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Investigation Report for Lower Mortandad/Cedro Canyons Aggregate Area, Revision 1

Los Alamos
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EXECUTIVE SUMMARY

This investigation report presents the investigation activities at four solid waste management units (SWMUs) located within the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). The four SWMUs are located in Technical Area 05 (TA-05).

The objectives of this investigation are to define the nature and extent of contamination and, if defined, to determine whether the sites pose a potential unacceptable risk to human health or the environment. This report presents the results of site characterization activities conducted during the 2011 investigation, as directed by the approved investigation work plan for the Lower Mortandad/Cedro Canyons Aggregate Area. Additional sampling was conducted at several new and existing locations to complete the extent of contamination determinations at the four SWMUs.

The 2011 investigation activities included collecting soil, sediment, and tuff samples from the surface to a maximum depth of 56 ft below ground surface. Data from samples collected during the 2011 investigation were evaluated along with data collected during previous investigations (if applicable) that meet current Laboratory data-quality requirements.

The sampling data presented in this report indicate the extent of contamination is defined at the four SWMUs. The human health risk-screening assessment results indicate no potential unacceptable risks or doses exist from chemicals of potential concern (COPCs) under the industrial and residential scenarios at SWMUs 05-003, 05-005(b), and 05-006(c). The total excess cancer risks are below the New Mexico Environment Department (NMED) target risk level of 1×10^{-5}, the hazard indexes (HIs) are below the NMED target HI of 1, and the total doses are below the U.S. Department of Energy target dose limit of 15 mrem/yr. SWMU 05-004 does not pose a potential unacceptable risk or dose under the industrial scenario, does not pose a potential unacceptable noncarcinogenic risk and potential unacceptable dose under the residential scenario, but poses a potential unacceptable cancer risk under the residential scenario. The cancer risk is from the presence of polycyclic aromatic hydrocarbons (PAHs) that are not site-related. After PAHs are removed from the residential carcinogenic screening evaluation, the total excess cancer risk is below the NMED target risk level of 1×10^{-5}.

An ecological risk-screening assessment was conducted for the four SWMUs at TA-05. The ecological risk-screening assessment results indicate no potential risks exist to any ecological receptors at these sites.

No further investigation or remediation activities are warranted in the Lower Mortandad/Cedro Canyons Aggregate Area. Based on the risk-screening assessment results, the Laboratory recommends corrective actions complete without controls for SWMUs 05-003, 05-004, 05-005(b), and 05-006(c).

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1.0 INTRODUCTION

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

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

This investigation report discusses the 2011 investigation of the Lower Mortandad/Cedro Canyons Aggregate Area at the Laboratory (Figure 1.0-1). These sites 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; DOE Order 435.1, Radioactive Waste Management; and DOE Order 458.1, Administrative Change 2, Radiation Protection of the Public and the Environment. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with DOE policy.

Corrective actions at the Laboratory are subject to the Compliance Order on Consent (the Consent Order). This investigation report describes work activities that were completed in accordance with the Consent Order.

1.1 General Site Information

The Lower Mortandad/Cedro Canyons Aggregate Area, located in Technical Area 05 (TA-05) at the Laboratory (Figure 1.1-1) consists of four SWMUs and two AOCs. Of the six sites, one AOC has been previously approved for no further action (NFA), and one AOC was included in the investigation of the Middle Mortandad/Ten Site Canyons Aggregate Area (LANL 2008, 102187). These two AOCs are not addressed in this report. The four remaining SWMUs were addressed in the approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451). Historical details of previous investigations and data were provided in the historical investigation report for the Lower Mortandad/Cedro Canyons Aggregate Area (LANL 2008, 101803). This investigation report describes the investigation status and results from sampling activities conducted to date for the four SWMUs. Table 1.1-1 lists the four sites and provides a brief description, summary of previous investigations, and summary of investigation activities conducted in 2011 for each site.

1.2 Purpose of Investigation

Four SWMUs within the Lower Mortandad/Cedro Canyons Aggregate Area were addressed during the 2011 investigation. The objectives of the 2011 investigation were to (1) establish the nature and extent of contamination, (2) determine whether current site conditions pose a potential unacceptable risk to human health and the environment, and (3) assess whether any additional sampling and/or corrective actions are required.

Sampling was conducted at the four SWMUs from January to March 2011 in accordance with the approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451). Additional sampling and soil removal were conducted in June 2011 as proposed by the Laboratory (2011, 203592) and approved by NMED (2011, 203618).

All analytical data collected during the 2011 investigation activities are presented and evaluated in this report in conjunction with decision-level data from previous investigations (if applicable).

1.3 Document Organization

This report is organized into nine sections, including this introduction, with multiple supporting appendixes. Section 2 provides site conditions (surface and subsurface) of the aggregate area. Section 3 provides an overview of the scope of the activities performed during the implementation of the work plan. Section 4 describes the regulatory criteria used to evaluate potential risks to human and ecological receptors. Section 5 describes the data review methods. Section 6 presents an overview of the operational history of each site, historical releases, summaries of previous investigations, results of the field activities performed during the 2011 investigation, site contamination, evaluation of the nature and extent of contamination, and summaries of human health and ecological risk-screening assessments. Section 7 presents the conclusions of the nature and extent of contamination and risk-screening assessments. Section 8 discusses recommendations based on applicable data and risk-screening assessment results. Section 9 includes a list of references cited and the map data sources used in all figures and plates.

Appendixes include a list of acronyms and abbreviations, a metric conversion table, and definitions of data qualifiers (Appendix A); field methods (Appendix B); x-ray fluorescence (XRF) survey results (Appendix C); borehole logs (Appendix D); analytical program descriptions and summaries of data quality (Appendix E); analytical suites and results and analytical reports (Appendix F); investigation-derived waste (IDW) management (Appendix G); box plots and statistical comparisons (Appendix H); and risk-screening assessments (Appendix I).

2.0 AGGREGATE AREA SITE CONDITIONS

2.1 Surface Conditions

2.1.1 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 is mostly steep rock outcrops consisting of approximately 90% bedrock with 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. In 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 mesa-top soil where the Lower Mortandad/Cedro Canyons Aggregate Area SWMUs are located is mapped as the Hackroy-Rock outcrop complex. The Hackroy-Rock outcrop complex consists of small areas of Hackroy soil and 70% rock outcrop so intermingled that they could not be separated at the scale selected for mapping. Shallow, well-drained Hackroy soil makes up about 20% of the complex, and Nyjack soil and very shallow undeveloped soil make up about 10% of the unit. The Hackroy-Rock outcrop complex exhibits slow permeability and low available water capacity. It has a moderate to severe water erosion hazard and medium to high runoff (Nyhan et al. 1978, 005702, p. 25).

2.1.2 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.

Mortandad Canyon has a relatively small drainage area (4.7 mi^2) that originates on Laboratory property within TA-03 at an elevation of approximately 7410 ft above sea level. The canyon has a length of 10 mi and trends east-southeast across Laboratory property and Pueblo de San Ildefonso before reaching the Rio Grande in White Rock Canyon. Named tributaries include Cañada del Buey, Effluent Canyon, and Ten Site Canyon on Laboratory property and Cedro Canyon on Pueblo de San Ildefonso.

Mortandad Canyon contains a small ephemeral stream. No perennial springs or natural perennial reaches occur. Snowmelt runoff and stormwater runoff flow for a limited distance in the upper part of the canyon. Surface water flows from the National Pollutant Discharge Elimination System (NPDES) permitted outfall at the TA-50 Radioactive Liquid Waste Treatment Facility but typically extends less than 1 mi below the outfall (LANL 1997, 056835, p. 3-2).

Reach MCW-1 is located downgradient of the sites addressed in this report (Figure 1.1-1). Cedro Canyon, a tributary of Mortandad Canyon located on San Ildefonso Pueblo land, starts approximately 1.3 mi southeast of the sites.

2.1.3 Land Use

Currently, land use of that portion of the Lower Mortandad/Cedro Canyons Aggregate Area on Laboratory property is industrial. The four SWMUs addressed in this report are located in TA-05 near Mortandad Canyon, and no SWMUs or AOCs are located near Cedro Canyon. TA-05 is currently used as a security buffer zone and contains physical support facilities such as an electrical substation, a water-supply well, test wells, several archeological sites, and environmental monitoring and buffer areas. In the past, Laboratory employees used the gravel road extending along the length of Mesita del Buey for recreational activities such as walking or jogging, but the road is currently inaccessible for such use. TA-05 is not accessible to the public. The current land use is not expected to change for the reasonably foreseeable future. The portion of Lower Mortandad/Cedro Canyons Aggregate Area outside the Laboratory boundary is on San Ildefonso Pueblo land and is not accessible to the public.

2.2 Subsurface Conditions

2.2.1 Stratigraphic Units of the Bandelier Tuff

The stratigraphy of the Lower Mortandad/Cedro Canyons 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 Laboratory's hydrogeologic synthesis report (Collins et al. 2005, 092028).

The bedrock at or near the surface of the mesa top is the Quarternary Tshirege Member of the Bandelier Tuff (Qbt). There are approximately 1250 ft of volcanic and sedimentary materials between any potential contaminant-bearing units at the mesa-top surface and the regional aquifer. The following descriptions of the stratigraphic units begin with the oldest (deepest) and proceed to the youngest (topmost). Stratigraphic units comprising the Bandelier Tuff are shown in Figure 2.2-1. The only stratigraphic unit encountered during the Lower Mortandad/Cedro Canyons Aggregate Area investigation was Qbt 3 of the Tshirege Member of the Bandelier Tuff.

2.2.1.1 Otowi Member of the Bandelier Tuff

Griggs and Hem (1964, 092516); Smith and Bailey (1966, 021584); Bailey et al. (1969, 021498); and Smith et al. (1970, 009752) described the Otowi Member. It consists of moderately consolidated (indurated) porous 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 basal part of the Otowi Member includes the Guaje Pumice Bed, which is a sequence of well-stratified pumice-fall and ash-fall deposits.

The Otowi Member is absent in Lower Mortandad Canyon where it either was not deposited or was removed by erosion before the Tshirege Member was deposited (LANL 2010, 108281, p. 8).

2.2.1.2 Tephra 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; Broxton and Reneau 1995, 049726; Goff 1995, 049682). 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). 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 equivalent 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).

2.2.1.3 Tshirege Member of the Bandelier Tuff

The Tshirege Member of the Bandelier Tuff is the upper member 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 years 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 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 present within the Lower Mortandad/Cedro Canyons Aggregate Area.

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 (4–10 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 Qbt 1g) to the crystallized tuff above. This feature forms a widespread marker horizon (locally termed the vapor-phase notch) throughout the Pajarito Plateau. The lower part of Qbt 1v is orange-brown, is 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 has an open, porous structure.

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.

Qbt 3 is a nonwelded to partially welded, vapor-phase altered tuff that forms the upper cliffs. 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. 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).

2.2.2 Hydrogeology

The hydrogeology of the Pajarito Plateau is generally 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 with the wettest canyons containing continuous streams and perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional stream flow and may lack alluvial groundwater. Perched-Intermediate 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 1250 ft bgs (Collins et al. 2005, 092028).

The hydrogeologic conceptual site model for the Laboratory (LANL 2010, 109830) 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.

2.2.2.1 Groundwater

In the Los Alamos area, groundwater occurs as (1) water in shallow alluvium in some of the larger canyons, (2) perched-intermediate 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 (Collins et al. 2005, 092028). 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 Laboratory formulated a comprehensive groundwater protection plan for an enhanced set of characterization and monitoring activities. The Laboratory's annual Interim Facility-Wide Groundwater Monitoring Plan (LANL 2010, 109830) details the implementation of extensive groundwater characterization across the Pajarito Plateau within an area potentially affected by past and present Laboratory operations.

The locations of the existing wells within the vicinity of the Lower Mortandad/Cedro Canyons Aggregate Area investigation sites are shown in Figure 1.1-1.

Alluvial Groundwater

Intermittent and ephemeral stream flows in the canyons of the Pajarito Plateau have deposited alluvium that can be as thick as 100 ft. The alluvium in canyons of the Jemez Mountains is generally composed of sand, gravel, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff. The alluvium in canyons of the Pajarito Plateau is finer grained, consisting of clay, silt, sand, and gravel derived from the Bandelier Tuff (Purtymun 1995, 045344).

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, resulting 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).

The downgradient extent of alluvial saturation in Mortandad Canyon is about 2300 ft below the confluence of Mortandad and Ten Site Canyons (LANL 2006, 094161, p. 60). The Lower Mortandad/Cedro Canyons Aggregate Area sites addressed in this report are located in TA-05 approximately 0.25 mi south of the confluence of Mortandad and Ten Site Canyons. Thus, alluvial groundwater is present in Ten Site Canyon to the north of the investigation sites. The unnamed canyon to the south of the investigation sites, the canyon receiving runoff from these sites, is a small tributary to Mortandad Canyon. This tributary does not join Mortandad Canyon until approximately 1 mi below the extent of alluvial saturation. Given the small drainage area of the tributary canyon and the absence of active outfalls, alluvial groundwater is not expected to the south of the investigation sites.

Perched-Intermediate Waters

Observations of perched-intermediate water are rare on the Pajarito Plateau. Perched-intermediate waters are thought to form mainly at horizons where medium properties change dramatically, such as at paleosol horizons containing clay or caliche. It is not known whether perched-intermediate water bodies are isolated or connected and to what degree they may influence travel times and pathways for contaminants in the vadose zone.

Two known locations of perched-intermediate groundwater have been identified in the vicinity of TA-05. One occurs near the confluence of Mortandad and Ten Site Canyons. At this location, a thin zone of saturation is found at a depth of approximately 520 ft at the top of the Cerros del Rio basalts. The other location is in Mortandad Canyon approximately 1150 ft east of the confluence with Ten Site Canyon. Perched water is encountered at this location in the lower part of the Cerros del Rio basalts at depths ranging from about 646 to 729 ft (LANL 2006, 094161, pp. 64–65).

Regional Groundwater

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 the regional aquifer below the mesa tops range between about 1200 ft bgs along the western margin of the plateau and about 600 ft bgs at the eastern margin. The location of wells and generalized water-level contours on top of the regional aquifer are described in the annual General Facility Information report (LANL 2011, 201568). The regional aquifer is typically separated from the alluvial groundwater and perched-intermediate zone groundwater by 350–620 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, pp. 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). Figure 2.2-2 shows depths to the top of the regional aquifer across the Laboratory.

Regional well R-14 is located in Ten Site Canyon, approximately one-half mi west of the investigation sites. The depth to the regional aquifer at this location is approximately 1200 ft (LANL 2003, 076062). Regional wells R-15 and R-33 are located in Mortandad Canyon to the north (Figure 1.1-1), and the depths to the regional aquifer are approximately 1200 ft (Figure 2.2-2). Supply well PM-5 is located on Mesita del Buey just west of the investigation sites, and the depth to the regional aquifer at this location is at least 1200 ft (LANL 2008, 102187, p. 38).

2.2.2.2 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 from 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 and generally decreases 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).

3.0 SCOPE OF ACTIVITIES

This section presents an overview of the field activities performed during the implementation of the Lower Mortandad/Cedro Canyons Aggregate Area approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451). The scope of activities for the 2011 investigation included site access and premobilization activities; geodetic, XRF, and radiological surveys; surface and shallow subsurface sampling; borehole drilling, subsurface sampling, and borehole abandonment; excavation and removal activities; health and safety monitoring; and waste management activities.

All activities were conducted in accordance with the approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451). Deviations from the approved investigation work plan are provided in section 3.3 and in Appendix B.

