may be added as necessary to describe and document quality-affecting activities.

Chemical and radionuclide analyses will be performed in accordance with the current analytical statement of work (LANL 2008, 109962). Accredited contract analytical laboratories will use the most recent EPA- and industry-accepted extraction and analytical methods for analyses of the samples.

5.1 Geodetic Surveys

Geodetic surveys will be conducted by a land surveyor in accordance with the latest version of procedure SOP-5028, Coordinating and Evaluating Geodetic Surveys, to locate historical structures and to document field activities such as sampling and excavation locations. The surveyors will use a Trimble 5700 global positioning system (GPS) or equivalent for the surveys. The coordinate values will be expressed in the New Mexico State Plane Coordinate System (transverse mercator), Central Zone, North American Datum 1983. Elevations will be reported per the National Geodetic Vertical Datum of 1929. All GPS equipment used will meet the accuracy requirements specified in SOP-5028.

5.2 Field Screening

As sampling is primarily being conducted to finalize nature and extent based on previous investigations, field screening will be conducted mainly for health and safety purposes rather than to direct sampling. However, if elevated field-screening levels are observed in the deepest interval at a specific sampling location, sample collection will continue until field-screening results show no elevated readings. The Laboratory’s proposed field-screening approach will be to (1) visually examine all samples for evidence of contamination, (2) screen for organic vapors, and (3) screen for radioactivity.

5.2.1 Organic Vapors

Based on site history and the previous RFI and VCA results, VOC contamination is not expected to be encountered, and organic vapor screening will be conducted primarily for health and safety purposes.

Screening will be conducted using a photoionization detector (PID) capable of measuring quantities as low as 1 ppm. Vapor screening of soil, sediment, and subsurface core will be conducted using a PID equipped with an 11.7 electron volt lamp. All samples will be screened in accordance with SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector.

The PID will be calibrated daily to the manufacturer's standard for instrument operation, and the daily calibration results will be documented in the field logbooks. All instrument background checks, background ranges, and calibration procedures will be documented daily in the field logbooks in accordance with SOP-5181, Notebook Documentation for Waste and Environmental Services Technical Field Activities.

5.2.2 Radioactivity

Field screening for radioactivity will be conducted primarily for health and safety purposes. Radiological screening will target gross-alpha, -beta, and -gamma radiation. Field screening for alpha, beta, and gamma radiation will be conducted within 6 in. from the core material and will be performed using appropriate field instruments calibrated in accordance with the Laboratory's Health Physics Operations Group procedures. All instrument calibration activities will be documented daily in the field logbooks in accordance with SOP-5181, Notebook Documentation for Waste and Environmental Services Technical Field Activities.

5.3 Sample Collection

5.3.1 Surface Samples

Samples will be placed in appropriate containers in accordance with SOP-5056, Sample Container and Preservation. Quality assurance/quality control (QA/QC) samples will include field duplicate samples, equipment blanks, and trip blanks. These samples will be collected following the current version of SOP-5059, Field Quality Control Samples, and will comply with a frequency of 10% of total samples collected for field duplicates and rinsate blanks. Trip blanks will be supplied by the SMO and will remain with the analytical samples when they are collected for VOC analysis. QA/QC samples are used to monitor the validity of the sample collection procedures.

Surface and shallow subsurface soil samples will be collected in accordance with SOP-06.09, Spade and Scoop Method for the Collection of Soil Samples. Stainless-steel shovels, spades, scoops, and bowls will be used for ease of decontamination. If the surface location is at bedrock, an axe or hammer and chisel will be used to collect samples. Samples collected for analyses will be placed in the appropriate sample containers, depending upon the requirement of the analytical method. The sample for VOC analysis is transferred immediately from the sampler to the sample container to minimize the loss of VOCs during the sample collection process. Containers for VOC samples are filled as completely as possible, leaving no or minimal headspace, and sealed with a Teflon-lined cap. The remaining sample material is typically placed in a clean stainless-steel bowl for transfer into various sample containers.

5.3.2 Subsurface Samples

Subsurface samples will be collected using hand- or hollow-stem auger methods, depending on the depth of the samples and the material being sampled. A brief description of these methods is provided below. The fill at some of the locations being sampled may contain boulders. If boreholes cannot be advanced to the target depth because of refusal due to boulders, the sampling location may be moved.

5.3.2.1 Hand Auger

Hand-auger samples will be collected in accordance with SOP-06.10, Hand Auger and Thin-Wall Tube Sampler. Hand augers may be used to bore shallow holes (e.g., 0.0 to 10.0 ft). The hand auger is advanced by turning or pounding the auger into the soil until the barrel is filled. The auger is removed to collect the sample The sample for VOC analysis is transferred immediately from the sampler to the sample container to minimize the loss of VOCs during the sample collection process. Containers for VOC samples are filled as completely as possible, leaving no or minimal headspace, and sealed with a Teflon-lined cap. The remaining sample material is typically placed in a clean stainless-steel bowl for transfer into various sample containers.

