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Investigation Work Plan for Threemile Canyon Aggregate Area, Revision 1

Los Alamos
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EXECUTIVE SUMMARY

The Threemile Canyon Aggregate Area consists of sites within Technical Area 14 (TA-14), TA-15, TA-18, TA-36, and TA-67 at Los Alamos National Laboratory. This aggregate area also includes sites associated with former TA-12 that lie within the boundaries of TA-15 and TA-67. The Threemile Canyon Aggregate Area includes 40 sites, 10 of which have been previously investigated and/or remediated and have been approved for no further action. Four of the 40 sites have been deferred per Table IV-2 of the March 1, 2005, Compliance Order on Consent, and the remaining 26 sites are under investigation.

The objective of this work plan is to propose additional sampling as necessary to define the nature and extent of contamination associated with the remaining 26 solid waste management units and areas of concern within the Threemile Canyon Aggregate Area. Details of previous investigations and analytical results for the 26 sites included in this work plan are provided in the historical investigation report for Threemile Canyon Aggregate Area and form the basis for the proposed sampling design to complete site investigations as presented in this investigation work plan.

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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 the 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 Threemile Canyon Aggregate Area consists of sites within Technical Area 14 (TA-14), TA-15, TA-18, TA-36, and TA-67 at the Laboratory. The location of Threemile Canyon Aggregate Area with respect to the Laboratory is shown in Figure 1.0-1.

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

The SWMUs and AOCs, or sites, 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 5400.5, "Radiation Protection of the Public and the Environment," and DOE Order 435.1, "Radioactive Waste Management." 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 the March 1, 2005, Compliance Order on Consent (the Consent Order). This work plan describes work activities that will be executed and completed in accordance with the Consent Order.

1.1 Work Plan Overview

The Threemile Canyon Aggregate Area includes 40 SWMUs and AOCs, 10 of which have been previously investigated and/or remediated and approved for no further action (NFA) and 4 of which have been deferred per Table IV-2 of the Consent Order. The remaining 26 sites require additional characterization. Of these 26 sites, 1 site is associated with TA-14, 11 sites are associated with TA-15, 4 sites are associated with TA-36, and 10 sites are associated with former TA-12 but are physically located within the boundaries of TA-67 and TA-15.

Historical details of previous investigations and data for the 4 deferred sites and the 26 sites under investigation are provided in the historical investigation report (HIR) for Threemile Canyon Aggregate Area (LANL 2008, 102244). This work plan proposes investigating 26 sites using information from previous field investigations or removal actions to evaluate current conditions at each site.

Table 1.1-1 provides a summary of the 40 sites within the Threemile Canyon Aggregate Area. For NFA sites, brief descriptions and the reference for the approval document are presented within this work plan in Table 1.1-1 only. Plate 1 shows the locations of the deferred sites and sites under investigation in the

Threemile Canyon Aggregate Area along with monitoring wells, surface water and stormwater runoff monitoring stations, canyon reaches, and springs.

Section 2 presents the general site information, operational history, conceptual site model, and data overview of the Threemile Canyon Aggregate Area. General site conditions are presented in section 3. Individual site descriptions, summaries of previous investigations and data for the 4 deferred sites and 26 sites under investigation, and proposed investigation activities for the 26 sites under investigation are presented in sections 4, 5, 6, and 7, respectively. Investigation methods are described in section 8. Ongoing monitoring and sampling programs in the Threemile Canyon Aggregate Area are presented in section 9, and an overview of the anticipated schedule is presented in section 10.0. The references cited in this report and the map data sources are listed in section 11.0. Appendix A contains a list of acronyms and abbreviations used in this investigation work plan, a metric conversion table, and a data qualifier definition table. Appendix B describes the management of investigation-derived waste (IDW).

1.2 Work Plan Objectives

The objective of this work plan is to propose sampling and analysis necessary to define the nature and extent of releases, if any, from the 26 sites under investigation. To accomplish this objective, this work plan presents historical and background information on the sites, describes the strategy for proposed sample collection and analysis activities, and identifies and proposes appropriate methods for collecting and analyzing samples.

2.0 BACKGROUND

2.1 General Site Information

The Threemile Canyon Aggregate Area includes of 40 SWMUs and AOCs located in TA-14, TA-15, TA-18, and TA-36, including 12 sites associated with former TA-12 that lie within the boundaries of TA-15 and TA-67 (Table 1.1-1 and Plate 1). Two sites at former TA-12 are approved for NFA, and 10 sites will be investigated as part of this work plan. TA-14 contains one AOC that will be investigated as part of this work plan. TA-15 contains 21 sites; 4 sites are deferred per Table IV-1 of the Consent Order, 6 sites are approved for NFA, and 11 sites will be investigated as part of this work plan. TA-18 contains one SWMU that has been approved for NFA. TA-36 contains five sites: one site has been approved for NFA and four sites will be investigated as part of this work plan.

Former TA-12, known as L-Site, was constructed in 1945 on Pajarito Mesa and was used as a firing site and dynamic testing area through the mid-1960s. Structures at the former site included a generator building, a junction shelter, and a steel-lined pit. Materials used included explosives, lead, aluminum, copper, and uranium-238. In 1960, the structures underwent decontamination and decommissioning activities. As a result of the Laboratory redefining TA boundaries in 1989, former TA-12 was incorporated into TA-15 and TA-67 (LANL 1994, 034755, p. E-1).

TA-14, known as Q-Site, is one of five major firing sites at the Laboratory and is used for high explosives (HE) testing. TA-14 contains 10 structures and 5 firing mounds.

TA-15, known as R-Site, was constructed on Threemile Mesa in 1945. TA-15 contains a complex of firing sites and related support structures used for HE research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. TA-15 personnel also investigate weapons functioning and systems behavior in nonnuclear testing. Part of former TA-12 now lies within the boundary of TA-15.

TA-36, known as Kappa Site, contains four active firing sites that support explosives testing. The sites and associated buildings are used for a wide variety of nonnuclear ordnance tests for the Department of Defense. TA-36 is primarily located within the Potrillo Canyon watershed; however, the northwest portion of TA-36 (west of TA-18) is located in the Threemile Canyon Aggregate Area.

TA-67 contains significant archeological sites and serves as a buffer area for Laboratory activities. Part of former TA-12 now lies within the boundary of TA-67.

2.2 Operational History

The former TA-12 was constructed in 1944 as a testing site for X Division. The testing site was abandoned in 1946. In 1950, the Biomedical Group used TA-12 and constructed a bermed radiation test bunker for conducting an experiment using a 1000-Ci radioactive lanthanum-140 source. In 1951, the Dynamic Experimentation Group began using the area, reportedly firing 600 shots per month (LANL 1994, 034755). By 1953, the entire site was vacated. In 1960, the structures were decontaminated, decommissioned, and intentionally burned (LANL 1996, 054086, p. 1-1).

TA-14, also constructed for X Division, was used for close observation work on small explosive charges and included both open and closed firing chambers. TA-14 has always been a dedicated site for developing and testing of explosives, including tests involving radioactive materials. TA-14 remains an active site with scheduled tests at both the firing area and bullet test facility (LANL 1994, 034755, p. 1-11).

TA-15 has been used from 1944 to the present for explosives experiments. Test explosions ranging from a few kilograms of HE to as much as 1800 kg have been detonated. In most cases, the tests are carried out aboveground, resulting in the test materials being scattered over areas as large as hundreds of square meters (LANL 1993, 020946, p. 1-10). Sites located within the Threemile Canyon Aggregate Area include Firing Sites C, R-44, and R-45, and Ector and related support structures.

Operations at TA-36 started in 1950. Structures at TA-36 consist of the group office and sanitary facilities, four active firing sites, and a storage magazine. In 1983, the boundary was changed to incorporate the I-J firing site (formerly part of TA-15). Activities at TA-36 include the storage and assembly of prefabricated metal and explosives components, detonators, cables, and instrumentation for shots; and the detonation of these shots (LANL 1993, 015313, p. 2-5). Sites located within the Threemile Canyon Aggregate Area are associated with building 36-1, which houses laboratory activities and photoprocessing operations. None of the TA-36 sites within Threemile Canyon Aggregate Area are associated with firing-site activities.

2.3 Conceptual Site Model

The sampling proposed in this work plan uses a conceptual site model to predict areas of potential contamination and allow for adequate characterization of these areas. The conceptual site model describes potential contaminant sources, transport mechanisms, and receptors.

2.3.1 Potential Contaminant Sources

Releases at the sites within the Threemile Canyon Aggregate Area may have occurred as a result of firing site activities, potential leaks from septic systems and associated drainlines, discharges from outfalls, and surface disposal areas. Previous sampling results indicate contamination from HE, inorganic chemicals, and radionuclides (LANL 2007, 098955). Additional sampling is needed to determine the nature and extent of contamination.

2.3.2 Potential Contaminant Transport Mechanisms

Current potential transport mechanisms that may lead to exposure include

- dissolution and/or particulate transport of surface contaminants during precipitation and runoff events,
- airborne transport of contaminated surface soil,
- continued dissolution and advective/dispersive transport of chemical contaminants contained in subsurface soil and tuff as a result of past operations,
- disturbance of contaminants in shallow soil and subsurface tuff by Laboratory operations, and
- disturbance and uptake of contaminants in shallow soil by plants and animals.

2.3.3 Potential Receptors

Potential receptors at one or more of the sites may include Laboratory and construction workers, recreational users, and plants and animals.

2.3.4 Cleanup Standards

As specified in section VII.B.1 of the Consent Order, soil screening levels will be used as soil cleanup levels unless they are determined to be impractical or unless values do not exist for the current and reasonably foreseeable future land use. Human health screening levels for chemicals and radionuclides are provided in Table 2.3-1.

2.4 Data Overview

Data evaluated for the Threemile Canyon Aggregate Area include historical data collected from 1994 to 1998 as part of Resource Conservation and Recovery Act (RCRA) facility investigations (RFIs) and other corrective actions. In the EP Directorate’s database, all data records include a vintage code field denoting how and where samples were submitted for analyses. In the early years of the RFI, the samples were submitted to the Laboratory’s Chemical Science and Technology (CST) Division and were either analyzed at a CST laboratory (on-site) or submitted to one of several off-site contract laboratories. Samples analyzed at a CST laboratory are identified by the vintage codes “CST Onsite.” Samples submitted by CST Division to off-site laboratories are identified by the vintage code “CST Offsite” if validation was not performed or “CSTROUT03” if validation was performed. From late 1995 until the present, samples have been submitted through the Sample Management Office (SMO) to off-site contract laboratories. These samples are identified by the vintage codes “AN95” if validation was not performed or “SMO” if validation was performed.

Analytical results are presented in the HIR (LANL 2008, 102244) have been determined to be screening-level data. The data are used to determine areas of contamination and to direct sample collection and analyses. Inorganic chemical and radionuclide data from previous investigations presented in the HIR (LANL 2008, 102244) are compared with background values (BVs) and fallout values (FVs) (LANL 1998, 059730). Organic chemicals are presented if detected.

New data collected as proposed in sections 4, 5, 6, and 7 will be used to evaluate the sites investigated as part of this work plan.

3.0 SITE CONDITIONS

3.1 Surface Conditions

3.1.1 Topography

Threemile Canyon Aggregate Area is located on the Pajarito Plateau and consists of roughly east-trending, flat-topped mesas that drain predominantly into Pajarito Canyon Watershed. Surface drainage patterns on the mesa tops are generally oriented to the north, east, and south and feed into the small systems of Threemile Canyon (Plate 1). The drainage area for the canyon systems extends from the topographic divide on the Sierra de Los Valles (to the west) eastward to the Rio Grande. During the summer, stormwater runoff occasionally reaches the Rio Grande via the canyon systems (LANL 1997, 055622, p. 3-1).

3.1.2 Vegetation

The vegetation communities are similar for all the areas comprising the Threemile Canyon Aggregate Area. The primary community on the mesa tops is piñon-juniper, and on the slopes it is mixed conifer. The dominant overstory trees on the mesa tops are one-seed juniper, piñon, and ponderosa pine. Douglas and white fir are also fairly common on the mesa tops. Ponderosa pine and Douglas fir are present on the north-facing slopes. Shrubs consist primarily of Gambel oak, wavyleaf oak, and mountain mahogany, and to a lesser extent cliff rose, squawbush, and big sagebrush. The dominant grass is blue gramma along with bluestem and mountain muhly. Common forbs include wormwood and bittersweet. Open areas without vegetation are also present.

3.1.3 Soil

Soil on the Pajarito Plateau was initially mapped and described by Nyhan et al. (1978, 005702). The soil on the slopes between the mesa tops and canyon floors was mapped as mostly steep rock outcrops consisting of approximately 90% bedrock outcrop and patches of shallow, weakly developed colluvial soil. South-facing canyon walls generally are steep and usually have shallow soil in limited, isolated patches between rock outcrops. By contrast, the north-facing canyon walls generally have more extensive areas of shallow, dark-colored soil under thicker forest vegetation. The canyon floors generally contain poorly developed, deep, well-drained soil on floodplain terraces or small alluvial fans (Nyhan et al. 1978, 005702).

The soil in the Threemile Canyon Aggregate Area belongs to the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Seaby, Tocal, Totavi and the fine Typic Eutoboralfs series, and the Sanjue-Arriba complex (LANL 1993, 015313, pp. 3-17–3-21; LANL 1993, 020946). Soil descriptions are summarized below (Nyhan et al. 1978, 005702).

- The Carjo series is typical of mesa tops and consists of moderately deep, well-drained, and moderately developed soil with an A-B-C horizon sequence. The parent material of the soil may range from Bandelier Tuff to sequences of alluvium/colluvium interstratified with moderately developed to well-developed buried soil. The soil textures of the Carjo series can be very fine sandy loams.

- The Frijoles series is characteristic of deep, well-drained soil formed from pumice on level to moderately sloping mesa tops. The soil is developed with an A-B-C horizon sequence, with textures grading from a brown sandy loam through a clay layer, to a gravelly clay loam.
- Hackroy soil consists of very shallow to shallow, well-drained, and moderately developed soil with an A-B horizon sequence. Soil textures can range from sandy loams to clay loams derived from tuff.
- Nyjack soil consists of moderately deep, well-drained, and moderately developed soil with an A-B-C horizon sequence. Soil textures can range from fine sandy loams to clay loams. The parent material of the soil may range from Bandelier Tuff to sequences of alluvium/colluvium interstratified with moderately developed to well-developed buried soil.
- The Pogna series is a shallow well-drained soil with an A-C horizon sequence. Typically, the soil is a fine sandy loam or sandy loam formed over tuff bedrock on gently to strongly sloping mesa tops.
- The Seaby series consists of shallow to moderately deep, well-drained soil with an A-B-C horizon sequence formed on weathered tuff on gently to moderately sloping mesas. The soil texture grades from a sandy loam to a strong brown gravelly clay loam.
- The Tocal series consists of very shallow to shallow, well-drained soil formed in material weathered from tuff on gently to moderately sloping mesa tops. The soil is developed with an A-B-C horizon sequence and grades from a very fine sandy loam through a clay loam to a silt loam.
- The Totavi series consists of deep, well-drained soil with an A horizon sequence that formed in alluvium in canyon bottoms. Soil textures are a gravelly loamy sand or sandy loam.
- The fine Typic Etoboralfs consist of moderately deep, well-drained soil that formed in colluvium and material weathered from tuff. Textures include very fine sandy loam, or sandy loam, developed with an A-B horizon sequence, on gentle to moderate slopes and are usually located downgradient of fault zones.
- The Sanjue-Arriba complex include deep, well-drained soil with an A-C horizon sequence that weathered in materials derived from pumice and that are found on moderately steep to very steep slopes. Soil textures range from a gravelly sandy loam to a loamy sand.

3.1.4 Surface Water

Most surface water in the Los Alamos area occurs as ephemeral, intermittent, or interrupted streams in canyons cut into the Pajarito Plateau. Springs on the flanks of the Jemez Mountains, west of the Laboratory's western boundary, supply flow to the upper reaches of Cañon de Valle and to Guaje, Los Alamos, Pajarito, and Water Canyons (Purtymun 1975, 011787; Stoker 1993, 056021). These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 2 to 135 gal./min (Abeele et al. 1981, 006273). The volume of flow from the springs maintains natural perennial reaches of varying lengths in each of the canyons.

The hydrogeology of the canyon systems is thoroughly discussed in section 2.1.3 of the hydrogeologic workplan (LANL 1998, 059599). The surface water infiltration pathways within the aggregate area include native or disturbed soil, unconsolidated alluvium, Bandelier Tuff, Puye Formation, and basalt, faults and fracture systems, and cooling joints (LANL 1999, 064617, p. 3-25).

Threemile Canyon is the second largest tributary to Pajarito Canyon. Threemile Canyon joins Pajarito Canyon at TA-18 and parallels Pajarito Canyon on the south and extends for a distance of approximately 3.3 mi. Threemile Canyon has several unnamed tributaries; the largest is referred to informally as the south fork of Threemile Canyon, which has a total drainage area of approximately 1.67 mi^2. Other tributaries to Threemile Canyon are informally referred to as the middle fork of Threemile Canyon and the west fork of Threemile Canyon (LANL 1998, 059577, p. 3-5).

Springs discharging to Threemile Canyon include Threemile Spring and TA-18 Spring (Plate 1). These springs are perennial and support short reaches of perennial flow in Threemile Canyon (LANL 1998, 059577, pp. 3-4–3-5).

3.1.5 Erosion

Surface water run-off and sediment transport are the primary pathways for transport of contaminants. Sediment deposition and erosion occur episodically as a result of snowmelt and stormwater runoff. Erosion by surface water can expose and transport contaminants off-site. Erosion is generally accelerated over areas where the natural soil surface has been disturbed, such as roads, firing pads, burial pits, and surface disposal areas. Slopes on the mesa tops are flat, generally 2% or less, and erosion occurs as sheet flow. The canyon walls have much steeper slopes, generally 30% to 40%, resulting in faster runoff velocities, which result in greater sediment transport and gully erosion. The erosion potential for the mesa top sites is low to moderate, while the sites along the mesa edge have erosion potential of moderate to high. Best management practices have been installed at all sites to minimize erosion and sediment transport off-site.

3.1.6 Land Use

Currently, land use of the Threemile Canyon Aggregate Area is industrial, with secondary recreational use by on-site workers. It is anticipated the area will remain industrial through continued use by the Laboratory and will not change in the foreseeable future. Public access is also controlled at TA-14, TA-15, TA-18, TA-36, and TA-67 through physical controls, including fencing and limited access.

3.2 Subsurface Conditions

3.2.1 Anticipated Stratigraphic Units

The stratigraphy of the Threemile Canyon Aggregate Area is summarized in this section. Additional information on the geologic setting of the area and information on the Pajarito Plateau can be found in the Hydrogeologic Workplan (LANL 1998, 059599).

The bedrock at or near the surface of the mesa top is the Bandelier Tuff. There are approximately 1250 ft of volcanic and sedimentary materials between any potential contaminant-bearing units at the mesa surface and the regional aquifer. The stratigraphic units that may be encountered during investigation of the Threemile Canyon Aggregate Area are described briefly in the following sections. The descriptions begin with the oldest (deepest) and proceed to the youngest (topmost). The stratigraphic units that may be encountered during investigation of the Threemile Canyon Aggregate Area are limited to the upper units (Qbt 3, Qbt 2, Qbt 1v, and Qbt 1g) of the Tshirege Member of the Bandelier Tuff, described below (LANL 1998, 059577, p. 13; LANL 2006, 093196). Stratigraphic units comprising the Bandelier Tuff are described briefly in the following sections and are shown in Figure 3.2-1.

The Bandelier Tuff

The Bandelier Tuff consists of the Otowi and Tshirege Members, which are stratigraphically separated in many places by the tephras and volcaniclastic sediment of the Cerro Toledo interval. The Bandelier Tuff was emplaced during cataclysmic eruptions of the Valles Caldera between 1.61 and 1.22 million yr ago. The tuff is composed of pumice, minor rock fragments, and crystals supported in an ashy matrix. It is a prominent cliff-forming unit because of its generally strong consolidation (Broxton and Reneau 1995, 049726).

Otowi Member. Griggs and Hem (1964, 092516), Smith and Bailey (1966, 021584), Bailey et al. (1969, 021498), and Smith et al. (1970, 009752) describe the Otowi Member. It consists of moderately consolidated (indurated), porous, and nonwelded vitric tuff (ignimbrite) that forms gentle colluvium-covered slopes along the base of canyon walls. The Otowi ignimbrites contain light gray to orange pumice supported in a white to tan ash matrix (Broxton et al. 1995, 050121; Broxton et al. 1995, 050119; Goff 1995, 049682). The ash matrix consists of glass shards, broken pumice, crystal fragments, and fragments of perlite.

The Guaje Pumice Bed. The Guaje Pumice Bed occurs at the base of the Otowi Member, making a significant and extensive marker horizon. The Guaje Pumice Bed (Bailey et al. 1969, 021498; Self et al. 1986, 021579) contains well-sorted pumice fragments whose mean size varies between 0.8 and 1.6 in. Its thickness averages approximately 28 ft below most of the plateau, with local areas of thickening and thinning. Its distinctive white color and texture make it easily identifiable in cuttings and core, and it is an important marker bed for the base of the Bandelier Tuff.

Tephras and Volcaniclastic Sediment of the Cerro Toledo Interval. The Cerro Toledo interval is an informal name given to a sequence of volcaniclastic sediment and tephra of mixed provenance that separates the Otowi and Tshirege Members of the Bandelier Tuff (Broxton et al. 1995, 050121; Goff 1995, 049682; Broxton and Reneau 1995, 049726). Although it is located between the two members of the Bandelier Tuff, it is not considered part of that formation (Bailey et al. 1969, 021498). Outcrops of the Cerro Toledo interval generally occur wherever the top of the Otowi Member appears in Pajarito Canyon and in canyons to the north. The unit contains primary volcanic deposits described by Smith et al. (1970, 009752) as well as reworked volcaniclastic sediment. The occurrence of the Cerro Toledo interval is widespread; however, its thickness is variable, ranging between several feet and more than 100 ft.

The predominant rock types in the Cerro Toledo interval are rhyolitic tuffaceous sediment and tephra (Heiken et al. 1986, 048638; Stix et al. 1988, 049680; Broxton et al. 1995, 050121; Goff 1995, 049682). The tuffaceous sediment is the reworked equivalents of Cerro Toledo rhyolite tephra. Oxidation and clay-rich horizons indicate at least two periods of soil development occurred within the Cerro Toledo deposits. Because the soil is rich in clay, it may act as a barrier to the movement of vadose zone moisture. Some of the deposits contain both crystal-poor and crystal-rich varieties of pumice. The pumice deposits tend to form porous and permeable horizons within the Cerro Toledo interval and locally may provide important pathways for moisture transport in the vadose zone. A subordinate lithology within the Cerro Toledo interval includes clast-supported gravel, cobble, and boulder deposits derived from the Tschicoma Formation (Broxton et al. 1995, 050121; Goff 1995, 049682; Broxton and Reneau 1996, 055429).

Tshirege Member. The Tshirege Member is the upper member of the Bandelier Tuff and is the most widely exposed bedrock unit of the Pajarito Plateau (Griggs and Hem 1964, 092516; Smith and Bailey 1966, 021584; Bailey et al. 1969, 021498; Smith et al. 1970, 009752). Emplacement of this unit occurred during eruptions of the Valles Caldera approximately 1.2 million yr ago (Izett and Obradovich 1994, 048817; Spell et al. 1996, 055542). The Tshirege Member is a multiple-flow, ash-and-pumice sheet that forms the prominent cliffs in most of the canyons on the Pajarito Plateau. It is a cooling unit whose physical properties vary vertically and laterally. The consolidation in this member is largely from compaction and welding at high temperatures after the tuff was emplaced. Its light brown, orange-brown, purplish, and white cliffs have numerous, mostly vertical fractures that may extend from several feet up to several tens of feet. The Tshirege Member includes thin but distinctive layers of bedded, sand-sized particles called surge deposits that demark separate flow units within the tuff. The Tshirege Member is generally over 200 ft thick.

The Tshirege Member differs from the Otowi Member most notably in its generally greater degree of welding and compaction. Time breaks between the successive emplacement of flow units caused the tuff to cool as several distinct cooling units. For this reason, the Tshirege Member consists of at least four cooling subunits that display variable physical properties vertically and horizontally (Smith and Bailey 1966, 021584; Crowe et al. 1978, 005720; Broxton et al. 1995, 050121). The welding and crystallization variability in the Tshirege Member produce recognizable vertical variations in its properties, such as density, porosity, hardness, composition, color, and surface-weathering patterns. The subunits are mappable based on a combination of hydrologic properties and lithologic characteristics.

Broxton et al. (1995, 050121) provide extensive descriptions of the Tshirege Member cooling units. The following paragraphs describe, in ascending order, subunits of the Tshirege Member.

The Tsankawi Pumice Bed forms the base of the Tshirege Member. Where exposed, it is commonly 20 to 30 in. thick. This pumice-fall deposit contains moderately well-sorted pumice lapilli (diameters reaching about 2.5 in.) in a crystal-rich matrix. Several thin ash beds are interbedded with the pumice-fall deposits.

Subunit Qbt 1g is the lowermost tuff subunit of the Tshirege Member. It consists of porous, nonwelded, and poorly sorted ash-flow tuff. This unit is poorly indurated but nonetheless forms steep cliffs because of a resistant bench near the top of the unit; the bench forms a harder, protective cap over the softer underlying tuff. A thin (4 to 10 in.), pumice-poor surge deposit commonly occurs at the base of this unit.

Subunit Qbt 1v forms alternating cliff-like and sloping outcrops composed of porous, nonwelded, crystallized tuff. The base of this unit is a thin, horizontal zone of preferential weathering that marks the abrupt transition from glassy tuff below (in unit Qbt 1g) to the crystallized tuff above. This feature forms a widespread marker horizon (locally termed the vapor-phase notch) throughout the Pajarito Plateau that is readily visible in canyon walls in parts of Pajarito Canyon. The lower part of Qbt 1v is orange-brown, resistant to weathering, and has distinctive columnar (vertical) joints; hence, the term “colonnade tuff” is appropriate for its description. A distinctive white band of alternating cliff- and slope-forming tuffs overlies the colonnade tuff. The tuff of Qbt 1v is commonly nonwelded (pumices and shards retain their initial equant shapes) and have an open, porous structure.

Subunit Qbt 2 forms a distinctive, medium-brown, vertical cliff that stands out in marked contrast to the slope-forming, lighter-colored tuff above and below. It displays the greatest degree of welding in the Tshirege Member. A series of surge beds commonly mark its base. It typically has low porosity and permeability relative to the other units of the Tshirege Member.

Subunit Qbt 3 is a nonwelded to partially welded, vapor-phase altered tuff that forms the upper cliffs in Pajarito Canyon. Its base consists of a purple-gray, unconsolidated, porous, and crystal-rich nonwelded tuff that forms a broad, gently sloping bench developed on top of Qbt 2. Abundant fractures extend through the upper units of the Bandelier Tuff, including the ignimbrite of Qbt 3 of the Tshirege. The origin of the fractures has not been fully determined, but the most probable cause is brittle failure of the tuff caused by cooling contraction soon after initial emplacement (Vaniman 1991, 009995.1; Wohletz 1995, 054404).

3.2.2 Hydrogeology

The hydrogeology of the Pajarito Plateau is separable in terms of mesas and canyons forming the plateau. Mesas are generally devoid of water, both on the surface and within the rock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and contain perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional stream flow and may lack alluvial groundwater. Intermediate perched groundwater has been found at certain locations on the plateau at depths ranging between 100 and 700 ft below ground surface (bgs). The regional aquifer is found at depths of about 600 to 1200 ft bgs.

The hydrogeologic conceptual site model for the Laboratory (LANL 1998, 059599) shows that, under natural conditions, relatively small volumes of water move beneath mesa tops because of low rainfall, high evaporation, and efficient water use by vegetation. Atmospheric evaporation may extend into mesas, further inhibiting downward flow.

3.2.2.1 Groundwater

In the Los Alamos area, groundwater occurs as (1) water in shallow alluvium in some of the larger canyons, (2) intermediate perched groundwater (a perched groundwater body lies above a less permeable layer and is separated from the underlying aquifer by an unsaturated zone), and (3) the regional aquifer. Numerous wells have been installed at the Laboratory and in the surrounding area to investigate the presence of groundwater in these zones and to monitor groundwater quality. The locations of the existing wells within the vicinity of the Threemile Canyon Aggregate Area are shown on Plate 1.

The Laboratory formulated a comprehensive groundwater protection plan (LANL 1995, 050124) for an enhanced set of characterization and monitoring activities. The approved hydrogeologic workplan (LANL 1998, 059599) details the implementation of extensive groundwater characterization across the Pajarito Plateau within an area potentially affected by past and present Laboratory operations.

Alluvial Groundwater

Intermittent and ephemeral stream flows in the canyons of the Pajarito Plateau have deposited alluvium that is as much as 100 ft thick. The alluvium in canyons that head on the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff on the flank of the mountains. The alluvium in canyons that head on the plateau is comparatively more finely grained, consisting of clays, silts, sands, and gravels derived from the Bandelier Tuff (LANL 1998, 059599, p. 2-17).

In contrast to the underlying volcanic tuff and sediment, alluvium is relatively permeable. Ephemeral runoff in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable tuff and sediment, which results in the buildup of a shallow alluvial groundwater body. Depletion by evapotranspiration and movement into the underlying rock limit the horizontal and vertical extent of the alluvial water (Purtymun et al. 1977, 011846). The limited saturated thickness and extent of the alluvial groundwater preclude its use as a viable source of water for municipal and industrial needs. Lateral flow of the alluvial perched groundwater is in an easterly, downcanyon direction (Purtymun et al. 1977, 011846).

Three alluvial groundwater wells, also called observations wells, are proposed for annual monitoring and/or sampling (Plate 1). Existing well 18-BG-4 will be used to cumulatively characterize the potential impact of SWMUs and AOCs in Threemile Canyon and provide a relative baseline to TA-18. Wells 18-MW-8 and 3MAO-2 will be used to characterize the potential impact of TA-18 facilities located in lower Threemile Canyon (LANL 2008, 101897).

Intermediate Groundwater

Identification of perched groundwater systems beneath the Pajarito Plateau comes mostly from direct observation of saturation in boreholes, wells, or piezometers or from borehole geophysics. In boreholes across the Pajarito Plateau, 33 occurrences of perched groundwater have been detected. Perched groundwater is widely distributed across the northern and central part of the Pajarito Plateau with depth to water ranging from 118 to 894 ft bgs. The principal occurrences of perched groundwater occur in (1) the relatively wet Los Alamos and Pueblo Canyon watersheds, (2) the smaller watersheds of Sandia and Mortandad Canyons that receive significant volumes of treated effluent from Laboratory operations, and (3) in the Cañon de Valle area in the southwestern part of the Laboratory. Perched water is most often found in Puye fanglomerates, Cerros del Rio basalt, and in units of Bandelier Tuff. There are few reported occurrences in the southern part of the Laboratory, but few deep boreholes are located in that area. Additional perched zones probably occur beneath the adjacent wet watersheds of Pajarito and Water Canyons (Collins et al. 2005, 092028, pp. 2-96–2-97).

Within the Threemile Canyon watershed, intermediate groundwater is monitored annually at regional well R-19 (LANL 2008, 101897), located on the mesa top near the southern boundary of the Threemile Canyon Aggregate Area (Plate 1).

Regional Aquifer

The regional aquifer is the only aquifer capable of large-scale municipal water supply in the Los Alamos area (Purtymun 1984, 006513). The surface of the regional aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Formation beneath the central and western part of the Pajarito Plateau. The depths to groundwater below the mesa tops range between about 1200 ft along the western margin of the plateau and about 600 ft at the eastern margin. The location of wells and generalized water-level contours on top of the regional aquifer are described in the 2008 General Facility Information report (LANL 2008, 101932). The regional aquifer is typically separated from the alluvial groundwater and intermediate perched zone groundwater by 350 to 620 ft of tuff, basalt, and sediment (LANL 1993, 023249).

Groundwater in the regional aquifer flows east-southeast toward the Rio Grande. The velocity of groundwater flow ranges from about 20 to 250 ft/yr (LANL 1998, 058841, p. 2-7). Details of depths to the regional aquifer, flow directions and rates, and well locations are presented in various Laboratory documents (Purtymun 1995, 045344; LANL 1997, 055622; LANL 2000, 066802).

Regional groundwater in the Threemile Canyon watershed is monitored annually at R-19 (LANL 2008, 101897) (Plate 1).

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 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.

Although water moves slowly through the unsaturated tuff matrix, it can move rapidly through fractures if saturated conditions exist (Hollis et al. 1997, 063131). Fractures may provide conduits for fluid flow but probably only in discrete, disconnected intervals of the subsurface. Because they are open to the passage of both air and water, fractures can have both wetting and drying effects, depending on the relative abundance of water in the fractures and the tuff matrix.

The Bandelier Tuff is very 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 of transpiration by vegetation, which flourishes during 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 native tuff 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 AT FORMER TA-12

Former TA-12 lies within the boundaries of TA-15 and TA-67 (Plate 1). Former TA-12, also known as L-Site, was constructed during World War II and used as an explosives testing facility. Activities at former TA-12 ceased in the early 1950s. An open area was used as the firing site where a number of shots were detonated, including one 70-kg charge (LANL 1996, 054086, p. 1-1).