3.1 Site Access and Premobilization Activities

The area encompassing the Lower Mortandad/Cedro Canyons Aggregate Area is currently used for Laboratory operations, and some areas are used by Laboratory personnel for road and foot traffic. Before field mobilization, the issue of Laboratory worker access (e.g., traffic control plan and notifications) was reviewed as part of the management self-assessment process. All efforts were made to provide a secure and safe work area and to reduce impacts to Laboratory personnel, cultural resources, and the environment.

3.2 Field Activities

This section describes the field activities conducted during the 2011 investigation. Additional details regarding the field methods and procedures used to perform these field activities are presented in Appendix B.

3.2.1 Geodetic Survey

Geodetic surveys were conducted during the Lower Mortandad/Cedro Canyons Aggregate Area investigation to locate surface and subsurface sampling locations. Initial geodetic surveys were performed to establish and mark the planned sampling locations in the field. Geodetic surveys were conducted in accordance with Standard Operating Procedure (SOP) 5028, Coordinating and Evaluating Geodetic Surveys, using a Trimble R8 Global Navigation Satellite System (GNSS). The surveyed coordinates for all 2011 sampling locations are presented in Table 3.2-1. All geodetic coordinates are expressed as State Plane Coordinate System 1983, New Mexico Central, U.S.

3.2.2 XRF Surveys

A survey of lead contamination at the former site of building 05-5 [SWMU 05-006(c) of Consolidated Unit 05-005(b)-00] was conducted using a field XRF instrument to identify areas of elevated metal concentrations. Lead was previously detected above the industrial soil screening level (SSL) of 800 mg/kg at the site (LANL 2010, 108281). The XRF survey was conducted using an instrument with sufficient sensitivity for lead (i.e., 100 mg/kg or less) to identify areas with lead concentrations above the industrial SSL. The instrument was operated according to the manufacturer’s instructions, including collecting, preparing, and analyzing samples. Appendix C presents the XRF survey report.

3.2.3 Field Screening

Environmental samples were field screened for headspace organic vapors with a MiniRAE 2000 photoionization detector (PID) equipped with an 11.7-electron volt lamp. Calibration was performed in accordance with the manufacturer’s specifications and SOP-06.33, Headspace Vapor Screening with a Photoionization Detector, and recorded in the field logbook. After collection, each sample was placed in a sealed plastic bag for approximately 5 min. Screening measurements were recorded in the field sample collection logs (SCLs). The organic vapor-screening results are presented in Table 3.2-2.

All samples collected were field screened for radioactivity before they were submitted to the Sample Management Office (SMO). A Laboratory radiation control technician (RCT) conducted radiological screening using an Eberline E-600 radiation meter with an SHP-380AB alpha/beta scintillation detector held within 1 in. of the sample. All field results for gross-alpha and gross-beta/gamma radioactivity were recorded in disintegrations per min (dpm) on the field SCL/chain-of-custody (COC) forms. The SCLs/COC forms are provided on DVD in Appendix F. The radioactivity-screening results are presented in Table 3.2-2.

3.2.4 Surface, Shallow Subsurface, and Sediment Sampling

Samples were collected according to the approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451). Table 3.2-1 shows the proposed sampling locations that were listed in the approved investigation work plan, with the corresponding actual location identifiers as sampled. In addition to those proposed in the work plan, additional samples were collected in June 2011 as proposed by the Laboratory (LANL 2011, 203592) and approved by NMED (2011, 203618). The locations of the additional samples are also listed in Table 3.2-1.

Surface samples were collected using the spade-and-scoop method in accordance with SOP-06.09, Spade and Scoop Method for Collection of Soil Samples, or with a hand auger in accordance with SOP-06.10, Hand Auger and Thin-Wall Tube Sampler. Shallow-subsurface samples were collected using the hand-auger method in accordance with SOP-06.10. The samples were collected in stainless-steel bowls and transferred to sample collection bottles with a stainless-steel spoon.

Sediment samples were collected from areas of sediment accumulation that include sediment determined as representative of the historical period of Laboratory operations. The locations were selected by the field geologist based on geomorphic relationships in areas likely to have been affected by discharges from Laboratory operations. Because sediment systems are dynamic and subject to redistribution by runoff events, sediment sampling locations were adjusted appropriately and the adjusted locations were surveyed using a Trimble R8 GNSS.

All surface, shallow subsurface, and sediment samples were placed in appropriate sample containers and submitted to the analytical laboratory for the analyses specified by the approved investigation work plan. Standard quality assurance (QA)/quality control (QC) samples (field duplicates, field trip blanks, and rinsate blanks) were collected in accordance with SOP-5059, Field Quality Control Samples.

All sample collection activities were coordinated with the SMO. After the samples were collected, they remained in the controlled custody of the field team at all times until they were delivered to the SMO. Sample custody was then relinquished to the SMO for delivery to a preapproved off-site contract analytical laboratory.

3.2.5 Borehole Drilling and Subsurface Sampling

At locations where the required sampling depths could not be reached by hand augers, a drill rig with a hollow-stem auger was used to collect subsurface samples. Samples were collected using stainless-steel core barrel samplers in accordance with SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials. For the 2011 investigation, three boreholes were drilled to depths ranging from 5–56 ft bgs. The samples were extracted from the core barrels, placed in stainless-steel bowls, and handled the same way as the surface and shallow-subsurface samples were handled (section 3.2.4). Samples were then delivered to the SMO where the sample custody was relinquished for delivery to a preapproved off-site contract analytical laboratory. Boreholes logs for these three boreholes are provided in Appendix D.

3.2.6 Borehole Abandonment

All boreholes were abandoned in accordance with SOP-5034, Monitoring Well and RFI Borehole Abandonment, by filling the boreholes with bentonite chips up to 2–3 ft from the ground surface. The chips were hydrated and clean soil was placed on top. All cuttings were managed as IDW, as described in Appendix G.

3.2.7 Debris Removal and Soil Excavation

Debris was removed from an area at the former site of building 05-5 [SWMU 05-006(c) of Consolidated Unit 05-005(b)-00]. The debris was believed to be associated with the destruction of former building 05-5 by burning. Because of the small volume of debris present, removal was conducted using hand tools. The debris included man-made debris, such as nails, wire, pieces of metal (including lead fragments), charred wood, and melted glass. Following removal of the debris, soil at the debris area was surveyed using a field XRF (Appendix C). Contaminated soil and tuff were then excavated to remove media that contained lead exceeding the 800 mg/kg industrial SSL. The total volume of the IDW (debris, elemental lead, and excavated media) was approximately 1.04 yd^3. Management of the waste generated from the excavation and associated IDW is described in Appendix G.

Upon evaluating the analytical results at SWMU 05-006(c) after completing the sampling from January to March 2011, the Laboratory conducted additional remediation and sampling activities at this site (LANL 2011, 203592). The additional activities included excavating the surface soil at location 05-613800 (outside the debris area) to remove lead-contaminated soil and tuff, and collecting confirmation samples. The total volume of the excavated media was approximately 1.02 yd^3. Management of the lead-contaminated soil and associated IDW is described in Appendix G. Although location 05-613800 is within the boundary of SWMU 05-005(b), it was originally proposed in the approved investigation work plan to be sampled to define the nature and extent of contamination at SWMU 05-006(c).

3.2.8 Equipment Decontamination

All field equipment with the potential to contact sample material (e.g., hand augers, sampling scoops, bowls, and core barrel sections) was decontaminated between sample collection and between sampling locations to prevent cross-contamination of samples and sampling equipment. Decontamination was performed in accordance with SOP-5061, Field Decontamination of Equipment. Rinsate blanks were collected on sampling equipment to check the effectiveness of decontamination. The decontamination methods used are described in Appendix B.

At sites where a drill rig was used, an RCT screened the drilling equipment for gross-alpha and -beta radioactivity in the field after each borehole was drilled. An RCT also surveyed the drill rig before it was brought on-site and before it was released back to the drilling contractor.

3.2.9 Sample Analyses

All samples were shipped by the SMO to off-site contract analytical laboratories for the requested analyses. The analyses requested were specified by the approved work plan (LANL 2010, 108281; NMED 2010, 108451). The samples were analyzed for all or a subset of the following: target analyte list (TAL) metals, nitrate, perchlorate, total cyanide, dioxin and furan congeners, explosive compounds, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), gamma-emitting radionuclides, isotopic plutonium, and isotopic uranium.

Field duplicates of investigation samples were analyzed for the same analytical suites as the corresponding investigation samples. Equipment rinsate blanks were analyzed for the same inorganic chemical suites as the related investigation samples. Field trip blanks were analyzed only for VOCs. Analytical methods and summaries of data quality are presented in Appendix E. Analytical results and analytical reports are included on DVD in Appendix F.

3.2.10 Health and Safety Measures

All 2011 investigation activities were conducted in accordance with an approved site-specific health and safety plan and integrated work document that detailed work steps, potential hazards, hazard controls, and required training to conduct work. These health and safety measures included the use of modified Level-D personal protective equipment and field monitoring for organic vapors and for gross-alpha and -beta radioactivity using portable air monitoring systems.

3.2.11 IDW Storage and Disposal

All IDW generated during the 2011 investigation was managed in accordance with SOP-5238, Characterization and Management of Environmental Program Waste. This procedure incorporates the requirements of all applicable U.S. Environmental Protection Agency (EPA) and NMED regulations, DOE orders, and Laboratory implementation requirements, policies, and procedures. The waste streams associated with the 2011 investigation included drill cuttings, contact waste, removed debris, and excavation waste. Each waste stream was containerized and managed in accordance with the approved waste characterization strategy form (WCSF). Details of IDW management are presented in Appendix G. All available waste documentation, including WCSF, waste profiles forms, and land application packages are provided in Appendix G (Attachment G-1 on CD).

3.3 Deviations

Deviations occurred while conducting field activities as defined in the approved work plan (LANL 2010, 108281; NMED 2010, 108451). The deviations did not adversely affect the completion or results of the investigation. The specific deviations are described in Appendix B, section B-9.0.

4.0 REGULATORY CRITERIA

This section describes the criteria used for evaluating potential risks and doses to human and ecological receptors. Regulatory criteria identified by medium in the Consent Order include cleanup standards, risk-based screening levels, and risk-based cleanup goals.

Human health risk-screening evaluations were conducted for the Lower Mortandad/Cedro Canyons Aggregate Area sites using NMED guidance (NMED 2009, 108070). Ecological risk-screening assessments were performed using Laboratory guidance (LANL 2004, 087630).

4.1 Current and Future Land Use

The specific screening levels used in the risk evaluation and corrective action decision process at a site depend on the current and reasonably foreseeable future land use. The current and reasonably foreseeable future land use for a site determines the receptors and exposure scenarios used to select screening and cleanup levels.

The land use of Laboratory property within and surrounding the Lower Mortandad/Cedro Canyons Aggregate Area is currently industrial and is expected to remain industrial for the reasonably foreseeable future. The four sites under investigation in the Lower Mortandad/Cedro Canyons Aggregate Area have undergone decontamination and decommissioning (D&D), and currently no aboveground structures remain at the sites. Future construction work is not anticipated at these sites. Therefore, the construction worker scenario is not evaluated for the sites investigated. TA-05 is not accessible to Laboratory employees for recreational activities such as walking or jogging and is not accessible to the general public. Therefore, the recreational scenario is also not evaluated for the sites investigated. Although the residential scenario is not applicable given the current and foreseeable future land use, this scenario is evaluated for comparison purposes.

4.2 Screening Levels

Human health risk-screening evaluations were conducted for all four sites investigated. The human health screening assessments (Appendix I) were performed for inorganic and organic chemicals of potential concern (COPCs) using NMED SSLs for the industrial and residential scenarios (NMED 2009, 108070). Radionuclides were assessed using the Laboratory screening action levels (SALs) (LANL 2009, 107655). When an NMED SSL was not available for a COPC, SSLs were obtained from EPA regional tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm) (adjusted to a risk level of 10^{-5} for carcinogens). Surrogate SSLs were used for some COPCs for which no SSLs were available, based on structural similarity or breakdown products.

4.3 Ecological Screening Levels

The ecological risk-screening assessments (Appendix I) were conducted using ecological screening levels (ESLs) obtained from the ECORISK Database, Version 2.5 (LANL 2010, 110846). The ESLs are based on similar species and are derived from experimentally determined no observed adverse effect levels, lowest observed adverse effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values, are presented in the ECORISK Database, Version 2.5 (LANL 2010, 110846).

4.4 Cleanup Standards

Screening levels are used as soil cleanup levels unless they are determined to be impracticable in accordance with the Consent Order, Section VIII.E, paragraph 2, or if values do not exist for current and reasonably foreseeable future land use.

The cleanup goals specified in Section VIII of the Consent Order are a target risk of 10^{-5} for carcinogens or a hazard index (HI) of 1 for noncarcinogens. For radionuclides, the target dose is 15 mrem/yr based on DOE guidance (DOE 2000, 067489). The SSLs and SALs used in the risk-screening assessments in Appendix I are based on these cleanup goals.

5.0 DATA REVIEW METHODOLOGY

The purpose of the data review is to identify COPCs for each SWMU in the Lower Mortandad/Cedro Canyons Aggregate Area, where the nature and extent of contamination have been defined.

Extent is determined for inorganic chemicals and radionuclides by spatial analysis of detections above background values (BVs) or fallout values (FVs) and by detection for organic chemicals. For inorganic chemicals and radionuclides, statistical comparisons are performed to determine if concentrations are comparable with background and to aid in defining extent. Across a site, extent is defined for inorganic chemicals and radionuclides whose concentrations decrease with depth and decrease laterally, or are not different from background. In addition, concentrations of certain naturally occurring inorganic chemicals (e.g., nitrate) that do not have an established BV likely reflect naturally occurring concentrations and not a contaminant release. Extent is defined for organic chemicals whose concentrations decrease with depth and decrease laterally, or are detected at or below the estimated quantitation limit (EQL) for the analytical method and are considered present at “trace” concentrations.

If the nature and extent of inorganic chemicals, organic chemicals, and/or radionuclides have been defined for a site, COPC identification is performed for that site. If nature and extent are not defined for all analytes, COPCs are not identified for that site and further investigation is recommended.

5.1 Identification of COPCs

Inorganic COPCs are identified by comparing site data with BVs (LANL 1998, 059730) or are based on detection status if no BVs are available. Organic chemicals are identified as COPCs based on detection status. Radionuclides are identified as COPCs based on comparisons to BVs or FVs or are based on detection status if no BVs or FVs are available.

For inorganic chemicals, data are evaluated by sample media to facilitate the comparison with media-specific background data. Background data are generally available for soil, sediment, and tuff (LANL 1998, 059730). However, some analytes (e.g., nitrate, perchlorate, and hexavalent chromium) have no BVs. A BV may be either a calculated value from the background data set (upper tolerance limit or the 95% upper confidence bound on the 95th quantile) or a detection limit (DL). When a BV is based on a DL, there is no corresponding background data set for that analyte/media combination.

To identify inorganic COPCs, the first step is to compare the sampling results with the BVs, if available. If sampling results are above BVs and sufficient data are available (10 or more sampling results), statistical tests are used to compare the site sample data with the background data set for the appropriate medium. If statistical tests cannot be performed because of insufficient data (less than 10 samples) or a high percentage of nondetects, the sampling results are compared with the BV and the maximum background concentration of the chemical in the appropriate medium. If sampling results are above the BV and maximum background concentration, the chemical is identified as a COPC. The same evaluation is performed using sample DLs when a constituent is not detected but has DLs above the BV. If no BV is available, detected inorganic chemicals are identified as COPCs.