5.3.2.2 Hollow-Stem Auger

Hollow-stem augers will be used to collect subsurface samples where hand-augering is impractical because of the depth or the material being sampled. The hollow-stem auger consists of a hollow-steel shaft with a continuous spiraled steel flight welded onto the exterior of the stem. The stem is connected to an auger bit; when the auger is rotated, it transports cuttings to the surface. The hollow stem of the auger allows insertion of drill rods, split-spoon core barrels, Shelby tubes, and other samplers through the center of the auger so samples may be retrieved during drilling operations.

During sampling, the auger will be advanced to just above the desired sampling interval. The sample will then be collected by driving a split-spoon sampler into undisturbed soil-tuff to the desired depth in accordance with SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials. Immediately after sampling, the boreholes will be abandoned as described below using bentonite chips or a bentonite/concrete mixture. All borehole cuttings will be managed as IDW, as described in Appendix B of this work plan. All borehole abandonment information will be provided in the TA-57 Aggregate Area investigation report.

If samples are collected for VOC analysis, the sampler will be lined with brass sleeves. Immediately upon retrieval of the sampler, it will be opened and a sleeve from the desired depth interval will be collected for VOC analysis. The ends of the sleeve will be covered immediately with Teflon film and capped with plastic caps. Tape will then be used to seal the ends of the cap to the sleeve. Material from the remaining sleeves will be field screened, visually inspected, and placed in a stainless-steel bowl. Samples for the remaining analysis will be transferred to appropriate sample containers, depending upon the analytical method requirement.

Field documentation will include detailed borehole logs for each borehole drilled using the hollow-stem auger method. The borehole logs will document the matrix material in detail and will include the results of all field screening; fractures and matrix samples will be assigned unique identifiers. All field documentation will be completed in accordance with the current version of SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials.

Borehole Abandonment

All hollow-stem auger boreholes will be properly abandoned in accordance with SOP-5034, Monitor Well and RFI Borehole Abandonment, by one of the following methods.

- Shallow boreholes, with a total depth of 20 ft or less, will be abandoned by filling the borehole with bentonite chips and then hydrating the chips in 1.0- to 2.0-ft lifts. The borehole will be visually inspected while the bentonite chips are being added to ensure bridging does not occur.

- Boreholes greater than 20 ft in depth will be pressure-grouted from the bottom of the borehole to the surface using the tremie pipe method. Acceptable grout materials include cement or bentonite grout, neat cement, or concrete.

The use of backfill materials such as bentonite and grout will be documented in a field logbook with respect to volumes (calculated and actual), intervals of placement, and additives used to enhance backfilling. All borehole abandonment information will be presented in the investigation report.

5.3.3 Sediment Samples

Sediment samples in drainages will be collected using SOP-06.09, Spade and Scoop Method for Collection of Soil Samples. Samples will be collected in the same manner described in section 5.3.1 for shallow soil samples. Sediment samples will be collected from areas of sediment accumulation that include sediment judged to be representative of the historical period of Laboratory operations. The locations will be selected based on geomorphic relationships in areas likely to have been affected by discharges from Laboratory operations. Preliminary sediment sampling locations have been selected and are shown in Figure 4.4-1. As sediment systems are dynamic and subject to redistribution by runoff events, however, some locations may need to be adjusted at the time this work plan is implemented. In the course of collecting sediment samples, it may be determined that the selected location is not appropriate because of conditions observed during sampling (e.g., the sediment is much shallower than anticipated, the sediment is predominantly coarse-grained, or the sediment shows evidence of being older than the target age). Sediment sampling locations may be adjusted as appropriate. Any changes to sediment sampling locations will be documented as deviations from this work plan in the investigation report.

5.4 Laboratory Methods

All analytical suites are presented in the statement of work for analytical laboratories (LANL 2008, 109962). The specific analytical methods to be used are specified in Table 5.4-1. Sample collection and analysis will be coordinated with the Laboratory’s SMO.

5.5 Health and Safety

The field investigations described in this investigation work plan will comply with all applicable requirements pertaining to worker health and safety. An integrated work document and a site-specific health and safety plan will be in place before fieldwork is performed.

5.6 Equipment Decontamination

Equipment for drilling and sampling will be decontaminated before and after drilling and sampling activities (as well as between drilling boreholes) to minimize the potential for cross-contamination. Dry decontamination methods are preferred and will be given priority because they do not generate liquid wastes. Residual material adhering to the equipment will be removed using dry decontamination methods, including wire-brushing and scraping, as described in SOP-5061, Field Decontamination of Equipment. Dry decontamination of sampling equipment may include use of a nonphosphate detergent such as Fantastik on a paper towel, and the equipment is wiped so no liquid waste is generated.