In 1950, a radiation test bunker was constructed at former TA-12 for conducting radiation experiments on animals using a radioactive lanthanum-140 source. Because of these radiation experiments, a section of the perimeter became contaminated. In 1951, the Dynamic Experimentation Group began using the area, firing several shots per month (LANL 1994, 034755). By 1953, the entire site was vacated. In 1960, the structures were decontaminated, decommissioned, and intentionally burned (LANL 1996, 054086, p. 1-1). During the Vietnam War, a portion of the site was used by a Laboratory group for “Mortar Locator” experiments in which an acetylene gas gun was used. Former TA-12 is no longer used for Laboratory operations (LANL 1994, 034755, p. 1-8).

TA-67 was established in 1989 when the Laboratory redefined TA boundaries and serves as a buffer area. During this process, the majority of former TA-12 was incorporated inside the boundary of TA-67 and the remaining area was incorporated into TA-15. In 2000, the Cerro Grande fire moved through former TA-12, damaging or destroying vegetation and remaining surface debris (LANL 1994, 034755, p. 1-8).

The following sections present site descriptions, summaries of previous investigation activities, and proposed sampling activities for 10 SWMUs and AOCs at former TA-12. Table 4.0-1 summarizes the investigation strategy proposed in this work plan for each SWMU or AOC.

In addition to the analytical suites proposed for each site in Table 4.0-1, polychlorinated biphenyls (PCBs) analysis will be performed on a minimum of 20% of the samples collected at former TA-12.

4.1 Consolidated Unit 12-001(a)-99

Consolidated Unit 12-001(a)-99 consists of SWMUs 12-001(a), 12-001(b), and 12-002, and AOC C-12-005 (Figure 4.1-1). This consolidated unit is located along the northern edge of the Threemile Canyon Aggregate Area and consists of firing points and associated structures. The proposed activities for each site are presented below.

The nearest downstream canyon investigation reach is TH-1C, located approximately 1250 ft southeast of Consolidated Unit 12-001(a)-99 (Figure 4.1-2 and Plate 1). Canyon investigations are described in section 9.2.

4.1.1 SWMU 12-001(a), Firing Site Steel-Lined Chamber

SWMU 12-001(a) is a belowground, steel-lined firing pit and aboveground steel cover (structure 12-4) (Figure 4.1-1). The firing pit, which began operating in 1944, is located approximately 3200 ft east of the former TA-12 entrance (LANL 034755, p. 5-1-1). The steel structure is hexagonal and measures 10.5 ft on each side and is 11.5 ft deep. A steel cover, a large box filled with soil, measures 20 ft × 22 ft and is 5 ft high. The base of the cover is at ground level and has 1-ft-high × 7-ft-long openings on four sides. The cover has a 5-ft × 5-ft hole in the center used to lower explosives into the firing area. Recovery shots, which used uranium, were conducted in the pit. Activities at the firing pit ceased in 1953, but the pit remains intact (LANL 1996, 055073, p. 1).

4.1.1.1 Summary of Previous Investigations for SWMU 12-001(a)

In 1993, a radiation survey was conducted outside structure 12-4 using a Geiger-Muller thin-window probe; no radionuclides were detected above background (Harris 1993, 055658, pp. 3–6; LANL 1994, 034755, p. 5-1-6). An internal survey of structure 12-4 was conducted in 1993; beta/gamma-emitting radiation was detected above background. Small pieces of uranium and HE were observed in the firing pit (LANL 1994, 034755, pp. 5-1-6–5-1-7).

In 1995, RFI activities were performed at SWMU 12-001(a) (LANL 1996, 054086, p. 5-1). Two samples were collected from two locations at the bottom of the firing pit, and two samples were collected from two locations in the surrounding area and analyzed for inorganic chemicals, HE, and radionuclides (LANL 1996, 055073, pp. 2–6). The 1995 requested analyses are presented in Table 2.1-1 of the Threemile Canyon Aggregate Area HIR.

In 1996, a voluntary corrective action (VCA) was conducted. During the VCA, all soil from within the firing pit was removed. No additional confirmatory samples were collected after soil removal (LANL 1996, 055073, pp.1–8; LANL 1996, 059535).

4.1.1.2 Summary of Data for SWMU 12-001(a)

Analytical data from the 1995 sampling event are presented in Tables 2.1-2 and 2.1-3 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs and radionuclides detected or detected above BVs/FVs are shown in Figures 2.1-2 and 2.1-3 of the Threemile Canyon Aggregate Area HIR. Uranium was detected above BV in two samples. No HE was detected. Uranium-238 was detected above BV in one sample.

The nature and extent of contamination have not been defined for this site.

4.1.1.3 Scope of Activities for SWMU 12-001(a)

A total of 18 samples will be collected from the surface and subsurface at nine locations radially bounding the firing pit (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for target analyte list (TAL) metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Four of the 18 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of 30 samples will be collected from the surface and subsurface at 15 locations in the drainage below Consolidated Unit 12-001(a) (Figure 4.1-2). These samples will be collected in association with SWMU 12-001(a) but will also be used to evaluate the other three sites within the consolidated unit: SWMUs 12-001(b) and 12-002 and AOC C-12-005 (sections 4.1.2, 4.1.3, and 4.1.4, respectively). Samples will be collected approximately every 50 ft from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Six of the 30 samples will be analyzed for PCBs.

4.1.2 SWMU 12-001(b), Former Firing Pit

SWMU 12-001(b) is a firing pit located approximately 175 ft east of SWMU 12-001(a) on the north side of Redondo Road (Figure 4.1-1). The open pit measured 21 ft × 17 ft × 3 ft and was used in 1945 for calorimetric experiments. Following World War II, the pit was used to fire HE shots using lead and uranium. This site ceased operations in the 1950s (LANL 1994, 034755, p. 5-1-5).

4.1.2.1 Summary of Previous Investigations for SWMU 12-001(b)

In 1993, a radiological survey detected beta/gamma radionuclides at approximately twice background in the open firing pit (LANL 1994, 034755, p. 5-1-6; LANL 1997, 055675, p. 1). Small fragments of uranium and pink material were observed in the open firing pit. Field HE spot-tests were conducted and fragments of pink material tested positive for RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) and 2,4,6-trinitrotoluene (Harris 1993, 055658).

In 1995, RFI activities were performed at SWMU 12-001(b) (LANL 1996, 054086, p. 5-1). Four soil samples were collected from three locations and analyzed for inorganic chemicals, HE, and radionuclides (LANL 1996, 054086, p. 5-1; LANL 1997, 055675, pp. 2–4). The 1995 requested analyses are presented in Table 2.1-4 of the Threemile Canyon Aggregate Area HIR.

4.1.2.2 Summary of Data for SWMU 12-001(b)

Analytical data from the 1995 sampling event are presented in Tables 2.1-5 and 2.1-6 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs and radionuclides detected or detected above BVs/FVs are shown in Figures 2.1-2 and 2.1-3 of the Threemile Canyon Aggregate Area HIR. Copper was detected above BV in one sample. Uranium was detected above BV in four samples. No HE was detected. Uranium-235 was detected above BV in two samples. Uranium-238 was detected above BV in three samples.

The nature and extent of contamination have not been defined for this site.

4.1.2.3 Scope of Activities for SWMU 12-001(b)

A total of 34 samples will be collected from the surface and subsurface at 17 locations within and radially bounding the firing pit (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Seven of the 34 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

Consolidated Unit 12-001(a)-99 [SWMUs 12-001(a), 12-001(b), 12-002, and AOC C-12-005 (sections 4.1.1, 4.1.2, 4.1.3, and 4.1.4, respectively)] is located near the head of a common drainage to Threemile Canyon. Samples collected within the drainage are associated with SWMU 12-001(a) and will be used to evaluate the other three sites within the consolidated unit.

4.1.3 SWMU 12-002, Potential Soil Contamination

SWMU 12-002 is a small area, approximately 3 ft^2, used once to burn scrap HE (Figure 4.1-1). The site is located in the roadbed just east of structure 12-4. In 1962, a can containing approximately 0.5 lb of HE, was discovered during a property survey and burned to destroy the HE (Anderson 1962, 004860; LANL 1994, 034755, p. 6-3). The area immediately surrounding SWMU 12-002 is cross-contaminated from many years of uncontained explosives testing that occurred in a nearby open firing pit, now designated as SWMU 12-001(b). It is likely that contamination associated with the one-time burning event will be indistinguishable from contamination associated with SWMU 12-001(b) (LANL 1994, 034755, p. 6-3). The location of SWMU 12-002 now lies beneath the asphalt pavement of Redondo Road.

4.1.3.1 Summary of Previous Investigations for SWMU 12-002

No sampling has been conducted at this SWMU.

4.1.3.2 Summary of Data for SWMU 12-002

The nature and extent of contamination have not been defined for this site.

4.1.3.3 Scope of Activities for SWMU 12-002

A total of two samples will be collected from the surface and subsurface at one location beneath the burn site (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) beneath the asphalt road and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. One of the two samples will be analyzed for PCBs.

SWMU 12-002 is located proximal to firing site SWMU 12-001(b) (Figure 4.1-2). Data collected at SWMU 12-001(b) (section 4.1.2) will be used to evaluate SWMU 12-002.

Consolidated Unit 12-001(a)-99 [SWMUs 12-001(a), 12-001(b), 12-002, and AOC C-12-005 (sections 4.1.1, 4.1.2, 4.1.3, and 4.1.4, respectively)] is located near the head of a common drainage to Threemile Canyon. Samples collected within the drainage are associated with SWMU 12-001(a) and will be used to evaluate the other three sites within the consolidated unit.

4.1.4 AOC C-12-005, Former Junction Box

AOC C-12-005 is the location of a former junction box (structure 12-6) used to support experiments for the firing sites at SWMUs 12-001(a) and 12-001(b) (Figure 4.1-1). The former junction box was located approximately 25 ft west of the steel-lined firing pit, SWMU 12-001(a), and measured 3 ft × 3 ft × 4 ft high. A soil berm surrounded three sides of the former junction box. The former junction box served as a relay between former control building 12-2 and the two firing sites. The former junction box housed diagnostic equipment, signal cables, and electrical power equipment. Approximately 750 ft of detonation wire connected the former junction box to building 12-2. The former junction box, constructed in 1945, was not used after 1953 and was intentionally burned in 1960 (LANL 1994, 034755, p. 5-1-5).

4.1.4.1 Summary of Previous Investigations for AOC C-12-005

A 1959 inspection determined the former junction box was free of radioactive and HE contamination (Blackwell 1959, 005773; LANL 1994, 034755, p. 5.2-2).

In 1995, RFI activities were performed at AOC C-12-005 (LANL 1996, 054086, p. 5-1-13). Two surface samples were collected from two locations and analyzed for uranium (LANL 1996, 054086 p. 5-15). The 1995 requested analyses are presented in Table 2.1-7 of the Threemile Canyon Aggregate Area HIR.

4.1.4.2 Summary of Data for AOC C-12-005

Analytical data from the 1995 sampling event are presented in Table 2.1-8 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 2.1-2 of the Threemile Canyon Aggregate Area HIR. Uranium was detected above BV in two samples.

The nature and extent of contamination have not been defined for this site.

4.1.4.3 Scope of Activities for AOC C-12-005

A total of 10 samples will be collected from the surface and subsurface at five locations within and bounding the footprint of the former junction box (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the 10 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

Consolidated Unit 12-001(a)-99 [SWMUs 12-001(a), 12-001(b), 12-002, and AOC C-12-005 (sections 4.1.1, 4.1.2, 4.1.3, and 4.1.4, respectively)] is located near the head of a common drainage to Threemile Canyon. Samples collected within the drainage are associated with SWMU 12-001(a) and will be used to evaluate the other three sites within the consolidated unit.

4.2 AOC 12-004(a), Radiation Test Facility

AOC 12-004(a) consists of the lanthanum radiation experiment site and surrounding area, including a drainage, used to conduct radiation experiments on animals (Figure 4.2-1) (LANL 1994, 034755, p. 5.2-1). The site contained the location of a former soil-bermed radiation shelter and three telephone poles. The shelter and poles were constructed in a line parallel to a drainage channel that flows southwest from Redondo Road into Threemile Canyon. The northernmost telephone pole was situated

30 ft south of Redondo Road in a drainage, and the second pole was situated 58 ft south of the first pole. The former radiation shelter and the third telephone pole were located 40 ft south of the second pole (LANL 1996, 054086, pp. 5-18–5-24).

Operations at the site consisted of deploying a lanthanum source from the former radiation shelter by raising it with a wire strung over the three telephone poles. The radiation source was stored in a lead container, or “pig,” at the base of the first pole and could be deployed at various heights by raising it inside of a guide tube attached to the pole. Test animal containers were located at various distances from the source. Different containers of various thicknesses and shapes were used to observe the effects of foreign elements. The site was constructed in March 1950, and experiments were conducted over a 3-wk period in the same year. At an unspecified date between 1962 and 1966, the lead “pig” and plastic guide pipe were removed (Blackwell 1962, 005011).

The nearest downstream canyon investigation reach is TH-2W, located approximately 850 ft south of AOC 12-004(a) (Figure 4.2-2 and Plate 1). Canyon investigations are described in section 9.2.

4.2.1 Summary of Previous Investigations for AOC 12-004(a)

A 1959 survey reported the former shelter and telephone pole closest to the road were contaminated with HE and strontium-90 (Blackwell 1959, 005773; LANL 1994, 034755, pp. 5-2-1–5-2-2).

A 1966 survey showed all former structures were contaminated with gamma- and beta-emitting radiation (Blackwell 1966, 005012; LANL 1994, 034755, pp. 5-2-1–5-2-2). The structures were subsequently decontaminated.

A 1993 radiation screening survey inside the former shelter showed a cardboard box with beta/gamma radioactivity at 10 times background levels. No other readings above instrument background were observed (LANL 1994, 034755, pp. 5-2-1–5-2-2).

In 1995, RFI activities were performed at AOC 12-004(a). Six surface soil samples were collected from six locations and analyzed for inorganic chemicals, HE, and radionuclides (LANL 1996, 054086, p. 5-20). The 1995 requested analyses are presented in Table 2.2-1 of the Threemile Canyon Aggregate Area HIR.

4.2.2 Summary of Data for AOC 12-004(a)

Analytical data from the 1995 sampling event are presented in Table 2.2-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 2.2-2 of the Threemile Canyon Aggregate Area HIR. Mercury was detected above BV in one sample. Zinc was detected above BV in one sample. No HE was detected. No radionuclides were detected or detected above BVs/FVs.

The nature and extent of contamination have not been defined for this site.

4.2.3 Scope of Activities for AOC 12-004(a)

A total of 16 will be collected from the surface and subsurface at eight locations within and bounding the experimental site (Figure 4.2-2). Samples will be collected from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, semivolatile organic compounds (SVOCs), HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Four of the

16 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of 16 samples will also be collected from the surface and subsurface at eight locations in the drainage below the experimental site (Figure 4.2-2). Samples will be collected approximately every 50 ft from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, SVOCs, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Four of the 16 samples will be analyzed for PCBs.

4.3 AOC 12-004(b), Pipe

AOC 12-004(b) is a belowground aluminum pipe at the edge of Redondo Road about 78 ft north of a former radiation shelter (structure 12-8) (Figure 4.2-1). The pipe protrudes 8 in. aboveground without a cover. Its outer opening diameter measures 25.5 in., with an inner diameter of 20 in. The inside of the pipe is filled with soil and the length of the pipe is estimated at 3 ft. Remnant fragments of HE were observed at the site (Blackwell 1959, 005773).

The nearest downstream canyon investigation reach is TH-2W, located approximately 850 ft south of AOC 12-004(b) (Figure 4.2-2 and Plate 1). Canyon investigations are described in section 9.2.

4.3.1 Summary of Previous Investigations for AOC 12-004(b)

A 1993 radiation survey was conducted and detected no radiation above background levels (LANL 1994, 034755, p. 5-2-2).

In 1995, RFI activities were performed at AOC 12-004(b). Two samples were collected from one location and analyzed for inorganic chemicals, SVOCs, HE, and radionuclides (LANL 1996, 054086, p. 5-25). The 1995 requested analyses are presented in Table 2.3.1 of the Threemile Canyon Aggregate Area HIR.

4.3.2 Summary of Data for AOC 12-004(b)

Analytical data from the 1995 sampling event are presented in Table 2.3-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 2.2-2 of the Threemile Canyon Aggregate Area HIR. Lead was detected above BV in one sample. Mercury was detected above BV in one sample. No HE or SVOCs were detected. No radionuclides were detected or detected above BVs/FVs.

The nature and extent of contamination have not been defined for this site.

4.3.3 Scope of Activities for AOC 12-004(b)

The pipe will be removed, swipe samples will be collected and analyzed for HE and radioactivity, and the pipe will be disposed of at an appropriate waste facility. Six samples will be collected from the surface and subsurface at two locations next to the pipe (Figure 4.2-2). Samples will be collected from three depths (0 to 0.5 ft, 2 to 3 ft, and 5 to 6 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. One of the six samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

AOCs 12-004(b) and 12-004(a) (section 4.2) are located near the head of a common drainage to Threemile Canyon. Samples collected within the drainage are associated with AOC 12-004(a) and will be used to evaluate AOC 12-004(b).

4.4 AOC C-12-001, Potential Soil Contamination Associated with Former Building

AOC C-12-001 is an area of potential soil contamination associated with the former trim building (building 12-1) for the former TA-12 firing sites (Figure 4.1-1). The trim building was built in 1944 and used to prepare HE for detonation. The building was 16 ft × 16 ft × 9 ft high and of wood-frame construction with soil on three sides and on top. HE was molded at S-Site (located at TA-16) and transported to former TA-12 for final preparation. Use of former TA-12 was discontinued in 1953, and the intentional burning of this area in 1960 destroyed building 12-1. Before the building was burned, a 1959 inspection report noted that building 12-1 was contaminated with HE. Some noncombustible debris was in place when the Operable Unit 1085 work plan was written but has since been removed (LANL 1994, 034755).

The nearest downstream canyon investigation reach is TH-1C, located approximately 1800 ft southeast of AOC C-12-001 (Figure 4.1-2 and Plate 1). Canyon investigations are described in section 9.2.

4.4.1 Summary of Previous Investigations for AOC C-12-001

A 1959 inspection reported building 12-1 to be contaminated with HE (Blackwell 1959, 005773).

In 1995, RFI activities were performed at AOC C-12-001. One sample was collected from one location and analyzed for inorganic chemicals and radionuclides (LANL 1996, 054086, pp. 5-1–5-5). The 1995 requested analyses are presented in Table 2.4-1 of the Threemile Canyon Aggregate Area HIR.

4.4.2 Summary of Data for AOC C-12-001

Data from the 1995 sampling event are presented in Table 2.4-2 of the Threemile Canyon Aggregate Area HIR. The sampling location and results for inorganic chemicals detected above BVs are shown in Figure 2.1-2 of the Threemile Canyon Aggregate Area HIR. Uranium was detected above BV in one sample. No radionuclides were detected or detected above BVs/FVs.

The nature and extent of contamination have not been defined for this site.

4.4.3 Scope of Activities for AOC C-12-001

A total of 10 samples will be collected from the surface and subsurface at five locations within and bounding the footprint of the former building (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the 10 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

4.5 AOC C-12-002, Potential Soil Contamination Associated with Former Building

AOC C-12-002 is the area of potential soil contamination associated with the former control building (building 12-2) for the former TA-12 firing sites (Figure 4.1-1). It was built in 1945 of wood-frame construction and measured 8 ft × 8 ft × 8 ft, with soil on three sides and on top. The structure was located south of Redondo Road, about 3000 ft east of the former TA-12 entrance. Use of former TA-12 was discontinued in 1953. A 1959 survey showed that the building was contaminated with HE. The control building was destroyed in 1960 by intentional burning.

The nearest downstream canyon investigation reach is TH-1C, located approximately 1800 ft southeast of AOC C-12-002 (Figure 4.1-2 and Plate 1). Canyon investigations are described in section 9.2.

4.5.1 Summary of Previous Investigations for AOC C-12-002

A 1959 inspection reported building 12-2 to be contaminated with HE (Blackwell 1959, 005773).

In 1995, RFI activities were performed at AOC C-12-002. One sample was collected from one location and analyzed for uranium (LANL 1996, 054086, pp. 5-5–5-8). The 1995 requested analysis is presented in Table 2.5-1 of the Threemile Canyon Aggregate Area HIR.

4.5.2 Summary of Data for AOC C-12-002

Data from the 1995 sampling event are presented in Table 2.5-2 of the Threemile Canyon Aggregate Area HIR. The sampling location and results for inorganic chemicals detected above BVs are shown in Figure 2.1-2 of the Threemile Canyon Aggregate Area HIR. Uranium was detected above BV in one sample.

The nature and extent of contamination have not been defined for this site.

4.5.3 Scope of Activities for AOC C-12-002

A total of 10 samples will be collected from the surface and subsurface at five locations within and bounding the footprint of the former building (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the 10 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

4.6 AOC C-12-003, Potential Soil Contamination Associated with Former Building

AOC C-12-003 is the area of potential soil contamination associated with a former HE-storage magazine (building 12-3) for the former TA-12 firing sites (Figure 4.1-1). The magazine was built in 1944 of wood-frame construction and measured 6 ft × 6 ft × 7 ft, with soil on three sides and on top. The building was located north of Redondo Road, about 3000 ft east of the former TA-12 entrance. Use of former TA-12 was discontinued in 1953. A 1959 survey reported the building was contaminated with HE. In 1960, building 12-3 was destroyed by intentional burning.

The nearest downstream canyon investigation reach is TH-1C, located approximately 2000 ft southeast of AOC C-12-003 (Figure 4.1-2 and Plate 1). Canyon investigations are described in section 9.2.

4.6.1 Summary of Previous Investigations for AOC C-12-003

A 1959 inspection reported building 12-3 to be contaminated with HE (Blackwell 1959, 005773).

No sampling has been conducted at this AOC.

4.6.2 Summary of Data for AOC C-12-003

The nature and extent of contamination have not been defined for this site.

4.6.3 Scope of Activities for AOC C-12-003

A total of 10 samples will be collected from the surface and subsurface at five locations within and bounding the footprint of the former building (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the 10 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

4.7 AOC C-12-004, Potential Soil Contamination Associated with Former Building

AOC C-12-004 is the area of potential soil contamination associated with a former generator building (building 12-5) for the former TA-12 firing sites (Figure 4.1-1). The generator building was of wood-frame construction and originally located next to a former junction box (structure 12-6) but was relocated 10 ft north of the former control building (building 12-2) in 1952. Use of generator building 12-5 was discontinued in 1953. A survey conducted in 1959 determined that the generator building was free of radiation and HE contamination (Blackwell 1959, 005773). The building was destroyed in 1960 by intentional burning (LANL 1996, 054086, pp. 5-12–5.15).

The nearest downstream canyon investigation reach is TH-1C, located approximately 1800 ft southeast of AOC C-12-004 (Figure 4.1-2 and Plate 1). Canyon investigations are described in section 9.2.

4.7.1 Summary of Previous Investigations for AOC C-12-004

A 1959 survey showed that building 12-5 was free of radioactive and HE contamination (Blackwell 1959, 005773).

In 1995, RFI activities were conducted at AOC C-12-004. One sample was collected from one location and analyzed for SVOCs (LANL 1996, 054086, p. 5-12). The 1995 requested analyses are presented in Table 2.7-1 of the Threemile Canyon Aggregate Area HIR.

4.7.2 Summary of Data for AOC C-12-004

No SVOCs were detected.

The nature and extent of contamination have not been defined for this site.

4.7.3 Scope of Activities for AOC C-12-004

A total of 10 samples will be collected from the surface and subsurface at five locations within and bounding the footprint of the former building (Figure 4.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the 10 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

5.0 PROPOSED INVESTIGATION ACTIVITIES AT TA-14

TA-14 (Plate 1) was established during World War II and used by X Division to test explosives beginning in 1944 (LANL 1996, 054086, p. 1-1). This site was used primarily for close-observation work on small explosive charges. Tests were conducted in open and closed firing chambers (LANL 1996, 054086, p. 1-1). Some of these tests used radioactive materials (LANL 1994, 034755). In 1994, experimental HE was subjected to performance testing. TA-14 remains active with scheduled tests at the firing area and bullet test facility (LANL 1994, 034755, p. 1-11). In May 2000, the Cerro Grande fire moved through this area, and surface structures were damaged or destroyed along with surface and over-story vegetation.

The Threemile Canyon Aggregate Area contains one AOC associated with TA-14; this site will be investigated as part of this work plan.

The following sections present a site description, a summary of previous investigation activities, and proposed sampling activities for the AOC at TA-14. Table 4.0-1 summarizes the investigation strategy for this AOC.

In addition to the analytical suites proposed in Table 4.0-1, PCB analysis will be performed on 20% of the samples collected at the site.

5.1 AOC C-14-006, Potential Soil Contamination Associated with Former Building

AOC C-14-006 is an area of potential soil contamination associated with an HE magazine, former building 14-9, located 60 ft northwest of the current HE magazine, building 14-22 (Figure 5.1-1). The former HE magazine was constructed of wood and measured 6 ft × 6 ft × 6 ft. A soil berm surrounded three sides of the former magazine, and soil covered the top of the structure. The former magazine was built in 1945 and removed in 1952. The former magazine location is covered with loose fill, possibly resulting from leveling the berm that surrounded the magazine. An asphalt road that circled the magazine is still visible. The location of AOC C-14-006 was determined from a 1950 Laboratory photograph (LANL 1996, 054086, pp. 5-61–5-64).

The nearest downstream canyon investigation reach is TH-1W, located approximately 900 ft north of AOC C-14-006 (Plate 1). Canyon investigations are described in section 9.2.

5.1.1 Summary of Previous Investigations for AOC C-14-006

No sampling has been conducted at this AOC.

5.1.2 Summary of Data for AOC C-14-006

The nature and extent of contamination have not been defined for this site.

5.1.3 Scope of Activities for AOC C-14-006

A total of 10 samples will be collected from the surface and subsurface at five locations within and bounding the footprint of the former building (Figure 5.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, HE, SVOCs, VOCs, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the 10 samples will be analyzed for PCBs. Dioxins and furans will not be analyzed for at this site because they are not contaminants based on knowledge of the site’s operations (i.e., an area of potential soil contamination associated with a former HE magazine). Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.0 PROPOSED INVESTIGATION ACTIVITIES AT TA-15

TA-15 (Plate 1) was established in 1945 as a firing site area. Current activities at TA-15 consist of HE research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. Many large explosive tests have taken place with the concurrent scattering of large amounts of natural uranium or depleted uranium (DU) and, to a lesser extent, beryllium and lead (LANL 1994, 040595).

The Threemile Canyon Aggregate Area contains 21 sites associated with TA-15. Of these, 4 sites are deferred per Table IV-2 of the Consent Order, 6 sites are approved for NFA, and 11 sites will be investigated as part of this work plan.

The following sections present site descriptions and summaries of previous investigation activities for 15 sites (including the deferred), and proposed sampling activities for the 11 SWMUs and AOCs under investigation at TA-15. Table 4.0-1 summarizes the investigation strategy proposed in this work plan for each SWMU or AOC.

In addition to the analytical suites proposed for each site in Table 4.0-1, PCB analysis will be performed on a minimum of 20% of the samples collected at TA-15.

6.1 SWMU 15-004(a), Firing Site C

SWMU 15-004(a), Firing Site C, is located near the center of TA-15 (Figure 6.1-1). SWMU 15-004(a) is deferred per Table IV-2 of the Consent Order (Table 1.1-1). Firing Site C began operations in 1944 and was used until 1948 or 1949. Concrete slabs [AOC 15-004(d)] were used as firing platforms at this site but were removed in 1947.

Additional structures associated with Firing Site C included a former control building and a former x-unit, a structure that contained a firing voltage distribution system used for the remote detonation of test firings. The former control building was a wood-frame structure that measured 11 ft × 17 ft × 10 ft. It was located 0.5 mi to the northeast of Firing Site C, built in 1944, and removed in 1962. The x-unit was a steel caging embedded in concrete that measured 6 ft × 10 ft × 4 ft, built in 1947, ceased operating in 1948, and was removed in 1969.

The explosive tests at Firing Site C were conducted within 25 ft of the x-unit, which indicates the explosions were small (LANL 1993, 020946).

The nearest downstream canyon investigation reach is THS-1W, located approximately 3200 ft east of SWMU 15-004(a) (Plate 1). Canyon investigations are described in section 9.2.

6.1.1 Summary of Previous Investigations for SWMU 15-004(a)

In 1991, one soil sample was collected from one location near the former x-unit site during the Sanitary Wastewater Systems Consolidation (SWSC) Project and analyzed for inorganic chemicals and radionuclides. The 1991 requested analyses are presented in Table 4.1-1 of the Threemile Canyon Aggregate Area HIR.

In 1995, RFI activities were performed at SWMU 15-004(a). Fourteen samples from nine locations were analyzed for inorganic chemicals and radionuclides. The 1995 requested analyses are presented in Table 4.1-1 of the Threemile Canyon Aggregate Area HIR.

6.1.2 Summary of Data for SWMU 15-004(a)

Analytical data from the 1991 sampling event are presented in Table 4.1-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 4.1-2 of the Threemile Canyon Aggregate Area HIR. Barium, copper, lead, and uranium were detected above BVs in one sample. Radionuclides were not detected or detected above BVs/FVs.

Analytical data from the 1995 sampling event are presented in Tables 4.1-2 and 4.1-3 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs and radionuclides detected or detected above BVs/FVs are shown in Figures 4.1-2 and 4.1-3, respectively, of the Threemile Canyon Aggregate Area HIR. Copper was detected above BV in six samples. Lead was detected above BV in seven samples. Mercury was detected above BV in one sample. Nickel was detected above BV in one sample. Uranium was detected above BV in 14 samples. Europium-152 was detected in one sample. Uranium-235 was detected or detected above BV in one sample.

The nature and extent of contamination have not been defined for this site.

6.1.3 Scope of Activities for SWMU 15-004(a)

SWMU 15-004(a) is deferred per Table IV-2 of the Consent Order. No investigation activities are proposed in this work plan.

6.2 AOC 15-004(d), Firing Platforms

AOC 15-004(d) consists of two former 12-ft × 12-ft × 2-ft concrete firing platforms (former structures 15-176 and 15-177) that were built in 1944 and removed in 1947 (Figure 6.1-1). The specific location of the platforms is not known. Engineering drawings show that the firing platforms were located at Firing Site R, which is collocated with Firing Site C [SWMU 15-004(a)] (LASL 1944, 072795; LASL 1948, 023958; LASL 1971, 024036). AOC 15-004(d) lies entirely within the boundaries of SWMU 15-004(a).

The nearest downstream canyon investigation reach is THS-1W, located approximately 3200 ft east of SWMU 15-004(a) (Plate 1). Canyon investigations are described in section 9.2.

6.2.1 Summary of Previous Investigations for AOC 15-004(d)

The 1991 SWSC Project sampling event and the 1995 RFI activities conducted at SWMU 15-004(a) are applicable to AOC 15-004(d) and are summarized in section 6.1.1.

6.2.2 Summary of Data for AOC 15-004(d)

The nature and extent of contamination have not been defined for this site.

6.2.3 Scope of Activities for AOC 15-004(d)

The location of the former AOC 15-004(d) firing platforms lies entirely within the boundary of and is collocated with SWMU 15-004(a). The investigation of surface soil contamination at SWMU 15-004(a) is deferred per Table IV-2 of the Consent Order. Because AOC 15-004(d) is collocated with SMWU 15-004(a), the surface characterization of AOC 15-004(d) cannot be conducted without compromising the surface soil of SWMU 15-004(a), which is deferred for investigation. Therefore, it is proposed that the full characterization of AOC 15-004(d) be delayed until characterization of the deferred site is conducted. In the interim, a sampling strategy is proposed in this work plan to determine if contaminants are migrating off-site.

A total of eight samples will be collected from the surface and subsurface at four locations beyond the historical sample locations to determine the lateral extent of contamination (Figure 6.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.3 AOC 15-005(c), Container Storage Area (R-41)

AOC 15-005(c) consists of an outdoor container storage area located near a storage building (building 15-41) in the central portion of TA-15, near Firing Site C (Figure 6.1-1). The ground surface on the northern, western, and eastern sides of the building is unpaved, and an asphalt road runs along the southern side. The operational period of this site is not known (LANL 1993, 020946, p. 10-18).

The nearest downstream canyon investigation reach is THM-1, located approximately 3500 ft northeast of AOC 15-005(c) (Plate 1). Canyon investigations are described in section 9.2.

6.3.1 Summary of Previous Investigations for AOC 15-005(c)

RFI activities were performed at AOC 15-005(c) in 1995 and reported in 1996. Four samples were collected from two locations and analyzed for inorganic chemicals. The 1995 requested analyses are presented in Table 4.3-1 of the Threemile Canyon Aggregate Area HIR.

6.3.2 Summary of Data for AOC 15-005(c)

Data from the 1996 sampling event are presented in Table 4.3-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 6.1-2. Cadmium was detected above BV in one sample. Uranium was detected above BV in four samples.

The nature and extent of contamination have not been defined for this site.

6.3.3 Scope of Activities for AOC 15-005(c)

A total of 14 samples will be collected from the surface and subsurface at seven locations at the storage area within and bounding the site (Figure 6.1-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, volatile organic compounds (VOCs), SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Three of the 14 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of six samples will also be collected from the surface and subsurface at three locations in the drainage ditch along the access road adjacent to and southwest of the storage area. Samples will be collected from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, and gamma spectroscopy. Two of the six samples will be analyzed for PCBs.