Radionuclides are identified as COPCs based on comparisons to BVs for naturally occurring radionuclides or to FVs for fallout radionuclides. Isotopic thorium and isotopic uranium are naturally occurring radionuclides. Americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, and tritium are fallout radionuclides. FVs apply only to surface soil (0–1 ft bgs) and sediment (all depths). Fallout radionuclides detected at any concentration below 1 ft bgs in soil are identified as COPCs. Fallout radionuclides in tuff are also identified as COPCs based on detection status.

Sample media encountered during investigations at Lower Mortandad/Cedro Canyons Aggregate Area include soil (all soil horizons, designated by the media code ALLH or SOIL), fill material (media code FILL); alluvial sediment (media code SED), alluvium (media code Qal), and Bandelier Tuff (media code QBT3—the only unit of Bandelier Tuff encountered during this investigation). Because no separate BVs are available for fill material, fill samples are evaluated by comparison with soil BVs (LANL 1998, 059730).

5.2 Overview of Statistical Methods

A variety of statistical methods may be applied to each of the data sets but generally include distributional comparisons and box plots comparing site data with background data. In cases where no background data are available, fewer than 10 samples were analyzed for a specific constituent or more than 80% of the site samples and background samples were nondetects, statistical tests are not valid. In such cases, COPC identification is based on detection status, direct comparison to the BV or FV (if one is available), and subsequent comparison with the maximum background concentration if it is greater than the BV or FV. If no BV or FV is available, the constituent is identified as a COPC if it was detected in any samples at the site.

Comparisons between site data sets and the Laboratory background data sets are performed using statistical methods. All comparisons begin with a simple comparison of site-specific data to media-specific BVs or FVs (LANL 1998, 059730). The BV/FV comparisons are followed, when appropriate, by statistical tests that evaluate potential differences between the distributions. These tests are used for testing hypotheses about data from two potentially different distributions (e.g., a test of the hypothesis that site concentrations are different from background levels).

Nonparametric tests most commonly performed include the two-sample Wilcoxon Rank Sum test (the Wilcoxon test), the Gehan test (modification of the Wilcoxon test), and the quantile test (Gehan 1965, 055611; Gilbert and Simpson 1990, 055612). The Gehan test is best suited for assessing complete shifts in distributions and accounts for nondetected concentrations at multiple DLs in a statistically robust manner. If the data have no nondetected concentrations, the Gehan test is equivalent to the Wilcoxon test. The quantile test is better suited for assessing shifts of a subset of the data. Most types of differences between distributions can be identified. Occasionally, if the differences between two distributions appear to occur far into the tails, the slippage test might be performed. This test evaluates the potential for some of the site data to be greater than the maximum concentration in the background data set if, in fact, the site data and background data came from the same distribution.

Observed significance levels (p-values) are obtained from the Gehan, quantile, or slippage test. If a p-value is less than a specified probability (e.g., 0.05, a nominal significance level), then there is some reason to suspect that a difference exists between the distributions. If the p-value is greater than 0.05, no difference is indicated. The standard set of tests is run whenever the detection rate for both the site data set and the Laboratory background data set is greater than 50%. If there are fewer than 50% detections in either set, then the Gehan test is not applicable. If all sample data are nondetects, statistical tests are not performed.

Paired tests are used to test whether site data are different from background. Specifically, the Gehan test (or the Wilcoxon Rank Sum test, if all sampling results are detects) is the preferred initial test. If the results of the Gehan test indicate the site data are not different from background (i.e., $p > 0.05$), the quantile test is performed. Site data must pass (i.e., $p > 0.05$) both tests to eliminate an inorganic chemical as a COPC. If the p-value from either the Gehan (or Wilcoxon) or the quantile test is less than 0.05, the constituent is identified as a COPC for the specific medium tested.

If the Gehan test is not applicable because either the site or background data set includes more than 50% nondetects, the quantile test is performed first. If the p-value from the quantile test is >0.05, the slippage test is performed next. Again, the p-value from both tests must be >0.05 to eliminate an inorganic chemical as a COPC. If the p-value from the first test is <0.05, indicating the site data are different from background, the second test does not need to be performed, and the inorganic chemical is identified as a COPC. Results of statistical tests are presented in Appendix H.

Box plots provide a visual representation of the data and may identify the presence of outliers or other anomalous data that might affect statistical results and interpretations. The plots allow a visual comparison between site and background concentration distributions. The plots are generally used in conjunction with the statistical tests (distributional comparisons) described above. A box plot consists of a box, a line across the box, whiskers (lines extended beyond the box and terminated with a short perpendicular line), and points outside the whiskers. The box area of the plot is the region between the 25th percentile and the 75th percentile of the data, which is the interquartile range or middle half of the data. The horizontal line within the box represents the median (50th percentile) of the data. The whiskers give an interval of 1.5 times the interquartile range, outside of which data may be evaluated for their potential to be outliers. The concentrations of individual samples are plotted as points overlaying the box plot.

When a data set contains both detected and nondetected concentrations reported as DLs, the detected concentrations are plotted as Xs, and the nondetected concentrations are plotted as Os. The medium-specific BV is also illustrated by a dashed line in each box plot. All box plots are presented in Appendix H.

6.0 TA-05 BACKGROUND AND FIELD INVESTIGATION RESULTS

The Lower Mortandad/Cedro Canyons Aggregate Area contains four sites associated with TA-05 that are addressed in this investigation report (Table 1.1-1). Each site is described separately in sections 6.2 through 6.4, including site description and operational history, relationship to other SWMUs and AOCs, historical and 2011 investigation activities, site contamination results based on qualified data (decision-level data from the current and previous investigations), and summaries of human health and ecological risk-screening assessments.

6.1 Background of TA-05

TA-05 is located on the eastern side of the Laboratory (Figure 1.0-1) and is situated on a small finger mesa, Mesita del Buey, that extends eastward from the main mesa between Mortandad and Pajarito Canyons. The western portion of TA-05 is located within the Middle Mortandad/Ten Site Canyons Aggregate Area, and the eastern portion is located within the Lower Mortandad/Cedro Canyons Aggregate Area. That portion of TA-05 within the Lower Mortandad/Cedro Canyons Aggregate Area is bounded by TA-53 and TA-72 to the north and east, Middle Mortandad/Ten Site Canyons Aggregate Area to the north and west, and Pueblo de San Ildefonso to the south.

6.1.1 Operational History

TA-05, also known as Beta Site, was established in 1944 as an adjunct test firing site to TA-04 (Alpha Site). Firing activities were conducted at two small firing sites located within the Middle Mortandad/Ten Site portion of TA-05 and one large firing site, known as Far Point Site, within the Lower Mortandad/Cedro portion of TA-05. Far Point Site was used briefly during 1944 and 1945 for half-scale mockup tests of the Trinity device (LANL 2008, 102187, p. 3). TA-05 was used as a firing site for implosion studies until 1947. After firing activities were halted, several Laboratory groups used the site for a variety of experiments, including the study of hydrogen fires, animal radiation experiments, and beryllium combustion experiments. In late 1959, two experimental reactors known as “Little Eva” and “Godiva” were brought to TA-05 and operated briefly (Ulery 1995, 046037). Little Eva was located inside a trailer, and Godiva was located in an underground chamber (SWMU 05-003). TA-05 was taken out of service in 1959 and underwent D&D in 1985 as part of the Los Alamos Site Characterization Program (LASCP). The 1985 LASCP addressed only radioactive contamination.

6.1.2 Summary of Releases

Potential contaminant sources at TA-05 include an underground chamber that housed an experimental reactor (Godiva), past discharges from outfalls and a septic system, and residual soil contamination associated with demolition of a former building by burning.

6.1.3 Current Site Usage and Status

Currently, land use of the Lower Mortandad/Cedro Canyons Aggregate Area within the Laboratory boundary is industrial. TA-05 is currently used as a security buffer zone and contains physical support facilities such as an electrical substation, a water-supply well, test wells, several archeological sites, and environmental monitoring and buffer areas. In the past, Laboratory employees used the gravel road extending along the length of Mesita del Buey for recreational activities such as walking or jogging but the road is currently inaccessible for such use. TA-05 is not accessible to the public. The current land use is not expected to change for the reasonably foreseeable future.

6.2 SWMU 05-003, Former Calibration Chamber

6.2.1 Site Description and Operation History

SWMU 05-003 is a former underground calibration facility (structures 05-20 and 05-21) located at the west end of TA-05 near the edge of Mortandad Canyon (Figure 6.2-1). The calibration facility consisted of an aboveground shed (structure 05-20) constructed over a 6-ft-diameter, 35-ft-deep access shaft equipped with a ladder to provide facility personnel access to the calibration chamber (structure 05-21), located belowground to the west of the access shaft. The aboveground shed (structure 05-20) was a wooden building that measured 8 ft wide × 12 ft long × 8 ft high. The belowground chamber (structure 05-21) measured 10 ft square × 10 ft deep and was used to calibrate neutron detector systems for experiments at TA-49. The base of the access shaft was connected to the calibration chamber by an 8-ft-tall, 9.5-ft-long tunnel. A second 24-in.-diameter shaft extended from the center of the chamber to the surface. The shafts were separated by 15 ft (center to center). The smaller shaft was lined with a 16-in.-diameter casing and capped with concrete, with a 3-in.-diameter opening in the concrete cap. The small shaft was used to direct neutrons from the underground chamber to detectors located above the shaft. The approximate dimensions and layout of the facility have been obtained through interviews with people who worked on the project, personal logs, and site inspections (Koch 1995, 091204; Pratt 1995, 091206) as well as historical drawings.

The neutron source used in the calibration facility was a critical assembly called Godiva. This assembly used highly enriched uranium (HEU) and was operated in the underground chamber beneath the smaller shaft. Neutron detectors were placed on the ground surface above the opening in the small shaft. The Godiva assembly could be pulsed every 2 h and produced 2×10^{16} fissions per pulse. Small amounts of HEU would spall off the source with each pulse (Pratt 1995, 091206). Borated paraffin and lead bricks were used as shielding, and heavy water was used to moderate the energy and intensity of the neutrons.

The Godiva assembly was installed in the TA-05 underground chamber on November 16, 1959 (Pratt 1995, 091206). The chamber was used only for approximately 1 mo. TA-05 officially ceased operation on December 18, 1959 (Montoya 1976, 004547). The Godiva assembly was moved to TA-49 where it became operational on January 12, 1960 (Pratt 1995, 091206).

The underground calibration chamber (structure 05-21) and the corrugated metal pipe (CMP) liner for the large access shaft are still present at the site. The CMP extends approximately 2.5 ft above the ground surface. The inside of the CMP contains backfill and some vegetation is presently growing in the backfill. An 8.75-ft-wide × 12.5-ft-long concrete pad extends around the CMP. Currently, the area of the smaller shaft is covered with dirt.

6.2.2 Relationship to Other SWMUs and AOCs

Although SWMU 05-004 is located approximately 50 ft east of SWMU 05-003, these two SWMUs are not associated. No other SWMUs or AOCs are associated with SWMU 05-003.

6.2.3 Summary of Previous Investigations

During a radiation survey of TA-05 in 1973, structure 05-20 was locked and could not be entered (Martin 1973, 004544). A subsequent inspection in January 1974 noted a hole in the side of the building and the door was unlocked. Because of safety concerns, a cover was placed over the shaft (Bacastow 1974, 000756). A radiation survey of structure 05-20 was conducted in May 1976 to prepare for removing the remaining structures from TA-05. This survey showed no detectable radioactivity (Blackwell 1976, 004546). Structure 05-20 was removed sometime around 1976, and the access shaft was backfilled at that time. Although the 1992 Resource Conservation and Recovery Act facility investigation (RFI) work plan for Operable Unit 1129 indicates the lead shielding bricks had not been removed before the area was backfilled (LANL 1992, 007666, p. 3-16), a subsequent review of records and interviews with former site staff concluded the lead bricks were removed before the shaft was backfilled (Pratt 1995, 091206).

In 1995, an engineering survey was conducted at the site of the former calibration chamber (structure 05-21) to locate the 24-in.-diameter shaft that was reported to be present at the site. This shaft was found 15 ft west of the 6-ft-diameter shaft. An 8.75-ft-wide × 12.25 ft-long concrete pad is present around the 6-ft-diameter shaft and a smaller 1.5-ft-wide × 5 ft-long concrete pad is located just north of the 24-in.-diameter shaft (Koch 1995, 091204). The larger pad is the foundation that remains from former aboveground structure 05-20. The site was surveyed for potential high explosives (HE) materials in May 1995. Fragments of white material were found near the shaft but were determined to be paraffin rather than HE (Koch 1995, 048943.21).

No previous sampling has been performed at SWMU 05-003; therefore, no historical analytical data exist for this site.

6.2.4 Site Contamination

6.2.4.1 Soil and Rock Sampling

As part of the 2011 investigation, the following activities were conducted at SWMU 05-003:

- All samples were field screened for organic vapors and gross-alpha, -beta, and -gamma radioactivity. Field-screening results were recorded on the SCLs/COC forms (Appendix F) and are presented in Table 3.2-2.

Twelve samples were collected from two locations (05-613784 and 05-613785) at depth intervals of 5–6 ft, 15–16 ft, 25–26 ft, 35–36 ft, 45–46 ft, and 55–56 ft bgs. All 12 samples were analyzed for TAL metals, perchlorate, gamma-emitting radionuclides, and isotopic uranium.

The 2011 sampling locations at SWMU 05-003 are shown in Figure 6.2-1. Table 6.2-1 presents the 2011 samples collected and the analyses requested for SWMU 05-003. The geodetic coordinates of the 2011 sampling locations are presented in Table 3.2-1.

6.2.4.2 Soil and Rock Sample Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient air during PID screening of the samples during the 2011 investigation. No radiological-screening results exceeded twice the daily site background levels. Field-screening results for the 2011 samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the field-screening results.

6.2.4.3 Soil and Rock Sample Analytical Results

Decision-level data at SWMU 05-003 consist of results from 12 Qbt 3 samples collected from two locations in 2011. The extent of contamination is defined at SWMU 05-003. Therefore, the COPCs for the site are identified below.

Inorganic Chemicals

Twelve Qbt 3 samples were analyzed for TAL metals and perchlorate. Table 6.2-2 presents the inorganic chemicals above BVs. Figure 6.2-2 shows the spatial distribution of inorganic chemicals detected above BVs at SWMU 05-003.

Antimony was not detected above the Qbt 3 BV (0.5 mg/kg) but had DLs (0.934 mg/kg to 1.06 mg/kg) above the Qbt 3 BV in nine samples. Antimony is identified as a COPC in tuff.

Chromium was detected above the Qbt 3 BV (7.14 mg/kg) in one sample (82.6 mg/kg). The Gehan and quantile tests indicated site concentrations are not different from background (Figure H-1.0-1 and Table H-1.0-1). Chromium is not identified as a COPC in tuff.

Perchlorate was not detected at SWMU 05-003. Therefore, perchlorate is not identified as a COPC.

Selenium was detected above the Qbt 3 BV (0.3 mg/kg) in one sample (0.316 mg/kg). Selenium was not detected but had DLs (0.886 mg/kg to 1.05 mg/kg) above the Qbt 3 BV in the other 11 samples at the site. Selenium is identified as a COPC in tuff.

Zinc was detected above the Qbt 3 BV (63.5 mg/kg) in one sample (66.5 mg/kg). The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-1.0-2 and Table H-1.0-1). Zinc is not identified as a COPC in tuff.

In summary, the inorganic COPCs identified at SWMU 05-003 are antimony and selenium.

Organic Chemicals

Samples were not analyzed for organic chemicals at SWMU 05-003 based on the materials used at this site (LANL 2010, 108281, pp. 13–14).

Radionuclides

Twelve Qbt 3 samples were analyzed for gamma-emitting radionuclides and isotopic uranium. Radionuclides were not detected or detected above BVs/FVs at SWMU 05-003. Therefore, no radionuclide COPCs were identified at SWMU 05-003.