If dry decontamination methods are not effective, the equipment may be decontaminated by steam-cleaning or hot water pressure-washing, as described in SOP-5061. Wet decontamination methods will be conducted on a high-density polyethylene liner on a temporary decontamination pad. 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.

5.7 IDW

The IDW generated during field-investigation activities may include, but is not limited to, drill cuttings; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from the decontamination of PPE and sampling equipment; and all other waste that has potentially come into contact with contaminants.

All IDW generated during field-investigation activities will be managed in accordance with applicable SOPs that incorporate the requirements of all applicable EPA and NMED regulations, DOE orders, and Laboratory implementation requirements. Appendix B presents the IDW management plan.

6.0 MONITORING PROGRAMS

No monitoring is currently being performed within the TA-57 Aggregate Area.

7.0 SCHEDULE

Preparation for fieldwork will not proceed until the work plan is approved. The period during which fieldwork can be performed at TA-57 is limited because of the heavy snowfall that typically occurs at the site during the winter and spring. It is assumed that fieldwork will be performed during the summer and fall of 2013. The expected duration of field activities is 3 mo. The investigation report for TA-57 Aggregate Area will be submitted within 6 mo after field activities are completed. Therefore, a submittal date of no later than April 30, 2014, is proposed for the investigation report.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs 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 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.

EPA (U.S. Environmental Protection Agency), January 21, 2005. "EPA's Prior Decisions on SWMU/AOC Sites at Los Alamos National Laboratory (LANL)," U.S. Environmental Protection Agency letter to J. Bearzi (NMED-HRMB) from L.F. King (EPA Federal Facilities Section Chief), Dallas, Texas. (EPA 2005, 088464)

Kaufman, E.L., and C.L.B. Siciliano (Comp. and Ed.), May 1979. “Environmental Analysis of the Fenton Hill Hot Dry Rock Geothermal Test Site,” Los Alamos National Laboratory report LA-7830-HDR, Los Alamos, New Mexico. (Kaufman and Siciliano 1979, 005941)

Kearl, P.M., J.J. Dexter, and M. Kautsky, December 1986. “Vadose Zone Characterization of Technical Area 54, Waste Disposal Areas G and L, Los Alamos National Laboratory, New Mexico, Report 4: Preliminary Assessment of the Hydrologic System through Fiscal Year 1986,” UNC Technical Services report GJ-54, Grand Junction, Colorado. (Kearl et al. 1986, 015368)

LANL (Los Alamos National Laboratory), May 1994. “RFI Work Plan for Operable Unit 1154,” Los Alamos National Laboratory document LA-UR-94-1096, Los Alamos, New Mexico. (LANL 1994, 034757)

LANL (Los Alamos National Laboratory), September 1995. “Voluntary Corrective Action Completion Report for Potential Release Site 57-006, A Buried Chemical Waste Vessel, Revision 1,” Los Alamos National Laboratory document LA-UR-96-465, Los Alamos, New Mexico. (LANL 1995, 054336)

LANL (Los Alamos National Laboratory), April 1996. “RFI Report for Potential Release Sites at TA-57, 57-001(b), 57-001(c), 57-002, 57-004(a), 57-006, 57-007 (located in former Operable Unit 1154),” Los Alamos National Laboratory document LA-UR-96-1062, Los Alamos, New Mexico. (LANL 1996, 053801)

LANL (Los Alamos National Laboratory), June 30, 2008. “Exhibit 'D' Scope of Work and Technical Specifications, Analytical Laboratory Services for General Inorganic, Organic, Radiochemical, Asbestos, Low-Level Tritium, Particle Analysis, Bioassay, Dissolved Organic Carbon Fractionation, and PCB Congeners,” Los Alamos National Laboratory document RFP No. 63639-RFP-08, Los Alamos, New Mexico. (LANL 2008, 109962)

LANL (Los Alamos National Laboratory), December 2009. “Radionuclide Screening Action Levels (SALs) from RESRAD, Version 6.5,” Los Alamos National Laboratory document LA-UR-09-8111, Los Alamos, New Mexico. (LANL 2009, 107655)

LANL (Los Alamos National Laboratory), April 2012. “Historical Investigation Report for Technical Area 57 Aggregate Area (Fenton Hill),” Los Alamos National Laboratory document LA-UR-12-20544, Los Alamos, New Mexico. (LANL 2012, 214549)

NMED (New Mexico Environment Department), December 2009. “Technical Background Document for Development of Soil Screening Levels, Revision 5.0,” with revised Table A-1, New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2009, 108070)