6.4 SWMU 15-006(b), Ector Firing Site

SWMU 15-006(b) is the Ector firing site, used for dynamic radiography of explosion-driven weapons components (Figure 6.4-1). SWMU 15-006(b) is deferred per Table IV-2 of the Consent Order (Table 1.1-1). This SWMU is located along the eastern side of TA-15. The firing site was originally established in 1973 and used periodically until 1982. The Ector radiography machine was constructed at this site, and the site has operated with this machine from the mid-1980s to the present. Structures associated with the firing site are the firing point chamber (structure 15-276), the multidiagnostic hydrotest building (building 15-306), and the blast-protection structure (structure 15-319). Materials used in the tests included uranium, beryllium, lead, and HE (LANL 1993, 020946, p. 6-9).

The nearest downstream canyon investigation reach is THS-1W, located approximately 2200 ft east of SWMU 15-006(b) (Plate 1). Canyon investigations are described in section 9.2.

6.4.1 Summary of Previous Investigations for SWMU 15-006(b)

No sampling has been conducted at this SWMU.

6.4.2 Summary of Data for SWMU 15-006(b)

The nature and extent of contamination have not been defined for this site.

6.4.3 Scope of Activities for SWMU 15-006(b)

SWMU 15-006(b) is deferred per Table IV-2 of the Consent Order. No investigation activities are proposed in this work plan.

6.5 Consolidated Unit 15-006(c)-99

Consolidated Unit 15-006(c)-99 consists of SWMUs 15-006(c) and 15-008(b) (Figure 6.5-1). This consolidated unit is located along the eastern side of TA-15.

The nearest downstream canyon investigation reach is THM-1, located less than 100 ft east of the boundary of Consolidated Unit 15-006(c)-99. Canyon investigation reaches and sampling locations are shown in Figure 6.5-2. Canyon investigations are described in section 9.2.

6.5.1 SWMU 15-006(c), Firing Site R-44

SWMU 15-006(c) is Firing Site R-44, named for its control building (structure 15-44) and was the third most extensively used firing site at TA-15 (Figure 6.5-1). SWMU 15-006(c) is deferred per Table IV-2 of the Consent Order (Table 1.1-1). This firing site was originally constructed in 1951 and was used extensively from 1956 to 1978 for diagnostic tests of weapons components. The diagnostic capabilities of this site differed from those of the Pulsed High-Energy Radiographic Machine Emitting X-rays (PHERMEX) and Ector firing sites, also located in TA-15. Once PHERMEX and Ector became operational, Firing Site R-44 was used only for small experiments. The last known use of Firing Site R-44 was in 1992. Materials used in the tests included uranium, beryllium, lead, and HE. This firing site is located on a flat, open area on a narrow mesa that overlooks Threemile Canyon. Debris from explosives tests has been scattered onto the slope and into the canyon (LANL 1993, 020946, p. 6-8).

6.5.1.1 Summary of Previous Investigations for SWMU 15-006(c)

In 1991, a surface radiological survey indicated elevated exposure rates associated with chunks of uranium. This survey was used to identify large pieces of uranium for removal (Schlapper 1991, 022533).

SWMU 15-006(c) was sampled during 1995 RFI activities. A total of 39 samples were collected from 23 locations and analyzed for inorganic chemicals, HE, and tritium. The requested analyses are presented in Table 4.5-1 of the Threemile Canyon Aggregate Area HIR.

6.5.1.2 Summary of Data for SWMU 15-006(c)

Analytical data for the 1995 RFI activities are presented in Tables 4.5-2, 4.5-3, and 4.5-4 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs, organic chemicals detected, and radionuclides detected or detected above BVs/FVs are shown in Figures 4.5-2, 4.5-3, and 4.5-4, respectively, of the Threemile Canyon Aggregate Area HIR. Aluminum was detected above BV in one sample. Antimony was detected above BV in two samples. Arsenic was detected above BV in one sample. Beryllium was detected above BV in 26 samples. Cadmium was detected above BV in two samples. Calcium was detected above BV in one sample. Chromium was detected above BV in five samples. Copper was detected above BV in 31 samples. Lead was detected above BV in 28 samples. Mercury was detected above BV in two samples. Nickel was detected above BV in four samples. Silver was detected above BV in seven samples. Uranium was detected above BV in 32 samples. Zinc was detected above BV in 11 samples. HMX (1,3,5,7-tetranitro-1,3,5,7-tetrazocine) was detected in 21 samples. RDX was detected in eight samples. Tritium was detected in 29 samples.

The nature and extent of contamination have not been defined for this site.

6.5.1.3 Scope of Activities for SWMU 15-006(c)

SWMU 15-006(c) is deferred per Table IV-2 of the Consent Order. No investigation activities are proposed for this site in this work plan.

6.5.2 SWMU 15-008(b), Surface Disposal Area Associated with Firing Site R-44

SWMU 15-008(b) is a surface disposal area located north of Firing Site R-44 [SWMU 15-006(c)] and extending along the edge of the mesa and downslope into Threemile Canyon (Figure 6.5-1). The surface disposal area potentially covers approximately 8.5 acres. Firing Site R-44 was built in 1951 for diagnostic tests of weapons components and used extensively until 1978 and sporadically until 1992 (LANL 1993, 020946, p. 6-8; LANL 1995, 050294, p. 4-73). Soil and debris from the firing site were disposed of at SWMU 15-008(b).

6.5.2.1 Summary of Previous Investigations for SWMU 15-008(b)

During 1995 RFI activities, 24 samples were collected from 18 locations and analyzed for inorganic chemicals, HE, and radionuclides. The requested analyses are presented in Table 4.5-5 of the Threemile Canyon Aggregate Area HIR.

An expedited cleanup (EC) was performed during 2000 following the Cerro Grande fire. The EC activities included removing 20 yd^3 of firing site debris from the SWMU and surrounding area and emplacing erosion-control features (such as straw wattles, rock check dams, and silt fencing) (LANL 2001, 071342, pp. 22–23). No sampling was conducted as part of this EC.

6.5.2.2 Summary of Data for SWMU 15-008(b)

Analytical data for the 1994 RFI activities are presented in Tables 4.5-6 and 4.5-7 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs and radionuclides detected or detected above BVs/FVs are shown in Figures 4.5-5 and 4.5-6, respectively, of the Threemile Canyon Aggregate Area HIR. Antimony was detected above BV in four samples. Arsenic was detected above BV in one sample. Beryllium was detected above BV in 14 samples. Cadmium was detected above BV in two samples. Chromium was detected above BV in one sample. Calcium was detected above BV in one sample. Copper was detected above BV in 19 samples. Lead was detected above BV in 16 samples. Mercury was detected above BV in two samples. Nickel was detected above BV in one sample. Silver was detected above BV in four samples. Uranium was detected above BV in 21 samples. Zinc was detected above BV in 10 samples. Cesium-137 was detected or detected above BV in one sample. Tritium was detected in seven samples. No HE was detected.

The nature and extent of contamination have not been defined for this site.

6.5.2.3 Scope of Activities for SWMU 15-008(b)

A total of 112 samples will be collected from the surface and subsurface at 56 locations at the disposal area on the mesa top and edge (Figure 6.5-2). The samples will be located on a grid with 50-ft centers. The grid will be sampled at a higher density (every node) proximal to the firing-site location extending to the mesa edge (most easily accessible by a bulldozer) and at a lesser density tapering to the periphery of the site. Samples will be collected from two depths (0 to 0.5 ft and 3 to 4 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Twenty-three of the 112 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of 52 samples will be collected from the surface and subsurface at 26 locations on the slope and in drainages below and bounding the disposal area and extending to the eastern boundary of sediment reach THM-1. The samples will be biased toward areas of sediment accumulation to confirm the results of previous investigations and further define the nature and extent of contamination (Figure 6.5-2). Samples will be collected from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy and tritium. Eleven of the 52 samples will be analyzed for PCBs.

6.6 Consolidated Unit 15-006(d)-99

Consolidated Unit 15-006(d)-99, which consists of SWMU 15-006(d) and AOC 15-008(g) (Figure 6.6-1), is located in the northeast corner of TA-15.

The nearest downstream canyon investigation reach is TH-1E, located approximately 600 ft north of Consolidated Unit 15-006(d)-99 (Plate 1). Canyon investigations are described in section 9.2.

6.6.1 SWMU 15-006(d), Firing Site R-45

SWMU 15-006(d) is Firing Site R-45, named for its control building (structure 15-45) (Figure 6.6-1). SWMU 15-006(d) is deferred per Table IV-2 of the Consent Order (Table 1.1-1). This firing site was constructed in 1951 and used until 1992. This site was the least used of the TA-15 firing sites. Firing Site R-45 had two firing points and was used for experiments involving small amounts of explosives, such as testing shock-wave phenomena and optical diagnostics. Materials used in the tests at this site include uranium, beryllium, lead, and HE (LANL 1996, 054977, pp. 5-94–5-97).

6.6.1.1 Summary of Previous Investigations for SWMU 15-006(d)

A surface radiological survey conducted in 1991 detected localized, elevated radiation at the surface of the camera building closest to the firing point (Schlapper 1991, 022533).

SWMU 15-006(d) was sampled during 1995 RFI activities. A total of 23 samples were collected from 17 locations and analyzed for inorganic chemicals and HE (LANL 1996, 054977, p. 5-97). The requested analyses are presented in Table 4.6-1 of the Threemile Canyon Aggregate Area HIR.

6.6.1.2 Summary of Data for SWMU 15-006(d)

Analytical data for the 1995 RFI activities are presented in Table 4.6-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 4.6-2 of the Threemile Canyon Aggregate Area HIR. Calcium was detected above BV in four samples. Copper was detected above BV in three samples. Lead was detected above BV in three samples. Sodium was detected above BV in one sample. Uranium was detected above BV in 22 samples. No HE was detected.

The nature and extent of contamination have not been defined for this site.

6.6.1.3 Scope of Activities for SWMU 15-006(d)

SWMU 15-006(d) is deferred per Table IV-2 of the Consent Order. No investigation activities are proposed in this work plan.

6.6.2 AOC 15-008(g), Surface Disposal Associated with Firing Site R-45

AOC 15-008(g) is the location of a former pile of broken sandbags located at Firing Site R-45 [SWMU 15-006(d)] (Figure 6.6-1). These sandbags were used as shielding for the explosives tests carried out at the firing site (LANL 1996, 054977, p. 5-103). A 2008 site visit found the sandbags had been removed.

6.6.2.1 Summary of Previous Investigations for AOC 15-008(g)

As part of 1995 RFI activities, a radiological survey of the site was conducted, and one sample was collected from one location. The sample was submitted for analyses of inorganic chemicals and HE (LANL 1996, 054977, p. 5-104). The requested analyses are presented in Table 4.6-3 of the Threemile Canyon Aggregate Area HIR.

6.6.2.2 Summary of Data for AOC 15-008(g)

Analytical data for the 1995 RFI activities are presented in Table 4.6-4 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 4.6-2 of the Threemile Canyon Aggregate Area HIR. Calcium was detected above BV in one sample. No HE was detected.

The nature and extent of contamination have not been defined for this site.

6.6.2.3 Scope of Activities for AOC 15-008(g)

A total of eight samples will be collected from the surface and subsurface at four locations within and bounding the best estimate of the location of the disposal site (Figure 6.6-2). Samples will be collected from two depths (0 to 0.5 ft and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.7 Consolidated Unit 15-007(c)-00

Consolidated Unit 15-007(c)-00 consists of SWMUs 15-007(c) and 15-007(d), both underground shafts dug into the tuff and used to conduct underground explosive tests (LANL 1990, 007512; LANL 1993, 020946, p. 5-9) (Figure 6.7-1). Each shaft is 6 ft in diameter and approximately 130 ft deep. The shaft openings are located within 20-ft × 20-ft concrete pads and are covered. Both shafts are located approximately 300 ft east of building 15-263, in the northeast corner of TA-15 near Firing Site R-45. Both shafts were constructed in 1972 and each was used for a single test (LANL 1993, 020946 pp. 5-9–5-12).

The nearest downstream canyon investigation reach is THM-1, located approximately 2200 ft east of Consolidated Unit 15-007(c)-00 (Plate 1). Canyon investigations are described in section 9.2.

6.7.1 SWMU 15-007(c), Shaft

The SWMU 15-007(c) shaft (structure 15-264) was used to conduct a single test involving approximately 2 tons of HE (Figure 6.7-1). This test was designed to determine the ability of tuff to absorb the explosion. The explosion was confined to the bottom of the shaft that was filled with layers of magnetite, cement, sand grout, bentonite, sand, and gravel. HE was the only material used in the underground test (LANL 1993, 020946, p. 5-9). Pieces of 0.25-in.-diameter lead shot are present at the site, scattered on the concrete pad at the surface of the shaft. The source of this lead is probably the bags of lead shot used for instrument shielding during the experiment. Shot is also present on the soil next to three sides of the pad (LANL 1997, 056562, p. 1).

6.7.1.1 Summary of Previous Investigations for SWMU 15-007(c)

No sampling has been conducted at this SWMU.

6.7.1.2 Summary of Data for SWMU 15-007(c)

The nature and extent of contamination have not been defined for this site.

6.7.1.3 Scope of Activities for SWMU 15-007(c)

Visible lead shot will be removed from the concrete pad and surrounding area and disposed of at an appropriate waste facility. Following removal activities, a total of 48 samples will be collected from the surface and subsurface at 24 locations on a grid centered on the shaft within the 20-ft × 20-ft concrete pad. Eight locations will be at the corners and sides of the pad at 10-ft spacing, and the remaining 16 locations will be on offset 20-ft nodes extending 30 ft from the center point of the grid (Figure 6.7-2). Samples will be collected from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, cyanide, perchlorate, and HE. Five of the 24 samples will be analyzed for PCBs. Because the SWMU 15-007(c) shaft (structure 15-264) was used to conduct a single test involving approximately 2 tons of HE (i.e., HE was the only material used in the underground test), samples will not be analyzed for other organic chemicals and radionuclides. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of 36 subsurface samples will be collected from three boreholes bounding an approximate 50-ft radius from the shaft (Figure 6.7-2). Three borehole locations were chosen to bound the extent of contamination that could originate from the symmetric nature of the test performed at this site. One of the three boreholes will be located equidistant between the SWMUs 15-007(c) and 15-007(d) (section 6.7.2) to concurrently define the extent of contaminants from both shafts. The target total depth of each borehole will be 180-ft bgs. A 50-ft separation from the center and base of the shaft will provide the lateral and vertical extent of contamination. In each borehole, samples will be collected from 12 depths at approximately 15-ft intervals and analyzed for TAL metals, cyanide, perchlorate, HE, and tritium. The samples will be biased toward fractures or zones of higher permeability, if present. Eight of the 36 samples will be analyzed for PCBs. Because the shaft was used only once and HE was the only material used in the underground test, samples will not be analyzed for other organic chemicals and radionuclides. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.7.2 SWMU 15-007(d), Shaft

The SWMU 15-007(d) shaft (structure 15-265) was used to conduct a single test involving HE, tritium, and beryllium (Figure 6.7-1). This test was confined to the bottom of the shaft that was filled in the same manner described for SWMU 15-007(c) (LANL 1993, 020946, p. 5.9).

6.7.2.1 Summary of Previous Investigations for SWMU 15-007(d)

No sampling has been conducted at this SWMU.

6.7.2.2 Summary of Data for SWMU 15-007(d)

The nature and extent of contamination have not been defined for this site.

6.7.2.3 Scope of Activities for SWMU 15-007(d)

A total of 24 subsurface samples will be collected from two boreholes bounding a radius of approximately 50 ft from the shaft (Figure 6.7-2). One borehole proposed at SWMU 15-007(c) (section 6.7.1) will be located approximately equidistant between the two shafts and will also be used to characterize SMWU 15-007(d). These two borehole locations were chosen to bound the extent of contamination that could originate from the symmetric nature of the test performed at this site. The target total depth of each borehole will be 180 ft bgs. A 50-ft separation from the center and base of the shaft will provide the lateral and vertical extent of contamination. In each borehole, samples will be collected from 12 depths at 15-ft intervals and analyzed for TAL metals, cyanide, perchlorate, HE, and tritium. The samples will be biased toward fractures or zones of higher permeability, if present. Four of the 24 samples will be analyzed for PCBs. Because the SWMU 15-007(d) shaft (structure 15-265) was used to conduct a single test involving only HE, tritium, and beryllium samples will not be analyzed for other organic chemicals and radionuclides. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.8 SWMU 15-009(b), Septic System

SWMU 15-009(b) is a septic system consisting of a tank (structure 15-61), seepage pit, associated drainlines, and former outfall (LANL 2003, 102118) located at Firing Site R-45 (Figure 6.6-1). The septic tank was constructed in 1951 of reinforced concrete with a 540-gal. capacity (LANL 1990, 007512).

This septic system received effluent from restroom facilities in the firing site control building 15-45 (LANL 1990, 007512). This septic tank discharged to an outfall. In the 1970s, a 4-ft-diameter × 50-ft-deep seepage pit was constructed to receive effluent from the tank, and the outfall was plugged (LANL 2003, 102118). From engineering schematics and site visits, the seepage pit and former outfall are assumed to be collocated.

The nearest downstream canyon investigation reach is THM-1, located approximately 2600 ft east of SWMU 15-009(b) (Plate 1). Canyon investigations are described in section 9.2.

6.8.1 Summary of Previous Investigations for SWMU 15-009(b)

No sampling has been conducted at this SWMU.

6.8.2 Summary of Data for SWMU 15-009(b)

The nature and extent of contamination have not been defined for this site.

6.8.3 Scope of Activities for SWMU 15-009(b)

The septic tank and its contents will be removed, characterized, and disposed of at an appropriate waste facility. Site characterization will be performed after the septic tank is removed using the methods discussed in section 8.9. After the tank has been removed, eight subsurface samples will be collected from four locations beneath the inlet pipe, tank inlet, tank, and tank outlet (Figure 6.6-2). Samples will be collected from two depths (at the base of the line or tank and 5 ft below the line or tank, biased toward fractures or zones of higher permeability, if present) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. Samples collected below the tank, tank inlet, and tank outlet will serve as confirmation samples following the removal of the septic tank.

Four subsurface samples will be collected from one borehole next to and downgradient of the seepage pit to determine the extent of contamination beyond the seepage pit (Figure 6.6-2). Samples will be collected from four depths (50 to 51 ft, 60 to 61 ft, 70 to 71 ft, and 80 to 81 ft) biased toward fractures or zones of higher permeability, if present, and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. One of the four samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of eight samples will be collected from the surface and subsurface at four locations in the drainage below the outfall (Figure 6.6-2). Samples will be collected approximately every 50 ft from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.9 SWMU 15-009(c), Septic System

SWMU 15-009(c) is a septic system consisting of a tank (structure 15-62), associated drainlines, and outfall (LANL 2003, 102119) located at Firing Site R-44 (Figure 6.5-1). The septic tank was constructed in 1951 of reinforced concrete with a 540-gal. capacity (LANL 1990, 007512). The drainlines were constructed of cast iron and discharged to an outfall into the south fork of Threemile Canyon. The outfall is located approximately 25 ft downgradient of the tank (LANL 2003, 102119).

This septic system received effluent from restroom facilities in the firing site control building 15-44 (LANL 1994, 040595, p. 7). An engineering drawing shows that the outfall has been plugged (LANL 2003, 102119).

The nearest downstream canyon investigation reach is THS-1W, located approximately 750 ft southeast of SWMU 15-009(c) (Figure 6.5-2 and Plate 1). Canyon investigations are described in section 9.2.

6.9.1 Summary of Previous Investigations for SWMU 15-009(c)

In 1998, interim action RFI activities were performed at SWMU 15-009(c). Nine samples were collected from four locations and analyzed for inorganic chemicals and radionuclides. Samples collected and analyses requested are presented in Table 4.9-1 of the Threemile Canyon Aggregate Area HIR.

6.9.2 Summary of Data for SWMU 15-009(c)

Analytical data from the 1998 interim action are presented in Table 4.9-2 of the Threemile Canyon Aggregate Area HIR. Sampling location coordinates are not available for these samples and therefore are not shown in a figure. Beryllium was detected above BV in one sample. No radionuclides were detected or detected above BVs/FVs.

The nature and extent of contamination have not been defined for this site.

6.9.3 Scope of Activities for SWMU 15-009(c)

The septic tank and its contents will be removed, characterized, and disposed of at an appropriate waste facility. Site characterization will be performed after the septic system is removed using the methods discussed in section 8.9. After the tank has been removed, eight subsurface samples will be collected from four locations beneath the inlet pipe, tank inlet, tank, and tank outlet (Figure 6.5-2). Samples will be collected from two depths (at the base of the line or tank and 5 ft below the line or tank) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. Samples collected below the tank, tank inlet, and tank outlet will serve as confirmation samples following the removal of the septic tank.

A total of 26 samples will be collected from the surface and subsurface at 13 locations in the drainage below the outfall (Figure 6.5-2). Samples will be collected approximately every 50 ft from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Six of the 26 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.10 SWMU 15-009(h), Septic System

SWMU 15-009(h) is a septic system consisting of a tank (structure 15-282), associated drainlines, and a drain field (LANL 2003, 102117) at the Ector firing site on the east side of TA-15 (Figure 6.4-1). The septic tank was constructed in the late 1970s of reinforced concrete with a 905-gal. capacity (LANL 1990, 007512; LANL 1994, 040595, p. 8).

The septic tank flowed to a drain field and received effluent from restroom facilities in the Ector firing site control building 15-280 (LANL 1990, 007512). In the 1990s, the sanitary waste drainlines that served this septic system were rerouted to the SWSC plant and are currently active (LANL 2003, 102117).

The nearest downstream canyon investigation reach is THS-1W, located approximately 2000 ft east of SWMU 15-009(h) (Plate 1). Canyon investigations are described in section 9.2.

6.10.1 Summary of Previous Investigations for SWMU 15-009(h)

No sampling has been conducted at this SWMU.

6.10.2 Summary of Data for SWMU 15-009(h)

The nature and extent of contamination have not been defined for this site.

6.10.3 Scope of Activities for SWMU 15-009(h)

The septic tank and its contents will be removed, characterized, and disposed of at an appropriate waste facility. Site characterization will be performed after the septic tank is removed using the methods discussed in section 8.9. After the tank has been removed, eight subsurface samples will be collected from four locations beneath the inlet pipe, tank inlet, tank, and tank outlet (Figure 6.10-1). Samples will be collected from two depths (at the base of the line or tank and 5 ft below the line or tank) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. Samples collected below the tank, tank inlet, and tank outlet will serve as confirmation samples following the removal of the septic tank.

A total of eight subsurface samples will be collected from four locations in the drain field (Figure 6.10-1). Samples will be collected from two depths (base of the drainline and 5 ft below the base of the drainline) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.11 SWMU 15-010(b), Settling Tank

SWMU 15-010(b) is a settling tank (structure 15-147) (LANL 2004, 102120) located in the northwest corner of TA-15 near a shop building (building 15-8) (Figure 6.11-1). The tank was constructed in 1947 and originally designed to be a septic tank; however, subsequent engineering records confirm that the tank was also used as an HE settling tank. The tank is constructed of concrete and measures 5 ft × 5 ft × 5.5 ft with an approximate 900-gal. capacity (LANL 1990, 007512).

This tank served building 15-8, which housed HE-machining operations during the 1950s, and discharged to an outfall at the edge of Threemile Canyon (LANL 1993, 020946, p. 10-25).

The nearest downstream canyon investigation reach is TH-1C, located approximately 1300 ft northeast of SWMU 15-010(b) (Plate 1). Canyon investigations are described in section 9.2.

6.11.1 Summary of Previous Investigations for SWMU 15-010(b)

In 1995, RFI activities were performed for SWMU 15-010(b). Four samples were collected from three locations and analyzed for HE. Samples collected and analyses requested are presented in Table 4.11-1 of the Threemile Canyon Aggregate Area HIR.

6.11.2 Summary of Data for SWMU 15-010(b)

Analytical data from the RFI activities are presented in Table 4.11-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for detected HE are shown in Figure 4.11-2 of the Threemile Canyon Aggregate Area HIR. Amino-4,6-dinitrotoluene[2-] was detected in one sample.

The nature and extent of contamination have not been defined for this site.

6.11.3 Scope of Activities for SWMU 15-010(b)

The settling tank and its contents will be removed, characterized, and disposed of at an appropriate waste facility. Site characterization will be performed after the settling tank is removed using the methods discussed in section 8.9. After the tank has been removed, eight subsurface samples will be collected from four locations beneath the inlet pipe, tank inlet, tank, and tank outlet (Figure 6.11-2). Samples will be collected from two depths (at the base of the line or tank and 5 ft below the line or tank) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the eight samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. Samples collected below the tank, tank inlet, and tank outlet will serve as confirmation samples following the removal of the septic tank.

A total of 18 samples will also be collected from the surface and subsurface at nine locations in the drainage below the outfall (Figure 6.11-2). Samples will be collected approximately every 50 ft from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Four of the 18 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

6.12 AOC 15-014(h), Outfalls from Building 15-40

AOC 15-014(h) consists of three outfalls that served a laboratory and office (building 15-40), located in the northwest corner of TA-15 (Figure 6.12-1). All three outfalls daylight north of building 15-40 and discharge to Threemile Canyon (LANL 1990, 007512; LANL 1993, 020946, p. 10-22).

The western-most outfall is a former National Pollutant Discharge Elimination System- (NPDES-) permitted outfall that received industrial effluent (including wastes from a photographic laboratory) from building 15-40. This outfall consists of an 8-in.-diameter vitrified clay pipe (VCP) that daylights approximately 75 ft north of the northwest corner of building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). Before the outfall was removed from the NPDES permit in 1994 (Dale 1998, 057524), all discharges to this outfall from building 15-40 ceased.

The middle outfall is a former NPDES-permitted outfall that received noncontact cooling water, roof runoff, and floor-drain effluent from building 15-40. The floor drains received water from drain valves in a potable water system. This outfall consists of an 8-in.-diameter VCP that daylights approximately 100 ft north of the northeast corner of building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). Before the outfall was removed from the NPDES permit in 1990 (EPA 1990, 012454), all discharges to this outfall from building 15-40 ceased.

The easternmost outfall receives stormwater from yard drains and is located north and east of building 15-40. This outfall consists of a 12-in. corrugated metal pipe that daylights approximately 75 ft northeast of the northeast corner of building 15-40 (LANL 1990, 007512; LANL 1993, 020946, p. 10-22). From the outfall, an approximately 60-ft-long ditch connects to a 30-ft-long, 12-in. corrugated metal pipe that accommodates drainage beneath a security fence.

The nearest downstream canyon investigation reach is THW-1, located approximately 1500 ft northeast of AOC 15-014(h) (Plate 1). Canyon investigations are described in section 9.2.

6.12.1 Summary of Previous Investigations for AOC 15-014(h)

In 1995, RFI activities were performed at AOC 15-014(h). Four samples were collected from two locations and analyzed for inorganic chemicals, SVOCs, and VOCs. Samples collected and analyses requested are presented in Table 4.12-1 of the Threemile Canyon Aggregate Area HIR.

6.12.2 Summary of Data for AOC 15-014(h)

Analytical data from the 1995 RFI are presented in Tables 4.12-2 and 4.12-3 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs and detected organic chemicals are shown in Figures 4.12-2 and 4.12-3, respectively, of the Threemile Canyon Aggregate Area HIR. Cadmium was detected above BV in two samples. Copper was detected above BV in three samples. Lead was detected above BV in one sample. Mercury was detected above BV in two samples. Silver was detected above BV in three samples. Zinc was detected above BV in two samples. Benzo(b)fluoranthene, fluoranthene, and pyrene were detected in one sample. Acetone and methylene chloride were detected in two samples.

The nature and extent of contamination have not been defined for this site.

6.12.3 Scope of Activities for AOC 15-014(h)

A total of six subsurface samples will be collected from three locations beneath the outfall drainlines (Figure 6.12-2). Samples will be collected from two depths (the base of the line and 5 ft below the base of the line) and analyzed for TAL metals, total uranium, cyanide, perchlorate, VOCs, SVOCs, HE, and isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. Two of the six samples will be analyzed for PCBs.

A total of 46 samples will be collected from the surface and subsurface at 23 locations in the drainages at and below the three outfalls (Figure 6.12-2). Samples will be collected approximately every 50 ft from two depths (0 to 0.5 ft and 1 to 2 ft) and analyzed for TAL metals, total uranium, cyanide, perchlorate, VOCs, SVOCs, HE, and isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

7.0 PROPOSED INVESTIGATION ACTIVITIES AT TA-36

TA-36 (Plate 1) is located in a remote area of the Laboratory. Activities at TA-36 include the storage and assembly of prefabricated metal and explosives components, detonators, cables, and instrumentation for shots and the detonation of these shots (LANL 1993, 015313, p. 2-5). None of the TA-36 sites within Threemile Canyon Aggregate Area are associated with firing site activities.

TA-36 operations associated with the Threemile Canyon Aggregate Area include a laboratory and experiment facility located on a mesa top south of Threemile Canyon and west of TA-18.

The Threemile Canyon Aggregate Area contains five SWMUs and AOCs; one site has been approved for NFA, and four sites will be investigated as part of this work plan.

The following sections present site descriptions, summaries of previous investigation activities, and proposed sampling activities for the four SWMUs and AOCs at TA-36. Table 4.0-1 summarizes the investigation strategy for each SWMU or AOC proposed in this work plan.

In addition to the analytical suites proposed for each site in Table 4.0-1, PCB analysis will be performed on a minimum of 20% of the samples collected at the sites investigated at TA-36, except SWMU C 36-003, where all samples collected will be analyzed for PCBs.

7.1 SWMU 36-002, Former Sump

SWMU 36-002 is a former sump (structure 36-49) located approximately 40 ft northwest of the controlled environment building (building 36-48) near the edge of Threemile Canyon (LASL 1965, 102122) (Figure 7.1-1). The sump consisted of a 4-ft-diameter × 4.5-ft-long section of corrugated metal pipe placed into an unlined 8-ft-deep excavation. The excavation and the interior of the pipe were filled with 3-in.-diameter rocks to a depth of approximately 2 ft belowgrade. The remainder of the excavation outside the pipe was backfilled to grade with soil, and the pipe was covered with a metal cover (LANL 1993, 015313, p. 5-13). The sump had an inlet pipe from building 36-48 that consisted of 4-in.-diameter VCP.

The sump was constructed in 1965 and received water from two sinks in building 36-48 (LANL 1993, 015313, p. 5-13). Building 36-48 was initially used for shot assembly and for controlled-temperature experiments. DU was cut, lapped, and polished in the building. One of the sinks connected to the sump had a chemical-resistant coating. The building was used infrequently (less than 10 times per year)

(LANL 1993, 015313, p. 5-15). The sinks were disconnected from the sump, and the sump was removed (LANL 1993, 015313, p. 5-15; LANL 1995, 062839, p. 1-1).

The nearest downstream canyon investigation reach is TH-3, located approximately 400 ft north of SWMU 36-002 (Figure 7.1-2 and Plate 1). Canyon investigations are described in section 9.2.

7.1.1 Summary of Previous Investigations for SWMU 36-002

In 1994, Phase I RFI activities were performed at SWMU 36-002. The soil and rock in and around the sump was excavated and stockpiled on the site on a lined, bermed pad. Five samples were collected from five depths from within the excavation (LANL 1995, 062839, p. 1-6) and analyzed for inorganic chemicals, SVOCs, and VOCs. The requested analyses are presented in Table 5.1-1 of the Threemile Canyon Aggregate Area HIR.

Based on the Phase I RFI results, the stockpiled material excavated during sampling was returned to the original sump excavation. The sump and part of the inlet pipe were removed and disposed of as construction debris (LANL 1995, 062839, p. 1-6).

7.1.2 Summary of Data for SWMU 36-002

Analytical data from the RFI activities are presented in Table 5.1-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 5.1-2 of the Threemile Canyon Aggregate Area HIR. Cadmium was detected above BV in one sample. Lead was detected above BV in two samples. Zinc was detected above BV in five samples. No organic chemicals were detected.

The nature and extent of contamination have not been defined for this site.

7.1.3 Scope of Activities for SWMU 36-002

Four subsurface samples will be collected from two boreholes at the location of and approximately 10 ft downgradient of the former sump (Figure 7.1-2). Samples will be collected from two depths (base of the excavation [9 to 10 ft] and 5 ft below the base of the excavation [14 to 15 ft]). The samples will be biased toward fractures or zones of higher permeability, if present, and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. One of the four samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

Two subsurface samples will be collected from one location associated with the elbow of the inlet line (Figure 7.1-2). If the line is present, the samples will be collected from the base of the line and 5 ft below the base of line. Otherwise, the samples will be collected from 4 to 5 ft and 9 to 10 ft and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. One of the two samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

7.2 SWMU 36-003(a), Septic System

SWMU 36-003(a) is a septic system located approximately 115 ft east of building 36-1 (Figure 7.2-1). The septic system consists of a septic tank (structure 36-17), associated drainlines, a manhole (structure 36-38), a distribution box/drain field, and seepage pit (LASL 1965, 102122; LANL 2004, 102121). The septic tank is a single-chamber tank constructed of reinforced concrete with a 1160-gal. capacity. The drain field consists of four 200-ft-long perforated tile pipes spaced 10 ft apart. The drain field was replaced with the seepage pit in late 1973 or early 1974. Details of the seepage pit are not known, but other seepage pits constructed during the same period were typically 4 ft in diameter × 50 ft deep and filled with gravel.