6.2.4.4 Nature and Extent of Soil and Rock Contamination

Inorganic COPCs

Antimony was not detected above BV but had DLs above BV at the site. Because antimony was not detected above BV and all results reported between the BV and the maximum DL were nondetects, the lateral and vertical extent of antimony are defined.

Selenium was detected above the Qbt 3 BV (0.3 mg/kg) in one sample (0.316 mg/kg) at location 05-613784 from 15–16 ft bgs. Selenium was not detected but had DLs above BV in deeper samples at this location. Selenium was not detected but had DLs above BV in all six samples at location 05-613785. The lateral and vertical extent of selenium are defined.

Organic COPCs

Samples were not analyzed for organic chemicals at SWMU 05-003.

Radionuclide COPCs

No radionuclide COPCs were identified at SWMU 05-003.

Summary of Nature and Extent

The lateral and vertical extent of TAL metals, perchlorate, gamma-emitting radionuclides, and isotopic uranium are defined at SWMU 05-003.

6.2.5 Summary of Human Health Risk Screening

The human health risk-screening assessment for SWMU 05-003 is discussed in Appendix I, section I-4.

SWMU 05-003 is a former underground calibration chamber located 35 ft bgs. No potential exposure pathway exists, and samples were not collected between 0–1 ft bgs. A risk-screening assessment was not performed for the industrial scenario.

No carcinogens were retained as COPCs; therefore, no potential unacceptable cancer risk exists for the residential scenario. The HI is 0.04 for the residential scenario, which is below the NMED target HI of 1. No radionuclides were retained as COPCs at the site; therefore, no potential unacceptable dose exists for the residential scenario.

Based on the risk-screening assessment results, no potential unacceptable risk and dose exist for the industrial and residential scenarios at SWMU 05-003.

6.2.6 Summary of Ecological Risk Screening

Because samples were collected below 5 ft bgs and no potential exposure pathway for terrestrial receptors exists, an ecological risk-screening assessment was not performed for the ecological receptors at SWMU 05-003. No potential unacceptable risk or dose for ecological receptors is expected at the site because the contamination source was 35 ft bgs.

6.3 SWMU 05-004, Former Septic Tank

6.3.1 Site Description and Operation History

SWMU 05-004 is a former septic tank (structure 05-13), associated drainlines, and outfall that were located at the west end of TA-05 near the edge of Mortandad Canyon (Figure 6.2-1). The tank was constructed in May 1948 to serve building 05-1 (a laboratory) and was decommissioned in place in December 1959 (LANL 1992, 007666, p. 3-14). It was constructed of reinforced concrete and was 5 ft^2 × 7 ft deep (LANL 1990, 007511). As-built drawings show an inlet line running from building 05-1 to the septic tank and an outlet line discharging south into an unnamed tributary of Mortandad Canyon.

From 1948 to 1949, the tank received industrial waste from a laboratory (building 05-1). A 1952 memorandum states that septic tank 05-13 was no longer needed to support use of building 05-1 and the structure was being returned to Engineering Division for disposition (Vogt 1952, 004379). The types of materials used in building 05-1 are not known. During the 1985 LASCP, building 05-1 was removed. The septic tank and associated drainlines had been removed before the 1985 LASCP activities. The removal of the tank and piping was confirmed by excavation of the area (LANL 1990, 007511).

The outfall, a 2-ft wide by 1-ft deep trench cut into the tuff, is located at the edge of the mesa. Stormwater best management practices (BMPs), including straw wattles, are in place above and downslope of the site.

6.3.2 Relationship to Other SWMUs and AOCs

Although SWMU 05-003 is located approximately 50 ft west of SWMU 05-004, these two SWMUs are not associated. No other SWMUs or AOCs are associated with SWMU 05-004.

6.3.3 Summary of Previous Investigations

A 1959 memorandum states the tank had been monitored for radioactivity, and no radioactivity above background was found (Blackwell 1959, 000761). A site inspection conducted in January 1974 identified the septic tank as an open concrete pit with a rotted wooden cover. The wooden cover was replaced with a metal grating cover (Bacastow 1974, 000756). Notes from a radiation survey conducted at TA-05 during May 1976 describe structure 05-13 as “an acid septic tank filled with liquid” (Blackwell 1976, 004546).

The 1985 LASCP investigation confirmed the tank and piping had been removed, and no evidence of radioactively contaminated soil was detected at that time (NUS Corporation 1990, 012571, p. 3-10). A 1988 survey detected gamma activity slightly above background. Notes taken during this survey described evidence of an outfall near the former location of structure 05-13 (LANL 1990, 007511).

A site inspection conducted in December 1994 noted the location of an approximately 2-ft-wide × 1-ft-deep outfall trench cut into the tuff. The trench, which was filled with plant debris, flowed to the south onto a natural bedrock rill/gully to the canyon (Koch 1994, 048943.21). This trench presumably contained the discharge drainline that was removed.

Phase I RFI sampling was performed in June 1995. Three surface samples (0–0.5 ft) were collected, two hand-augered holes were drilled to a depth of 3 ft, and one borehole was drilled to a depth of 15 ft. The hand-auger and surface samples were collected in the outfall trench between the septic tank location and the edge of the canyon. Three samples were collected from each hand-augured hole at depth intervals of 0–1 ft, 1–2 ft, and 2–3 ft bgs. The borehole was drilled at the former location of the septic tank. Three samples were collected from the borehole at depth intervals of 3.5–4.5 ft, 8.8–9.8 ft, and

14–15 ft bgs. All samples were submitted for laboratory analysis of isotopic plutonium and isotopic uranium. One sample from one hand-augured hole was also submitted for laboratory analysis of SVOCs, and one sample from another hand-augured hole was submitted for laboratory analysis of VOCs, gross-alpha, gross-beta, and gamma-emitting radionuclides. One sample from the 15-ft borehole was also submitted for laboratory analysis of TAL metals, and one surface sample was submitted for analysis of HE. No metals were detected above BVs or had DLs above BVs during the 1995 RFI. Benzoic acid, the only organic chemical detected, was detected in one sample at 0.61 mg/kg. Plutonium-239/240, the only radionuclide detected, was detected at 0.098 pCi/g in one subsurface sample.

A second sampling event was conducted at this site in 1998. A deeper borehole was advanced at the location of the former septic tank, and 11 samples were collected at 1-ft intervals from 14–25 ft bgs. Additional samples were collected downslope of the outfall. Surface samples (0–0.5 ft) were collected at five locations and subsurface samples (0.5–1.0 ft bgs) were collected at three of these locations. All samples were submitted for laboratory analysis of TAL metals, SVOCs, and HE. No metals were detected above BVs during the 1998 sampling. Mercury had DLs above BV for two soil samples and one sediment sample. Selenium had DLs above BV in two sediment samples. No organic chemicals were detected, and no samples were analyzed for radionuclides.

All decision-level data collected during previous investigations are presented and evaluated together with the 2011 decision-level data in section 6.3.4.3.

6.3.4 Site Contamination

6.3.4.1 Soil and Rock Sampling

As part of the 2011 investigation, the following activities were conducted at SWMU 05-004 from January to March 2011:

- All samples were field screened for organic vapors and gross-alpha, -beta, and -gamma radioactivity. Field-screening results were recorded on the SCLs/COC forms (Appendix F) and are presented in Table 3.2-2.
- Six samples were collected from locations 05-613786, 05-613787, and 05-613788 along the inlet drainline between building 05-1 and the septic tank at depth intervals of 3–4 ft and 5–6 ft bgs.
- Five samples were collected in a borehole at the former septic tank (location 05-613790 at previous location 05-02001) at depth intervals of 5–6 ft, 9–10 ft, 14–15 ft, 19–20 ft, and 24–25 ft bgs.
- Six samples were collected from locations 05-613958, 05-613959, and 05-613789 (at previous locations 05-02002, 05-02003, and 05-02005, respectively) in the outfall trench and at the outfall at depth intervals of 3–4 ft and 5–6 ft bgs.
- Fifteen samples were collected from five locations in the drainage downgradient of the outfall. Locations 05-613794, 05-613795 (at previous location 05-02089), 05-613796, and 05-613797 were sampled at depth intervals of 0–1 ft, 1–2 ft, and 2–3 ft bgs. The most downgradient location, 05-613793, was sampled at depth intervals of 0–1 ft, 4.5–5.5 ft, and 5.5–6.5 ft bgs.

All samples were analyzed for TAL metals, nitrate, perchlorate, total cyanide, explosive compounds, PCBs, SVOCs, VOCs, isotopic plutonium, and isotopic uranium.

After evaluating the analytical results from sampling conducted from January to March 2011 to define the nature and extent of contamination, the Laboratory proposed to conduct additional sampling (LANL 2011, 203592) and NMED approved the proposed sampling (NMED 2011, 203618). The following activities were conducted at SWMU 05-004 in June 2011:

- One deeper sample was collected at location 05-613788 from 9–10 ft bgs and was analyzed for lead, nitrate, and SVOCs.
- Two deeper samples were collected at location 05-613790 from 34–35 and 44–45 ft and were analyzed for 2-hexanone and uranium-235/236.

One deeper sample each was collected at locations 05-613789, 05-613958, and 05-613959 from 9–10 ft bgs and was analyzed for selenium, copper, and copper and selenium, respectively.

Historical and 2011 sampling locations at SWMU 05-004 are shown in Figure 6.2-1. Table 6.3-1 presents the historical and 2011 samples collected and the analyses requested for SWMU 05-004. The geodetic coordinates of the 2011 sampling locations are presented in Table 3.2-1.

6.3.4.2 Soil and Rock Sample Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient air during PID screening of the samples during the 2011 investigation. No radiological screening results exceeded twice the daily site background levels. Field-screening results for the 2011 samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the field-screening results.

6.3.4.3 Soil and Rock Sample Analytical Results

Decision-level data at SWMU 05-004 consist of results from 69 samples collected from 23 locations in 1995, 1998, and 2011. The 69 samples include 12 soil/fill, 50 Qbt 3, and 7 sediment samples. The nature and extent of contamination are defined at SWMU 05-004. Therefore, the COPCs for the site are identified below.

Inorganic Chemicals

Fifty-two samples (7 soil/fill, 38 Qbt 3, and 7 sediment) were analyzed for TAL metals, and additionally, one Qbt 3 sample was analyzed for copper, one Qbt 3 sample for lead, one Qbt 3 sample for selenium, and a fourth Qbt 3 sample for copper and selenium. Thirty-two samples (27 Qbt 3 and 5 sediment) were analyzed for perchlorate and total cyanide. Thirty-three samples (28 Qbt 3 and 5 sediment) were analyzed for nitrate. Table 6.3-2 presents the inorganic chemicals above BVs. Figure 6.3-1 shows the spatial distribution of inorganic chemicals detected or detected above BVs at SWMU 05-004.

Antimony was detected at a concentration (0.505 mg/kg) equivalent to the Qbt 3 BV (0.5 mg/kg) in one sample and was not detected but had DLs (0.56 mg/kg to 1.04 mg/kg) above the Qbt 3 BV in 18 samples. Antimony is identified as a COPC in tuff. Antimony was not detected but had a DL (0.832 mg/kg) equivalent to the sediment BV (0.83 mg/kg). Antimony is not identified as a COPC in sediment.

Barium was detected above the Qbt 3 BV (46 mg/kg) in five samples, with a maximum concentration of 96.9 mg/kg. The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-2.0-1 and Table H-2.0-1). Barium is not identified as a COPC in tuff.

Cadmium was not detected above the sediment BV (0.4 mg/kg) but had DLs (0.527 mg/kg to 0.55 mg/kg) above the sediment BV in four samples. Cadmium is identified as a COPC in sediment.

Calcium was detected above the Qbt 3 BV (2200 mg/kg) in one sample (2910 mg/kg). The Wilcoxon test indicated site concentrations are different from background (Figure H-2.0-2 and Table H-2.0-1). Calcium is identified as a COPC in tuff.

Copper was detected above the Qbt 3 BV (4.66 mg/kg) in nine samples, with a maximum concentration of 13.8 mg/kg. The Gehan test indicated site concentrations are different from background (Figure H-2.0-3 and Table H-2.0-1). Copper is identified as a COPC in tuff.

Cyanide was not detected above BV at the site. Therefore, cyanide is not identified as a COPC.

Lead was detected above the Qbt 3 BV (11.2 mg/kg) in two samples, with a maximum concentration of 54.1 mg/kg. The Gehan test indicated site concentrations are different from background (Figure H-2.0-4 and Table H-2.0-1). Lead is identified as a COPC in tuff.

Mercury was not detected but had two DLs (both 0.11 mg/kg) equivalent to the soil BV (0.1 mg/kg). Mercury is not identified as a COPC in soil. Mercury was not detected but had a DL (0.11 mg/kg) that is equivalent to the sediment BV (0.1 mg/kg). Mercury is not identified as a COPC in sediment.

Nickel was detected above the Qbt 3 BV (6.58 mg/kg) in one sample (6.68 mg/kg). Because the background data set had more than 50% nondetects, the Gehan test could not be performed. The quantile and slippage tests indicated site concentrations are not different from background (Figure H-2.0-5 and Table H-2.0-1). Nickel is not identified as a COPC in tuff.

Nitrate was detected in 26 Qbt 3 and sediment samples, with a maximum concentration of 71.8 mg/kg. No background data are available for nitrate. Nitrate is identified as a COPC.

Perchlorate was detected in eight Qbt 3 and sediment samples, with a maximum concentration of 0.00346 mg/kg. No background data are available for perchlorate. Perchlorate is identified as a COPC.

Selenium was detected above the Qbt 3 BV (0.3 mg/kg) in six samples, with a maximum concentration of 0.406 mg/kg, and was not detected but had DLs (0.885 mg/kg to 1.04 mg/kg) above the Qbt 3 BV in 23 samples. Selenium is identified as a COPC in tuff. Selenium was not detected but had DLs (0.51 mg/kg to 1.1 mg/kg) above the sediment BV (0.3 mg/kg) in seven samples. Selenium is identified as a COPC in sediment.

In summary, the inorganic COPCs identified at SWMU 05-004 are antimony, cadmium, calcium, copper, lead, nitrate, perchlorate, and selenium.

Organic Chemicals

Fifty-two samples (7 soil, 38 Qbt 3, and 7 sediment) were analyzed for explosive compounds; 32 samples (27 Qbt 3 and 5 sediment) were analyzed for PCBs; 53 samples (7 soil, 39 Qbt 3, and 7 sediment) were analyzed for SVOCs; and 33 samples (28 Qbt 3 and 5 sediment) were analyzed for VOCs. Additionally, two Qbt 3 samples were analyzed for 2-hexanone. Table 6.3-3 presents the organic chemicals detected. Figure 6.3-2 shows the spatial distribution of organic chemicals detected at SWMU 05-004.

Explosive compounds and PCBs were not detected at SWMU 05-004.

Organic chemicals detected at SWMU 05-004 include acenaphthene; acenaphthylene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; benzoic acid; chrysene; dibenz(a,h)anthracene; diethylphthalate; fluoranthene; fluorene; 2-hexanone;

indeno(1,2,3-cd)pyrene; 4-isopropyltoluene; methylene chloride; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; and styrene.

These organic chemicals are retained as COPCs at SWMU 05-004.

Radionuclides

One Qbt 3 sample was analyzed for gamma-emitting radionuclides. Forty-four samples (6 soil/fill, 33 Qbt 3, and 5 sediment) were analyzed for isotopic plutonium and isotopic uranium. Additionally, two Qbt 3 samples were analyzed for uranium-235/236. Table 6.3-4 presents the radionuclides detected or detected above BVs/FVs. Figure 6.3-3 shows the spatial distribution of radionuclides detected or detected above BVs/FVs at SWMU 05-004.