NMOCD (New Mexico Oil Conservation Division), August 29, 2003. “Termination of Discharge Plan Gw-031, Fenton Hill Geothermal Facility,” New Mexico Oil Conservation Division letter to B. Beers (LANL) from W. Price (NMOCD), Santa Fe, New Mexico. (NMOCD 2003, 101265)

Nyhan, J.W., L.W. Hacker, T.E. Calhoun, and D.L. Young, June 1978. “Soil Survey of Los Alamos County, New Mexico,” Los Alamos Scientific Laboratory report LA-6779-MS, Los Alamos, New Mexico. (Nyhan et al. 1978, 005702)

Purtymun, W.D., and A.K. Stoker, September 1990. "Perched Zone Monitoring Well Installation," Los Alamos National Laboratory document LA-UR-90-3230, Los Alamos, New Mexico. (Purtymun and Stoker 1990, 007508)

Purtymun, W.D., F.G. West, and R.A. Pettitt, November 1974. "Geology of Geothermal Test Hole GT-2, Fenton Hill Site, July 1974," Los Alamos Scientific Laboratory report LA-5780-MS, Los Alamos, New Mexico. (Purtymun et al. 1974, 005483)

Rea, K.H., December 1977. "Environmental Investigations Associated with the LASL Hot Dry Rock Geothermal Energy Development Project," Los Alamos Scientific Laboratory report LA-6972, Los Alamos, New Mexico. (Rea 1977, 005713)

8.2 Map Data Sources

Data sources used in original figures created for this report are described below and identified by legend title.

Legend Item	Data Source
LANL technical areas	Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 04 December 2008.
Unpaved roads	Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL structures	Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL electric lines	Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL sewer lines	Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
LANL AOC boundaries	Areas of Concern; Los Alamos National Laboratory, Waste and Environmental Services Division, Environmental Data and Analysis Group, EP2009-0137; 1:2,500 Scale Data; 25 January 2010.
Contours	Hypsography, 2, 10, 20, and 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