This septic system was constructed in 1949 and received effluent from the restroom facilities in an office and laboratory building (building 36-1). In addition to sanitary wastes, spent photoprocessing chemicals from x-ray developing may have been discharged to the septic system (LANL 1993, 015313, pp. 5-24, 5-27). The main guard station at TA-36 (building 36-22) was later added to the septic system. In 1988, the guard station was disconnected from the septic tank (structure 36-17) and rerouted to an adjacent septic system. In 1992, the sanitary waste drainlines that previously served SWMU 36-003(a) were rerouted to the SWSC plant and are currently active (LANL 1993, 015313, pp. 5-22–5-23).

The nearest downstream canyon investigation reach is TH-3, located approximately 250 ft north of SWMU 36-003(a) (Plate 1). Canyon investigations are described in section 9.2.

7.2.1 Summary of Previous Investigations for SWMU 36-003(a)

In 1994, RFI activities were performed at SWMU 36-003(a). Four sludge samples were collected from four locations in the septic tank. Twelve subsurface samples were collected from borings at six locations. A sample was collected from each boring at the soil/tuff interface and in the tuff 2 ft below the interface. The samples were analyzed for inorganic chemicals, SVOCs, and VOCs (LANL 1995, 053985, p. 1-15). The 1994 requested analyses are presented in Table 5.2-1 of the Threemile Canyon Aggregate Area HIR.

In 1995, an EC was performed at SWMU 36-003(a). The cleanup involved excavating soil to expose the top of the tank, opening the tank and removing the contents, decontaminating the tank by steam cleaning, filling the tank with concrete, and placing backfill above the tank. The tank contents were disposed of as hazardous waste. Five confirmation subsurface samples were collected from four locations outside the tank walls, beneath the tank inlet, beneath the tank outlet, and below the bottom of the tank. These samples were submitted for analyses of inorganic chemicals and VOCs (LANL 1996, 054484, pp. 1–5). The 1995 requested analyses are presented in Table 5.2-1 of the Threemile Canyon Aggregate Area HIR.

7.2.2 Summary of Data for SWMU 36-003(a)

Analytical data from the 1994 RFI activities are presented in Table 5.2-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 5.2-2 of the Threemile Canyon Aggregate Area HIR. Aluminum was detected above BV in three samples. Arsenic was detected above BV in two samples. Barium was detected above BV in three samples. Beryllium was detected above BV in three samples. Calcium was detected above BV in three samples. Chromium was detected above BV in three samples. Copper was detected above BV in three samples. Iron was detected above BV in three samples. Lead was detected above BV in one sample. Magnesium was detected above BV in three samples. Mercury was detected above BV in one sample. Nickel was detected above BV in two samples. Vanadium was detected above BV in three samples. Zinc was detected above BV in one sample. No VOCs were detected.

Analytical data from the 1995 EC activities are presented in Tables 5.2-2 and 5.2-3 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs and detected organic chemicals are shown in Figures 5.2-2 and 5.2-3, respectively, of the Threemile Canyon Aggregate Area HIR. Chromium was detected above BV in two samples. Strontium was detected in two samples. Acetone and methylene chloride were detected in three samples.

The nature and extent of contamination have not been defined for this site.

7.2.3 Scope of Activities for SWMU 36-003(a)

The septic tank associated with SWMU 36-003(a) was filled with concrete during EC activities conducted in 1995 (LANL 1996, 054484) and will not be removed. Ten subsurface samples will be collected from five locations adjacent to the inlet pipe (two locations), tank inlet, tank, and tank outlet (Figure 7.2-2). Samples will be collected from two depths (at the base of the line or tank and 5 ft below the line or tank) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the ten samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites. Samples collected beneath the tank inlet, tank, and tank outlet will serve as confirmation samples for this SWMU.

Four subsurface samples will be collected from one borehole adjacent to the seepage pit to determine the extent of contamination beyond the seepage pit (Figure 7.2-2). Samples will be collected from four depths (50 to 51 ft, 60 to 61 ft, 70 to 71 ft, and 80 to 81 ft, biased toward fractures or zones of higher permeability, if present) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. One of the four samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

A total of 10 subsurface samples will also be collected from five locations within and bounding the drain field (Figure 7.2-2). Samples will be collected from two depths (base of the drainline and 5 ft below the base of the drainline) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Two of the 10 samples will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

7.3 AOC 36-008, Surface Disposal Area Located Near Building 36-1

AOC 36-008 is a surface disposal area located on the south rim of Threemile Canyon behind an office and laboratory building (building 36-1) (Figure 7.1-1). The disposal area covers an estimated 1 to 2 acres and extends below the building over the steeply sloping edge of the canyon. The dates the site was used for disposal are not known, but the site appears to be associated with building 36-1, constructed in 1949. Materials disposed of at the site included laboratory glassware, metal cans, metal pipe, miscellaneous metal pieces, and other debris. This disposal area was revealed in June 2000 after the Cerro Grande fire burned the vegetation surrounding the site. As part of the emergency response actions associated with the fire, approximately 5 yd^3 of debris was collected from the site, segregated, and staged for disposal. Also as part of the emergency response action, stormwater best management practices were implemented to prevent erosion. No previous environmental investigations have been conducted at AOC 36-008 (LANL 2000, 068656).

The nearest downstream canyon investigation reach is TH-3, located immediately north of the site boundary of AOC 36-008 (Figure 7.1-2 and Plate 1). Canyon investigations are described in section 9.2.

7.3.1 Summary of Previous Investigations for AOC 36-008

No sampling has been conducted at this AOC.

7.3.2 Summary of Data for AOC 36-008

The nature and extent of contamination have not been defined for this site.

7.3.3 Scope of Activities for AOC 36-008

A total of 100 samples will be collected from the surface and subsurface at 50 locations within and bounding the disposal area (Figure 7.1-2). Samples will be collected from two depths (0 to 0.5 and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Twenty of the 100 samples will be analyzed for PCBs. Sampling locations will be based on a high-density grid (25-ft centers) on the steep portion of the upper slope adjacent to building 36-1. Samples will also be collected approximately every 50 ft in drainages below and bounding the site and extending to the toe of the slope and boundary of sediment reach TH-3. These samples will be biased toward areas of sediment accumulation. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

SWMU C-36-003 (section 7.4) is an outfall from building 36-1 that discharges to a drainage located within the boundary of AOC 36-008. Data collected as part of the sampling strategy for SWMU C-36-003 will be used to characterize both sites.

7.4 SWMU C-36-003, Outfall from Building 36-1

SWMU C-36-003 is a former NPDES-permitted outfall located on the south rim of Threemile Canyon, north of an office and laboratory building (building 36-1) (Figure 7.1-1). The outfall received effluent from a floor drain and spent photoprocessing chemicals from a sink in building 36-1. The outfall became operational shortly after building 36-1 was constructed in 1949. During its operation, the outfall discharged a steady stream of liquid that ran downstream for approximately 35 ft (LANL 1993, 015313, pp. 5-63–5-64). During a July 1994 sampling effort, it was found that the photoprocessing unit was no longer plumbed to the outfall; however, a floor drain in room 6 of building 36-1 was (LANL 1995, 053985, p. 1-16). This outfall was removed from the NPDES permit by 2001 (EPA 2001, 082282).

The nearest downstream canyon investigation reach is TH-3, located approximately 150 ft north of SWMU C-36-003 (Figure 7.1-2 and Plate 1). Canyon investigations are described in section 9.2.

7.4.1 Summary of Previous Investigations for SWMU C-36-003

In 1994, RFI activities were performed at SWMU C-36-003. One surface and one water sample were collected from one location just below the outfall. Water from a source in building 36-1 was flushed through the drainline and outfall to provide water for sampling. Five surface samples were collected from five locations in the drainage channel below the outfall. The samples were analyzed for inorganic chemicals and SVOCs. The 1994 requested analyses are presented in Table 5.4-1 of the Threemile Canyon Aggregate Area HIR.

7.4.2 Summary of Data for SWMU C-36-003

Analytical data from the RFI activities are presented in Table 5.4-2 of the Threemile Canyon Aggregate Area HIR. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 5.1-2 of the Threemile Canyon Aggregate Area HIR. Cadmium was detected above BV in four samples. Calcium was detected above BV in three samples. Chromium was detected above BV in four samples. Copper was detected above BV in four samples. Lead was detected above BV in four samples. Manganese was detected above BV in one sample. Nickel was detected above BV in two samples. Silver was detected above BV in four samples. Zinc was detected above BV in four samples. No SVOCs were detected.

The nature and extent of contamination have not been defined for this site.

7.4.3 Scope of Activities for SWMU C-36-003

A total of 16 samples will be collected from the surface and subsurface at eight locations in the drainage at and below the outfall (Figure 7.1-2). Samples will be collected from two depths (0 to 0.5 and 2 to 3 ft) and analyzed for TAL metals, total uranium, cyanide, nitrate, perchlorate, VOCs, SVOCs, PCBs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites.

SWMU C-36-003 discharges to a drainage located within the boundary of AOC 36-008 (section 7.3). Data collected as part of the sampling strategy for SWMU C-36-003 will be used to characterize both sites.

8.0 INVESTIGATION METHODS

A summary of investigation methods to be implemented is presented in Table 8.0-1. The standard operating procedures (SOPs) used to implement these methods are available at http://www.lanl.gov/environment/all/qa/adep.shtml.

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

Chemical analyses will be performed in accordance with the analytical statement of work (LANL 2000, 071233). Accredited contract analytical laboratories will use the most recent U.S. Environmental Protection Agency- (EPA-) and industry-accepted extraction and analytical methods for chemical analyses of analytical suites.

8.1 Field Surveys

The following sections describe the field surveys that will be conducted at sites within the Threemile Canyon Aggregate Area.

8.1.1 Geodetic Surveys

Geodetic surveys will be conducted by a land surveyor in accordance with the latest version of SOP-03.11, 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 GeoXT hand-held 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 as per the National Geodetic Vertical Datum of 1929. All GPS equipment used will meet the accuracy requirements specified in the SOP.

8.1.2 Geophysical Surveys

Geophysical surveys may be performed at selected sites to verify the location, dimensions, total depth, base profile, topography, low-elevation point, and downslope end using as-built construction drawings and boring logs. The surveys will verify locations determined from engineering drawings, site reconnaissance, and geodetic surveys and refine assessments of the subsurface structures. Geophysical methods employed may include electromagnetic, gravity, and ground-penetrating radar as appropriate to effectively delineate the materials or feature being surveyed.

8.2 Subsurface Characterization

8.2.1 Drilling Methods for Subsurface Sample Collection

Subsurface samples will be obtained by hollow-stem auger or hand-auger methods. A brief, general description of these methods is provided below. More information can be found in SOP-04.01, Drilling Methods and Drill Site Management.

8.2.1.1 Hand Auger

Hand augers may be used to bore shallow holes (0 to 15 ft). The hand auger is advanced by turning or pounding the auger into the soil until the barrel is filled. The auger is removed and the sample dumped out. Motorized units for one or two operators may be used and can reach depths up to 30 ft under certain conditions.

8.2.1.2 Hollow-Stem Auger

Hollow-stem auger may be used to bore holes deeper than 15 ft or at shallower depths where hand-auger refusal is encountered. 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 it 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 that samples may be retrieved during drilling operations. The hollow stem also acts to case the borehole core temporarily so that a well casing (riser) may be inserted down through the center of the auger once the desired depth is reached, thus minimizing the risk of possible collapse of the borehole. A bottom plug or pilot bit can be fastened onto the bottom of the auger to keep out most of the soil and/or water that tends to clog the bottom of the augers during drilling. Drilling without a center plug is acceptable if the soil plug, formed in the bottom of the auger, is removed before sampling or installing a well casing. The soil plug can be removed by washing out the plug using a side-discharge rotary bit or auguring out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger.

8.2.2 Groundwater Monitoring Well Installation

Perched intermediate groundwater is not anticipated during investigation activities proposed for the Threemile Canyon Aggregate Area, and no groundwater monitoring wells are planned. If perched groundwater is encountered during borehole advancement, drilling will cease immediately to avoid penetrating the perched unit. The depth to water will be sounded and a groundwater sample will be collected if sufficient water is present. A temporary well will be installed, and NMED will be notified of the presence of perched water. A perched groundwater single-completion well installation and monitoring plan will be prepared in accordance with the current versions of SOP-5.01, Well Construction, and SOP-5.02, Well Development. The plan for well construction will be submitted to NMED for approval before construction begins.

8.2.3 Borehole Abandonment

All boreholes will be properly abandoned according to the most recent version of SOP-5.03, Monitoring Well and RFI Borehole Abandonment.

Shallow boreholes, with a total depth of 20 ft or less, will be abandoned by filling the borehole with bentonite chips, which are subsequently hydrated. Chips will be hydrated in 1- to 2-ft lifts. The borehole will be visually inspected while the bentonite chips are being added to ensure that 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 regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling. All borehole abandonment information will be provided in the investigation report.

8.3 Sample Collection

8.3.1 Surface Samples

Surface and shallow subsurface soil and sediment 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 may be used to collect samples. Samples collected for analyses will be placed in the appropriate sample containers depending on the analytical method requirement. The analytical suites for the samples from each borehole will vary according to the data requirements as described in sections 4, 5, 6, and 7 and presented in Table 4.0-1.

Sampling locations in drainages will be predetermined based on geomorphic relations and sedimentary packages in accordance with canyon investigation procedures.

Quality assurance/quality control (QA/QC) samples will include field duplicate samples, equipment rinsate blanks, trip blanks, and reagent blanks. These samples will be collected following the current version of SOP-01.05, Field Quality Control Samples. Trip blanks will be supplied by the SMO and will remain with the analytical samples when samples are collected for VOC analysis.

8.3.2 Subsurface Samples

Subsurface samples will be collected following the current version of SOP-06.24, Sample Collection from Split-Spoon Samplers and Shelby Tube Samplers, and SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials. Samples collected for analyses will be placed in the appropriate sample containers depending on the analytical method requirement. The analytical suites for the samples from each borehole will vary according to the data requirements as described in sections 4, 5, 6, and 7 and presented in Table 4.0-1.

Field screening will be used to guide sample collection and to ensure worker safety. Samples will be collected from boreholes at the depths indicated in the work plan. If field screening indicates that contamination is present at the bottom of the borehole, the hand-auger borehole will be extended until field screening indicates no contamination or until refusal occurs.

The QA/QC samples will include field-duplicate samples, equipment rinsate blanks, trip blanks, and reagent blanks. These samples will be collected following the current version of SOP-01.05, Field Quality Control Samples. Trip blanks will be supplied by the SMO and will remain with the analytical samples when samples are collected for VOC analysis.

Field documentation will include detailed borehole logs to document the matrix material in detail; 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.

8.3.3 Groundwater Samples

Perched intermediate groundwater is not anticipated during investigation activities proposed for the Threemile Canyon Aggregate Area. If saturation is encountered as a borehole advances, drilling will be stopped to determine whether sufficient water volume is available for analyzing the water quality. Generally, the total water volume required for an analytical sample is approximately 0.5 to 1 L. If this minimum volume of groundwater cannot be collected, the borehole will be advanced to the target depth or until saturation is encountered again and the process is repeated, or until the required total depth is achieved. A porous cup lysimeter or absorbent membrane will be installed at the depth of saturation to monitor the zone if the borehole is completed for monitoring. Insufficient water-sample volumes from discrete depths will not be composited to make up the required volume for screening analysis.

If a sufficient volume exists, a groundwater sample will be collected and analyzed for TAL metals, anions, HE, VOCs, SVOCs, perchlorate, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, tritium, alkalinity, nitrates, total organic carbon, total inorganic carbon, and total dissolved solids at a Laboratory-certified analytical laboratory. A minimum of 20% of samples collected will be analyzed for PCBs. Typically, results of groundwater screening samples are available within 48 hr. During this time, the borehole may be advanced to the target depth, and the perched zone (and subsequent perched zones encountered during drilling) will be isolated to prevent downhole migration.

Geophysical logging will be conducted according to SOP-04.04, Contract Geophysical Logging, and SOP-05.07, Operation of LANL Owned Borehole Logging Trailer. Geophysical logging will determine the thickness of the zone of saturation and the characteristics of the perching horizon. A monitoring well design will be submitted to NMED for approval. Following approval of the design, the well will be installed, and a groundwater-monitoring plan will be included in the investigation report or in the appropriate annual update of the Interim Facility-wide Groundwater Monitoring Plan (IFWGMP) (LANL 2008, 101897).

Groundwater samples from developed wells will be collected in accordance with SOP-06.01, Purging and Sampling Methods for Single Completion Wells. After a groundwater sample has been collected and processed, aliquots of the sample are placed in appropriate containers and preserved according to SOP ENV-DO-206, Sample Container and Preservation. Requirements for sample volume, containerization, hold times, and detection limits are provided in the analytical services statement of work (LANL 2000, 071233).

8.3.4 Excavations

Excavations will be completed using a track excavator or backhoe at selected site(s). Excavated soil will be staged a minimum of 3 ft from the edge of the excavation, and excavations deeper than 4 ft bgs will be properly benched to allow access and egress, if necessary. After confirmatory sampling and any necessary overexcavation work are completed, the excavations and/or trenches will be backfilled with clean fill material or overburden (if it is not contaminated). Excavators may also be used to collect grab samples.

8.4 Field-Screening Method

The field-screening to be conducted on subsurface core includes (1) visual examination and (2) radiological screening. Radiological field screening is proposed because radiological contamination is likely to be collocated with inorganic chemical contamination and x-ray fluorescence (XRF) detection limits are not sufficiently low for most inorganic chemicals. Thus, XRF is not useful for field screening to determine the extent of contamination, and radiological field-screening instruments are more likely to detect contamination. Samples collected based on radiological field-screening results will be submitted for inorganic chemical analyses. VOC contamination is not suspected or expected based on the site history and historical documentation. Therefore, field screening for VOCs is not proposed.

8.4.1 Radiological Screening

Radiological screening will target gross alpha-, beta-, and gamma-emitting radionuclides. Field screening will be conducted within 1 in. of the sampled material by a radiation control technician. All radiological screening will be conducted using an Eberline E-600 radiation meter with an SHP-380AB alpha/beta scintillation detector, or equivalent. This equipment consists of a dual phosphor plate covered by two mylar windows housed in a light-excluding metal body. The phosphor plate is a plastic scintillator for the detection of beta emissions and is thinly coated with zinc sulfide for detecting alpha emissions. The operational range varies from trace emissions to 1 million disintegrations/min.

Local background levels will be collected, at a minimum, twice daily, once in the morning and once in the afternoon. If more than one site is visited in a day, background levels will be calculated before work begins at each new site. Background will be measured from 10 locations surrounding the site and from known or suspected areas of radiological contamination. An average will be calculated to determine the local background level for the site. Radiological field screening will be conducted in accordance with SOP-10.14, Performing and Documenting Gross Gamma Radiation Scoping Surveys. All local background checks, background ranges, and calibration procedures will be documented daily in the field logbook in accordance with the current version of SOP MAQ-011, Logbook Use and Control.

Boreholes completed using mechanical drilling methods will be advanced 25 ft beyond elevated field-screening results. If elevated field-screening results are recorded within 10 ft of the target depth, the borehole will be advanced using mechanical drilling methods at 5-ft intervals until no elevated field-screening results are recorded over a 10-ft interval.

8.5 Laboratory Analytical Methods

The analytical suites required for laboratory analyses vary by site and are provided in Table 4.0-1. All analytical suites are presented in the statement of work for analytical laboratories (LANL 2000, 071233). Sample collection and analysis will be coordinated with the SMO.

8.6 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 conducting fieldwork.

8.7 Equipment Decontamination

Equipment for drilling and sampling will be decontaminated before and after sampling activities to minimize the potential for cross-contamination. Dry decontamination methods will be used between sampling locations to avoid the generation of liquid waste and to minimize the IDW. Decontamination will be completed using a dry decontamination method with disposable paper towels and over-the-counter cleaner, such as Fantastik or equivalent. All sampling and measuring equipment, including but not limited to, stainless-steel sampling tools, split-barrel or core samplers, well developing or purging equipment, groundwater quality measurement instruments, and water-level measurement instruments, will be decontaminated in accordance with SOP-01.08, Field Decontamination of Drilling and Sampling Equipment. 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.

8.8 Investigation-Derived Waste

IDW may include, but is not limited to, drill cuttings, excavated media, excavated man-made debris, contact waste, decontamination fluids, 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. These SOPs incorporate the requirements of all applicable EPA and NMED regulations, DOE orders, and Laboratory implementation requirements. Appendix B presents the IDW management plan.

8.9 Removal Activities

Removal of the inactive septic tanks associated with SWMUs 15-009(b), 15-009(c), 15-009(h), and 15-010(b) (sections 6.8, 6.9, 6.10, and 6.11, respectively) are proposed under this investigation work plan. Excavation of potentially contaminated media, waste disposition, and confirmation sampling will be completed during these removal activities. This section summarizes proposed removal activities.

8.9.1 Removal of Septic and Settling Tanks

The approach for removing septic tanks at SWMUs 15-009(b), 15-009(c), and 15-009(h) and settling tank 15-010(b) (sections 6.8, 6.9, 6.10, and 6.11, respectively) will generally follow the same approach in this work plan. The septic tank at SWMU 36-003(a) was filled with concrete during an EC performed in 1995; removal of this tank is not proposed in this work plan.

Each septic or settling tank will be located and soil, fill, or other material covering the tank will be excavated. The excavated material will be field screened during the excavation process and will remain within the SWMU boundary from which it was excavated. If the field screening does not indicate contamination is present, the excavated material will be stored on the ground surface with appropriate best management practices. If field screening indicates the presence of contamination, the excavated material will be placed in rolloff containers and disposed of accordingly. A minimum of one sample will be collected for every 50 yd^3 of excavated material and submitted for laboratory analyses of TAL metals, nitrate, cyanide, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. The analytical results will be compared to the residential soil screening levels (SSLs). The excavated material will be used as backfill if concentrations are below the residential SSLs and disposed of properly if concentrations exceed residential SSLs.

Once exposed, the location of the tank and its dimensions will be surveyed. The concrete tank and the material within the tank (tank contents, or sand and gravel if previously cleaned and filled) will be sampled and characterized for waste management purposes. The tank and its contents will be removed and disposed of at an appropriate waste disposal facility. The inlet and outlet drainlines to the tank will be plugged. Potentially contaminated soil beneath the tank will be excavated, characterized, and disposed of at an appropriate waste disposal facility.

Visual observations and field screening will be used to guide the sampling to determine the extent of contamination and to guide collecting confirmatory samples. If visual observations or field screening indicate contamination, the excavation will be extended (either vertically or laterally), as necessary. Excavation will continue until visual observations and field screening indicate that contamination is no longer present. Confirmatory samples will be collected, analyzed, and evaluated to verify contamination has been removed before the excavation is backfilled.

Once excavation has been completed, confirmation samples will be collected from beneath the inlet and outlet to each tank and from below the tank. Confirmation samples may be collected from additional locations beneath the drainlines. Samples will be collected from two depths (at the base of the drainline or tank and 5 ft below the base of the drainline or tank) and analyzed for TAL metals, nitrate, cyanide, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. A minimum of 20% of samples collected will be analyzed for PCBs. Table 4.0-1 provides a summary of the proposed sampling strategy, locations, depths, and analytical suites for each tank, including confirmation samples.

Confirmation samples will be collected beneath the distribution box (if present) and from the drain field or seepage pit. Samples will be collected from two depths (directly beneath the distribution box [if present] and 5 ft below the box or at the soil/tuff interface) and within and adjacent to seepage pits or drain field. The samples will be analyzed for TAL metals, nitrate, cyanide, perchlorate, VOCs, SVOCs, HE, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. A minimum of 20% of samples collected will be analyzed for PCBs. The excavated area will then be backfilled with clean fill and material excavated from the surface of the tank.

8.9.2 Waste Management and Disposal

Management of all IDW, including waste generated during removal activities, is described in Appendix B.

9.0 MONITORING PROGRAMS

9.1 Groundwater

Section IV.B.2.a.ii of the Consent Order requires monitoring and sampling of all wells that contain alluvial, intermediate, and regional groundwater located in Threemile Canyon, located within the Pajarito Canyon watershed. Alluvial groundwater observation wells 3MAO-2, 18-BG-4, and 18-MW-8 are located within the Threemile Canyon Aggregate Area upstream of TA-18 and the confluence of Threemile Canyon and Pajarito Canyon. Perched intermediate and regional groundwater in the Threemile Canyon Aggregate Area is monitored at regional well R-19, screen 2, and screens 3 and 4, respectively. Springs located in

Threemile Canyon include Threemile Spring and TA-18 Spring. These wells and springs are monitored as part of the IFWGMP (LANL 2008, 101897) (Plate 1).

9.2 Sediment and Surface Water

Ten subreaches consisting of six reaches in Threemile Canyon were proposed for sediment sampling in the work plan for Pajarito Canyon (LANL 1998, 059577, p. 7-10). Phase 1 and Phase 2 of the Pajarito Canyon sediment investigations have been completed (LANL 2006, 091812; LANL 2007, 095408). Canyon investigation reaches are shown in Figures 4.1-2, 4.2-2, 6.5-2, and 7.1-2 and on Plate 1.

Stormwater runoff and snowmelt are monitored under the 2005 the Facilities Compliance Agreement (FFCA) and the NPDES Multi-Sector General Permit. The Laboratory conducts two types of stormwater-runoff monitoring: site-specific monitoring of discharges from SWMUs and AOCs and discharges of stormwater (LANL 2007, 096981). Surface water and stormwater runoff sampling stations are shown on Plate 1. Base flow is monitored under the IFWGMP at six sampling locations in Pajarito Canyon; however, no base-flow stations are present within the Threemile Canyon Aggregate Area (LANL 2008, 101897, p. 18).

Analytical results from the Pajarito Canyon investigations and monitoring conducted under the FFCA and IFWGMP will be evaluated in conjunction with the sampling results obtained from the work plan investigations to assess potential contaminant migration from SWMUs and AOCs within the Threemile Canyon Aggregate Area.

10.0 SCHEDULE

The scheduled notice date for NMED to approve this investigation work plan is November 28, 2008. Preparation for investigation activities is scheduled to start in March 2009. Fieldwork is expected to start in early July 2009 and will take approximately 7 mo to complete. Fieldwork is scheduled to be completed by February 2010. Therefore, a submittal date of no later than August 31, 2010, is proposed for the investigation report.

11.0 REFERENCES AND MAP DATA SOURCES

11.1 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 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 U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, 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.

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11.2 Map Data Sources

Legend Item	Data Source
2-ft elevation contour	Hypsography, 2-ft Contour Interval; LANL, Environmental Stewardship (ENV) Environmental Remediation and Surveillance Program; 1991.
10-ft elevation contour	Hypsography, 10-ft Contour Interval; LANL, ENV Environmental Remediation and Surveillance Program; 1991. Hypsography, 20-ft Contour Interval; LANL, ENV Environmental Remediation and Surveillance Program; 1991.
100-ft elevation contour	Hypsography, 100-ft Contour Interval; LANL, ENV Environmental Remediation and Surveillance Program; 1991.
Threemile Canyon Aggregate Area	Aggregate Areas; LANL, ENV Environmental Remediation & Surveillance Program, ER2005-0496; 1:2,500 Scale Data; 22 September 2005.
LANL boundary	LANL Areas Used and Occupied; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 04 June 2008.
TA boundary	TA Boundaries; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 04 June 2008.
Fence	Security and Industrial Fences and Gates; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.

Legend Item	Data Source
Former Structure	Structures; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 20 March 2001.
Structure	Structures; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Communication line	Communication Lines; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 04 March 2008.
Electric line	Primary Electric Grid; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Gas line	Primary Gas Distribution Lines; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Industrial waste line	Primary Industrial Waste Lines; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Sewer line	Sewer Line System; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Water line	Water Lines; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Paved road	Paved Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Unpaved road	Dirt Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 March 2008.
Primary paved road Secondary paved road	Road Centerlines for the County of Los Alamos; County of Los Alamos, Information Services; as published 03 December 2007.
SWMU or AOC Deferred SWMU or AOC Consolidated Unit	Potential Release Sites; LANL, Waste and Environmental Services Division, Environmental Data and Analysis Group, EP2008-0224; 1:2,500 Scale Data; 30 May 2008. Change control requests pending.
Sampling location Canyons sampling location	Point Feature Locations of the Environmental Restoration Project Database; LANL, Waste and Environmental Services Division, EP2008-0284; 28 May 2008.
Spring	Locations of Springs; LANL, Waste and Environmental Services Division in cooperation with the New Mexico Environment Department, Department of Energy Oversight Bureau, EP2008-0138; 1:2,500 Scale Data; 17 March 2008.
Surface water and stormwater runoff monitoring station	Storm Water Runoff Monitoring Stations; ENV Water Quality & Hydrology Group; 19 October 2004. Unpublished 2008 data for 3M-SMA-3 acquired from Waste and Environmental Services Division.
Monitoring well	Penetrations; LANL, Environment and Remediation Support Services, EP2007-0442; 1:2,500 Scale Data; 16 July 2007. Unpublished 2008 survey data for well 3MAO-2 acquired from Waste and Environmental Services Division.
Canyon reach	Canyon Reaches; LANL, ENV Environmental Remediation and Surveillance Program, ER2002-0592; 1:24,000 Scale Data; Unknown publication date.