Plutonium-239/240 was detected in one Qbt 3 sample (0.098 pCi/g). Plutonium-239/240 is identified as a COPC in tuff.

Uranium-234 was detected above the sediment BV (2.59 pCi/g) in one sample (4.71 pCi/g). Uranium-234 is identified as a COPC in sediment.

Uranium-235/236 was detected above the Qbt 3 BV (0.09 pCi/g) in three samples, with a maximum concentration of 0.11 pCi/g. Uranium-235/236 is identified as a COPC in tuff. Uranium-235/236 was detected at a concentration of 0.206 pCi/g equivalent to the sediment BV (0.2 pCi/g) in one sample. Uranium-235/236 is not identified as a COPC in sediment.

Uranium-238 was detected above the sediment BV (2.29 pCi/g) in one sample (4.66 pCi/g). Uranium-238 is identified as a COPC in sediment.

In summary, the radionuclide COPCs identified at SWMU 05-004 are plutonium-239/240, uranium-234, uranium-235/236, and uranium-238.

6.3.4.4 Nature and Extent of Soil and Rock Contamination

Inorganic COPCs

Antimony was detected at a concentration (0.505 mg/kg) equivalent to the Qbt 3 BV (0.5 mg/kg) in one sample at location 05-613790 from 5–6 ft bgs. Concentrations of antimony decreased with depth at this location. The vertical extent of antimony is defined. Antimony was not detected above BVs, and all results reported between the BVs and the maximum DL were nondetects downgradient of location 05-613790. The lateral extent of antimony is defined.

Cadmium was not detected above BV but had DLs above BV at the site. Because cadmium was not detected above BV and all results reported between the BV and the maximum DL were nondetects, the lateral and vertical extent of cadmium are defined.

Calcium was detected above the Qbt 3 BV (2200 mg/kg) in one sample (2910 mg/kg) at location 05-613958 from 3–4 ft bgs. Concentrations of calcium decreased with depth at this location. The vertical extent of calcium is defined. Calcium was not detected above BV in the drainage downgradient of location 05-613958. The lateral extent of calcium is defined.

Copper was detected above the Qbt 3 BV (4.66 mg/kg) in nine samples at five locations. Concentrations of copper decreased with depth at locations 05-613789, 05-613793, 05-613958, and 05-613959. Copper was not detected above BV in the deepest sample from 9–10 ft bgs at location 05-613958

(RE05-11-14585, Table 6.3-1 and Appendix F). Copper was detected at a concentration of 6.75 mg/kg in the deepest sample (5–6 ft bgs) at location 05-613786. However, copper was not detected above BV in samples as deep as 25 ft bgs at location 05-613790, which is approximately 5 ft downgradient of location 05-613786. The vertical extent of copper is defined at all five locations. Concentrations of copper decreased downgradient in the drainage. The lateral extent of copper is defined.

Lead was detected above the Qbt 3 BV (11.2 mg/kg) in two samples at location 05-613788. Concentrations of lead decreased with depth at this location. Lead was not detected above BV downgradient of location 05-613788. The lateral and vertical extent of lead are defined.

Nitrate was detected in 26 Qbt 3 and sediment samples at 11 locations. The maximum concentration (71.8 mg/kg) was detected at location 05-613788 from 3–4 ft bgs. Concentrations of nitrate decreased with depth at this location. No background data for nitrate are available. Nitrate is naturally occurring, and the concentrations detected at the other 10 locations—all of which are downgradient of location 05-613788 with a highest concentration of 5.27 mg/kg—likely reflect naturally occurring levels. The lateral and vertical extent of nitrate are defined.

Perchlorate was detected in eight Qbt 3 and sediment samples at five locations. Concentrations of perchlorate decreased with depth at all five locations and overall decreased downgradient. The lateral and vertical extent of perchlorate are defined.

Selenium was detected above the Qbt 3 BV (0.3 mg/kg) in six samples at four locations. Concentrations of selenium were essentially unchanged with depth at location 05-613786, and selenium was not detected above BV in deeper samples at location 05-613790, which is approximately 5 ft downgradient of location 05-613786. Concentrations of selenium were essentially unchanged at location 05-613787. Selenium was detected above BV in two samples at locations 05-613789 and 05-613959 but was not detected above BV in the deeper samples at both locations. The vertical extent of selenium is defined at all four locations. Selenium was not detected and all results reported between the BVs, and the maximum DL were nondetects downgradient of location 05-613789. The lateral extent of selenium is defined.

Organic COPCs

Seventeen organic COPCs [acenaphthene; acenaphthylene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; dibenz(a,h)anthracene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; 2-methylnaphthalene; naphthalene; phenanthrene; and pyrene] were detected at location 05-613788. They were either not detected in deeper samples or concentrations decreased with depth at this location. The vertical extent of these 17 organic COPCs is defined at location 05-613788. Fluoranthene was also detected in one sample at location 05-613790 from 5–6 ft bgs and was not detected in deeper samples at this location. The vertical extent of fluoranthene is defined at location 05-613790. None of the 17 organic COPCs were detected downgradient of location 05-613790. The lateral extent of these organic COPCs is defined.

Diethylphthalate was detected only in the deepest sample (0.0824 mg/kg) below the EQL from 9–10 ft bgs at location 05-613788. The lateral and vertical extent of diethylphthalate are defined.

Benzoic acid was detected in six samples at four locations. It was detected in one sample (0.61 mg/kg) at location 05-02003 from 0–1 ft bgs. This location was resampled as location 05-613959 in 2011, and benzoic acid was not detected in the 2011 samples as deep as 6 ft bgs. Concentrations of benzoic acid decreased with depth at locations 05-613796 and 05-613797. Benzoic acid was detected only in the sample (0.266 mg/kg) below the EQL from 5–6 ft bgs at location 05-613789, while the deeper sample from 9–10 ft bgs was not analyzed for SVOCs (section 6.3.4.1). The vertical extent of benzoic acid is defined at all four locations. Benzoic acid was not detected downgradient of location 05-613796. The lateral extent of benzoic acid is defined.

Hexanone(2-) was detected in six samples at two locations. Location 05-613790 is approximately 5 ft downgradient of location 05-613786; therefore, the sampling results from these two locations are evaluated together. Hexanone(2-) was not detected in deeper samples from 34–35 ft and 44–45 ft bgs at location 05-613790 (RE05-11-14587 and RE05-11-14588, Table 6.3-1 and Appendix F). The vertical extent of 2-hexanone is defined. Hexanone(2-) was not detected downgradient of location 05-613790. The lateral extent of 2-hexanone is defined.

Isopropyltoluene(4-) was detected in one sample (0.000429 mg/kg) at location 05-613790 from 5–6 ft bgs. Isopropyltoluene(4-) was not detected in deeper samples at this location. The vertical extent of 4-isopropyltoluene is defined. Isopropyltoluene(4-) was not detected downgradient of location 05-613790. The lateral extent of 4-isopropyltoluene is defined.

Methylene chloride was detected in three samples at three locations. Methylene chloride was detected in samples from 1–2 ft and 3–4 ft bgs, respectively, at locations 05-613796 and 05-613959 but was not detected in deeper samples at both locations. Methylene chloride was detected only in the deepest sample (0.00228 mg/kg) below the EQL from 2–3 ft bgs at location 05-613797. The vertical extent of methylene chloride is defined at all three locations. Methylene chloride was not detected downgradient of location 05-613796. The lateral extent of methylene chloride is defined.

Styrene was detected in one sample (0.00035 mg/kg) at location 05-613797 from 0–1 ft bgs. Styrene was not detected in deeper samples at this location. The vertical extent of styrene is defined. Styrene was not detected downgradient of location 05-613797. The lateral extent of styrene is defined.

Radionuclide COPCs

Plutonium-239/240 was detected in one sample (0.098 pCi/g) at historical location 05-02003 from 2–3 ft bgs. This location was resampled as location 05-613959 in 2011, and plutonium-239/240 was not detected in the 2011 samples as deep as 6 ft bgs. The vertical extent of plutonium-239/240 is defined. Plutonium-239/240 was not detected or detected above FV downgradient of location 05-613959. The lateral extent of plutonium-239/240 is defined.

Uranium-234 was detected above the sediment BV (2.59 pCi/g) in one sample (4.71 pCi/g) at location 05-613796 from 0–1 ft bgs. Concentrations of uranium-234 decreased with depth at this location. The vertical extent of uranium-234 is defined. Uranium-234 was not detected above BV downgradient of location 05-613796. The lateral extent of uranium-234 is defined.

Uranium-235/236 was detected above the Qbt 3 BV (0.09 pCi/g) in three samples at locations 05-613790 and 05-613958 and was detected at a concentration (0.206 pCi/g) equivalent to the sediment BV (0.2 pCi/g) in one sample at location 05-613796. Concentrations of uranium-235/236 decreased with depth at all three locations. Uranium-235/236 was not detected above BV in the deepest sample from 44–45 ft bgs at location 05-613790 (RE05-11-14588, Table 6.3-1 and Appendix F). The vertical extent of uranium-235/236 is defined. Uranium-235/236 was not detected above BV downgradient of location 05-613796. The lateral extent of uranium-235/236 is defined.

Uranium-238 was detected above the sediment BV (2.29 pCi/g) in one sample (4.66 pCi/g) at location 05-613796 from 0–1 ft bgs. Concentrations of uranium-238 decreased with depth at this location. The vertical extent of uranium-238 is defined. Uranium-238 was not detected above BV downgradient of location 05-613796. The lateral extent of uranium-238 is defined.

Summary of Nature and Extent

The lateral and vertical extent of TAL metals, nitrate, perchlorate, total cyanide, explosive compounds, PCBs, SVOCs, VOCs, and radionuclides are defined at SWMU 05-004.

6.3.5 Summary of Human Health Risk Screening

The human health risk-screening assessment is discussed in section I-4.0 in Appendix I.

No carcinogens were retained as COPCs; therefore, there is no cancer risk for the industrial scenario. The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (DOE 2000, 067489).

The total excess cancer risk for the residential scenario is approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is approximately 0.06, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.5 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (DOE 2000, 067489).

The cancer risk of 4×10^{-5} for the residential scenario is from polycyclic aromatic hydrocarbons (PAHs) detected next to former building 05-1. PAHs were not detected below the locations of the former drainlines and septic tank or in the drainage. Therefore, PAHs were not discharged from the building to the septic system. An engineering drawing (LASL 1947, 206411) indicates the access road to building 05-1 was gravel-surfaced with one coat of hot oil penetration, the most likely source of the PAHs detected next to former building 05-1. Because the PAHs are not related to SWMU 05-004, they are removed from the residential carcinogenic and noncarcinogenic screening evaluations. Consequently, the total excess cancer risk is approximately 1×10^{-10}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.05, which is below the NMED target HI of 1 (NMED 2009, 108070).

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMU 05-004.

6.3.6 Summary of Ecological Risk Screening

The ecological risk-screening assessment is discussed in section I-5.0 in Appendix I. No potential ecological risk was found for any receptor following evaluations based on minimum ESLs, HI analyses, comparison with background concentrations, potential effects to populations (individuals for threatened and endangered [T&E] species), and LOAEL analyses.

6.4 Consolidated Unit 05-005(b)-00

Consolidated Unit 05-005(b)-00 consists of SWMU 05-005(b), a former outfall, and SWMU 05-006(c), an area of potential soil contamination associated with a former building (Figure 6.4-1).

6.4.1 SWMU 05-005(b), Former Outfall

6.4.1.1 Site Description and Operation History

SWMU 05-005(b) is an area of potentially contaminated soil associated with a former outfall that was located in TA-05 at the edge of Mortandad Canyon (Figure 6.4-1). The outfall served building 05-5 (a shop and darkroom) and is believed to have operated during the same period as the building, from

1944 to 1959. Building 05-5 supported TA-05 firing site activities, including shop work and processing photographs of experiments conducted at the firing sites. For a brief period in 1952, high-range radiation meters were also calibrated in the building.

No evidence of the outfall has been found at the site. A capped pipe was found at the ground surface at the former location of building 05-5 (LANL 2010, 108281, p. 17). The pipe, about 18 in. long, was removed with the debris at SWMU 05-006(c) (section 6.4.2.1). A drainage channel that collects most of the runoff from the site is present at the edge of the mesa. Stormwater BMPs, including straw wattles, are in place above and downslope of the site.

6.4.1.2 Relationship to Other SWMUs and AOCs

The outfall of SWMU 05-005(b) was associated with former building 05-5 [SWMU 05-006(c)]. SWMUs 05-005(b) and 05-006(c) comprise Consolidated Unit 05-005(b)-00.

6.4.1.3 Summary of Previous Investigations

A Phase I RFI was conducted at SWMU 05-005(b) in 1994 and 1995. Preliminary RFI activities included an interview with a former Beta Site supervisor and engineering surveys to identify sampling locations. The engineering surveys consisted of reviews of archival aerial photos and engineering drawings, site environmental surveys, and site visits and walkovers to locate the former building and site features. The location of the outfall was surveyed for potential HE contamination in May 1995, and no contamination was found (Koch 1995, 048943.21). A radiation grid survey performed on July 7, 1995, covered an area of approximately 70 ft × 120 ft and provided contiguous coverage of SWMUs 05-005(b) and 05-006(c). The radiation grid locations were spaced at 20-ft intervals. Gross-beta/-gamma radiation measurements were within background levels.

Phase I RFI sampling was performed in July 1995. Nine soil and tuff samples were collected from three locations at and below the outfall. At each location, samples were collected from depth intervals of 0–1 ft, 1–2 ft, and 2–3 ft bgs. All samples were submitted for laboratory analysis of TAL metals, isotopic uranium, and isotopic plutonium. One sample was also submitted for laboratory analysis of HE and another sample for laboratory analysis of SVOCs. Metals detected above BVs in the 1995 sampling were chromium and nickel, each detected above its BV in four tuff samples. Antimony and selenium had DLs above the tuff BVs. Bis(2-ethylhexyl)phthalate, the only organic chemical detected, was detected in one sample at 0.29 mg/kg. Plutonium-238, the only radionuclide detected or detected above BV/FV, was detected at 0.0225 pCi/g in one sample.

Decision-level data from the 1995 RFI are presented and evaluated together with the 2011 decision-level data in section 6.4.1.4.

6.4.1.4 Site Contamination

Soil and Rock Sampling

As part of the 2011 investigation, the following activities were conducted at SWMU 05-005(b) from January to March 2011:

- All samples were field screened for organic vapors and gross-alpha, -beta, and -gamma radioactivity. Field-screening results were recorded on the SCLs/COC forms (Appendix F) and are presented in Table 3.2-2.

- Six samples were collected from locations 05-613920 and 05-613801 (at previous locations 05-02042 and 05-02043, respectively) at depth intervals of 0–1 ft, 2–3 ft, and 5–6 ft bgs.
- Twelve samples were collected from locations 05-613799 (at previous location 05-02044), 05-613798, 05-613803, and 05-613802 in the drainage at depth intervals of 0–1 ft, 1–2 ft, and 2–3 ft bgs.
- Nine samples were collected from three new locations (05-613921, 05-613922, and 05-613923) in another discernable drainage identified during sampling activities. Samples were collected at depth intervals of 0–1 ft, 2–3 ft, and 5–6 ft bgs.

All samples were analyzed for TAL metals, nitrate, perchlorate, total cyanide, explosive compounds, dioxin and furan congeners, PCBs, SVOCs, VOCs, isotopic plutonium, and isotopic uranium.