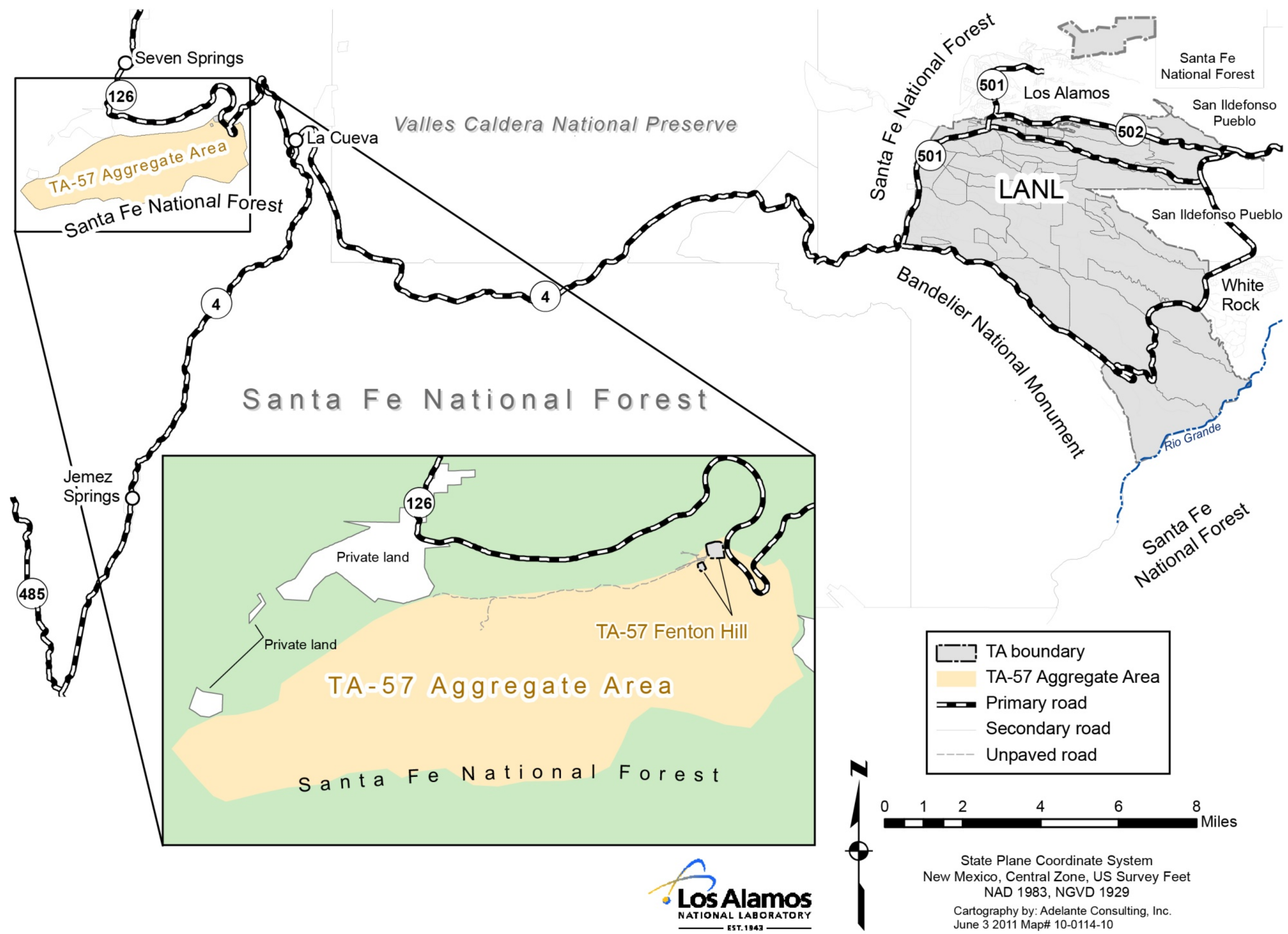

Figure 1.0-1 Location of TA-57 Aggregate Area

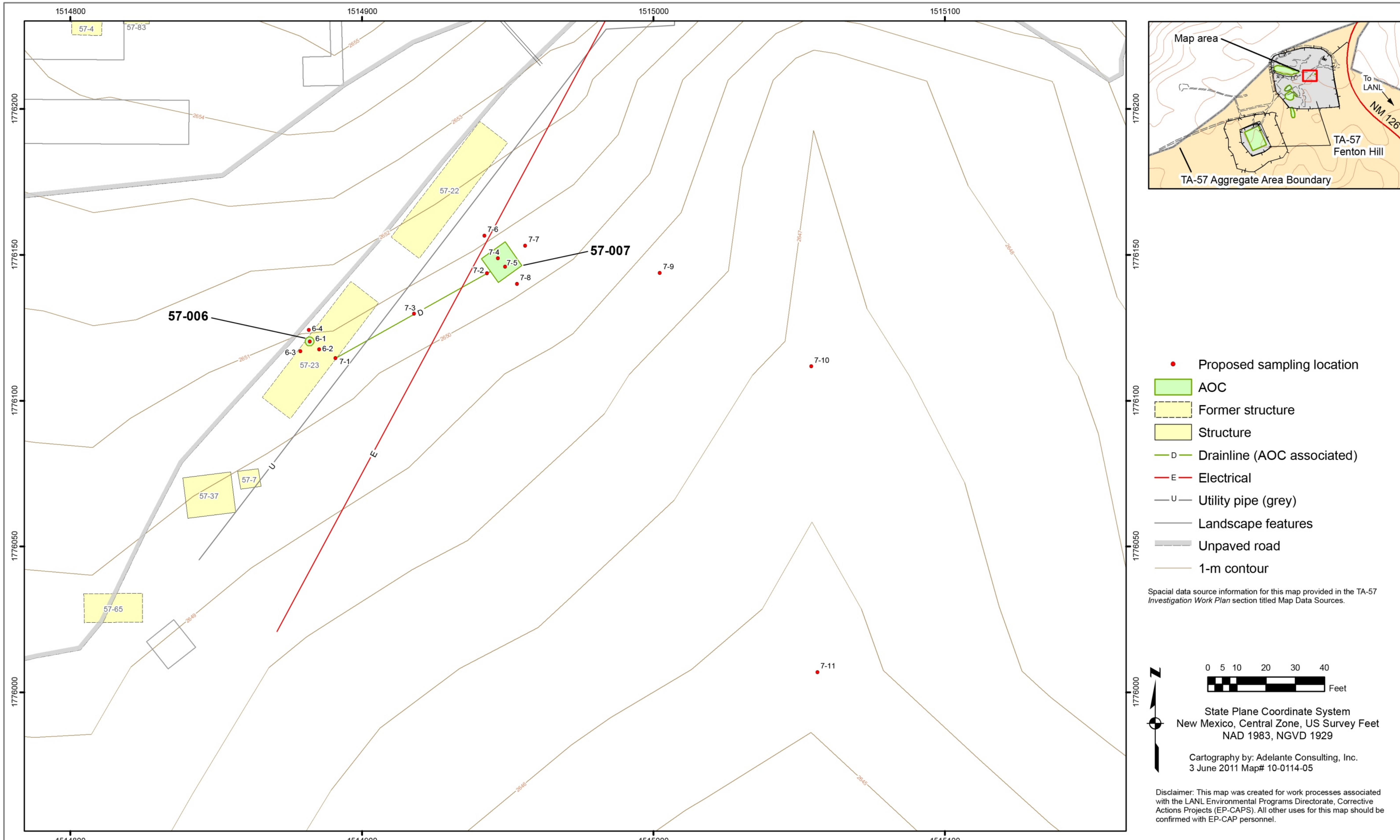

Figure 4.1-1 Proposed sampling locations for AOCs 57-006 and 57-007

Table 1.1-1
Status of AOCs in the TA-57 Aggregate Area

Site ID	Brief Description	Site Status	Reference
AOC 57-001(a)	Drilling mud pits	NFA approved 01/21/05	EPA 2005, 088464
AOC 57-001(b)	Former settling ponds	NFA approved 08/13/03	NMOCD 2003, 101265
AOC 57-001(c)	Former settling pond	NFA approved 08/13/03	NMOCD 2003, 101265
AOC 57-002	Disposal pit	NFA approved 08/13/03	NMOCD 2003, 101265
AOC 57-003	Container storage facility	NFA approved, 01/21/05	EPA 2005, 088464
AOC 57-004(a)	Former settling ponds	NFA approved 08/13/03	NMOCD 2003, 101265
AOC 57-004(b)	Storage pond	NFA approved 08/13/03	NMOCD 2003, 101265
AOC 57-005	Pond filtration unit	NFA approved, 01/21/05	EPA 2005, 088464
AOC 57-006	Former waste storage drum	Under investigation	Section 4.1
AOC 57-007	Leach field	Under investigation	Section 4.2

Note: Shading denotes NFA approved.

Table 4.1-1
Proposed Samples and Analyses for AOC 57-006

Sampling Justification	Number of Locations and Samples	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	Isotopic Uranium (HASL-300)
Sample location of former waste drum to define vertical extent	One location (6-1), three samples	3–4 ft, 5–6 ft, and 8–9 ft bgs	Soil, tuff	X*	X	X	X	X	X	X
Sample stepout locations around former drum to define lateral extent	Three locations (6-2–6-4), nine samples	3–4 ft, 5–6 ft, and 8–9 ft bgs	Soil, tuff	X	X	X	X	X	X	X

*X = Analysis proposed.

Table 4.2-1
Proposed Samples and Analyses for AOC 57-007

Sampling Justification	Number of Locations and Samples	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	Isotopic Uranium (HASL-300)
Sample along drainline to define vertical extent	Three locations (7-1–7-3), six samples	0–1 ft below drainline, 1 ft above tuff, 2–3 ft into tuff	Soil, tuff	X[a]	X	X	X	X	X	X
Sample within leach field to define vertical extent	Two locations (7-4–7-5), six samples	0–1 ft below leach field, 1 ft above tuff, 2–3 ft into tuff	Soil, tuff	X	X	X	X	X	X	X
Sample stepout locations around leach field to define lateral extent	Three locations (7-6–7-8), nine samples	0–1 ft below leach field, 1 ft above tuff, 2–3 ft into tuff	Soil, tuff	X	X	X	X	X	X	X
Sample in drainage below site to define lateral extent	Three locations (7-9–7-11), nine samples	0–1 ft bgs, 1 ft above tuff, 2–3 ft into tuff	Soil, sediment, tuff	X	X	X	X	X[b]	X	X

[a] X = Analysis proposed.
[b] Subsurface samples only.

Table 5.0-1
Summary of Investigation Methods

Method	Summary