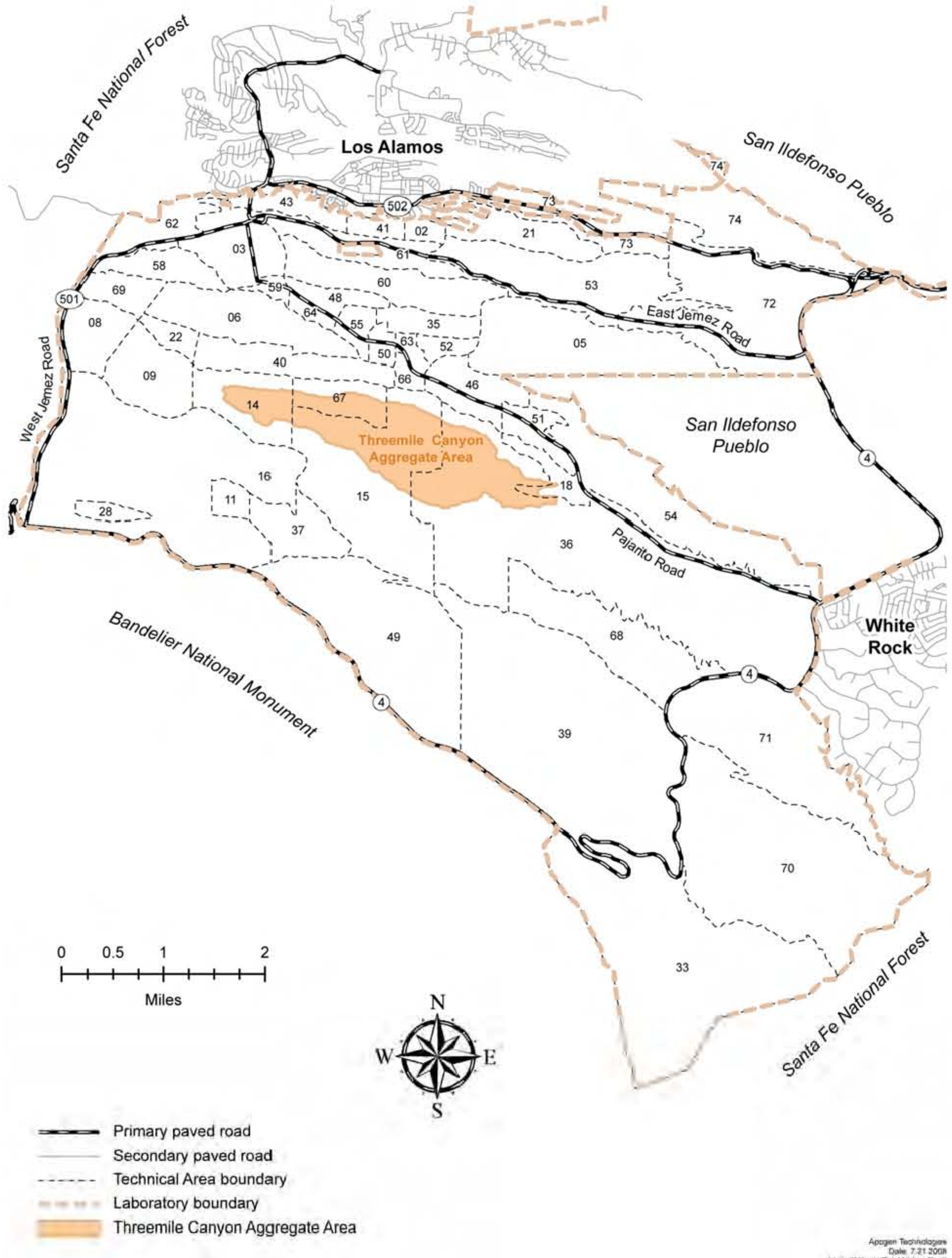

Figure 1.0-1 Threemile Canyon Aggregate Area

Bandelier Tuff	Tshirege Member	Qbt 4	Ash-Flow Units
		Qbt 3	
		Qbt 2	
		Qbt 1v	
		Qbt 1g	
		Tsankawi Pumice Bed	
Cerro Toledo Interval		Volcaniclastic Sediments and Ash-Falls	
Bandelier Tuff	Otowi member	Ash-Flow Units	
		Guaje Pumice Bed	
Puye Formation	Fanglomerate	Fanglomerate Facies includes sand, gravel, conglomerate, and tuffaceous sediments	
	Basalt and Andesite	Cerros del Rio Basalts intercalated within the Puye Formation, includes up to four interlayered basaltic flows. Andesites of the Tschicoma Formation present in western part of plateau	
	Fanglomerate	Fanglomerate Facies includes sand, gravel, conglomerate, and tuffaceous sediments; includes "Old Alluvium"	
	Axial facies deposits of the ancestral Rio Grande	Totavi Lentil	
Santa Fe Group	Coarse Sediments	Coarse-Grained Upper Facies (formerly called the "Chaquehui Formation" by Purtymun 1995, 045344)	
	Basalt		
	Coarse Sediments		
	Basalt		
	Coarse Sediments		
	Basalt		
	Coarse Sediments		
	Arkosic clastic sedimentary deposits	Undivided Santa Fe Group (includes Chamita[?] and Tesuque Formations)	

Figure 3.2-1 Generalized stratigraphy of bedrock geologic units of the Pajarito Plateau

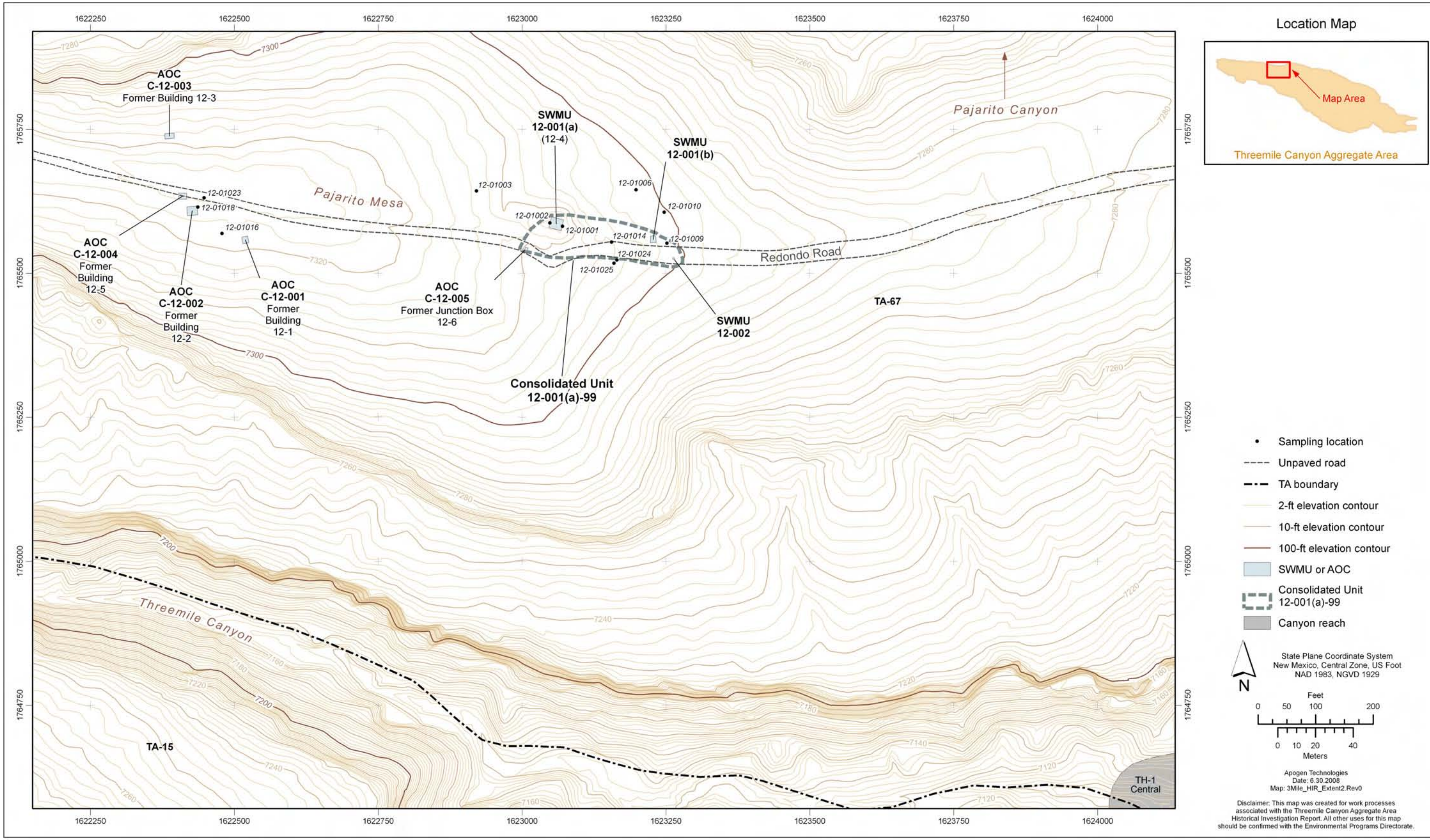

Figure 4.1-1 Site features of Consolidated Unit 12-001(a)-99 [SWMUs 12-001(a), 12-001(b), and 12-002 and AOC C-12-005] and AOCs C-12-001, C-12-002, C-12-003, and C-12-004

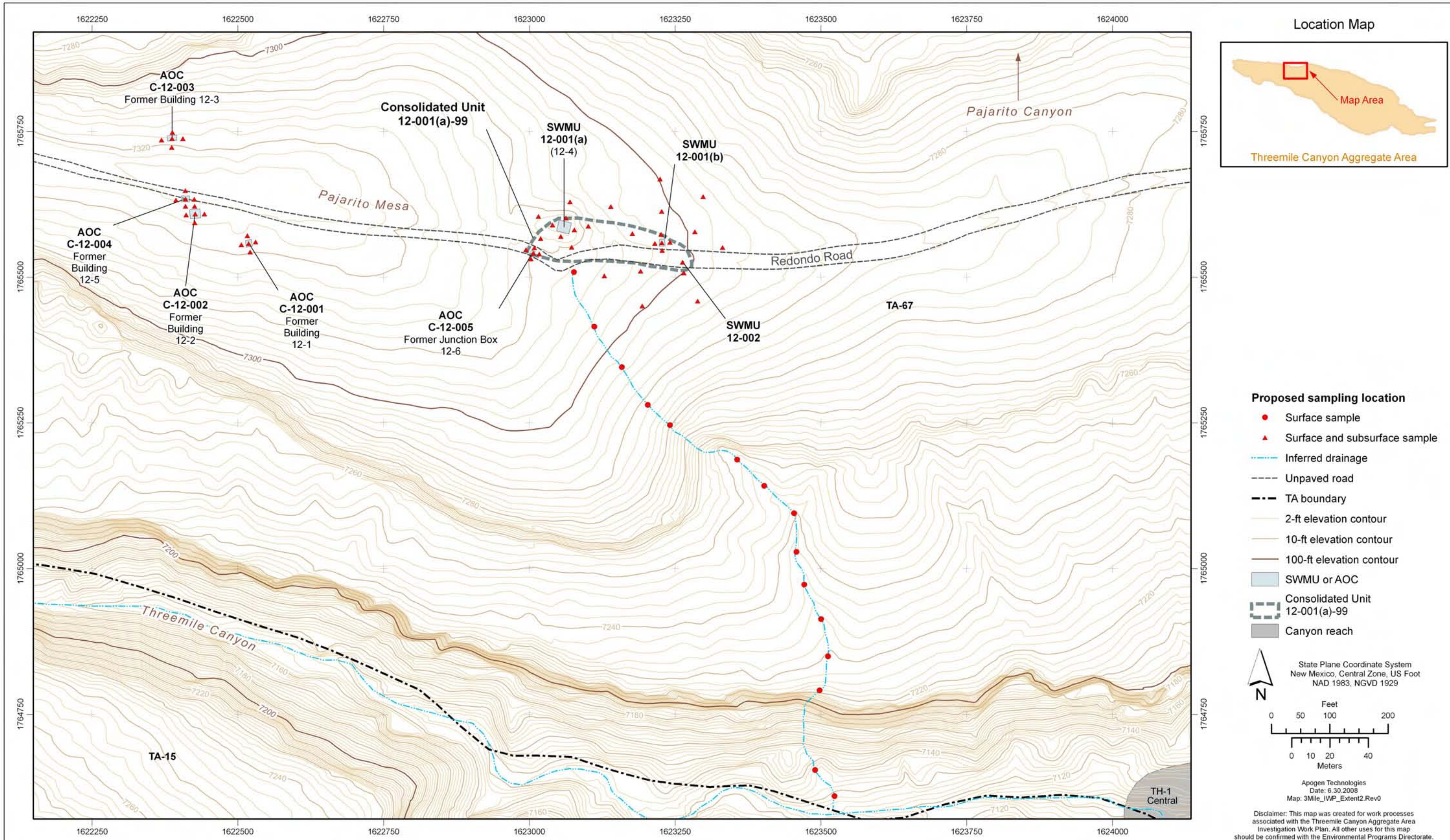

Figure 4.1-2 Proposed sampling locations for SWMUs 12-001(a), 12-001(b), and 12-002 and AOCs C-12-001, C-12-002, C-12-003, C-12-004, and C-12-005.

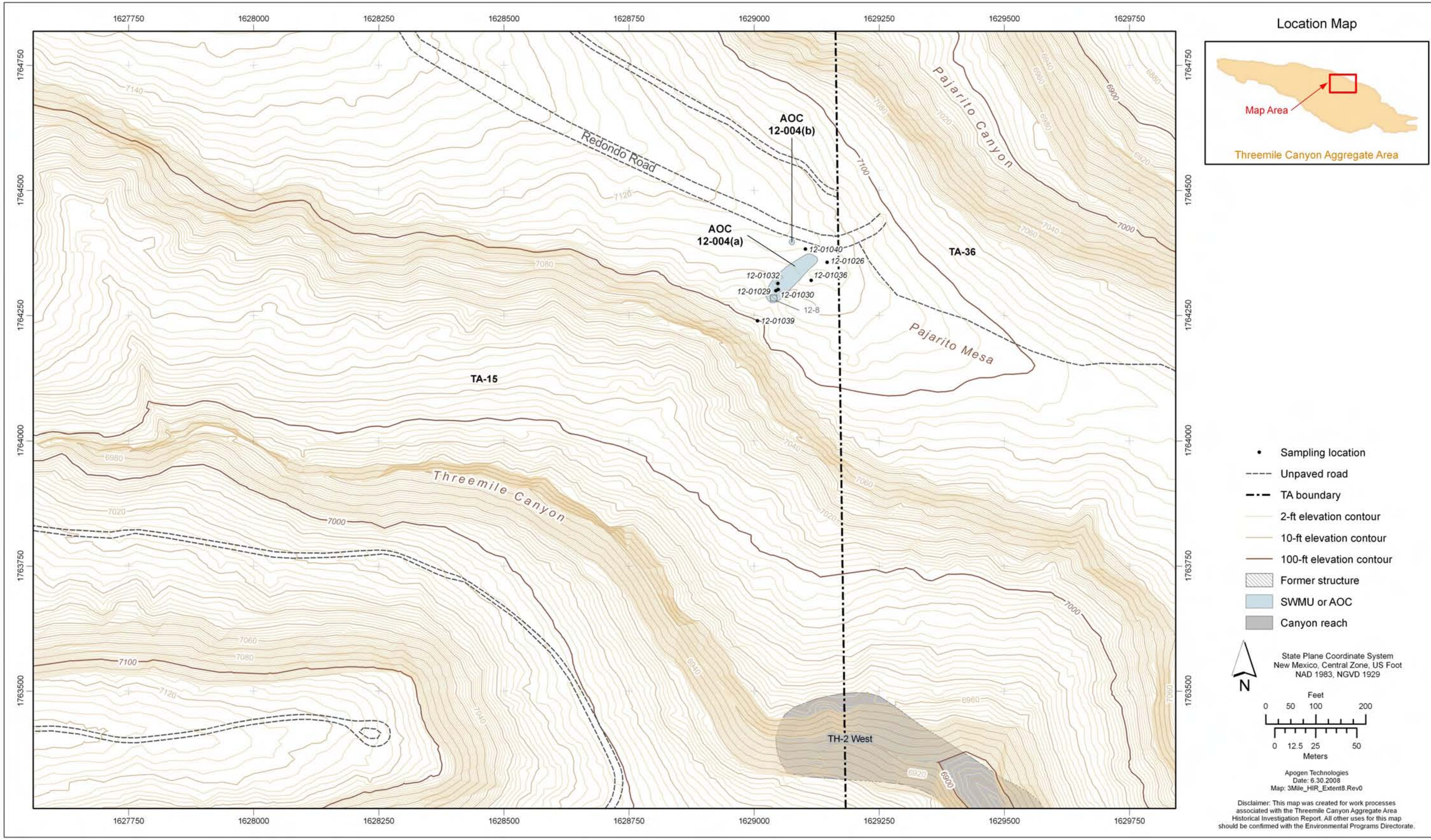

Figure 4.2-1 Site features of AOCs 12-004(a) and 12-004(b)

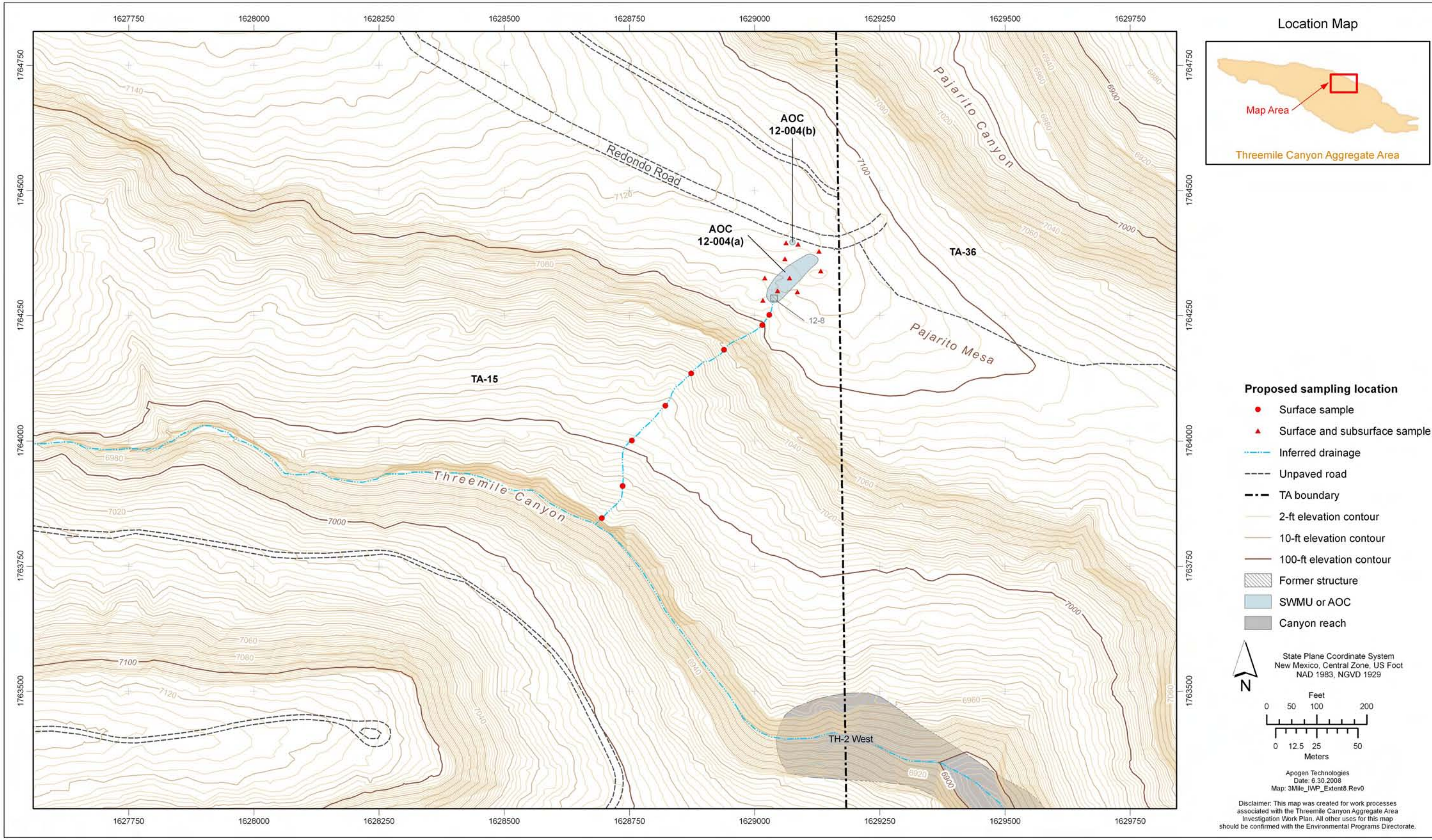

Figure 4.2-2 Proposed sampling locations for AOCs 12-004(a) and 12-004(b)

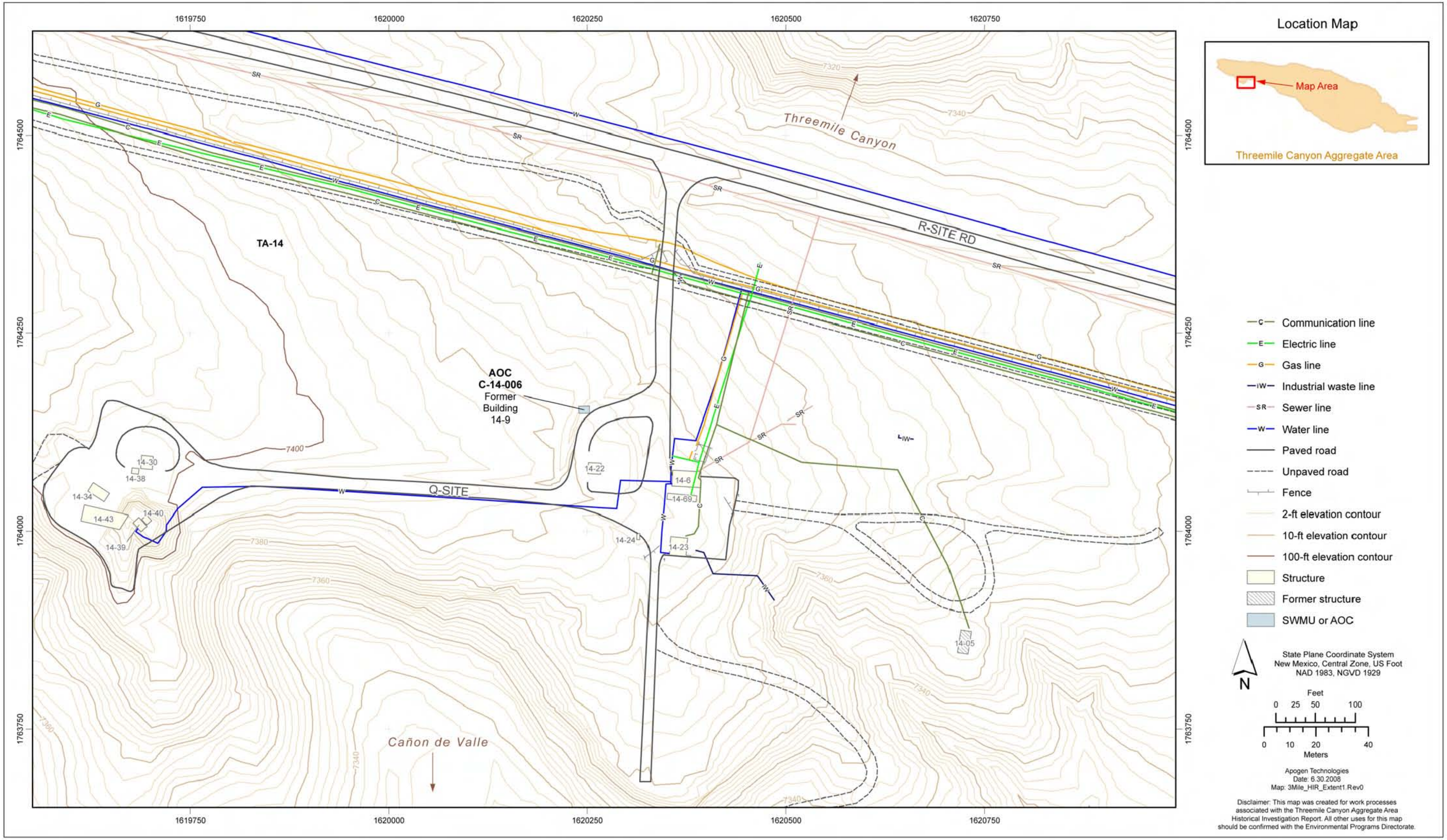

Figure 5.1-1 Site features of AOC C-14-006

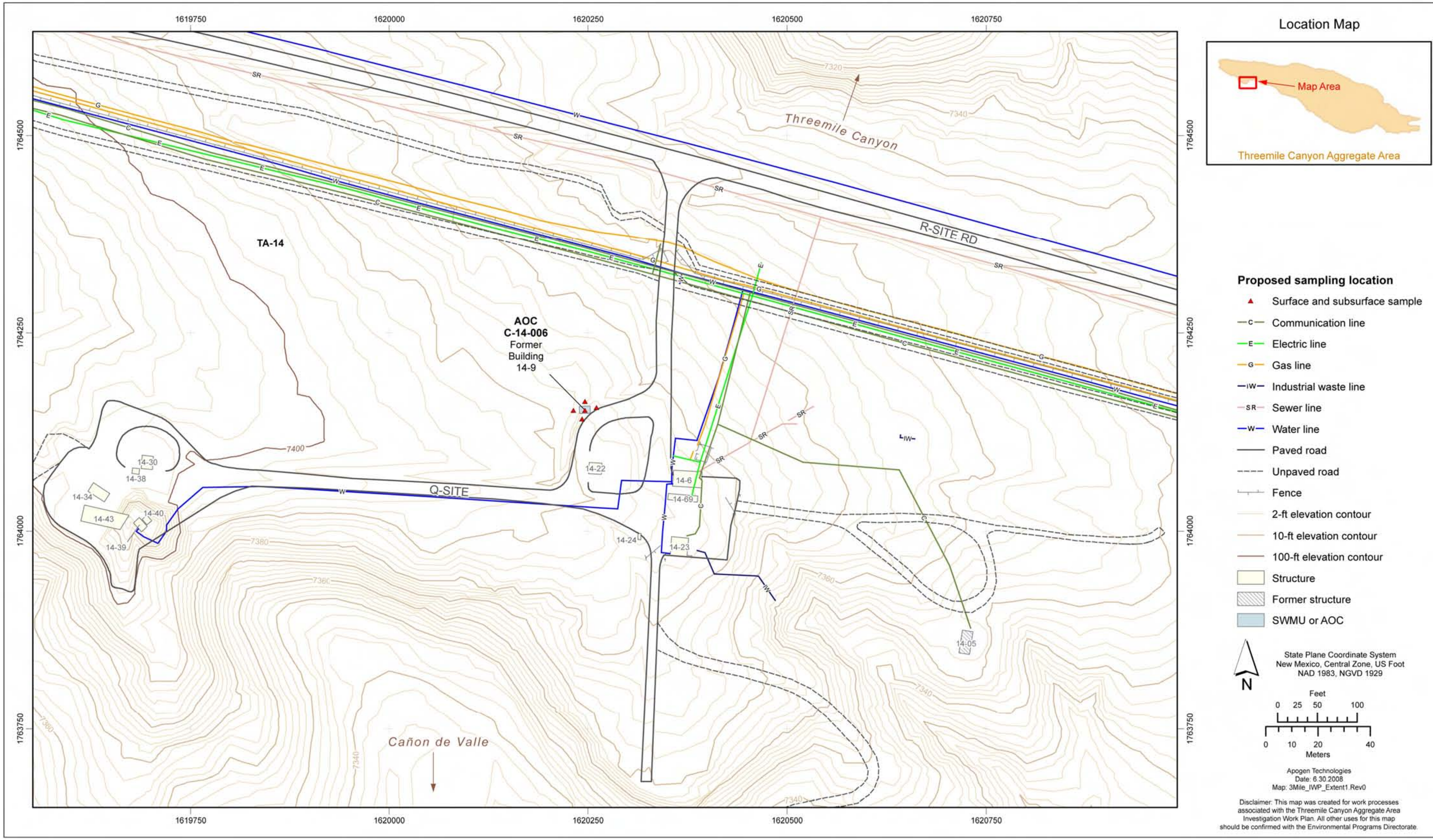

Figure 5.1-2 Proposed sampling locations for AOC C-14-006

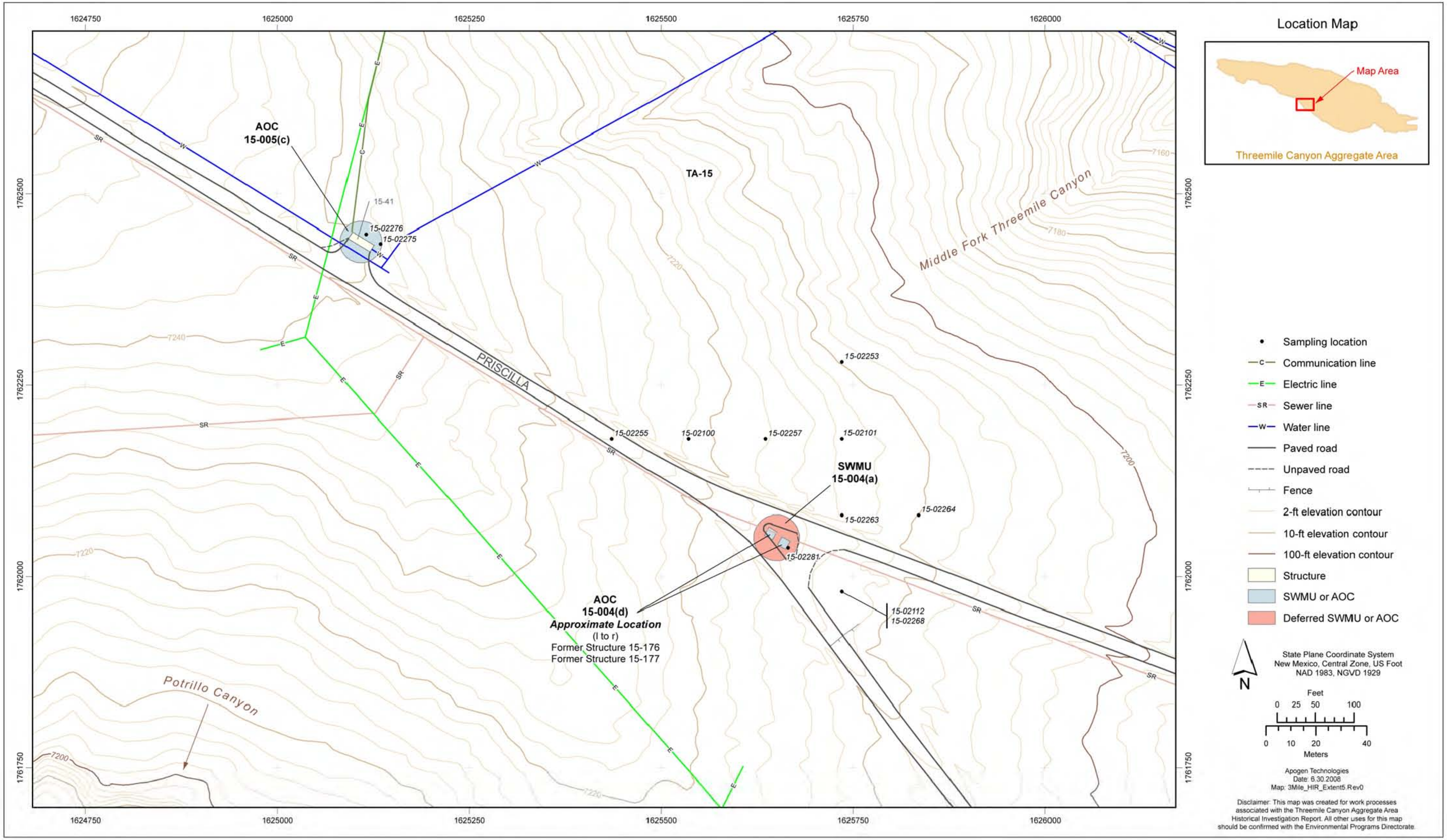

Figure 6.1-1 Site features of SWMU 15-004(a) and AOCs 15-004(d) and 15-005(c)

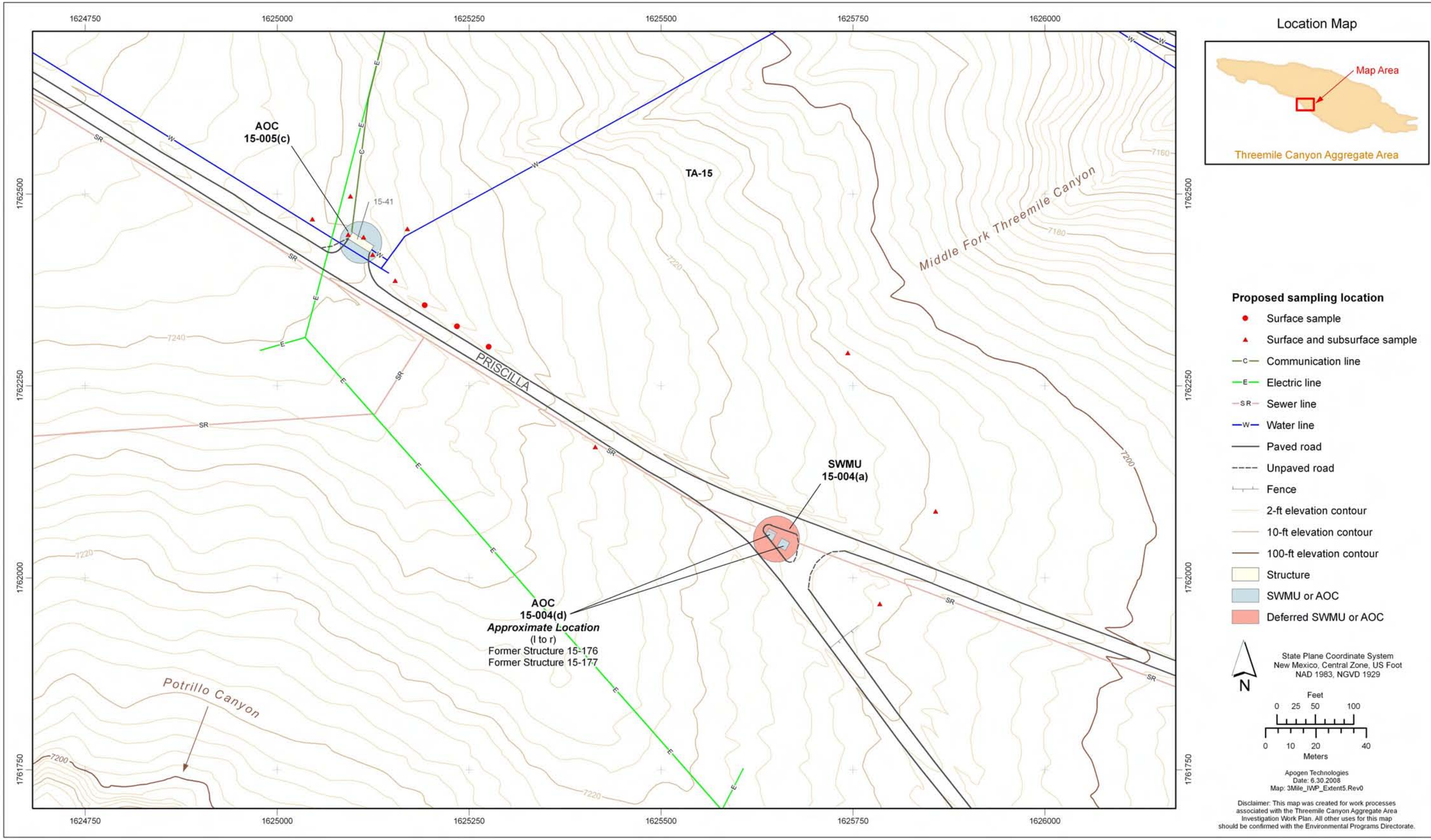

Figure 6.1-2 Proposed sampling locations for AOCs 15-004(d) and 15-005(c)