After evaluating the analytical results from sampling conducted from January to March 2011 to define the nature and extent of contamination, the Laboratory proposed to conduct additional sampling (LANL 2011, 203592) and NMED approved the proposed sampling (NMED 2011, 203618). The following activities were conducted at SWMU 05-005(b) in June 2011:

- Two deeper samples were collected at location 05-613799 from 5–6 ft and 9–10 ft bgs and were analyzed for antimony.
- Four samples were collected at a new location (05-614429) farthest downgradient at depth intervals of 0–1 ft, 2–3 ft, 5–6 ft, and 9–10 ft bgs and were analyzed for perchlorate and acenaphthene.

Historical and 2011 sampling locations at SWMU 05-005(b) are shown in Figure 6.4-1. Table 6.4-1 presents the historical and 2011 samples collected and the analyses requested for SWMU 05-005(b). The geodetic coordinates of the 2011 sampling locations are presented in Table 3.2-1.

Soil and Rock Sample Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient air during PID screening of the samples during the 2011 investigation. No radiological-screening results exceeded twice the daily site background levels. Field-screening results for the 2011 samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the field-screening results.

Soil and Rock Sample Analytical Results

Decision-level data at SWMU 05-005(b) consist of results from 42 samples collected from 13 locations in 1995 and 2011. The 42 samples include 6 soil, 5 Qal, 27 Qbt 3, and 4 sediment samples. The extent of contamination is defined at SWMU 05-005(b). Therefore, the COPCs for the site are identified below.

Inorganic Chemicals

Thirty-six samples (6 soil, 26 Qbt 3, and 4 sediment) were analyzed for TAL metals, and additionally one Qal sample and one Qbt 3 sample were analyzed for antimony. Twenty-seven samples (3 soil, 20 Qbt 3, and 4 sediment) were analyzed for nitrate and total cyanide, and 31 samples (3 soil, 4 Qal, 20 Qbt 3, and 4 sediment) were analyzed for perchlorate. Table 6.4-2 presents the results of the inorganic chemicals above BVs. Figure 6.4-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs at SWMU 05-005(b).

Antimony was not detected but had DLs (0.986 mg/kg to 1.09 mg/kg) above the soil BV (0.83 mg/kg) in three soil samples. One DL exceeded the maximum soil background concentration (1 mg/kg). Antimony is identified as a COPC in soil. Antimony was detected above the Qbt 3 BV (0.5 mg/kg) in two samples, with a maximum concentration of 0.834 mg/kg. Antimony was not detected but had DLs (0.52 mg/kg to 1.05 mg/kg) above the Qbt 3 BV in 18 samples. Antimony is identified as a COPC in tuff. Antimony was not detected above the sediment BV (0.83 mg/kg) but had two DLs (1.02 mg/kg and 1.06 mg/kg) above the sediment BV. Antimony is identified as a COPC in sediment.

Barium was detected above the Qbt 3 BV (46 mg/kg) in two samples, with a maximum concentration of 68 mg/kg. The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-3.0-1 and Table H-3.0-1). Barium is not identified as a COPC in tuff.

Cadmium was not detected but had DLs (0.493 mg/kg to 0.544 mg/kg) above the soil BV (0.4 mg/kg) in three samples. These DLs are below the maximum soil background concentration (2.6 mg/kg). Cadmium is not identified as a COPC in soil. Cadmium was not detected but had DLs (0.484 mg/kg to 0.535 mg/kg) above the sediment BV (0.4 mg/kg) in four samples. Cadmium is identified as a COPC in sediment.

Calcium was detected above the Qbt 3 BV (2200 mg/kg) in one sample (3220 mg/kg). The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-3.0-2 and Table H-3.0-1). Calcium is not identified as a COPC in tuff.

Chromium was detected above the Qbt 3 BV (7.14 mg/kg) in four samples, with a maximum concentration of 45.9 mg/kg. The Gehan test indicated site concentrations are different from background (Figure H-3.0-3 and Table H-3.0-1). Chromium is identified as a COPC in tuff.

Copper was detected above the Qbt 3 BV (4.66 mg/kg) in one sample (4.72 mg/kg). The Gehan test indicated site concentrations are different from background (Figure H-3.0-4 and Table H-3.0-1). Copper is identified as a COPC in tuff.

Cyanide was not detected above BV at the site. Therefore, cyanide is not identified as a COPC.

Lead was detected above the Qbt 3 BV (11.2 mg/kg) in four samples, with a maximum concentration of 29.8 mg/kg. The Wilcoxon test indicated site concentrations are different from background (Figure H-3.0-5 and Table H-3.0-1). Lead is identified as a COPC in tuff.

Nickel was detected above the Qbt 3 BV (6.58 mg/kg) in four samples, with a maximum concentration of 23.7 mg/kg. The quantile test indicated site concentrations are not different from background, but the slippage test indicated site concentrations are different from background (Figure H-3.0-6 and Table H-3.0-1). Nickel is identified as a COPC in tuff.

Nitrate was detected in 17 soil, Qbt 3, and sediment samples, with a maximum concentration of 2.73 mg/kg. No background data are available for nitrate. Nitrate is naturally occurring, and the concentrations detected likely reflect naturally occurring levels. Nitrate is not identified as a COPC.

Perchlorate was detected in six Qbt 3 and sediment samples, with a maximum concentration of 0.00107 mg/kg. No background data are available for perchlorate. Perchlorate is identified as a COPC.

Selenium was not detected but had DLs (0.43 mg/kg to 1.06 mg/kg) above the Qbt 3 BV (0.3 mg/kg) in 26 samples. Selenium is identified as a COPC in tuff. Selenium was not detected but had DLs (1.04 mg/kg to 1.07 mg/kg) above the sediment BV (0.3 mg/kg) in four samples. Selenium is identified as a COPC in sediment.

Silver was not detected but had a DL (1.11 mg/kg) above the Qbt 3 BV (1 mg/kg) in one sample. The DL is below the maximum Qbt 3 background concentration (1.9 mg/kg). Silver is not identified as a COPC in tuff.

In summary, the inorganic COPCs identified at SWMU 05-005(b) are antimony, cadmium, chromium, copper, lead, nickel, perchlorate, and selenium.

Organic Chemicals

Twenty-eight samples (3 soil, 21 Qbt 3, and 4 sediment) were analyzed for explosive compounds and SVOCs, and 27 samples (3 soil, 20 Qbt 3, and 4 sediment) were analyzed for dioxin and furan congeners, PCBs, and VOCs. Additionally, four Qal samples were analyzed for acenaphthene. Table 6.4-3 presents the organic chemicals detected. Plate 1 shows the spatial distribution of organic chemicals detected at SWMU 05-005(b).

Explosive compounds and PCBs were not detected at SWMU 05-005(b).

Organic chemicals detected at SWMU 05-005(b) include acenaphthene; benzoic acid; bis(2-ethylhexyl)phthalate; di-n-butylphthalate; fluoranthene; 1,2,3,4,6,7,8-heptachlorodibenzodioxin; 1,2,3,4,6,7,8-heptachlorodibenzofuran; 4-isopropyltoluene; 1,2,3,4,6,7,8,9-octachlorodibenzodioxin; 1,2,3,4,6,7,8,9-octachlorodibenzofuran; 2,3,4,7,8-pentachlorodibenzofuran; and toluene.

These organic chemicals are retained as COPCs at SWMU 05-005(b).

Radionuclides

Thirty-six samples (6 soil, 26 Qbt 3, and 4 sediment) were analyzed for isotopic plutonium and isotopic uranium. Table 6.4-4 presents the radionuclides detected or detected above BVs/FVs. Figure 6.4-3 shows the spatial distribution of radionuclides detected or detected above BVs/FVs at SWMU 05-005(b).

Plutonium-238 was detected in one Qbt 3 sample (0.0225 pCi/g). Plutonium-238 is identified as a COPC in tuff.

Plutonium-239/240 was detected in one Qbt 3 sample (0.0281 pCi/g). Plutonium-239/240 is identified as COPC in tuff.

Uranium-235/236 was detected above the Qbt 3 BV (0.09 pCi/g) in one sample (0.103 pCi/g). Uranium-235/236 is identified as a COPC in tuff.

In summary, the radionuclide COPCs identified at SWMU 05-005(b) are plutonium-238, plutonium-239/240, and uranium-235/236.

Nature and Extent of Soil and Rock Contamination

Inorganic COPCs

Antimony was detected above the Qbt 3 BV (0.5 mg/kg) in two samples at locations 05-613799 and 05-613921. Antimony was not detected but had DLs above BV in deeper samples at both locations. The vertical extent of antimony is defined. Antimony was not detected above BVs and all results reported between the BVs, and the maximum DL were nondetects downgradient of location 05-613799. The lateral extent of antimony is defined.

Cadmium and selenium were not detected but had DLs above BVs. Because they were not detected above BVs and all results reported between the BVs and the maximum DL were nondetects, the lateral and vertical extent of cadmium and selenium are defined.

Chromium was detected above the Qbt 3 BV (7.14 mg/kg) in four samples at two historical locations 05-02042 and 05-02043 (depths ranging from 0–3 ft bgs), which were resampled in 2011 as locations 05-613920 and 05-613801, respectively. Chromium was not detected above BV in the 2011 samples (depths ranging from 0–6 ft bgs). The lateral and vertical extent of chromium are defined.

Copper was detected above the Qbt 3 BV (4.66 mg/kg) in one sample (4.72 mg/kg) at location 05-613803 from 2–3 ft bgs. This concentration is below the maximum Qbt 3 background concentration (6.2 mg/kg). Copper was not detected above BV at location 05-613802, downgradient of location 05-613803. The lateral and vertical extent of copper are defined.

Lead was detected above the Qbt 3 BV (11.2 mg/kg) in four samples at locations 05-613801, 05-613920, 05-613921, and 05-613922. Concentrations of lead decreased with depth at all four locations. The vertical extent of lead is defined. Lead was not detected above BV downgradient of location 05-613922. The lateral extent of lead is defined.

Nickel was detected above the Qbt 3 BV (6.58 mg/kg) in four samples at two historical locations 05-02042 and 05-02043 (depths ranging from 0–3 ft bgs), which were resampled in 2011 as locations 05-613920 and 05-613801, respectively. Nickel was not detected above BV in the 2011 samples (depths ranging from 0–6 ft bgs). The lateral and vertical extent of nickel are defined.

Nitrate was detected in 17 soil, Qbt 3, and sediment samples at eight locations. Nitrate is naturally occurring, and the concentrations detected likely reflect naturally occurring levels. The lateral and vertical extent of nitrate are defined.

Perchlorate was detected in six Qbt 3 and sediment samples at four locations. Concentrations of perchlorate decreased with depth at all four locations. The vertical extent of perchlorate is defined. Perchlorate was not detected in samples (depths ranging from 0–10 ft bgs) at location 05-614429 (RE05-11-14596 through RE05-11-14599, Table 6.4-1 and Appendix F). The lateral extent of perchlorate is defined.

Organic COPCs

Acenaphthene was detected in one sample (0.0444 mg/kg) at location 05-613802 from 1–2 ft bgs. Acenaphthene was not detected in deeper samples at this location. The vertical extent of acenaphthene is defined. Acenaphthene was not detected in samples (depths ranging from 0–10 ft bgs) at location 05-614429 (RE05-11-14596, RE05-11-14598, and RE05-11-14599, Table 6.4-1 and Appendix F). The lateral extent of acenaphthene is defined.

Benzoic acid was detected in one sample (0.538 mg/kg) below the EQL at location 05-613803 from 0–1 ft bgs. Benzoic acid was not detected in deeper samples at this location. The vertical extent of benzoic acid is defined. Benzoic acid was not detected at location 05-613802, downgradient of location 05-613803. The lateral extent of benzoic acid is defined.

Bis(2-ethylhexyl)phthalate was detected in one sample (0.29 mg/kg) at historical location 05-02043 from 1–2 ft bgs. This location was resampled as location 05-613801 in 2011, and bis(2-ethylhexyl)phthalate was not detected in the 2011 samples (depths ranging from 0–6 ft bgs). The lateral and vertical extent of bis(2-ethylhexyl)phthalate are defined.

Di-n-butylphthalate was detected in one sample (0.0774 mg/kg) below the EQL at location 05-613921 from 0–1 ft bgs. Di-n-butylphthalate was not detected in deeper samples at this location. The vertical extent of di-n-butylphthalate is defined. Di-n-butylphthalate was not detected downgradient of location 05-613921. The lateral extent of di-n-butylphthalate is defined.

Fluoranthene was detected in one sample (0.0116 mg/kg) below the EQL at location 05-613922 from 0–1 ft bgs. Fluoranthene was not detected in deeper samples at this location. The vertical extent of fluoranthene is defined. Fluoranthene was not detected downgradient of location 05-613922. The lateral extent of fluoranthene is defined.

Dioxin and furan congeners were detected at eight locations. Dioxin and furan congeners were either not detected in deeper samples or their concentrations decreased with depth. Dioxin and furan congeners were not detected at the farthest downgradient location 05-613802. The lateral and vertical extent of dioxin and furan congeners are defined.

Isopropyltoluene(4-) was detected in one sample (0.000748 mg/kg) below the EQL at location 05-613798 from 0–1 ft bgs. Isopropyltoluene(4-) was not detected in deeper samples at this location. The vertical extent of 4-isopropyltoluene is defined. Isopropyltoluene(4-) was not detected downgradient of location 05-613798. The lateral extent of 4-isopropyltoluene is defined.

Toluene was detected in one sample (0.000326 mg/kg) below the EQL at location 05-613802 from 0–1 ft bgs. The lateral and vertical extent of toluene are defined.

Radionuclide COPCs

Plutonium-238 was detected in one sample (0.0225 pCi/g) at historical location 05-02042 from 0–1 ft bgs. This location was resampled as location 05-613920 in 2011, and plutonium-238 was not detected in the 2011 samples (depths ranging from 0–6 ft bgs). Plutonium-238 was not detected or detected above FV downgradient of location 05-613920. The lateral and vertical extent of plutonium-238 are defined.

Plutonium-239/240 was detected in one Qbt 3 sample (0.0281 pCi/g) at location 05-613921 from 0–1 ft bgs. Concentrations of plutonium-239/240 decreased with depth at this location. The vertical extent of plutonium-239/240 is defined. Plutonium-239/240 was not detected or detected above FV downgradient of location 05-613921. The lateral extent of plutonium-239/240 is defined.

Uranium-235/236 was detected above the Qbt 3 BV (0.09 pCi/g) in one sample (0.103 pCi/g) at location 05-613801 from 0–1 ft bgs. Concentrations of uranium-235/236 decreased with depth at this location. The vertical extent of uranium-235/236 is defined. Uranium-235/236 was not detected above BV downgradient of location 05-613801. The lateral extent of uranium-235/236 is defined.

Summary of Nature and Extent

The lateral and vertical extent of TAL metals, nitrate, perchlorate, total cyanide, dioxin and furan congeners, explosive compounds, PCBs, SVOCs, VOCs, and radionuclides are defined at SWMU 05-005(b).

6.4.1.5 Summary of Human Health Risk Screening

The human health risk-screening assessment is discussed in section I-4.0 in Appendix I.

The total excess cancer risk for the industrial scenario is 1×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (DOE 2000, 067489).

The total excess cancer risk for the residential scenario is 6×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (DOE 2000, 067489).

Based on the risk-screening assessment results, no potential unacceptable risks and doses exist for the industrial and residential scenarios at SWMU 05-005(b).

6.4.1.6 Summary of Ecological Risk Screening

The ecological risk-screening assessment is discussed in section I-5.0 in Appendix I. No potential ecological risk was found for any receptor following evaluations based on minimum ESLs, HI analyses, comparison with background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analyses.