Spade-and-Scoop Collection of Soil Samples	This method is typically used to collect shallow (e.g., approximately 0–12 in.) soil or sediment samples. The spade-and-scoop method involves digging a hole to the desired depth, as prescribed in the sampling and analysis plan, and collecting a discrete grab sample. The sample is typically placed in a clean stainless-steel bowl for transfer into various sample containers.
Hand-Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but in some cases may be used for collecting samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in. inside diameter), creating a vertical hole that can be advanced to the desired sampling depth. When the desired depth is reached, the auger is decontaminated before the hole is advanced to the sampling depth. The sample material is transferred from the auger bucket to a stainless-steel sampling bowl before the various required sample containers are filled. Carbon-steel auger buckets may be used, particularly in cases where chromium and nickel are the primary constituents of interest and cross-contamination from stainless-steel equipment is a concern.
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing and ensure the sample containers and the containers used for transport 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 the samples either to the SMO or to an SMO-approved radiation screening laboratory under chain-of-custody (COC). The SMO arranges to ship samples to the analytical laboratories. The field team member must inform the SMO and/or the radiation screening laboratory coordinator when levels of radioactivity are in the action-level or limited-quantity ranges.
Sample Control and Field Documentation	The collection, screening, and transport of samples are documented on standard forms generated by the SMO. These include sample container labels and combined sample collection log/COC forms. Sample collection portions of the combined forms are completed at the time of sample collection and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. The COC portions of the combined forms are completed and signed to verify the samples are not left unattended. 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 the samples are not left unattended. Site attributes (e.g., former and proposed soil sampling locations, sediment sampling locations) are located by using a GPS. Horizontal locations will be measured to the nearest 0.5 ft. The survey results for this field event are included in the investigation report. Sample coordinates are uploaded into the Sample Management Database.
Field QC Samples	Field QC samples are collected as follows. *Field duplicate*: At a frequency of 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 are containers of certified clean sand that are opened and kept with the other sample containers during the sampling process.