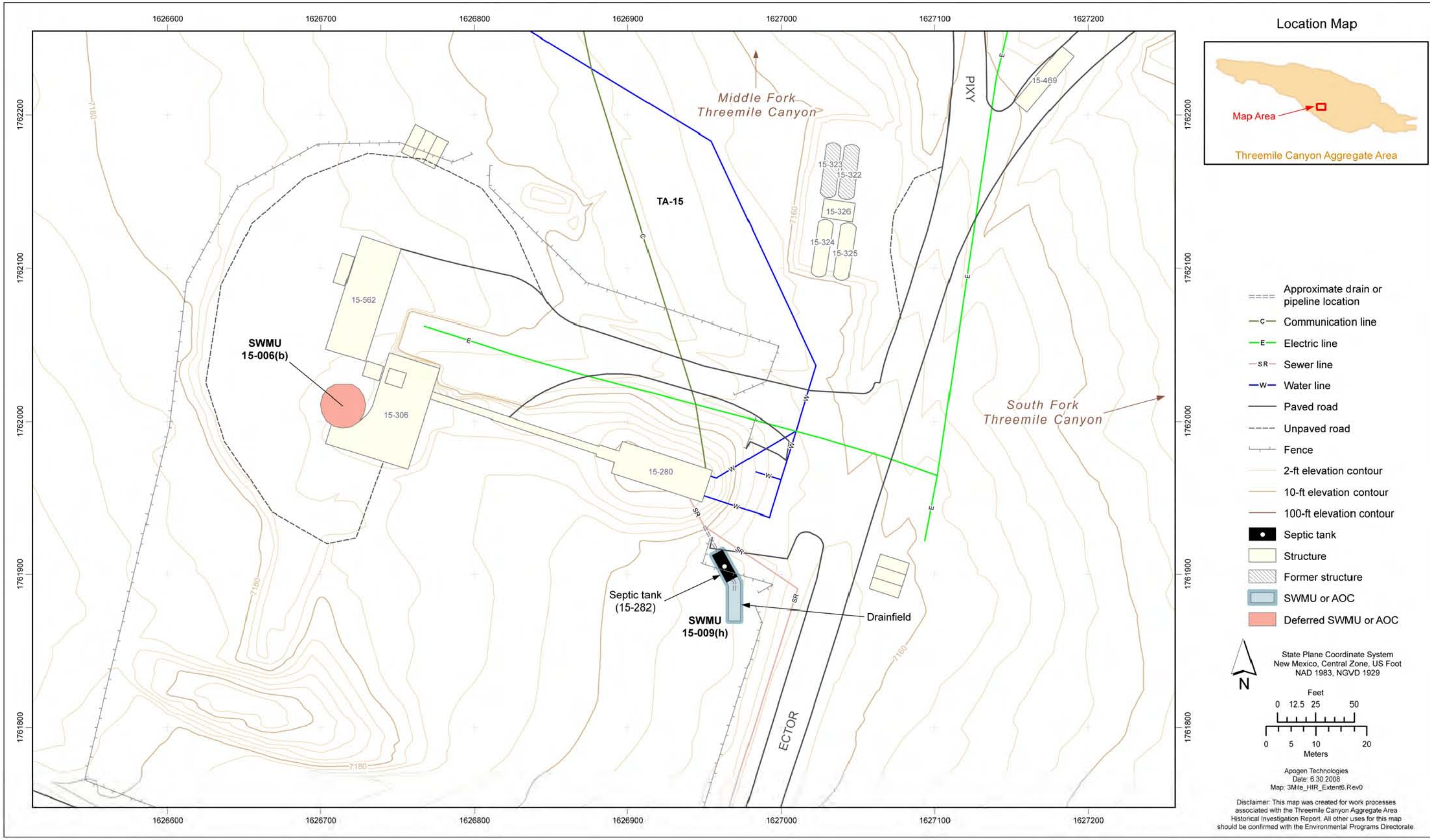

Figure 6.4-1 Site features of SWMUs 15-006(b) and 15-009(h)

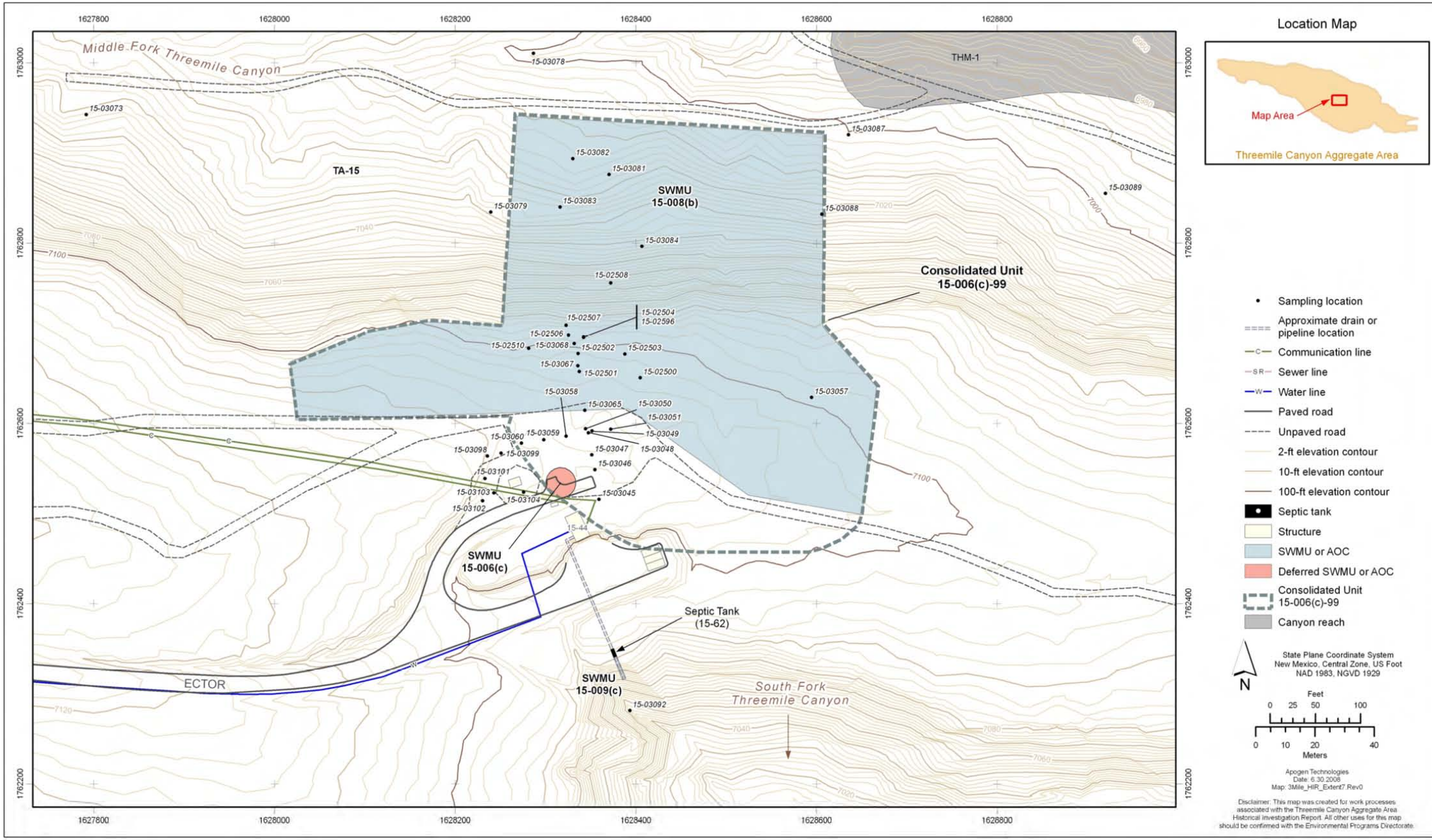

Figure 6.5-1 Site features of Consolidated Unit 15-006(c)-99 [SWMUs 15-006(c) and 15-008(b)] and SWMU 15-009(c)

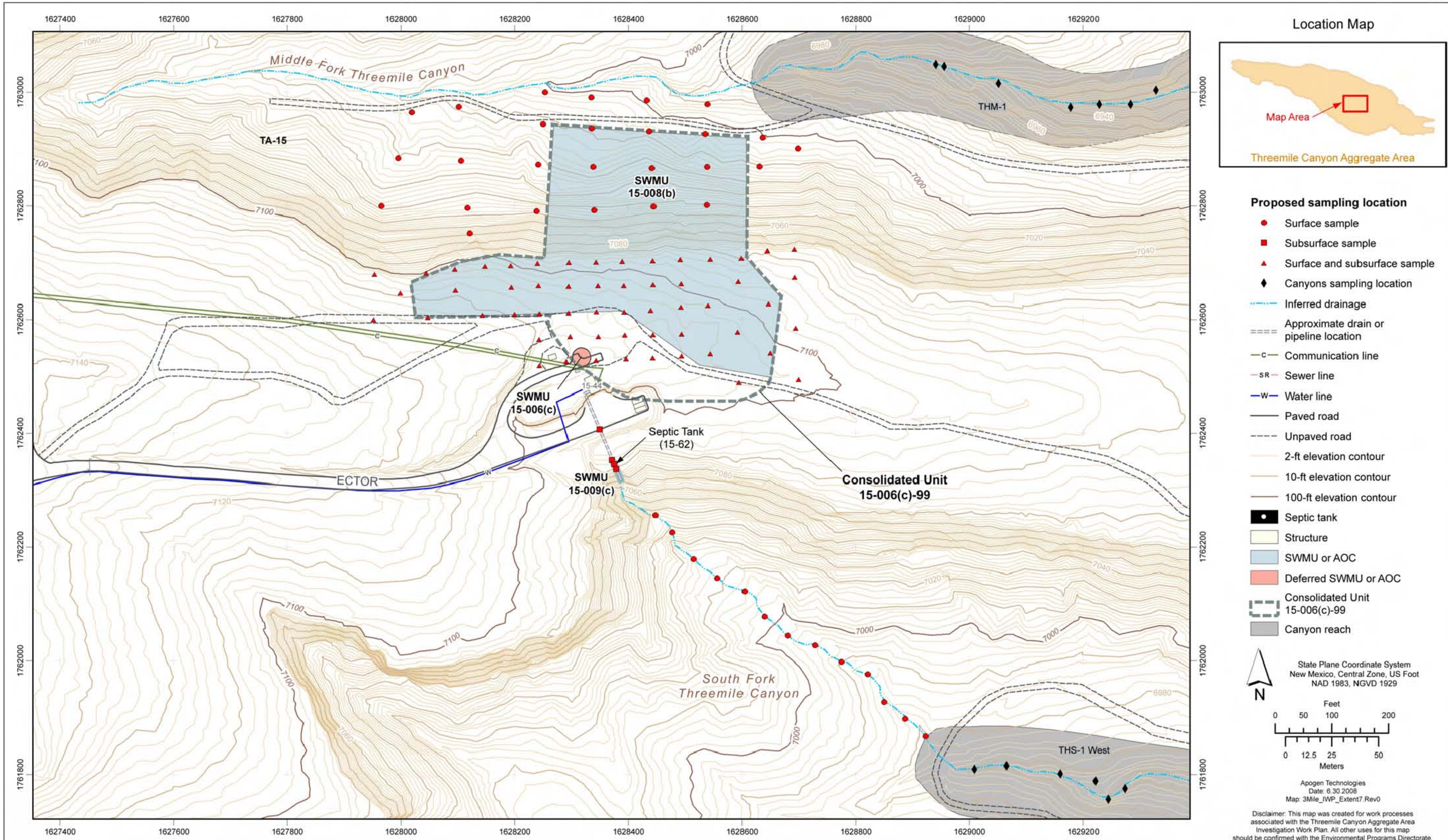

Figure 6.5-2 Proposed sampling locations for SWMUs 15-008(b) and 15-009(c)

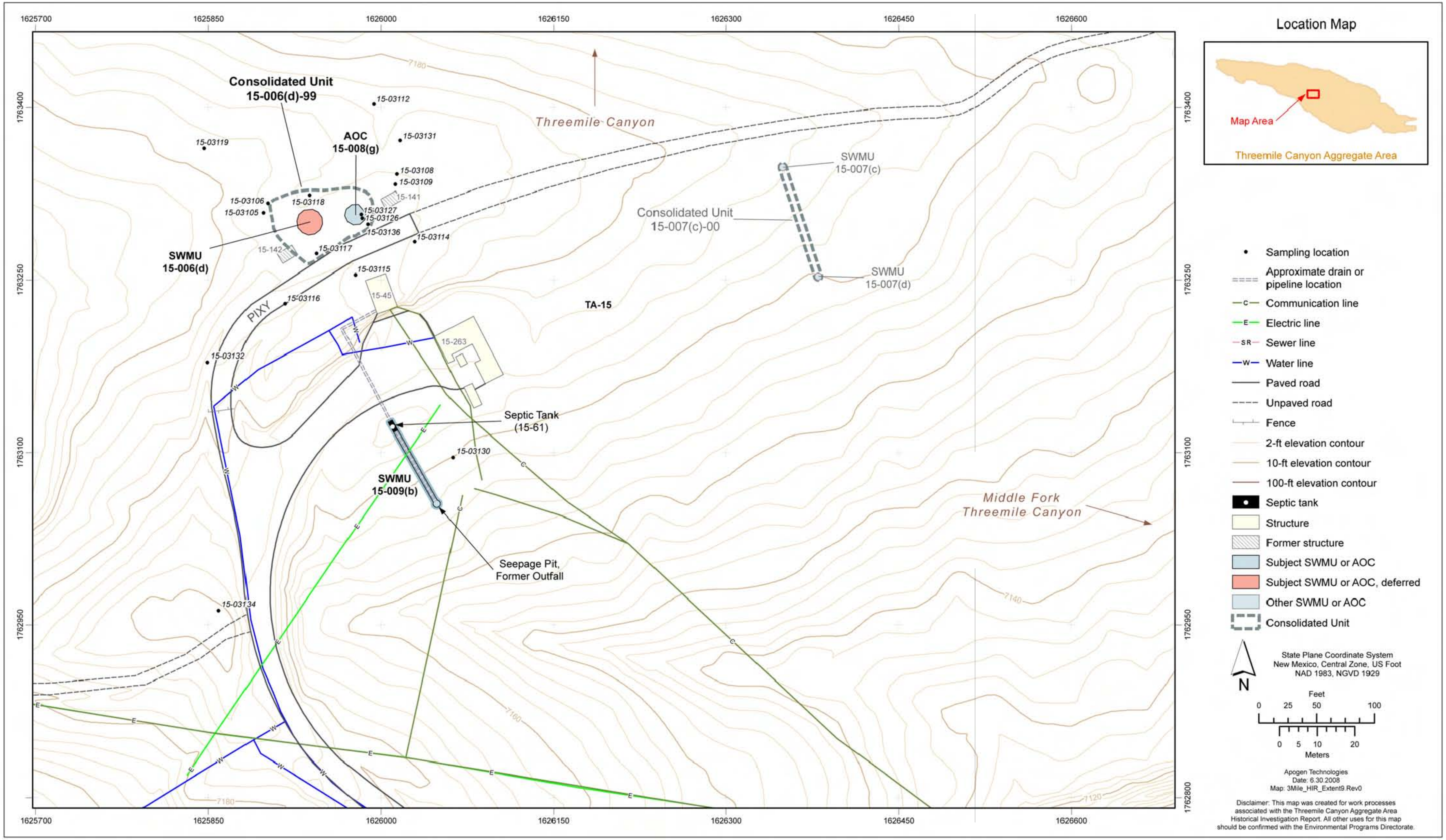

Figure 6.6-1 Site features of Consolidated Unit 15-006(d)-99 [SWMU 15-006(d) and AOC 15-008(g)] and SWMU 15-009(b)

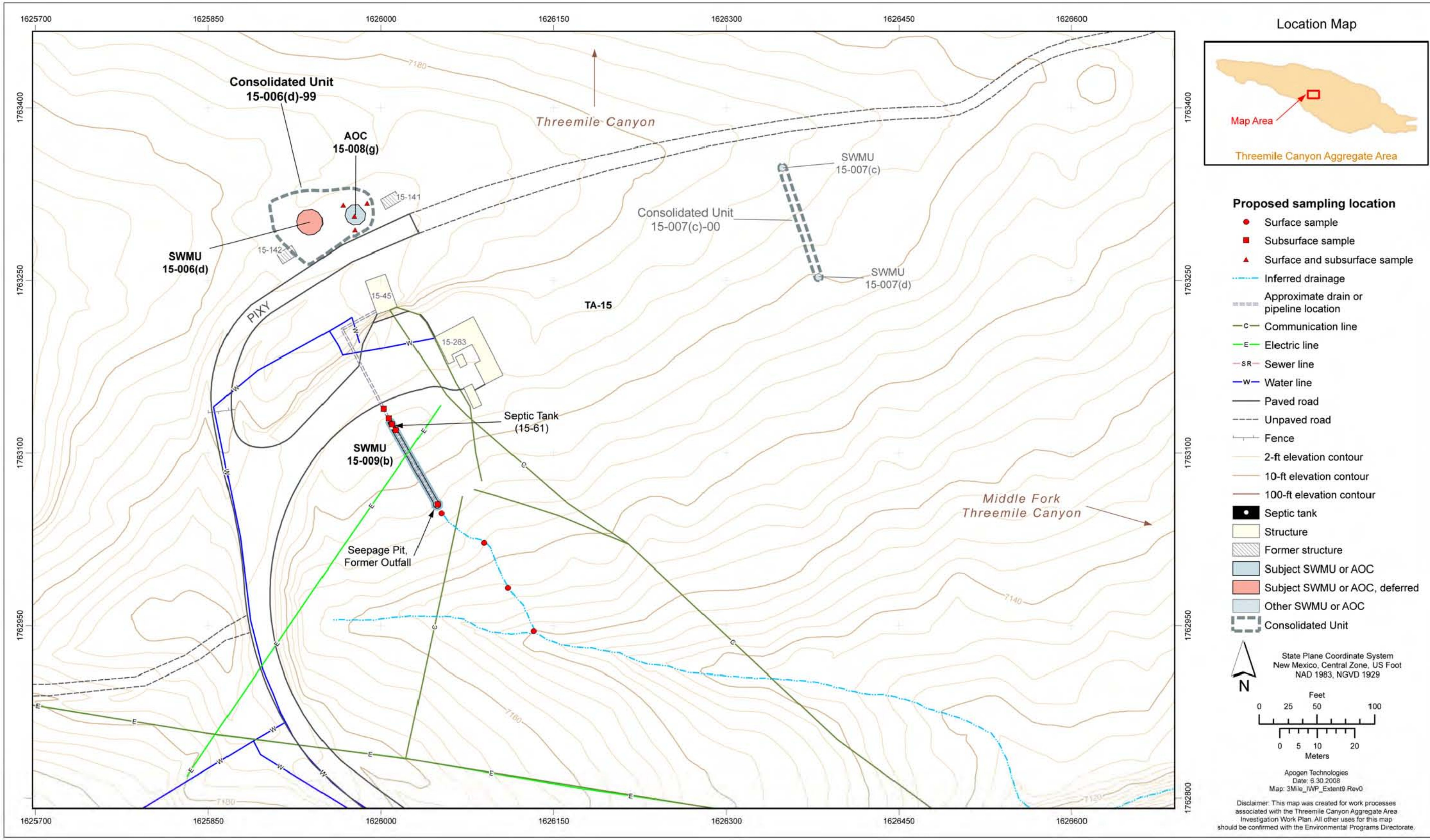

Figure 6.6-2 Proposed sampling locations for AOC 15-008(g) and SWMU 15-009(b)

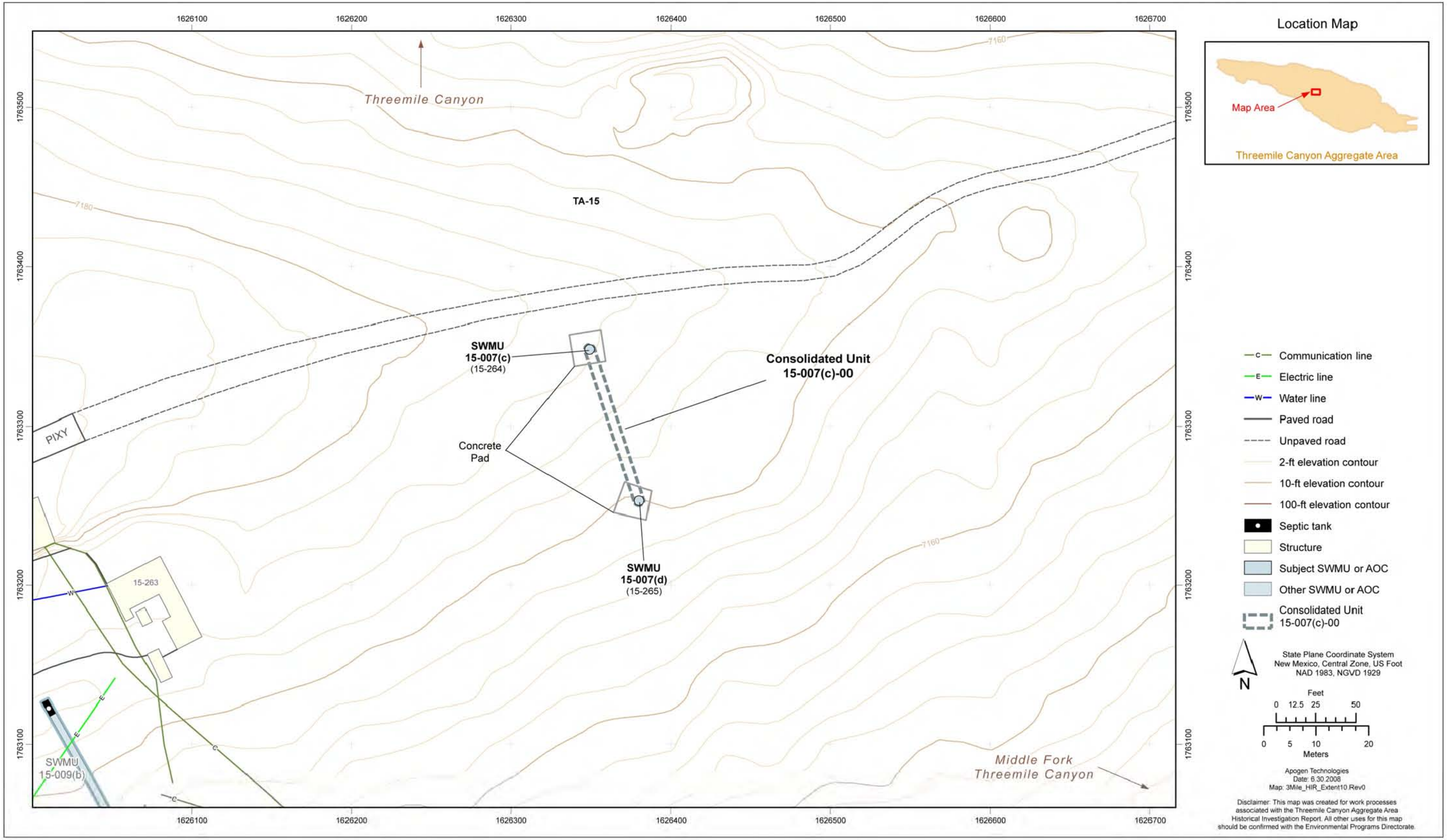

Figure 6.7-1 Site features of Consolidated Unit 15-007(c)-00 [SWMUs 15-007(c) and 15-007(d)]

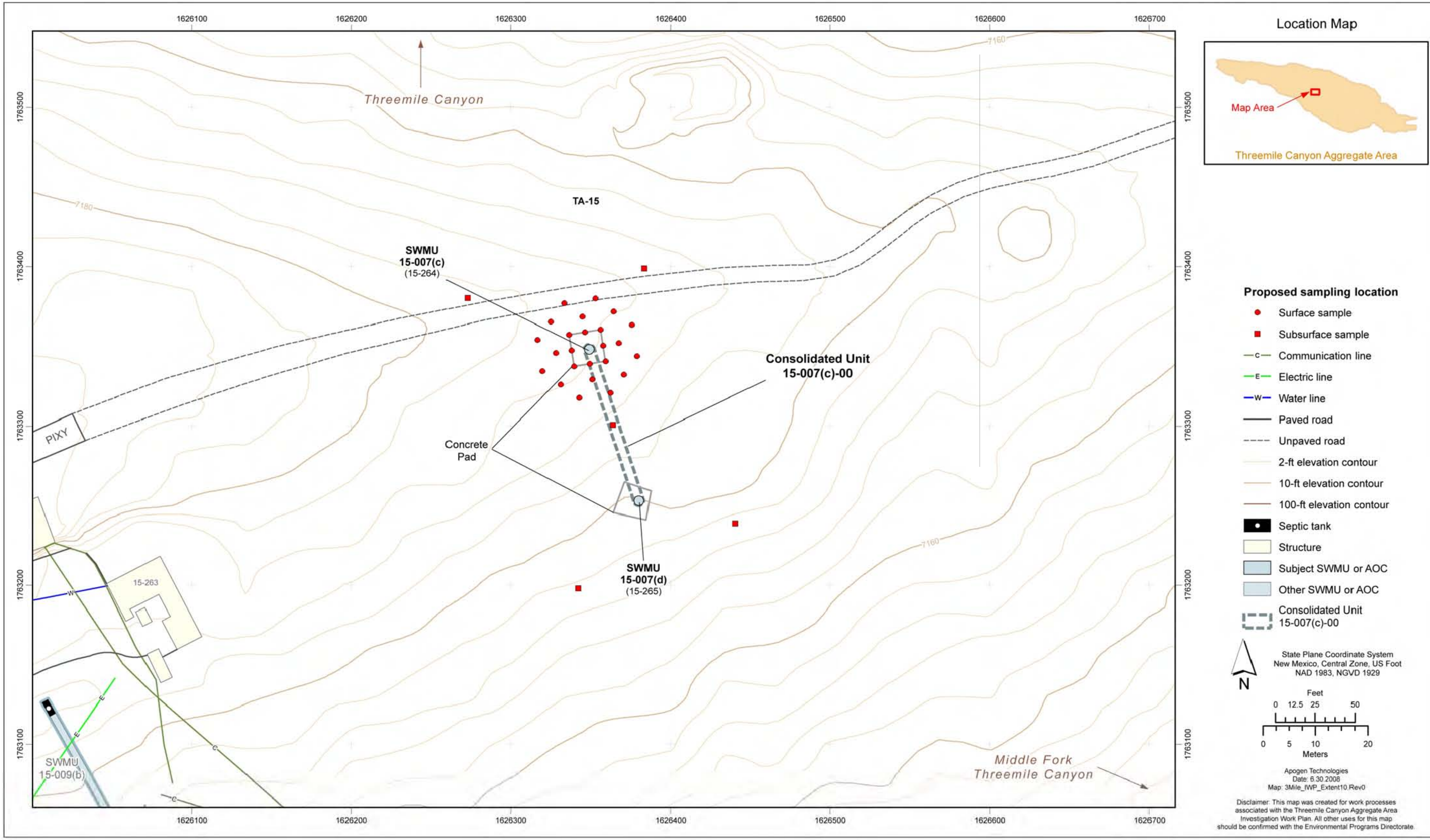

Figure 6.7-2 Proposed sampling locations for SWMUs 15-007(c) and 15-007(d)

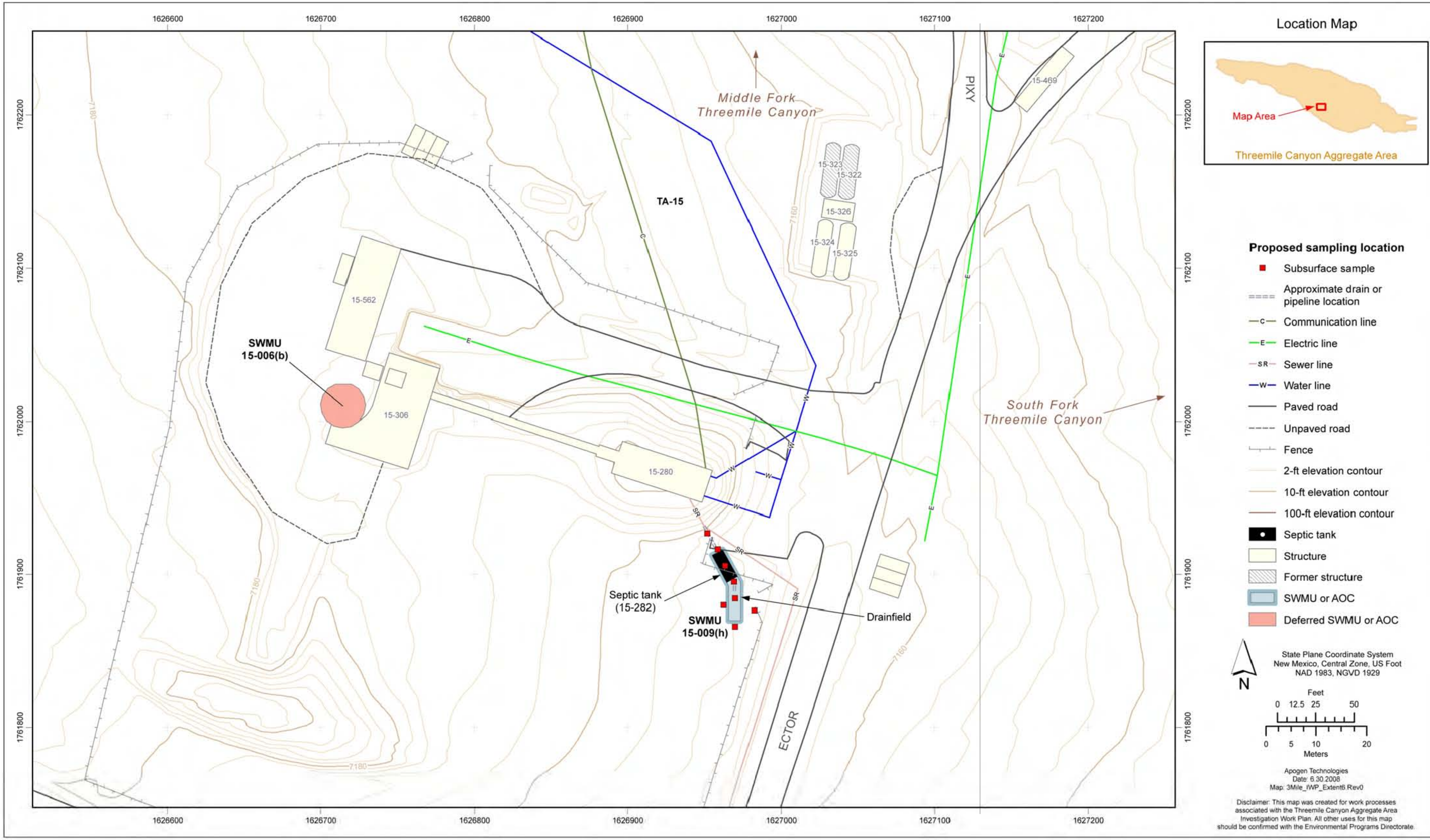

Figure 6.10-1 Proposed sampling locations for SWMU 15-009(h)

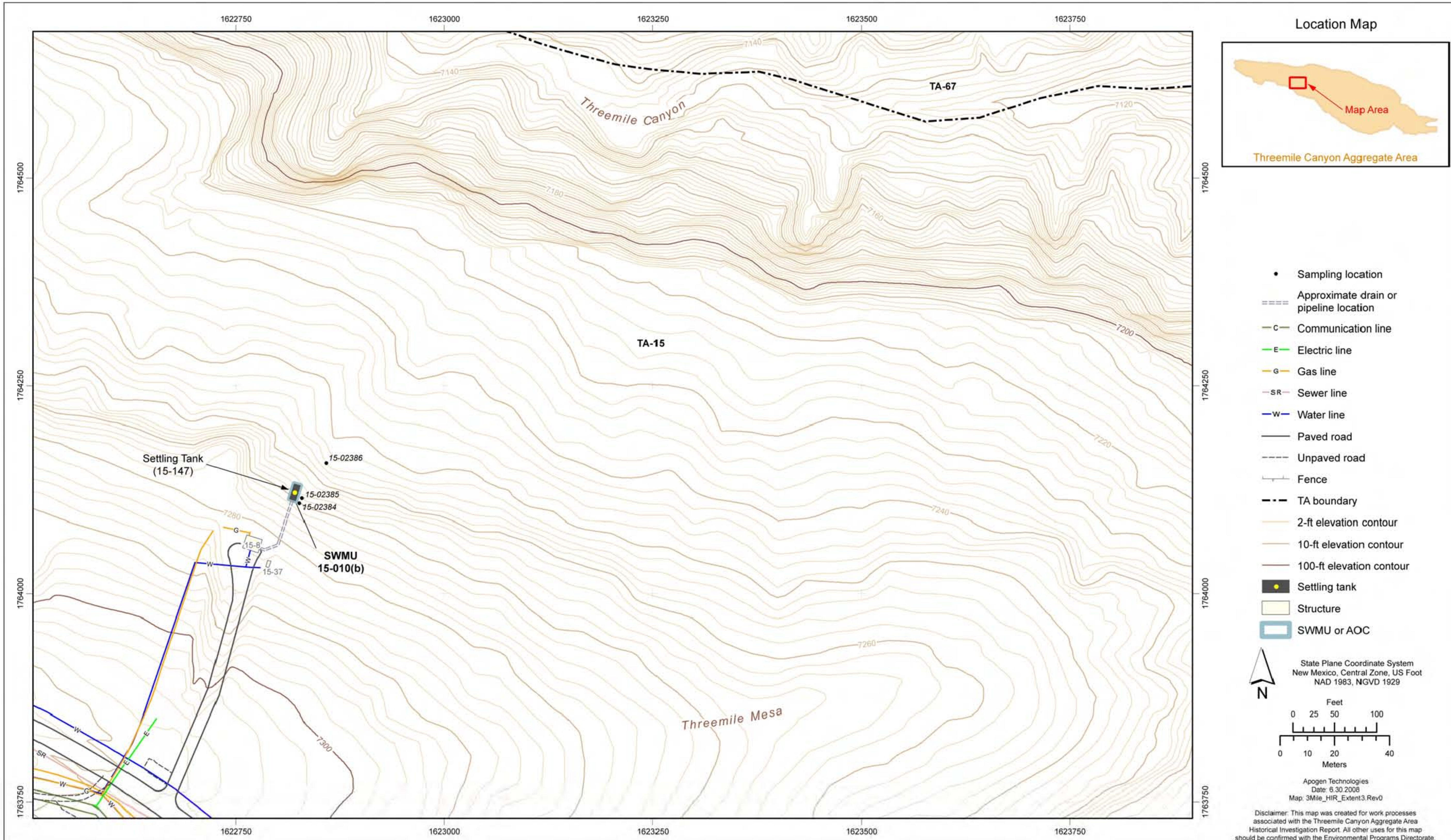

Figure 6.11-1 Site features of SWMU 15-010(b)