6.4.2 SWMU 05-006(c), Area of Potential Soil Contamination

6.4.2.1 Site Description and Operation History

SWMU 05-006(c) is an area of potentially contaminated soil associated with the location of former building 05-5, a shop and darkroom (Figure 6.4-1). The shop was 16 ft^2, and the darkroom was 6 ft wide × 9 ft long (LANL 1990, 007511). The building was operational from about 1944 to 1959. The structure was originally used to support firing-site activities, including processing photographs of experiments conducted at the TA-05 firing sites. In 1952, J Division temporarily used the building to calibrate high-range radiation meters (LANL 1992, 007666, p. 3-12). A 1959 memorandum indicates this structure was contaminated with HE (Penland 1959, 000806), as does a 1959 list generated by the Laboratory's H-3 Group. Potential soil contamination associated with SWMU 05-006(c) was reported to also include uranium. Building 05-5 was destroyed by intentional burning on March 5, 1960 (Wingfield 1960, 029398).

During the 2011 investigation activities, a small amount of burned debris (charred wood, melted glass, and metal) was removed from the former location of building 05-5. An 18-in.-long capped pipe was also removed. Stormwater BMPs, including a soil berm with straw wattles, are in place south of the site.

6.4.2.2 Relationship to Other SWMUs and AOCs

The outfall of SWMU 05-005(b) was associated with former building 05-5 [SWMU 05-006(c)]. SWMUs 05-005(b) and 05-006(c) comprise Consolidated Unit 05-005(b)-00.

6.4.2.3 Summary of Previous Investigations

Cleanup of the site of the former building was included in the 1985 LASCP. Surface debris, including wood, copper wire, scrap metal, and other building debris, was removed. No radioactive contamination was detected (NUS Corporation 1990, 012571). A mound of burned debris, including charred wood and melted glass, was noted to be present at the site during an inspection in September 1994 (Koch 1994, 048943.13).

A Phase I RFI was conducted at SWMU 05-006(c) in 1994 and 1995. Preliminary RFI activities included an interview with a former Beta Site supervisor and engineering surveys to identify sampling locations. The engineering surveys consisted of reviews of archival aerial photographs and engineering drawings, site environmental surveys, site visits and walkovers to locate the former buildings, and the staking of sampling locations. A radiation grid survey performed on July 7, 1995, covered an area of approximately 70 ft × 120 ft and provided contiguous coverage of SWMUs 05-005(b) and 05-006(c). The radiation grid locations were spaced at 20-ft intervals. Gross-beta/-gamma radiation measurements were within background levels.

Phase I RFI sampling was performed in July 1995. Thirteen soil and tuff samples were collected from seven locations. (Two samples from two locations were excavated in 2011; therefore, they are not listed in Table 6.4-5 [see section 6.4.2.4].) To characterize potential contamination from chemical disposal, nine soil and tuff samples were collected from three locations around three sides of the former building in areas where chemicals may have been poured on the ground. At each location, samples were collected from depth intervals of 0–1 ft, 1–2 ft, and 2–3 ft bgs. All samples were submitted for laboratory analysis of TAL metals, isotopic uranium, and isotopic plutonium. One sample was also submitted for analysis of gross-alpha and gross-beta radioactivity and gamma-emitting radionuclides. Four additional samples were collected to characterize potential contamination associated with the debris remaining from the demolition of the building. A surface (0–0.5 ft) sample was collected at each of four locations at and downslope of the debris pile. All samples were submitted for laboratory analysis of TAL metals. Two of these four surface samples were excavated in 2011 (section 6.4.2.4). No samples collected in 1995 were analyzed for organic chemicals.

Metals detected above BV in the 1995 sampling were antimony, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, nickel, selenium, silver, and zinc (results before the 2011 excavation are presented in LANL 2010, 108281, Table 4.0-3). Antimony, cadmium, and silver each were detected above their BVs for one soil sample. Arsenic was detected slightly above the BV in one soil sample and slightly above the BV in one tuff sample. Barium was detected above the BV in one tuff sample, and calcium was detected above the BV in one tuff sample. Chromium was detected above the BV in six tuff samples. Copper was detected above the BV in three soil samples. Iron and selenium were each detected slightly above the BVs in one soil sample. Lead was detected above the BV in four soil samples and one tuff sample. Nickel was detected above the BV for two soil samples and five tuff samples. Zinc was detected above the BV in three soil samples. Mercury had DLs above the soil BV in one sample.

Samples were not analyzed for organic chemicals, and no radionuclides were detected or detected above BVs or FVs.

Decision-level data from the 1995 RFI are presented and evaluated together with the 2011 decision-level data in section 6.4.2.4.

6.4.2.4 Site Contamination

Soil and Rock Sampling

As part of the 2011 investigation, the following activities were conducted at SWMU 05-006(c) from January to March 2011:

- All samples were field screened for organic vapors and gross-alpha, -beta, and -gamma radioactivity. Field-screening results were recorded on the SCLs/COC forms (Appendix F) and are presented in Table 3.2-2.
- Originally 24 samples were collected from eight locations (05-613800, 05-613804, 05-613805, 05-613806, 05-613807, 05-613808, 05-613809, and 05-613929) within and around the footprint at depth intervals of 0–1 ft, 2–3 ft, and 5–6 ft bgs. Locations 05-613805, 05-613804, 05-613807, 05-613806, 05-613800, and 05-613808 were at previous locations 05-02039, 05-02040, 05-02041, 05-02070, 05-02071, and 05-02072, respectively.
- An XRF survey conducted at SWMU 05-006(c) identified locations with elevated concentrations of lead. All remaining debris and all soil containing lead above the industrial SSL (800 mg/kg) were removed. The depth of the excavation ranged from 0.5–1 ft bgs within the remediated area (Figure 6.4-1). During the excavation, locations 05-02072 (0–0.5 ft) and 05-613808 (0–1 ft) were removed (excavated samples 0405-95-0300 and RE05-11-3427, respectively, Appendix F). Because only a surface sample was collected at location 05-02072 in 1995 and the location was subsequently excavated in 2011, Figure 6.4-1 shows this location only as location 05-613808. Four confirmation samples were collected at four locations (05-613925 through 05-613928) from 0–1 ft bgs at the bottom of excavation. Only surface samples were collected because other locations with multiple depths are within the immediate vicinity of these four locations.

All samples were analyzed for TAL metals, nitrate, perchlorate, total cyanide, explosive compounds, dioxin and furan congeners, PCBs, SVOCs, VOCs, isotopic plutonium, and isotopic uranium.

After evaluating the analytical results from sampling conducted from January to March 2011 to define the nature and extent of contamination, the Laboratory proposed to conduct additional sampling (LANL 2011, 203592) and NMED approved the proposed sampling (NMED 2011, 203618). The following activities were conducted at SWMU 05-006(c) in June 2011:

- One deeper sample each was collected at locations 05-613807 and 05-613929 from 9–10 ft bgs and analyzed for toluene and silver, respectively.
- Location 05-613800 was excavated to remove additional lead contamination. The excavation depth ranged from 1–2 ft bgs within the 6-ft ×6-ft remediated area (Figure 6.4-1). Location 05-613800 is collocated with historical location 05-02071. Location 05-02071, although located within the boundary of SWMU 05-005(b), was originally planned and sampled west of SWMU 05-006(c). During the excavation, locations 05-02071 (0–0.5 ft) and 05-613800 (0–1 ft) were removed (excavated samples 0405-95-0299 and RE05-11-3393, respectively, Appendix F). Two deeper samples (2–3 ft and 5–6 ft bgs) at location 05-613800 remain and serve to define vertical extent. Because only a surface sample was collected at location 05-02071 in 1995 and the location was subsequently excavated in 2011, Figure 6.4-1 shows this location only as location 05-613800.

Confirmation samples for excavation at location 05-613800 were collected from three step-out locations 3 ft to the north, east, and south of location 05-613800 (locations 05-614430, 05-614431, and 05-614432, respectively) at depth intervals of 0–1 ft, 2–3 ft, and 5–6 ft bgs. No confirmation sample was collected to the west because of the close proximity to the other sampled locations at SWMU 05-006(c). Confirmation samples were analyzed only for lead.

Historical and 2011 sampling locations at SWMU 05-006(c) are shown in Figure 6.4-1. Table 6.4-5 presents the historical and 2011 samples collected and the analyses requested for SWMU 05-006(c). The geodetic coordinates of the 2011 sampling locations are presented in Table 3.2-1.

Soil and Rock Sample Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient air during PID screening of the samples during the 2011 investigation. No radiological screening results exceeded twice the daily site background levels. Field-screening results for the 2011 samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the field-screening results.

Soil and Rock Sample Analytical Results

Decision-level data at SWMU 05-006(c) consist of results from 48 samples collected from 20 locations in 1995 and 2011. The 48 samples include 5 soil and 43 Qbt 3 samples. The extent of contamination is defined at SWMU 05-006(c). Therefore, the COPCs for the site are identified below.

Inorganic Chemicals

Thirty-seven samples (5 soil and 32 Qbt 3) were analyzed for TAL metals; in addition, nine Qbt 3 samples were analyzed only for lead, and one Qbt 3 sample was analyzed only for silver. Twenty-six Qbt 3 samples were analyzed for nitrate, perchlorate, and total cyanide. Table 6.4-6 presents the inorganic chemicals above BVs. Figure 6.4-4 shows the spatial distribution of inorganic chemicals detected or detected above BVs SWMU 05-006(c).

Aluminum was detected above the Qbt 3 BV (7340 mg/kg) in one sample (9190 mg/kg). The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-4.0-1 and Table H-4.0-1). Aluminum is not identified as a COPC in tuff.

Antimony was detected above the soil BV (0.83 mg/kg) and the maximum soil background concentration (1 mg/kg) in one sample (2.3 mg/kg) and was not detected but had a DL (0.85 mg/kg) above the soil BV in one sample. Antimony is identified as a COPC in soil. Antimony was detected above the Qbt 3 BV (0.5 mg/kg) in five samples, with a maximum concentration of 2.13 mg/kg, and was not detected but had DLs (0.55 mg/kg to 1.2 mg/kg) above the Qbt 3 BV in 14 samples. Antimony is identified as a COPC in tuff.

Arsenic was detected above the Qbt 3 BV (2.79 mg/kg) in one sample (3.2 mg/kg). The Gehan and quantile tests indicated site concentrations are not different from background (Figure H-4.0-2 and Table H-4.0-1). Arsenic is not identified as a COPC in tuff.

Barium was detected above the Qbt 3 BV (46 mg/kg) in three samples, with a maximum concentration of 87.9 mg/kg. The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-4.0-3 and Table H-4.0-1). Barium is not identified as a COPC in tuff.

Calcium was detected above the Qbt 3 BV (2200 mg/kg) in three samples, with a maximum concentration of 6710 mg/kg. The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-4.0-4 and Table H-4.0-1). Calcium is not identified as a COPC in tuff.

Chromium was detected above the Qbt 3 BV (7.14 mg/kg) in six samples, with a maximum concentration of 187 mg/kg. The Gehan test indicated site concentrations are different from background (Figure H-4.0-5 and Table H-4.0-1). Chromium is identified as a COPC in tuff.

Copper was detected above the soil BV (14.7 mg/kg) and the maximum soil background concentration (16 mg/kg) in one sample (126 mg/kg). Copper is identified as a COPC in soil. Copper was detected above the Qbt 3 BV (4.66 mg/kg) in 10 samples, with a maximum concentration of 317 mg/kg. The Gehan test indicated site concentrations are different from background (Figure H-4.0-6 and Table H-4.0-1). Copper is identified as a COPC in tuff.

Cyanide was not detected at SWMU 05-006(c). Therefore, cyanide is not identified as a COPC.

Iron was detected above the soil BV (21,500 mg/kg) in one sample (25,100 mg/kg). This concentration is below the maximum soil background concentration (36,000 mg/kg). Iron is not identified as a COPC in soil. Iron was detected above the Qbt 3 BV (14,500 mg/kg) in one sample (18,600 mg/kg). The Wilcoxon and quantile tests indicated site concentrations in Qbt 3 tuff are not different from background (Figure H-4.0-7 and Table H-4.0-1). Iron is not identified as a COPC in tuff.

Lead was detected above the soil BV (22.3 mg/kg) and the maximum soil background concentration (28 mg/kg) in two samples, with a maximum concentration of 42.9 mg/kg. Lead is identified as a COPC in soil. Lead was detected above the Qbt 3 BV (11.2 mg/kg) in 26 samples, with a maximum concentration of 337 mg/kg. The Gehan test indicated site concentrations are different from background (Figure H-4.0-8 and Table H-4.0-1). Lead is identified as a COPC in tuff.

Magnesium was detected above the Qbt 3 BV (1690 mg/kg) in one sample (1710 mg/kg). The Wilcoxon and quantile tests indicated site concentrations are not different from background (Figure H-4.0-9 and Table H-4.0-1). Magnesium is not identified as a COPC in tuff.

Nickel was detected above the soil BV (15.4 mg/kg) in one sample (28.2 mg/kg). This concentration is below the maximum soil background concentration (29 mg/kg). Nickel is not identified as a COPC in soil. Nickel was detected above the Qbt 3 BV (6.58 mg/kg) in five samples, with a maximum concentration of 89.4 mg/kg. The quantile test indicated site concentrations are not different from background, but the slippage test indicated site concentrations are different from background (Figure H-4.0-10 and Table H-4.0-1). Nickel is identified as a COPC in tuff.

Nitrate was detected in 11 Qbt 3 samples, with a maximum concentration of 1.63 mg/kg. No background data are available for nitrate. Nitrate is naturally occurring, and the concentrations detected likely reflect naturally occurring levels. Nitrate is not identified as a COPC in tuff.

Perchlorate was not detected at SWMU 05-006(c). Therefore, perchlorate is not identified as a COPC.

Selenium was detected above the Qbt 3 BV (0.3 mg/kg) in four samples, with a maximum concentration of 0.394 mg/kg, and was not detected but had DLs (0.43 mg/kg to 1.09 mg/kg) above the Qbt 3 BV in 28 samples. Selenium is identified as a COPC in tuff.

Silver was detected above Qbt 3 BV (1 mg/kg) and the maximum Qbt 3 background concentration (1.9 mg/kg) in one sample (2.22 mg/kg). Silver is identified as a COPC in tuff.

Zinc was detected above the soil BV (48.8 mg/kg) in one sample (58.4 mg/kg). This concentration is below the maximum soil background concentration (75.5 mg/kg). Zinc is not identified as a COPC in soil.

In summary, the inorganic COPCs identified at SWMU 05-006(c) are antimony, chromium, copper, lead, nickel, selenium, and silver.

Organic Chemicals

Twenty-six Qbt 3 samples were analyzed for dioxin and furan congeners, explosive compounds, PCBs, SVOCs, and VOCs. Additionally, one Qbt 3 sample was analyzed for toluene only. Table 6.4-7 presents the organic chemicals detected. Plate 2 shows the spatial distribution of organic chemicals detected at SWMU 05-006(c).

Explosive compounds and SVOCs were not detected at SWMU 05-006(c).

Organic chemicals detected at SWMU 05-006(c) include acetone; Aroclor-1260; 1,2,3,4,6,7,8-heptachlorodibenzodioxin; 1,2,3,4,6,7,8-heptachlorodibenzofuran; 1,2,3,6,7,8-hexachlorodibenzodioxin; 4-isopropyltoluene; methylene chloride; 1,2,3,4,6,7,8,9-octachlorodibenzodioxin;1,2,3,4,6,7,8,9-octachlorodibenzofuran; 2,3,7,8-tetrachlorodibenzofuran; toluene; 1,2,4-trimethylbenzene. These organic chemicals are retained as COPCs at SWMU 05-006(c).