Table 5.0-1 (continued)

Method	Summary
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination is the preferred method to minimize generating liquid waste. Dry decontamination may include using a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by using 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.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and QA. Specific requirements for each sample are printed on the sample collection logs provided by the SMO (size and type of container [glass, amber glass, polyethylene, preservative, etc.]). All samples are preserved by placing them in insulated containers with ice to maintain a temperature of 4°C. Other requirements such as nitric acid or other preservatives may apply to different media or analytical requests.
Management, Characterization, and Storage of IDW	IDW is 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 complies with on-site or off-site waste acceptance criteria. All stored IDW will be marked with appropriate signage and labels, as appropriate. Drummed IDW will be stored on pallets to prevent the containers from deterioration. Generators are required to reduce the volume of waste generated as much as technically and economically feasible. Means to store, control, and transport each potential waste type and classification shall be determined before field operations that generate waste begin. A waste storage area will be established before waste is generated. Waste storage areas located in controlled areas of the Laboratory will be controlled as needed to prevent inadvertent addition or management of wastes by unauthorized personnel. Each container of waste generated will be individually labeled as to waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste shall be segregated by classification and compatibility to prevent cross-contamination. Appendix B describes the management of IDW.
Geodetic Surveys	This method describes the procedure for coordinating and evaluating geodetic surveys and establishing QA/QC for geodetic survey data. The procedure covers evaluating geodetic survey requirements, preparing to perform a geodetic survey, performing geodetic survey field activities, preparing geodetic survey data for QA review, performing QA review of geodetic survey data, and submitting geodetic survey data.
Hollow-Stem Auger Drilling Methods	In this method, hollow-stem augers (sections of seamless pipe with auger flights welded to the pipe) act as a screw conveyor to bring cuttings of sediment, soil, and/or rock to the surface. Auger sections are typically 5 ft in length and have outside diameters of 4.25 to 14 in. Drill rods, split-spoon core barrels, Shelby tubes, and other samplers can pass through the center of the hollow-stem auger sections to collect discrete samples from desired depths. Hollow-stem augers are used as temporary casings when setting wells to prevent cave-ins of the borehole walls.

Table 5.4-1
Summary of Analytical Methods

Analyte	Analytical Method
TAL metals	SW-846:6010B; SW-846:6020; SW-846:7471A (mercury)
Total cyanide	EPA SW-846:9012A
Perchlorate	SW-846:6850
Nitrate	EPA 300
SVOCs	SW-846:8270C
VOCs	SW-846:8260B
Isotopic uranium	HASL-300:ISOU

Appendix A

Acronyms and Abbreviations and Metric Conversion Table

A-1.0 ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
amsl	above mean sea level
AOC	area of concern
bgs	below ground surface
BV	background value
COC	chain of custody
Consent Order	Compliance Order on Consent
CST	Chemical Science and Technology (a Laboratory division)
DOE	Department of Energy (U.S.)
EPA	Environmental Protection Agency (U.S.)
GPS	global positioning system
HDR	Hot Dry Rock
HIR	historical investigation report
IDW	investigation-derived waste
LANL	Los Alamos National Laboratory
LLW	low-level waste
MLLW	mixed low-level waste
NFA	no further action
NMED	New Mexico Environment Department
NMOCD	New Mexico Oil Conservation Division
PID	photoionization detector
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RPF	Records Processing Facility
SAL	screening action level
SMO	Sample Management Office
SOP	standard operating procedure
SSL	soil screening level
SVOC	semivolatile organic compound
TA	technical area

TAL	target analyte list
TCLP	toxicity characteristic leaching procedure
VCA	voluntary corrective action
VOC	volatile organic compound
WAC	waste acceptance criteria
WCSF	waste characterization strategy form

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. 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)

Appendix B

Management Plan for Investigation-Derived Waste

B-1.0 INTRODUCTION

This appendix describes how investigation-derived waste (IDW) generated during the Technical Area 57 (TA-57) Aggregate Area investigation will be managed by Los Alamos National Laboratory (the Laboratory). IDW may include, but is not limited to, drill cuttings, contact waste, decontamination fluids, and all other waste that has potentially come into contact with contamination.