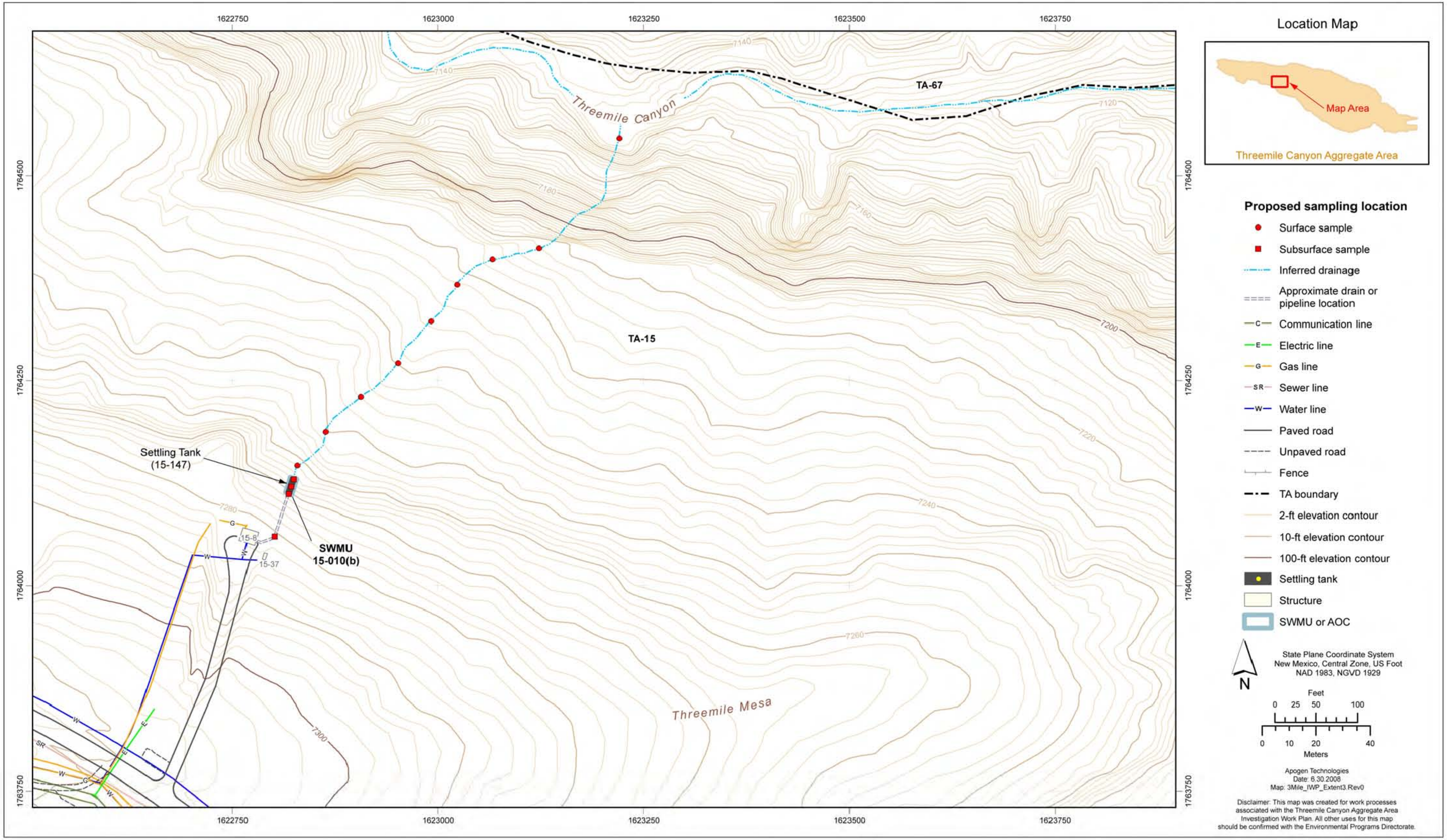

Figure 6.11-2 Proposed sampling locations for SWMU 15-010(b)

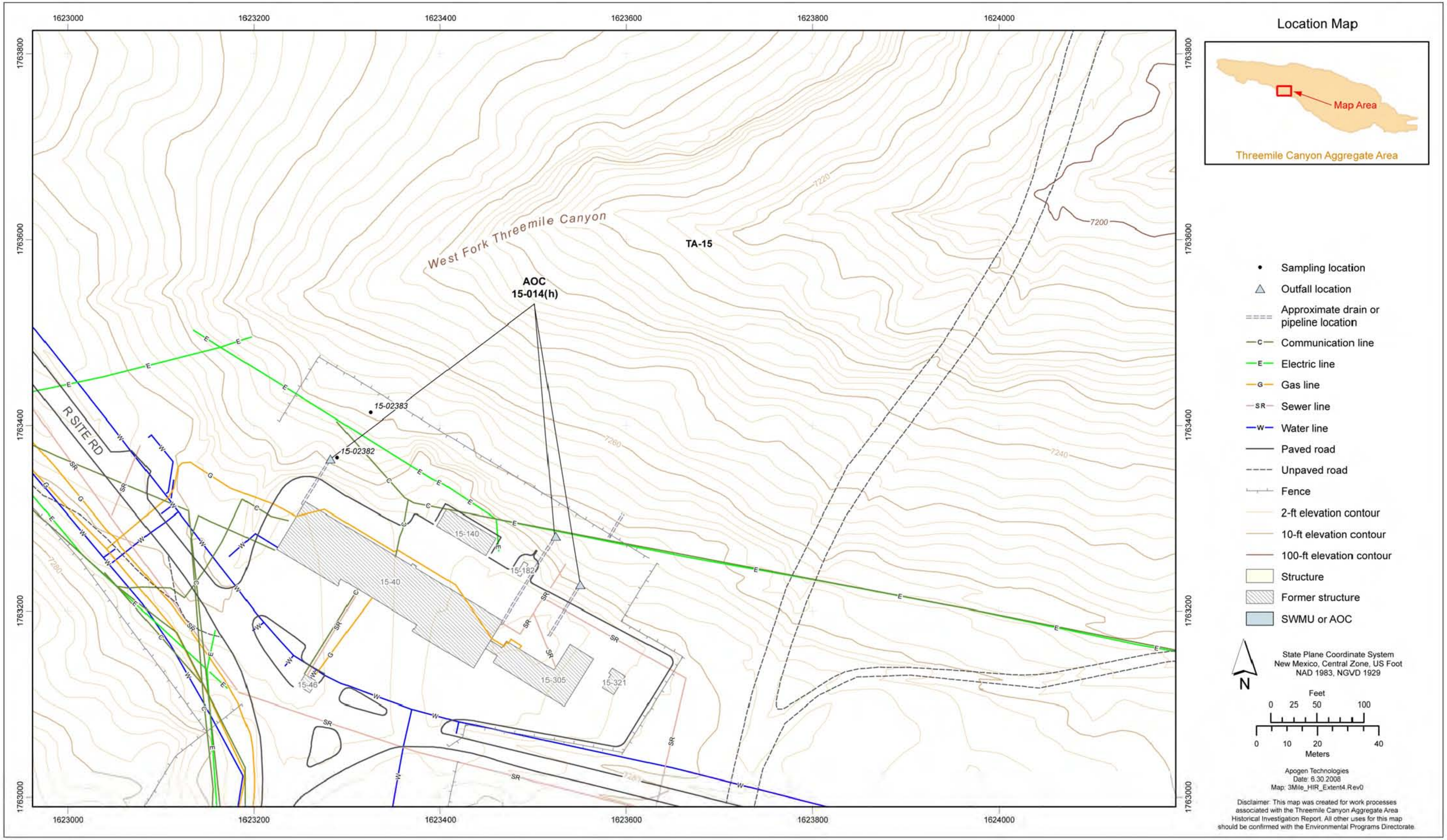

Figure 6.12-1 Site features of AOC 15-014(h)

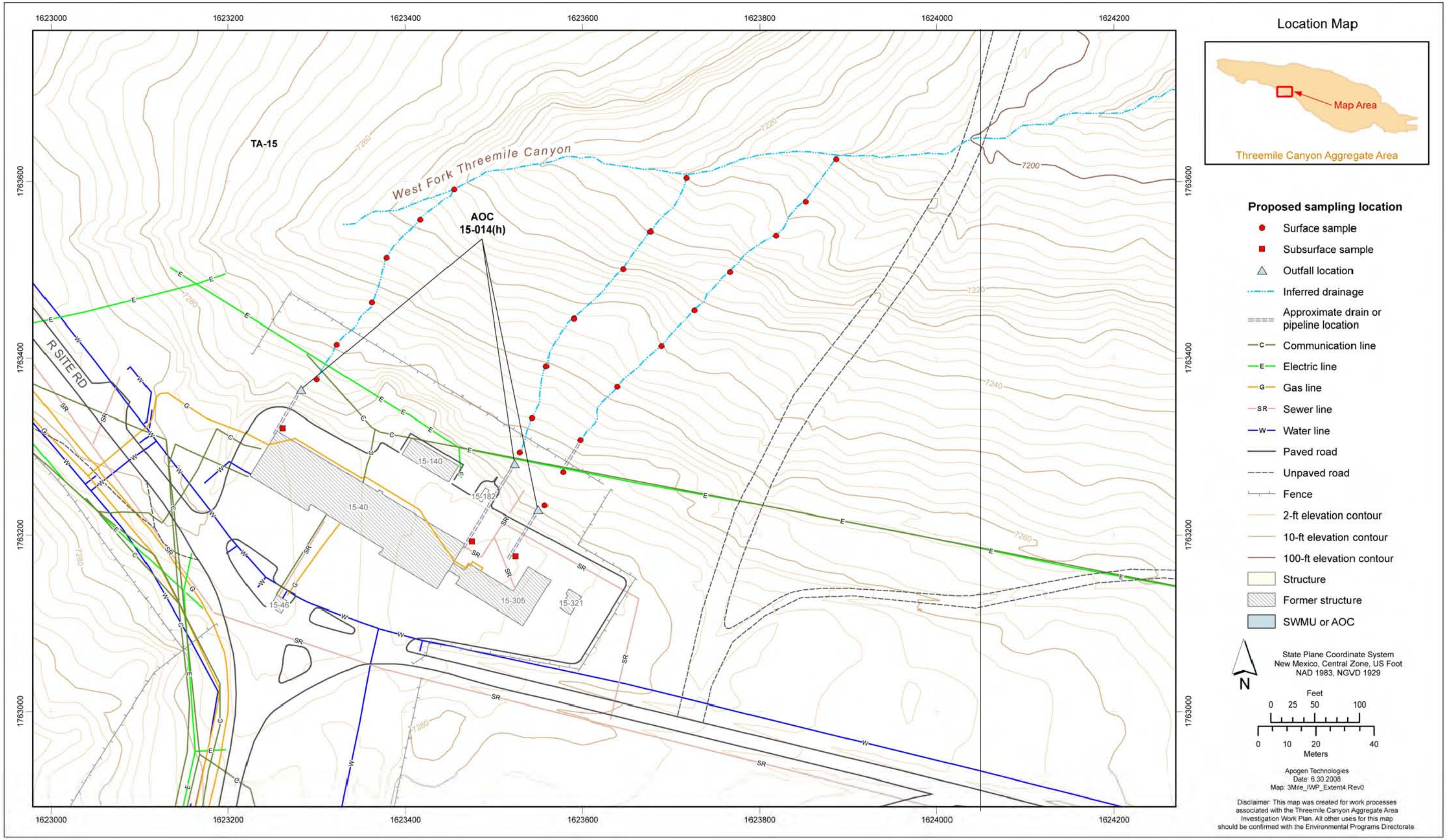

Figure 6.12-2 Proposed sampling locations for AOC 15-014(h)

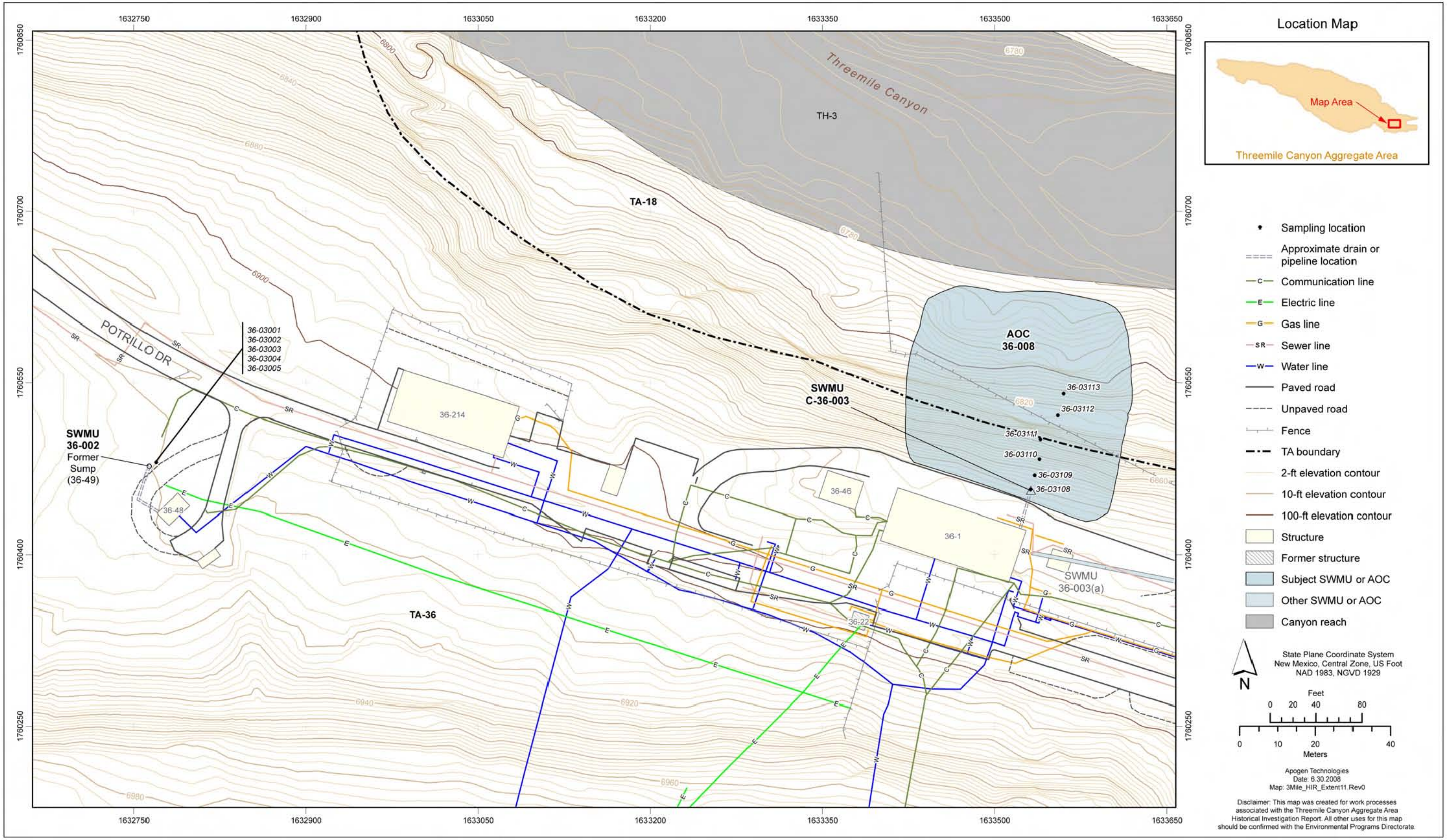

Figure 7.1-1 Site features of SWMUs 36-002 and AOCs C-36-003 and 36-008

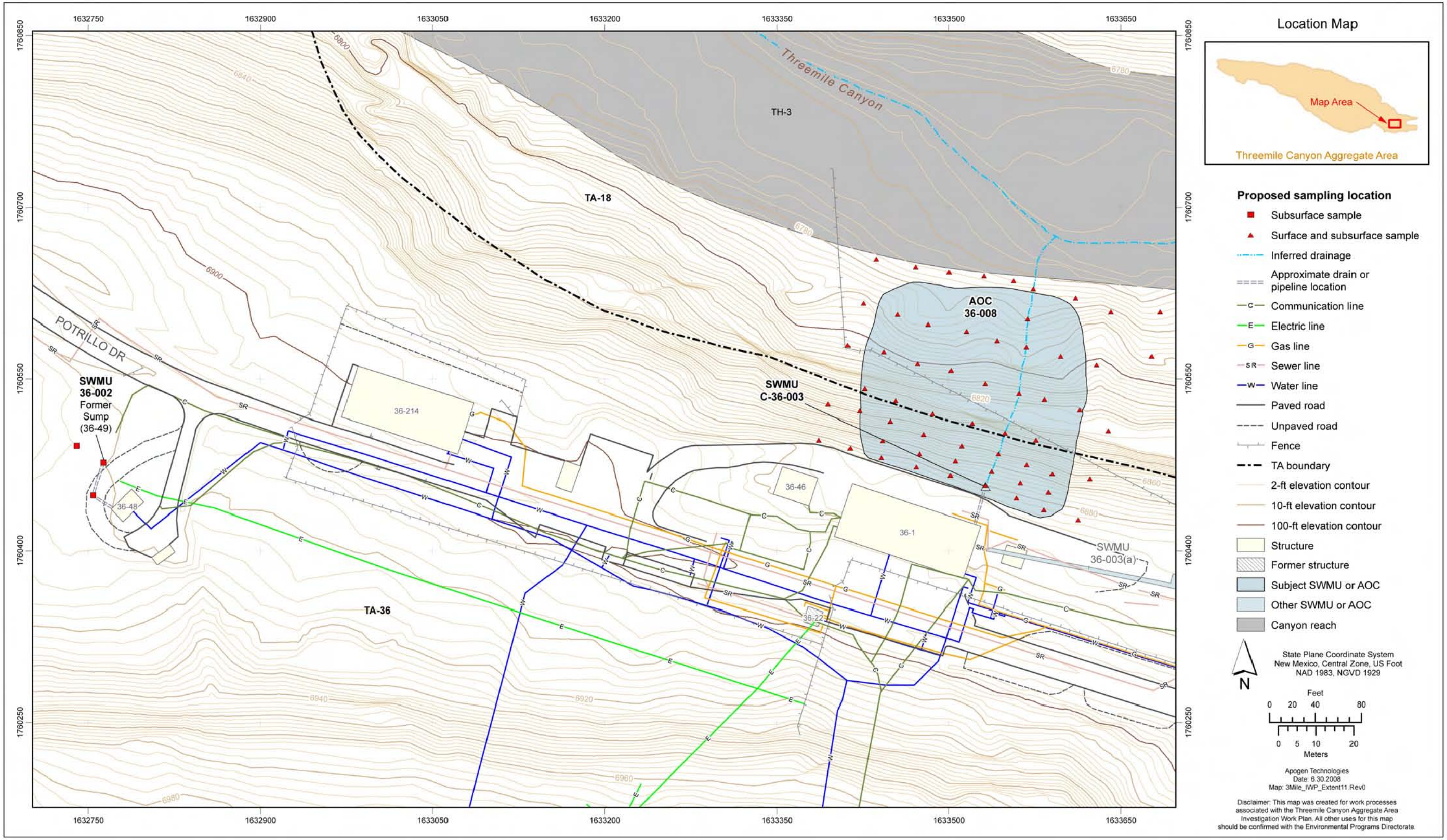

Figure 7.1-2 Proposed sampling locations for SWMUs 36-002 and AOCs C-36-003 and 36-008

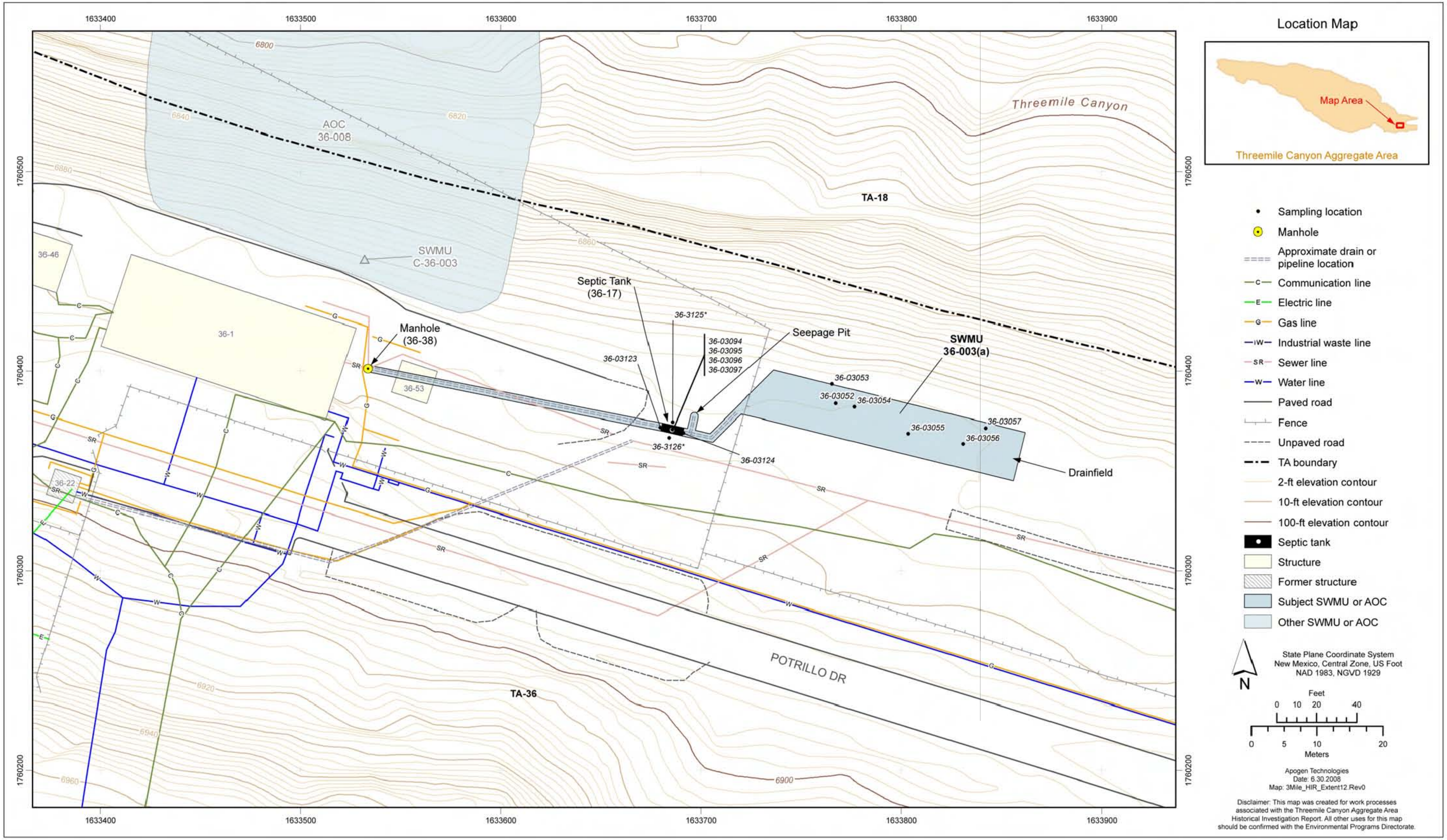

Figure 7.2-1 Site features of SWMU 36-003(a)

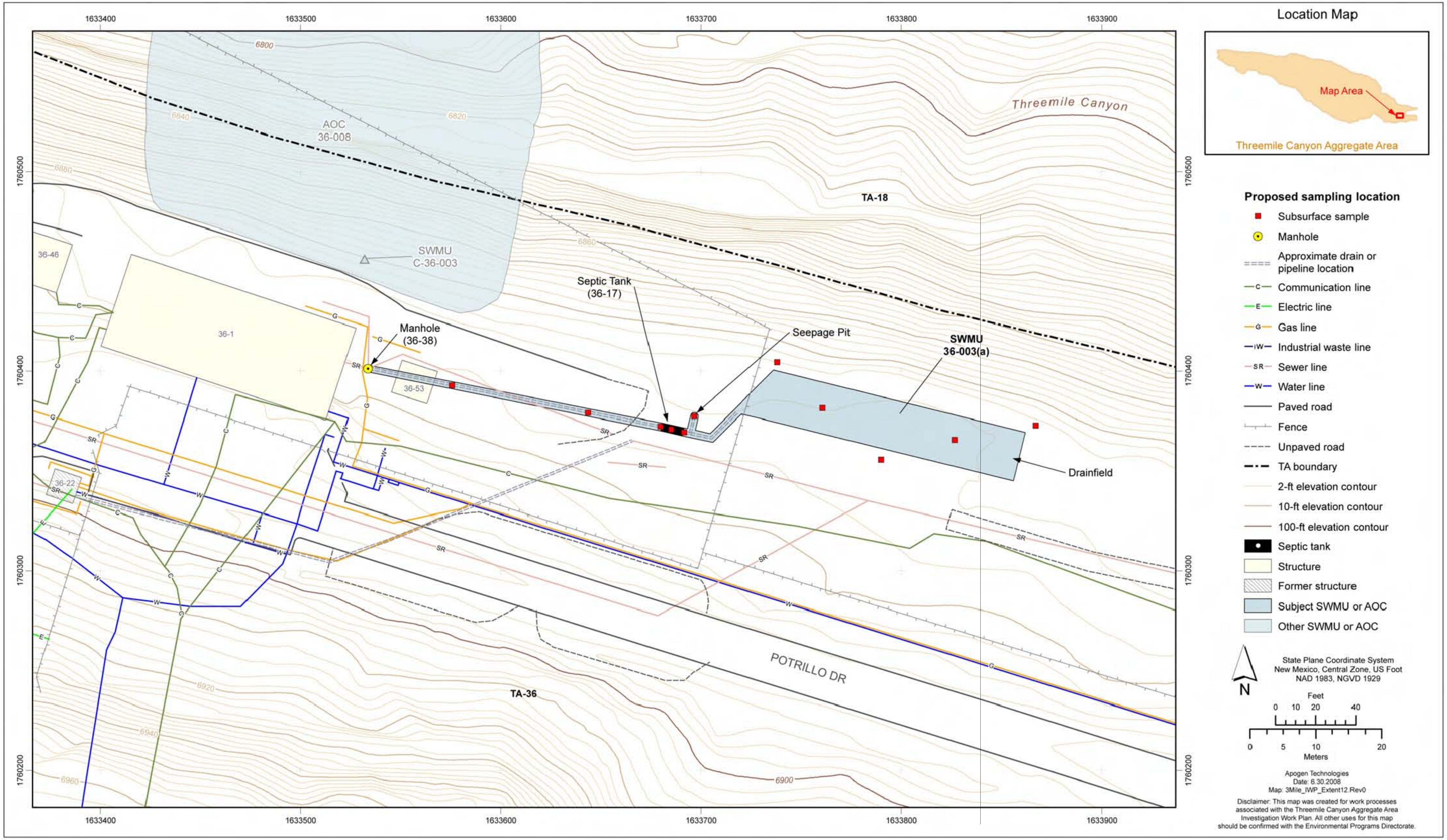

Figure 7.2-2 Proposed sampling locations for SWMU 36-003(a)

Table 1.1-1
SWMUs and AOCs within the Threemile Canyon Aggregate Area

Site ID Number	Subunit	Site Description	Site Status	Reference/Work Plan Location
Former TA-12				
Consolidated Unit 12-001(a)-99	SWMU 12-001(a)	Firing pit steel-lined chamber	Under investigation	Work plan section 4.1.1
	SWMU 12-001(b)	Firing pit	Under investigation	Work plan section 4.1.2
	SWMU 12-002	Potential soil contamination	Under investigation	Work plan section 4.1.3
	AOC C-12-005	Former junction box	Under investigation	Work plan section 4.1.4
AOC 12-003		A former gas cylinder storage area located on the southern side of the unimproved road and about one mile east of the firing pit (structure 12-4)	NFA approved 01/21/05	EPA 2005, 088464
AOC 12-004(a)		Radiation test facility	Under investigation	Work plan section 4.2
AOC 12-004(b)		Pipe	Under investigation	Work plan section 4.3
AOC C-12-001		Potential soil contamination associated with former building	Under investigation	Work plan section 4.4
AOC C-12-002		Potential soil contamination associated with former building	Under investigation	Work plan section 4.5
AOC C-12-003		Potential soil contamination associated with former building	Under investigation	Work plan section 4.6
AOC C-12-004		Potential soil contamination associated with former building	Under investigation	Work plan section 4.7
AOC C-12-006		A duplicate reporting of one of the elements of AOC 12-004(a)	NFA approved 01/21/05	EPA 2005, 088464
TA-14				
AOC C-14-006		Potential soil contamination associated with former building	Under investigation	Work plan section 5.1
TA-15				
SWMU 15-004(a)		Firing site C	Deferred per Table IV-2 of the Consent Order	Work plan section 6.1
AOC 15-004(d)		Firing platforms	Under investigation	Work plan section 6.2

Table 1.1-1 (continued)

Site ID Number	Subunit	Site Description	Site Status	Reference/ Work Plan Location
SWMU 15-004(e)		A manhole bunker for electric cables located 140 ft south and 115 ft east of the southwestern corner of building 15-41	NFA approved 01/21/05	EPA 2005, 088464
AOC 15-005(c)		Container storage area (R-41)	Under investigation	Work plan section 6.3
SWMU 15-006(b)		Ector firing site	Deferred per Table IV-2 of the Consent Order	Work plan section 6.4
Consolidated Unit 15-006(c)-99	SWMU 15-006(c)	Firing site R-44	Deferred per Table IV-2 of the Consent Order	Work plan section 6.5.1
	SWMU 15-008(b)	Surface disposal area associated with firing site R-44	Under investigation	Work plan section 6.5.2
Consolidated Unit 15-006(d)-99	SWMU 15-006(d)	Firing site R-45	Deferred per Table IV-2 of the Consent Order	Work plan section 6.6.1
	AOC 15-008(g)	Surface disposal area associated with firing site R-45	Under investigation	Work plan section 6.6.2
Consolidated Unit 15-007(c)-00	SWMU 15-007(c)	Shaft	Under investigation	Work plan section 6.7.1
	SWMU 15-007(d)	Shaft	Under investigation	Work plan section 6.7.2
SWMU 15-009(b)		Septic system	Under investigation	Work plan section 6.8
SWMU 15-009(c)		Septic system	Under investigation	Work plan section 6.9
AOC 15-009(d)		A building drain on the north side of R-40 (building 15-40)	NFA approved 01/21/05	EPA 2005, 088464
SWMU 15-009(h)		Septic system	Under investigation	Work plan section 6.10
SWMU 15-010(b)		Settling tank	Under investigation	Work plan section 6.11
AOC 15-014(f)		A drainline for cooling water from building 15-263 and an associated outfall draining into Threemile Canyon. The outfall discharged once-through cooling water only and was NPDES-permitted (04A121).	NFA approved 01/21/05	EPA 2005, 088464
AOC 15-014(h)		Outfalls from building 15-40	Under investigation	Work plan section 6.12

Table 1.1-1 (continued)

Site ID Number	Subunit	Site Description	Site Status	Reference/ Work Plan Location
SWMU 15-014(m)		An NPDES-permitted outfall that handled non-contact cooling water from building 15-306	Removed from Module VIII of the Hazardous Waste Facility Permit (HWFP), 12/23/98	NMED 1998, 063042
AOC C-15-003		A pile of black granular material located north of structure 15-45.	NFA approved 01/21/05	EPA 2005, 088464
AOC C-15-009		An underground butane storage tank (structure 15-48) located a few feet north and west of building 15-8.	NFA approved 01/21/05	EPA 2005, 088464
TA-18				
SWMU 18-007		An armored vehicle suspected to have been buried west of structure 18-32. Field investigations, including an extensive electromagnetic survey, and archival information were unable to verify the burial of the armored vehicle at the suspected locations.	Removed from Module VIII of the HWFP, 5/02/01	NMED 2001, 070010
TA-36				
SWMU 36-002		Former sump	Under investigation	Work plan section 7.1
SWMU 36-003(a)		Septic system	Under investigation	Work plan section 7.2
AOC 36-003(d)		A Septic system that was first used in 1988 to serve building 36-1 and is comprised of a 1,000 gal. septic tank (structure 36-100) and associated leach field. The system was built to handle sanitary waste from transportable structures 36-81 and 36-84.	NFA approved 01/21/05	EPA 2005, 088464
AOC 36-008		Surface disposal area located near building 36-1	Under investigation	Work plan section 7.3
SWMU C-36-003		Outfall from building 36-1	Under investigation	Work plan section 7.4

Note: Shading denotes NFA approved or pending.

Table 2.3-1
Summary of Human Health Screening Levels for Chemicals and Radionuclides

Chemical/Radionuclide	Residential[a]	Industrial[a]	Recreational[a]
Acenaphthene	3730	33,500	47,500
Acenaphthylene (use Pyrene)	2290	30,900	23,800
Acetone	28,100	100,000	100,000
Acrolein	0.206	0.752	6.33
Aldrin	0.284	1.12	1.49
Amino-2,6-dinitrotoluene[4-] (use Dinitrotoluene[2,6-])	61	680	399
Amino-4,6-dinitrotoluene[2-] (use Dinitrotoluene[2,6-])	61	680	399
Anthracene	22,000	100,000	100,000
Aroclor-1016	3.93	41.3	23.3
Aroclor-1221	1.12	8.26	10.5
Aroclor-1232	1.12	8.26	10.5
Aroclor-1242	1.12	8.26	10.5
Aroclor-1248	1.12	8.26	10.5
Aroclor-1254	1.12	8.26	6.65
Aroclor-1260	1.12	8.26	10.5
Benzene	10.3	25.8	224
Benzidine	0.0211	0.0833	0.111
Benzo(a)anthracene	6.21	23.4	30.1
Benzo(a)pyrene	0.621	2.34	3.01
Benzo(b)fluoranthene	6.21	23.4	30.1
Benzo(g,h,i)perylene (use Pyrene)	2290	30,900	23,800
Benzo(k)fluoranthene	62.1	234	301
Benzoic acid	100,000[b]	100,000[b]	100,000
BHC[alpha-]	0.902	3.99	6.05
BHC[beta-]	3.16	14	21.2
BHC[gamma-]	4.37	19.3	29.3
Bis(2-chloroethyl)ether	2.44	7.45	34.5
Bis(2-chloroisopropyl)ether or Oxybis(1-chloropropane)[2,2'-]	38.7	119	453
Bis(2-ethylhexyl)phthalate	347	1370	1830
Bromobenzene	37	137	245
Bromodichloromethane	14.4	37.2	290
Bromoform or Tribromomethane	621	2460	7160
Bromomethane	8.51	32.8	228
Butanone[2-] or Methyl ethyl ketone	31,800	48,700	48,700
Butylbenzene[n-]	62.1	62.1	62.1
Butylbenzene[sec-]	60.6	60.6	60.6

Table 2.3-1 (continued)

Chemical/Radionuclide	Residential[a]	Industrial[a]	Recreational[a]
Butylbenzene[tert-]	106	106	106
Butylbenzylphthalate	240[b]	240[b]	240
Carbon disulfide	460	460	460
Carbon tetrachloride	3.47	8.64	77.9
Chlordane (Technical Grade)	16.2	71.9	109
Chlordane[alpha-] (use Chlordane)	16.2	71.9	109
Chlordane[gamma-] (use Chlordane)	16.2	71.9	109
Chlorobenzene	194	245	245
Chlorodibromomethane or Dibromochloromethane	14.8	39.5	673
Chloroethane or Ethyl chloride	63.3	154	1420
Chloroform	4	9.59	102
Chloromethane	21.8	53.4	510
Chloronaphthalene[2-] or [b-]	3990	27,800	63,400
Chlorophenol[2-]	166	885	2750
Chlorotoluene[2-] or [o-]	202	202	202
Chrysene	615	2310	3010
DDD[4,4'-]	24.4	111	173
DDE[4,4'-]	17.2	78.1	122
DDT[4,4'-]	17.2	78.1	122
Dibenz(a,h)anthracene	0.621	2.34	3.01
Dibenzofuran	142	1620	1580
Dibromo-3-chloropropane[1,2-]	1.84	9.68	40.4
Dibromoethane[1,2-]	0.504	1.31	9.88
Dibromomethane or Methylene bromide	179	785	3780
Dichlorobenzene[1,2-]	37.4	37.4	37.4
Dichlorobenzene[1,3-]	32.6	37.4	37.4
Dichlorobenzene[1,4-]	39.5	103	2360
Dichlorobenzidine[3,3'-]	10.8	42.6	56.9
Dichlorodifluoromethane	161	211	211
Dichloroethane[1,1-]	1400	1420	1420
Dichloroethane[1,2-]	6.04	15.2	132
Dichloroethene[1,1-]	206	777	927
Dichloroethene[cis-1,2-]	76.5	300	863
Dichloroethene[trans-1,2-]	112	429	1740
Dichlorophenol[2,4-]	183	2050	1200
Dichloropropane[1,2-]	6	14.9	136
Dichloropropene[cis/trans-1,3-] or [1,3-]	12	31.7	225
Dieldrin	0.304	1.2	1.6
Diethylphthalate	48,900	100,000	100,000

Table 2.3-1 (continued)

Chemical/Radionuclide	Residential[a]	Industrial[a]	Recreational[a]
Dimethyl phthalate	100,000	100,000	100,000
Dimethylphenol[2,4-]	1220	13,700	7970
Di-n-butylphthalate	6110	68,400	39,900
Dinitrobenzene[1,3-]	6.1[b]	68[b]	39.9
Dinitrotoluene[2,4-]	122	1370	797
Dinitrotoluene[2,6-]	61[b]	680[b]	399
Di-n-octylphthalate	2400[b]	25,000[b]	15,900
Diphenylhydrazine[1,2-]	6.08	23.9	32
Endosulfan Sulfate (use Endrin)	18.3	205	120
Endosulfan/Endosulfan I/Endosulfan II	367	4100	2390
Endrin	18.3	205	120
Endrin aldehyde (use Endrin)	18.3	205	120
Endrin ketone (use Endrin)	18.3	205	120
Ethylbenzene	128	128	128
Fluoranthene	2290	24,400	13,900
Fluorene	2660	26,500	31,700
Heptachlor	1.08	4.26	5.69
Heptachlor epoxide	0.53[b]	2.1[b]	2.81
Hexachlorobenzene	3.04	12	16
Hexachlorobutadiene or Hexachloro-1,3-butadiene	12.2	137	79.7
Hexachlorocyclopentadiene	366	4100	2390
Hexachloroethane	61.1	684	399
Hexanone[2-] (use Butanone[2-])	31,800	48,700	48,700
HMX	3060	34,200	19,900
Indeno(1,2,3-cd)pyrene	6.21	23.4	30.1
Isopropylbenzene or Cumene	271	389	389
Isopropyltoluene[4-] (use Isopropylbenzene)	271	389	389
Methoxychlor[4,4'-]	310[b]	3400[b]	1690
Methyl-2-pentanone[4-] or Methyl isobutyl ketone	5510	7010	7010
Methylene chloride	182	490	2630
Methylnaphthalene[2-] (use Naphthalene)	79.5	300	15,800
Naphthalene	79.5	300	15,800
Nitrobenzene	22.8	147	320
Nitrophenol[2-] (use Chlorophenol[2-])	166	885	2750
Nitrosodiethylamine[N-]	0.0324	0.128	0.171
Nitrosodimethylamine[N-]	0.0954	0.376	0.502
Nitrosodiphenylamine[N-]	993	3910	5220
Nitrotoluene[2-] or [o-}	10.8	32.3	158
Nitrotoluene[3-] or [m-]	569	569	569

Table 2.3-1 (continued)

Chemical/Radionuclide	Residential[a]	Industrial[a]	Recreational[a]
Nitrotoluene[4-] or [p-]	146	437	2140
Pentachlorophenol	29.8	100	117
Phenanthrene	1830	20,500	12,000
Phenol	18,300	100,000	100,000
Propylbenzene[1-] or [n-]	62.1	62.1	62.1
Pyrene	2290	30,900	23,800
RDX	44.2	174	233
Styrene	100	100	100
Tetrachloroethane[1,1,1,2-]	43.2	114	827
Tetrachloroethane[1,1,2,2-]	5.55	14.6	106
Tetrachloroethene	12.5	31.6	134
Toluene	252	252	252
Toxaphene (Technical Grade)	4.42	17.4	23.3
Trichloro-1,2,2-trifluoroethane[1,1,2-]	3280	3280	3280
Trichlorobenzene[1,2,4-]	69.3	269	855
Trichloroethane[1,1,1-]	563	563	563
Trichloroethane[1,1,2-]	11.9	30.2	252
Trichloroethene	0.638	1.56	15.1
Trichlorofluoromethane	588	983	983
Trichlorophenol[2,4,5-]	6110	68,400	39,900
Trichlorophenol[2,4,6-]	6.11	68.4	39.9
Trimethylbenzene[1,2,4-]	58	213	39600
Trimethylbenzene[1,3,5-]	24.8	69.2	69.2
Trinitrobenzene[1,3,5-]	1800[b]	21,000[b]	12,000
Trinitrotoluene[2,4,6-]	30.6	342	199
Vinyl acetate	1070	3680	3680
Vinyl chloride	2.25	14	29.7
Xylene[1,2-] or [m-]	82	82	82
Xylene[1,3] + [1,4-]	82	82	82
Xylene[1,3-] or [o-]	99.5	99.5	99.5
Xylenes (Total)	82	82	82
Aluminum	77,800	100,000	100,000
Antimony	31.3	454	317
Arsenic	3.9	17.7	27.7
Barium	15,600	100,000	100,000
Beryllium	156	2250	1580
Cadmium	39	564	392
Chromium	2100[b]	5000[b]	14,300
Cobalt	1520	20,500	15,700

Table 2.3-1 (continued)

Chemical/Radionuclide	Residential[a]	Industrial[a]	Recreational[a]
Copper	3130	45,400	31,700
Cyanide (Total)	1220	13,700	7970
Iron	23,500	100,000	100,000
Lead	400	800	560
Manganese	3590	48,400	36,900
Mercury	23[b]	340[b]	238
Molybdenum	391	5680	3960
Nickel	1560	22,700	15,800
Selenium	391	5680	3960
Silver	391	5680	3960
Strontium	46,900	100,000	100,000
Thallium	5.16	74.9	52.3
Uranium	16[b]	200[b]	2380
Vanadium	78.2	1140	792
Zinc	23,500	100,000	100,000
Americium-241	30	180	280
Cesium-134	2.4	9.7	87
Cesium-137	5.6	23	210
Cobalt-60	1.3	5.1	46
Europium-152	2.9	11	100
Neptunium-237	2.4	50	170
Sodium-22	1.6	6.5	58
Thorium-230	5	5	5
Tritium	750	440,000	5,100,000
Uranium-234	170	1500	3200
Uranium-235	17	87	520
Uranium-238	86	430	2100

Note: SSLs are from the "Technical Background Document for Development of Soil Screening Levels" (NMED 2006, 092513); shading denotes surrogate analytes.

[a] Chemical concentrations are in mg/kg and radionuclide concentrations are in pCi/g.

[b] SSLs are from the "EPA Region 6 Human Health Medium-Specific Screening Levels," www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm (EPA 2007, 099314).

Table 4.0-1
Proposed Sampling Description and Analyses

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
Former TA-12																
Consolidated Unit 12-001(a)-99																
SWMU 12-001(a), Firing Pit Steel-Lined Chamber	18 surface and subsurface samples will be collected from 9 locations bounding the firing pit	Section 4.1.1.3 Figure 4.1-2	0–0.5 2–3	Fill, soil, tuff	X[b]	X	X	-[c]	X	-	-	X	X	X	X	-
	30 surface and subsurface samples will be collected from 15 locations in the drainage below the firing pit Data collected at SWMU 12-001(a) will be used to evaluate SWMU 12-001(b) (section 4.1.2.3), SWMU 12-002 (section 4.1.3.3), and AOC C-12-005 (section 4.1.4.3)	Section 4.1.1.3 Figure 4.1-2	0–0.5, 1–2	Sediment, tuff	X	X	X	-	X	-	-	X	X	X	X	-

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082) [a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
SWMU 12-001(b), Firing Pit	34 surface and subsurface samples will be collected from 17 locations within and bounding the firing site Data collected at SWMU 12-001(a) (section 4.1.1.3) will be used to evaluate SWMU 12-001(b)	Section 4.1.2.3 Figure 4.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-
SWMU 12-002, Potential Soil Contamination	2 surface and subsurface samples will be collected from 1 location beneath the asphalt covering the burn site Data collected at SWMU 12-001(a) (section 4.1.1.3) and SWMU 12-001(b) (section 4.1.2.3) will be used to evaluate SWMU 12-002	Section 4.1.3.3 Figure 4.1-2	0–0.5 2–3 beneath asphalt	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
AOC C-12-005, Former Junction Box	10 surface and subsurface samples will be collected from 5 locations within and bounding the former junction box footprint Data collected at SWMU 12-001(a) (section 4.1.1.3) will be used to evaluate AOC C-12-005	Section 4.1.4.3 Figure 4.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-
AOC 12-004(a), Radiation Test Facility	16 surface and subsurface samples will be collected from 8 locations within and bounding the experiment site	Section 4.2.3 Figure 4.2-2	0–0.5 1–2	Soil, tuff	X	X	X	-	X	-	X	X	X	X	X	-
	16 surface and subsurface samples will be collected from 8 locations in the drainage below the experiment site	Section 4.2.3 Figure 4.2-2	0–0.5 1–2	Sediment, tuff	X	X	X	-	X	-	X	X	X	X	X	-

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082) [a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
AOC 12-004(b), Pipe	6 surface and subsurface samples will be collected from 2 locations beneath the pipe Data collected at SWMU 12-004(a) (section 4.2.3) will be used to evaluate AOC 12-004(b)	Section 4.3.3 Figure 4.2-2	0–0.5 2–3 5–6	Soil, tuff	X	X	X	-	X	-	X	X	X	X	X	-
AOC C-12-001, Potential Soil Contamination Associated with Former Building	10 surface and subsurface samples will be collected from 5 locations within and bounding the footprint of the former building	Section 4.4.3 Figure 4.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-
AOC C-12-002, Potential Soil Contamination Associated with Former Building	10 surface and subsurface samples will be collected from 5 locations within and bounding the footprint of the former building	Section 4.5.3 Figure 4.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-
AOC C-12-003, Potential Soil Contamination Associated with Former Building	10 surface and subsurface samples will be collected from 5 locations within and bounding the footprint of the former building	Section 4.6.3 Figure 4.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
AOC C-12-004, Potential Soil Contamination Associated with Former Building	10 surface and subsurface samples will be collected from 5 locations within and bounding the footprint of the former building	Section 4.7.3 Figure 4.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-
TA-14																
AOC C-14-006, Potential Soil Contamination Associated with Former Building	10 surface and subsurface samples will be collected from 5 locations within and bounding the footprint of the former building	Section 5.1.3 Figure 5.1-2	0–0.5 2–3	Soil, tuff	X	X	X	X	X	X	X	X	X	X	X	-
TA-15																
AOC 15-004(d), Firing Platforms	8 surface and subsurface samples will be collected from 4 locations beyond the historical sampling locations	Section 6.2.3 Figure 6.1-4	0–0.5 2–3	Soil, tuff	X	X	X	-	X	-	-	X	X	X	X	-
AOC 15-005(c), Container Storage Area (R-41)	14 surface and subsurface samples will be collected from 7 locations within and bounding the site	Section 6.3.3 Figure 6.1-2	0–0.5 2–3	Soil, tuff	X	X	X	-	X	X	X	X	X	X	X	-
	6 surface and subsurface samples will be collected from 3 locations in the drainage along the road southwest of the storage area	Section 6.3.3 Figure 6.1-2	0–0.5 1–2	Soil, sediment, tuff	X	X	X	-	X	X	X	X	X	X	X	-

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
Consolidated Unit 15-006(c)-99																
SWMU 15-008(b), Surface Disposal Area Associated with Firing Site R-44	112 surface and subsurface samples will be collected from 56 locations within and bounding the disposal area on the mesa top and edge	Section 6.5.2.3 Figure 6.5-2	0–0.5 3–4	Debris, soil, tuff	X	X	X	-	X	-	-	X	X	X	X	X
	52 surface and subsurface samples will be collected from 26 locations in drainages below the disposal area	Section 6.5.2.3 Figure 6.5-2	0–0.5 1–2	Sediment, tuff	X	X	X	-	X	-	-	X	X	X	X	X
Consolidated Unit 15-006(d)-99																
AOC 15-008(g), Surface Disposal Area Associated with Firing Site R-45	8 surface and subsurface samples will be collected from 4 locations within and bounding the disposal area	Section 6.6.2.3 Figure 6.6-2	0–0.5 2–3	Debris, soil, tuff	X	X	X	-	X	-	-	X	X	X	X	X

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
Consolidated Unit 15-007(c)-00																
SWMU 15-007(c), Shaft	36 surface and subsurface samples will be collected from 3 locations bounding the location of the shaft	Section 6.7.1.3 Figure 6.7-2	0–1 16–17 32–33 48–49 64–65 80–81 96–97 112–113 128–129 144–145 160–161 176–177	Tuff	X	-	X	-	X	-	-	X	X	-	-	X
	48 surface and subsurface samples will be collected from 24 locations on a 20-ft grid bounding the concrete pad around the shaft	Section 6.7.1.3 Figure 6.7-2	0–0.5 1–2	Soil, tuff	X	-	X	-	X	-	-	X	X	-	-	-
SWMU 15-007(d), Shaft	24 surface and subsurface samples will be collected from 2 locations bounding the location of the shaft. One borehole from SWMU 15-007(c) (section 6.7.1.3) will be located to jointly characterize SWMUs 15-007(c) and 15-007(d)	Section 6.7.2.3 Figure 6.7-2	0–1 16–17 32–33 48–49 64–65 80–81 96–97 112–113 128–129 144–145 160–161 176–177	Tuff	X	-	X	-	X	-	-	X	X	-	-	X

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
SWMU 15-009(b), Septic system	8 subsurface samples will be collected from 4 locations beneath the inlet line, tank inlet, tank, tank outlet	Section 6.8.3 Figure 6.6-2	Base of the line/tank, 5 ft below the base of the line/tank	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X
	4 subsurface samples will be collected from 1 location adjacent to and downgradient of the seepage pit	Section 6.8.3 Figure 6.6-2	50–51 60–61 70–71 80–81	Tuff	X	X	X	X	X	X	X	X	X	X	X	X
	8 surface and subsurface samples will be collected from 4 locations in the drainage below the outfall	Section 6.8.3 Figure 6.6-2	0–0.5 1–2	Sediment, tuff	X	X	X	X	X	X	X	X	X	X	X	X
SWMU 15-009(c), Septic system	8 subsurface samples will be collected from 4 locations beneath the inlet line, tank inlet, tank, tank outlet	Section 6.9.3 Figure 6.5-2	Base of the line/tank, 5 ft below the base of the line/tank	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X
	26 surface and subsurface samples will be collected from 13 locations in the drainage below the outfall	Section 6.9.3 Figure 6.5-2	0–0.5 1–2	Sediment, tuff	X	X	X	X	X	X	X	X	X	X	X	X
SWMU 15-009(h), Septic system	8 subsurface samples will be collected from 4 locations beneath the inlet line, tank inlet, tank, tank outlet	Section 6.10.3 Figure 6.10-1	Base of the line/tank, 5 ft below the base of the line/tank	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
SWMU 15-009(h), Septic system	8 subsurface samples will be collected from 4 locations within and bounding the drainfield	Section 6.10.3 Figure 6.10.1	Base of the drainline, 5 ft below the base of the drainline	Soil, tuff	X	X	X	X	X	X	X	X	X	X	X	X
SWMU 15-010(b), Septic system	8 subsurface samples will be collected from 4 locations beneath the inlet line, tank inlet, tank, tank outlet	Section 6.11.3 Figure 6.11-2	Base of the line/tank, 5 ft below the base of the line/tank	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X
	18 surface and subsurface samples will be collected from 9 locations in the drainage below the outfall	Section 6.11.3 Figure 6.11-2	0–0.5 1–2	Sediment, tuff	X	X	X	X	X	X	X	X	X	X	X	X
AOC 15-014(h), Outfalls from Building 15-40	6 subsurface samples will be collected from 3 locations beneath the drainlines	Section 6.12.3 Figure 6.12-2	Base of line, 5 ft below base of line	Fill, tuff	X	X	X	-	X	X	X	X	X	X	X	X
	46 surface and subsurface samples will be collected from 23 locations in the drainages at and below the three outfalls	Section 6.12.3 Figure 6.12-2	0–0.5 1–2	Sediment, tuff	X	X	X	-	X	X	X	X	X	X	X	X

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
TA-36																
SWMU 36-002, Former Sump	4 subsurface samples will be collected from 2 locations at the location of and 10 ft down-gradient of the former sump	Section 7.1.3 Figure 7.1-2	9–10 14–15	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X
	2 subsurface samples will be collected from 1 location at the location of the inlet line	Section 7.1.3 Figure 7.1-2	Base of line, 5 ft below base of line (if present), else 4–5 and 9–10	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X
SWMU 36-003(a), Septic system	10 subsurface samples will be collected from 5 locations beneath the inlet line, tank inlet, tank, tank outlet	Section 7.2.3 Figure 7.2-2	Base of drainline, 5 ft below base of drainline	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X
	4 subsurface samples will be collected from 1 location adjacent to and downgradient of the seepage pit	Section 7.2.3 Figure 7.2-2	50–51 60–61 70–71 80–81	Tuff	X	X	X	X	X	X	X	X	X	X	X	X
	10 subsurface samples will be collected from 5 locations within and bounding the drainfield	Section 7.2.3 Figure 7.2-2	Base of drainline, 5 ft below base of drainline	Fill, tuff	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.0-1 (continued)

Location Description	Sampling Strategy	Section/ Figure	Depth (ft)	Media	TAL Metals (EPA SW-846:6010B/6020)	Total Uranium (EPA SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	VOCs (EPA SW-846:8260B)	SVOCs (EPA SW-846:8270C)	PCBs (EPA SW-846:8082)[a]	Explosive Compounds (NMED List) EPA 8321A_MOD)	Isotopic Uranium, Plutonium, and Americium (HASL-300)	Gamma Spectroscopy (EPA 901.1)	Tritium (EPA 906)
AOC 36-008, Surface Disposal Area Located Near Building 36-1	100 surface and subsurface samples will be collected from 50 locations within and bounding the disposal area	Section 7.3.3 Figure 7.1-2	0–0.5 2–3	Sediment, tuff	X	X	X	X	X	X	X	X	X	X	X	X
SWMU C-36-003, Outfall from Building 36-1	16 surface and subsurface samples will be collected from 8 locations in the drainage at and below the outfall. Data collected at C-36-003 will be used to evaluate AOC 36-008 (section 7.4.3)	Section 7.4.3 Figure 7.1-2	0–0.5 2–3	Sediment, tuff	X	X	X	X	X	X	X	X[d]	X	X	X	X

[a] A minimum of 20% of all samples collected will be submitted for PCB analysis (except SWMU C-36-003).

[b] X = Analysis will be performed.

[c] - = Analysis is not proposed and will not be performed.

[d] All samples will be submitted for PCB analysis.

Table 8.0-1
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 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 which can be advanced to the desired sample depth. When the desired depth is reached, the auger is decontaminated before advancing the hole through the sample depth. The sample material is transferred from the auger bucket to a stainless-steel sampling bowl before filling the various required sample containers.
Handling, Packaging, and Shipping of Samples	Field team member seal and label samples before packing and ensure that the sample containers and the containers used for transport are free of external contamination. Field team members package all samples so as to minimize the possibility of breakage during transportation. After all environmental samples are collected, packaged, and preserved; a field team member transports the samples to either the SMO or an SMO-approved radiation screening laboratory under chain of custody. The SMO arranges for shipping of samples to 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 collection logs, chain-of-custody forms, and sample container labels. Collection logs 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. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. Chain-of-custody forms are completed and assigned to verify that the samples are not left unattended. Site attributes (e.g., former and proposed soil sampling locations, sediment sampling locations) are located by using a global positioning system. Horizontal locations will be measured to the nearest 0.5 ft. The survey results for this field event will be presented as part of the investigation report. Sample coordinates will be uploaded into the Environmental Restoration Database.
Field Quality Control Samples	Field quality control samples are collected as directed in the Order on Consent 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.

Table 8.0-1 (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 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.
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 quality assurance. Specific requirements for each sample are printed on the sample collection logs provided by the sample management office (size and type of container (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 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 shall be adequate to comply 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 shall be established before generating waste. Waste storage areas located in controlled areas of the laboratory shall be controlled as needed to prevent inadvertent addition or management of wastes by unauthorized personnel. Each container of waste generated shall 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. See Appendix B for additional information.
Geodetic Surveys	This method describes the methodology for coordinating and evaluating geodetic surveys and establishing QA and 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 for collection of discrete samples from desired depths. Hollow-stem augers are used as temporary casings when setting wells to prevent cave-ins of the borehole walls.

Appendix A

Acronyms and Abbreviations, Metric Conversion Table, and Data Qualifier Definitions

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
CST	Chemical Sciences and Technology
DOE	Department of Energy (U.S.)
DU	depleted uranium
EC	expedited cleanup
EP	Environmental Programs (Directorate)
EPA	Environmental Protection Agency (U.S.)
ENV	Environmental Stewardship (Division)
FFCA	Federal Facilities Compliance Agreement
FV	fallout value
GPS	global positioning system
HE	high explosives
HIR	historical investigation report
HMX	1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HWFP	Hazardous Waste Facility Permit
IDW	investigation-derived waste
IFWGMP	Interim Facility-Wide Groundwater Monitoring Plan
LANL	Los Alamos National Laboratory
MSGP	Multi-Sector General Permit
NFA	no further action
NMED	New Mexico Environment Department
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
PHERMEX	Pulsed High-Energy Radiographic Machine Emitting X-rays [facility in DX Division]
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RFI	RCRA facility investigation

RPF	Records Processing Facility
SMO	Sample Management Office
SOP	standard operating procedure
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWSC	Sanitary Wastewater Systems Consolidation
TA	technical area
TAL	target analyte list
TPH	total petroleum hydrocarbons
VCA	voluntary corrective action
VCP	vitrified clay pipe
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 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-3.0 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

Management Plan for Investigation-Derived Waste

B-1.0 INTRODUCTION

This appendix describes how investigation-derived waste (IDW) generated during the Threemile Canyon Aggregate Area investigation will be managed. IDW may include, but is not limited to, drill cuttings, excavated media, excavated man-made debris, contact waste, decontamination fluids, and all other waste that has potentially come into contact with contaminants.

B-2.0 IDW

All IDW generated during investigation activities will be managed in accordance with applicable standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable U.S. Environmental Protection Agency and New Mexico Environment Department (NMED) regulations, U.S. Department of Energy Orders, and Laboratory requirements. The SOP applicable to the characterization and management of IDW is

- EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration Project Waste, (http://www.lanl.gov/environment/all/qa.shtml).

The most recent version of the Los Alamos National Laboratory's (the Laboratory's or LANL's) Hazardous Waste Minimization Report will be implemented during the investigation to minimize waste generation. The report is updated annually as a requirement of Module VIII of the Laboratory's Hazardous Waste Facility Permit.

A waste characterization strategy form (WCSF) will be prepared and approved per requirements of EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration Project Waste. The WCSF will provide detailed information on IDW characterization methods, management, containerization, and potential volumes. IDW characterization is completed through review of sampling data and/or documentation or by direct sampling of the IDW or the media being investigated (e.g., surface soil, subsurface soil). 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 for approval to NMED.

Wastes will be containerized and placed 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. Transportation and disposal requirements will also be detailed in the WCSF and approved before waste is generated. Table B-2.0-1 summarizes the estimated IDW waste streams, waste types, waste volumes, and other data.

The waste streams that are 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 for the intent of sampling. Drill cuttings include excess core sample not submitted for analysis, and any returned samples sent for analysis. Drill cuttings will be initially placed in containers at a hazardous waste accumulation area until the cuttings are characterized. If the drill cuttings are found to be nonhazardous, they will be stored as nonhazardous waste. Cuttings will be land applied if they meet the criteria in the NMED-approved Notice of Intent (NOI) Decision Tree for Land Application of Investigation Derived Waste Solids from Construction of Wells and Boreholes. 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), radionuclides, total metals, and if needed, toxicity characteristic metals. If process knowledge, odors, or staining indicate that the cuttings may be contaminated with petroleum products, the materials will also be analyzed for total petroleum hydrocarbons (TPH) and polychlorinated biphenyls (PCBs). 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 land applied or disposed of as a low-level waste at Technical Area 54 (TA-54), Area G.

B-2.2 Excavated Environmental Media

Overburden soil and rock excavated above sumps and piping are expected to be noncontaminated. Excavated material will be field-screened during the excavation process and will remain within the solid waste management unit boundary from which it was excavated. If the field screening does not indicate that contamination is present, the excavated material will be stored on the ground surface with appropriate best management practices. If field screening indicates contamination is present, the excavated material will be placed in rolloff containers. . Representative composite samples will be collected for each 50 yd^3 of material excavated and will be submitted for laboratory analyses of target analyte list metals, nitrate, cyanide, perchlorate, VOCs, SVOCs, high explosives, isotopic uranium, isotopic plutonium, americium-241, gamma spectroscopy, and tritium. The analytical results will be compared to residential soil screening levels (SSLs). If the concentrations are less than the residential SSLs the material will be used as backfill for the excavation. If the concentrations exceed the residential SSLs, the material will be disposed of at an appropriate off-site disposal facility.

The Laboratory expects most of the potentially contaminated media to be designated as nonhazardous waste and will be disposed of at a New Mexico solid waste landfill or low-level waste that will be disposed of at TA-54, Area G.

B-2.3 Excavated Man-made Debris

Waste from the demolition and removal of septic and settling tanks will consist of concrete reinforced with steel rebar and vitrified clay pipe or steel pipe. Where practicable, this waste stream will be characterized by direct sampling of the waste (e.g., concrete and vitrified clay pipe). If the materials are difficult to sample (e.g., metal piping), the data from associated structures, such as concrete tanks connected to the piping, may be used. The sampled materials will be analyzed for VOCs, SVOCs, radionuclides, total metals, and if needed, toxicity characteristic metals. Other constituents may be analyzed as necessary to meet the WAC for a receiving facility or if process knowledge or visual observations indicate that other contaminants may be present (e.g., PCBs or asbestos). A minimum of one direct sample will be collected for every 50 yd^3 of potentially contaminated debris generated.

The excavated materials will be initially placed in containers (e.g., roll off bins) at a hazardous waste accumulation area until the waste is characterized. If the wastes are found to be nonhazardous, they will be stored as nonhazardous waste. The Laboratory expects most of this waste to be designated as nonhazardous, nonradioactive waste that will be disposed of at an authorized solid waste facility or as low-level waste that will be disposed of at TA-54, Area G.

Waste minimization will be implemented, where practicable. For example, cast iron pipe and vitrified clay pipe may contain lead collars. Lead collars that are nonradioactive when generated will be managed as hazardous waste or recycled. Radioactively contaminated lead collars may be decontaminated to below free-release criteria for radionuclides so that they do not have to be managed as mixed waste. Materials such as metal pipes that meet release criteria will be recycled, if practicable.

B-2.4 Liquids from Septic and Settling Tanks

Liquids in septic and settling tanks will be removed before the structures are excavated. The liquids will be initially placed in containers at a hazardous waste accumulation area until the waste is characterized. If the wastes are found to be nonhazardous, they will be stored as nonhazardous waste. The liquids will be sampled and analyzed for VOCs, SVOCs, radionuclides, and total metals. Other constituents may be analyzed as necessary to meet the WAC for a receiving facility or if process knowledge or visual observations indicate that other contaminants may be present. The Laboratory expects most of these wastes to be nonhazardous liquid waste or radioactive liquid waste that will be sent to one of the Laboratory's wastewater treatment facilities where WAC allow the waste to be received.

B-2.5 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, and analysis of the material contacted (e.g., drill cuttings, soil, sumps, etc.). Contact waste will be initially placed in containers at a hazardous waste accumulation area until they are characterized. If the waste is found to be nonhazardous, it will be stored as nonhazardous waste. The Laboratory expects most of the contact waste to be designated as nonhazardous, nonradioactive waste that will be disposed of at an authorized facility or as low-level waste that will be disposed of at TA-54, Area G.

B-2.6 Decontamination Fluids

Dry decontamination methods will be used between sampling locations to avoid the generation of liquid waste and to minimize the IDW. Decontamination will be completed using a dry decontamination method with disposable paper towels and over-the-counter cleaner, such as Fantastik or equivalent. All sampling and measuring equipment, including but not limited to, stainless-steel sampling tools, split-barrel or core samplers, well developing or purging equipment, groundwater quality measurement instruments, and water-level measurement instruments, will be decontaminated in accordance with SOP-01.08, Field Decontamination of Drilling and Sampling Equipment.

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. The decontamination fluids 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, radionuclides, total metals, and, if needed, toxicity characteristic metals. The Laboratory expects most of these wastes to be nonhazardous liquid waste or radioactive liquid waste that will be sent to one of the Laboratory's wastewater treatment facilities where WAC allow the waste to be received.

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

Waste Stream	Expected Waste Type	Estimated Volume	Characterization Method	On-Site Management	Expected Disposition
Drill Cuttings and Soil	Industrial waste, nonhazardous, nonradioactive	6 yd^3	Analytical results from waste and core samples	Accumulation in 55-gal. drums, covered rolloff containers, or soft-sided containers	Land application, TA-54, Area G, or permitted off-site facility for which waste meets acceptance criteria
Septic Tank	Structure: Industrial waste, nonhazardous, nonradioactive	30 yd^3	Analytical results from direct sampling of waste	Accumulation in 55-gal. drums or covered rolloff containers	Permitted off-site facility for which waste meets acceptance criteria
	Soil: Industrial waste, nonhazardous, nonradioactive	5 yd^3	Analytical results from direct sampling of waste	Accumulation in 55-gal. drums or covered rolloff containers	Permitted off-site facility for which waste meets acceptance criteria
	Tank contents: Liquid waste, nonhazardous	<1000 gal.	Analytical results from direct sampling of waste	Accumulation in 55-gal. drum	On-site Clean Water Act-permitted treatment facility for which waste meets acceptance criteria
Spent Personal Protective Equipment and Disposable Sampling Supplies	Industrial waste, nonhazardous, nonradioactive	0.5 yd^3	Acceptable knowledge	Accumulation in 55-gal. drums	TA-54, Area G or permitted off-site facility for which waste meets acceptance criteria