B-2.0 IDW

All IDW generated during investigation activities will be managed in accordance with the current version of Standard Operating Procedure (SOP) 5238, Characterization and Management of Environmental Program Waste. This SOP incorporates the requirements of applicable U.S. Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) regulations, U.S. Department of Energy (DOE) orders, and Laboratory requirements.

The most recent version of the Laboratory's Hazardous Waste Minimization Report will be implemented during the investigation to minimize waste generation. The Hazardous Waste Minimization Report is updated annually as a requirement of section 2.9 of the Laboratory's Hazardous Waste Facility Permit.

A waste characterization strategy form (WCSF) will be prepared and approved per requirements of SOP-5238, Characterization and Management of Environmental Program Waste. The WCSF will provide detailed information on IDW characterization methods, management, containerization, and potential volumes. IDW characterization is completed through review of investigation data and/or documentation or by direct sampling. Waste characterization may include a review of historical information and process knowledge to identify whether listed hazardous waste may be present (i.e., due diligence reviews). If low levels of listed hazardous waste are identified, a "contained in" determination may be submitted to NMED for approval.

Wastes will be containerized and placed in clearly marked and appropriately constructed waste accumulation areas. The initial management of the waste will rely on the data from previous investigations and/or process knowledge. If new analytical data changes the expected waste category, the waste will be managed in accumulation areas appropriate to the final waste determination. 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-2.0-1 summarizes how waste is expected to be managed. The waste streams anticipated to be generated during work plan implementation are described below.

B-2.1 Drill Cuttings

This waste stream consists of soil and rock chips generated by the drilling of boreholes with the intent to sample. Drill cuttings include excess core sample not submitted for analysis and any returned samples sent for analysis. Drill cuttings will be containerized in 20 yd^3 rolloff containers, 55-gal. drums, B-12 containers, or other appropriate containers at the point of generation.

This waste stream will be characterized based either on direct sampling of the waste or on the results from core samples collected during drilling. If directly sampled, the following analyses will be performed: volatile organic compounds (VOCs); semivolatile organic compounds (SVOCs); total cyanide, nitrate, perchlorate, isotopic uranium, total metals; and, if needed, toxicity characteristic leaching procedure

(TCLP) metals. If process knowledge, odors, or staining indicates the cuttings may be contaminated with petroleum products, the materials will also be analyzed for total petroleum hydrocarbons and polychlorinated biphenyls. Other constituents may be analyzed as necessary to meet the waste acceptance criteria (WAC) for a receiving facility. The Laboratory expects most cuttings will be disposed of as nonhazardous industrial waste; however, the waste may also be classified as hazardous, low-level waste (LLW), or mixed low-level waste (MLLW). All wastes will be treated/disposed of at an authorized off-site facility appropriate for the waste classification.

B-2.2 Contact Waste

The contact waste stream consists of potentially contaminated materials that “contacted” waste during sampling and excavation. This waste stream consists primarily of, but is not limited, to personal protective equipment such as gloves; decontamination wastes such as paper wipes; and disposable sampling supplies. Characterization of this waste stream will use acceptable knowledge (AK) of the waste materials; the methods of generation, the extent of contamination, and analysis of the material contacted (e.g., drill cuttings and soil). The waste will be containerized (e.g., in 55-gal. drums) and managed in accordance with applicable Laboratory waste management requirements based on the waste characterization results. The Laboratory expects most of the contact waste to be designated nonhazardous industrial waste; however, the waste may also be classified as hazardous, LLW, or MLLW. All wastes will be treated/disposed of at an authorized off-site facility appropriate for the waste classification.

B-2.3 Decontamination Fluids

This waste stream will consist of liquid wastes from decontamination activities if dry decontamination cannot be performed. Consistent with waste minimization practices, the Laboratory uses dry equipment 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. The fluids from decontaminating drilling or sampling equipment will be characterized through AK of the waste materials, the levels of contamination measured in the environmental media (e.g., the results of the associated drill cuttings), and, if necessary, direct sampling of the containerized waste. If directly sampled, the following analyses will be performed: VOCs, SVOCs, isotopic uranium, total metals, and, if needed, TCLP metals and other analytes required by the receiving facility (i.e., total suspended solids, MICROTOX, chemical oxygen demand, oil and grease, pH, nitrates). The Laboratory expects any decontamination liquid waste to be nonhazardous liquid waste that will be sent to an authorized off-site facility where the WAC allows the waste to be received.

Table B-2.0-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Expected Disposition
Drill Cuttings	Industrial Hazardous LLW MLLW	Disposal at an approved off-site facility
Contact Waste	Industrial Hazardous LLW MLLW	Disposal at an approved off-site facility
Decontamination Fluids	Industrial	Treatment at an authorized off-site facility