Radionuclides

One soil sample was analyzed for gamma-emitting radionuclides, and 35 samples (3 soil and 32 Qbt 3) were analyzed for isotopic plutonium and isotopic uranium. Table 6.4-8 presents the radionuclides detected or detected above BVs/FVs. Figure 6.4-3 shows the spatial distribution of radionuclides detected or detected above BVs/FVs.

Uranium-235/236 was detected above the Qbt 3 BV (0.09 pCi/g) in three samples, with a maximum concentration of 0.103 pCi/g. Uranium-235/236 is identified as a COPC in tuff.

The radionuclide COPC identified at SWMU 05-006(c) is uranium-235/236.

Nature and Extent of Soil and Rock Contamination

Inorganic COPCs

Antimony was detected above the soil BV (0.83 mg/kg) in one sample at historical location 05-02070 and was detected above the Qbt 3 BV (0.5 mg/kg) in five samples at four locations. Historical location 05-02070 was resampled as location 05-613806 in 2011. Concentrations of antimony decreased with depth at locations 05-613804, 05-613806, and 05-613929. Only surface samples (0–1 ft bgs) were collected at locations 05-613926 and 05-613928. However, antimony was not detected above BV at location 05-613808 (approximately 4 ft from location 05-613926), and its concentrations decreased with depth at location 05-613929 (approximately 3 ft from location 05-613928). Therefore, the vertical extent of antimony is defined at all five locations. Antimony was not detected above the BV, and all results reported between the BV and the maximum DL were nondetects at perimeter locations 05-613800, 05-613806, 05-613807, and 05-613809. The lateral extent of antimony is defined.

Chromium was detected above the Qbt 3 BV (7.14 mg/kg) in six samples at three historical locations 05-02039, 05-02040, and 05-02041 (depths ranging from 0–3 ft bgs), which were resampled in 2011 as locations 05-613805, 05-613804, and 05-613807 (depths ranging from 0–6 ft bgs), respectively. Chromium was not detected above BV in the 2011 samples at these three locations. The lateral and vertical extent of chromium are defined.

Copper was detected above the soil BV (14.7 mg/kg) in one sample (0–0.5 ft bgs) at historical location 05-02070. This historical location was resampled as location 05-613806 (depths ranging 0–6 ft bgs) in 2011, and copper was not detected above BV at location 05-613806. Copper was detected above the Qbt 3 BV (4.66 mg/kg) in 10 samples at eight locations. Concentrations of copper decreased with depth at five of the eight locations. At location 05-613808, a surface sample (0–1 ft bgs) was collected before the debris was removed at SWMU 05-006(c); this location was subsequently removed during the excavation (section 6.4.2.4). Decision-level data from this surface sample (RE05-11-3427, excavated sample, Appendix F) showed copper at a concentration of 49 mg/kg. Copper was detected at concentrations of 7.94 mg/kg and 9.18 mg/kg from 2–3 ft and 5–6 ft bgs, respectively. Overall, concentrations of copper decreased with depth at location 05-613808. At locations 05-613926 and 05-613928, where only surface samples (0–1 ft bgs) were collected, concentrations of copper decreased with depth at locations 05-613808 (approximately 4 ft from location 05-613926) and 05-613929 (approximately 3 ft from 05-613928), respectively. Therefore, the vertical extent of copper is defined at all eight locations. Concentrations of copper decreased laterally in all four directions. The lateral extent of copper is defined.

Lead was detected above the soil BV (22.3 mg/kg) in two samples at historical locations 05-02040 and 05-02070 and was detected above the Qbt 3 BV (11.2 mg/kg) in 26 samples at 14 locations, including at historical location 05-02040. Historical locations 05-02040 and 05-02070 were resampled as locations 05-613804 and 05-613806 in 2011, respectively. Concentrations of lead decreased with depth at location 05-613804, and it was not detected above BV at location 05-613806. Concentrations of lead also decreased with depth at five other locations. Only surface samples (0–1 ft bgs) were collected at locations 05-613925, 05-613926, and 05-613928, and the concentrations of lead decreased with depth at locations 05-613804 (approximately 4 ft from location 05-613925), 05-613808 (approximately 4 ft from location 05-613926), and 05-613929 (approximately 3 ft from 05-613928), respectively. The vertical extent of lead is defined. Location 05-613800 was excavated to remove lead contamination, with confirmation samples collected from three step-out locations 05-614430, 05-614431, and 05-614432 (section 6.4.2.4). The preexcavated concentration of lead was 26,500 mg/kg from 0–1 ft bgs at location 05-613800 (RE05-11-3393, excavated sample, Appendix F). Lead was detected at concentrations of 26.4 mg/kg and 60.1 mg/kg from 2–3 ft and 5–6 ft bgs, respectively. Overall, lead concentrations decreased with depth at this location from 0–1 ft to 5–6 ft bgs, and the remaining concentrations are approximately an order of magnitude below the residential SSL (400 mg/kg). Lead concentrations decreased laterally in all four directions at the excavation. Lead concentrations also decreased with depth at step-out locations 05-614430 and 05-614432. Lead concentrations increased slightly with depth at step-out location 05-614431 but showed essentially no change with depth from 2–3 ft to 5–6 ft. The lead concentrations at depth at this location are slightly above the maximum Qbt 2,3,4 background concentration (15.5 mg/kg) and are comparable with the lead concentrations detected at the other step-out locations (locations 05-614430 and 05-614432). All lead concentrations within and around the excavated area are an order of magnitude or more below the residential SSL (400 mg/kg). Therefore, further sampling for extent is not warranted.

Nickel was detected above the soil BV (15.4 mg/kg) in one sample at historical location 05-02070, which was resampled in 2011 as location 05-613806. Nickel was detected above the Qbt 3 BV (6.58 mg/kg) in five samples at three historical locations 05-02039, 05-02040, and 05-02041, which were resampled in 2011 as locations 05-613805, 05-613804, and 05-613807, respectively. Nickel was not detected above BV in the 2011 samples at these four locations. The lateral and vertical extent of nickel are defined.

Selenium was detected above the Qbt 3 BV (0.3 mg/kg) in four samples at three locations. Concentrations of selenium decreased with depth at locations 05-613800 and 05-613929. Only a surface sample (0–1 ft bgs) was collected at location 05-613928, but its concentrations decreased with depth at location 05-613929 (approximately 3 ft from 05-613928). The vertical extent of selenium is defined at all three locations. Selenium was not detected above BVs and all results reported between the BVs and the maximum DL were nondetects at all other locations at the site. The lateral extent of selenium is defined.

Silver was detected above Qbt 3 BV (1 mg/kg) in one sample from 5–6 ft bgs at location 05-613929. Silver was not detected above BV in the deepest sample from 9–10 ft bgs at location 05-613929 (RE05-11-14605, Table 6.4-5 and Appendix F). Concentrations of silver decreased with depth at location 05-613929. The vertical extent of silver is defined. Silver was not detected above BV at any other locations at the site. The lateral extent of silver is defined.

Organic COPCs

Acetone was detected in two samples below the EQLs at two locations. The lateral and vertical extent of acetone are defined.

Aroclor-1260 was detected in three samples below the EQLs at two locations. The lateral and vertical extent of Aroclor-1260 are defined.

Dioxin and furan congeners were detected at 12 locations. Concentrations of all dioxin and furan congeners decreased with depth at all locations, except locations 05-613925, 05-613926, 05-613927, and 05-613928 where only surface samples collected. The concentrations detected at these four locations are less than the EQLs, except for total heptachlorodibenzodioxins; 1,2,3,4,6,7,8,9-octachlorodibenzodioxin; and total tetrachlorodibenzofurans at location 05-613928. However, concentrations of these congeners decreased with depth at location 05-613929 (approximately 3 ft from 05-613928). The concentrations of dioxin and furan congeners also decreased laterally in all four directions at the site. The lateral and vertical extent of dioxin and furan congeners are defined.

Isopropyltoluene(4-) was detected in six samples at five locations. Concentrations of 4-isopropyltoluene decreased with depth at 05-613808 and 05-613929. Only surface samples (0–1 ft bgs) were collected at locations 05-613925, 05-613927, and 05-613928, but 4-isopropyltoluene was not detected at locations 05-613804 (approximately 4 ft from location 05-613925), and its concentrations decreased with depth at locations 05-613808 and 05-613929 (approximately 5 ft from location 05-613927 and 3 ft from location 05-613928, respectively). Therefore, the vertical extent of 4-isopropyltoluene is defined at all five locations. Isopropyltoluene(4-) was not detected at perimeter locations 05-613800, 05-613806, 05-613807, and 05-613809. The lateral extent of 4-isopropyltoluene is defined.

Methylene chloride was detected in 11 samples below the EQLs at seven locations. The lateral and vertical extent of methylene chloride are defined.

Toluene was detected in nine samples at four locations. Concentrations of toluene are below the EQLs at locations 05-613804, 05-613805, and 05-613806. Toluene was not detected in the deepest sample from 9–10 ft bgs at location 05-613807 (RE05-11-14604, Table 6.4-5 and Appendix F). The vertical extent of toluene is defined at all four locations. Toluene was not detected at perimeter locations 05-613800 and 05-613809, was detected at concentrations below the EQLs at location 05-613806, and was not detected to the south at location 05-613920 (Table 6.4-3). The lateral extent of toluene is defined.

Trimethylbenzene(1,2,4-) was detected in one sample (0.000461 mg/kg) below the EQL at location 05-613805 from 0–1 ft bgs. The lateral and vertical extent of 1,2,4-trimethylbenzene are defined.

Radionuclide COPCs

Uranium-235/236 was detected above the Qbt 3 BV (0.09 pCi/g) in three samples at three locations. Concentrations of uranium-235/236 decreased with depth at location 05-613805. Only a surface sample (0–1 ft bgs) was collected at location 05-613927, but uranium-235/236 was not detected above BV at location 05-613929, which is approximately 3 ft from location 05-613927. Uranium-235/236 was detected above the Qbt 3 BV only in the deepest sample (0.0903 pCi/g) at location 05-613800; however, this concentration is equivalent to the BV. Uranium-235/236 was not detected above BV at the other three perimeter locations 05-613806, 05-613807, and 05-613809. The lateral and vertical extent of uranium-235/236 are defined.

Summary of Nature and Extent

The lateral and vertical extent of TAL metals, nitrate, perchlorate, total cyanide, dioxin and furan congeners, explosive compounds, PCBs, SVOCs, VOCs, and radionuclides are defined at SWMU 05-006(c).

6.4.2.5 Summary of Human Health Risk Screening

The human health risk-screening assessment is discussed in section I-4.0 in Appendix I.

The total excess cancer risk for the industrial scenario is 1×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (DOE 2000, 067489).

The total excess cancer risk for the residential scenario is approximately 8×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.3, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.04 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (DOE 2000, 067489).

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMU 05-006(c).

6.4.2.6 Summary of Ecological Risk Screening

The ecological risk-screening assessment is discussed in section I-5.0 in Appendix I. No potential ecological risk was found for any receptor following evaluations based on minimum ESLs, HI analyses, comparison with background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analyses.

7.0 CONCLUSIONS

7.1 Nature and Extent of Contamination

The nature and extent of contamination from inorganic, organic, and/or radionuclide COPCs have been defined at SWMUs 05-003, 05-004, 05-005(b), and 05-006(c).

7.2 Summary of Risk-Screening Assessments

Risk-screening assessments were conducted for SWMUs 05-003, 05-004, 05-005(b), and 05-006(c) under the industrial and residential scenarios and for ecological receptors.

7.2.1 Human Health Risk-Screening Assessments

The human health risk-screening assessments are presented in section I-4.0 in Appendix I.

The human health risk-screening assessments indicated no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMUs 05-003, 05-005(b) and 05-006(c).

The human health risk-screening assessments indicated no potential unacceptable risks or doses exist for the industrial scenario, and no potential unacceptable noncarcinogenic risk and no potential unacceptable dose exist for the residential scenario at SWMU 05-004. However, a potential unacceptable cancer risk exists for the residential scenario at SWMU 05-004. The cancer risk is because of the presence of PAHs that are not site-related (section 6.3.5). After removing the PAHs from the residential carcinogenic screening evaluation, the total excess cancer risk is below the NMED target risk level of 1×10^{-5}.

7.2.2 Ecological Risk-Screening Assessments

The ecological risk-screening assessments are presented in section I-5.0 in Appendix I.

No potential ecological risk exists at SWMU 05-003 because there is no potential exposure pathway for ecological receptors at SWMU 05-003.

No potential ecological risks exist for ecological receptors at SWMUs 05-004, 05-005(b), and 05-006(c) based on minimum ESL comparisons, HI analyses, comparisons to background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analysis.

8.0 RECOMMENDATIONS

The determination of site status is based on the results of the risk-screening assessments and the nature and extent evaluation. Depending on the decision scenario used, the sites are recommended as corrective actions complete either with or without controls or for additional action. The residential scenario is the only scenario under which corrective action complete without controls is applicable; that is, no additional corrective actions or conditions are necessary. The other decision scenario—industrial—results in corrective action complete with controls; that is, some type of institutional controls must be in place to ensure the land use remains consistent with site cleanup levels. The current and reasonably foreseeable future land use for sites in the Lower Mortandad/Cedro Canyons Aggregate Area is industrial.

8.1 Recommendations for Corrective Actions Complete

The extent of contamination has been defined for all four sites, SWMUs 05-003, 05-004, 05-005(b), and 05-006(c), within the Lower Mortandad/Cedro Canyons Aggregate Area (Table 8.1-1). Therefore, no further investigation or remediation activities are warranted in this aggregate area.

SWMUs 05-003, 05-004, 05-005(b), and 05-006(c) do not pose a potential unacceptable risk or dose under the industrial and residential scenarios and do not pose potential ecological risk to any receptor at the site. The Laboratory recommends corrective actions complete without controls for SWMUs 05-003, 05-004, 05-005(b), and 05-006(c).

9.0 REFERENCES AND MAP DATA SOURCES

9.1 References

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

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

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9.2 Map Data Sources

Sampling location- er_location_ids_pnt; Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2010-0035; 21 January 2010.

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Paved road: ksl_paved_rds_arc; Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

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Storm drain: ksl_stormdrn_arc;Storm Drain Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Contours: lanl_contour1991_;Hypsography, 2, 10, 20, 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

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Water: ksl_water_arc; Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Technical area boundary: plan_tecareas_ply; Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 04 December 2008.

(inset)LANL Boundary: plan_ownerclip_reg;Ownership Boundaries Around LANL Area; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; 19 September 2007; as published 04 December 2008.

(Inset)ROADS: lac_streets_arc; Streets; County of Los Alamos, Information Services; as published 16 May 2006.

Landscape: ksl_landscape_arc;Primary Landscape Features; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Berms: ksl_berm_arc: Primary Berm Features; Los Alamos National Laboratory,KSL Site Support Services, Planning, Locating and Mapping Section; 12 September 2002; as published 29 November 2010.

Inactive Outfall:wqh_inact_outfalls_pnt; WQH Inactive Outfalls; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; Edition 2002.01; 01 September 2003.

NPDES Outfalls:wqh_npdes_outfalls_pnt: WQH NPDES Outfalls; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; Edition 2002.01; 01 September 2003.

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Drainage:wqh_drainage_arc:WQH Drainage_arc; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; 1:24,000 Scale Data; 03 June 2003.

Aggregate Area:er_agg_areas_ply:Aggregate Areas; Los Alamos National Laboratory, ENV Environmental Remediation & Surveillance Program, ER2005-0496; 1:2,500 Scale Data; 22 September 2005.

Canyon Reaches:er_reaches_ply:Canyon Reaches; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0592; 1:24,000 Scale Data; Unknown publication date.

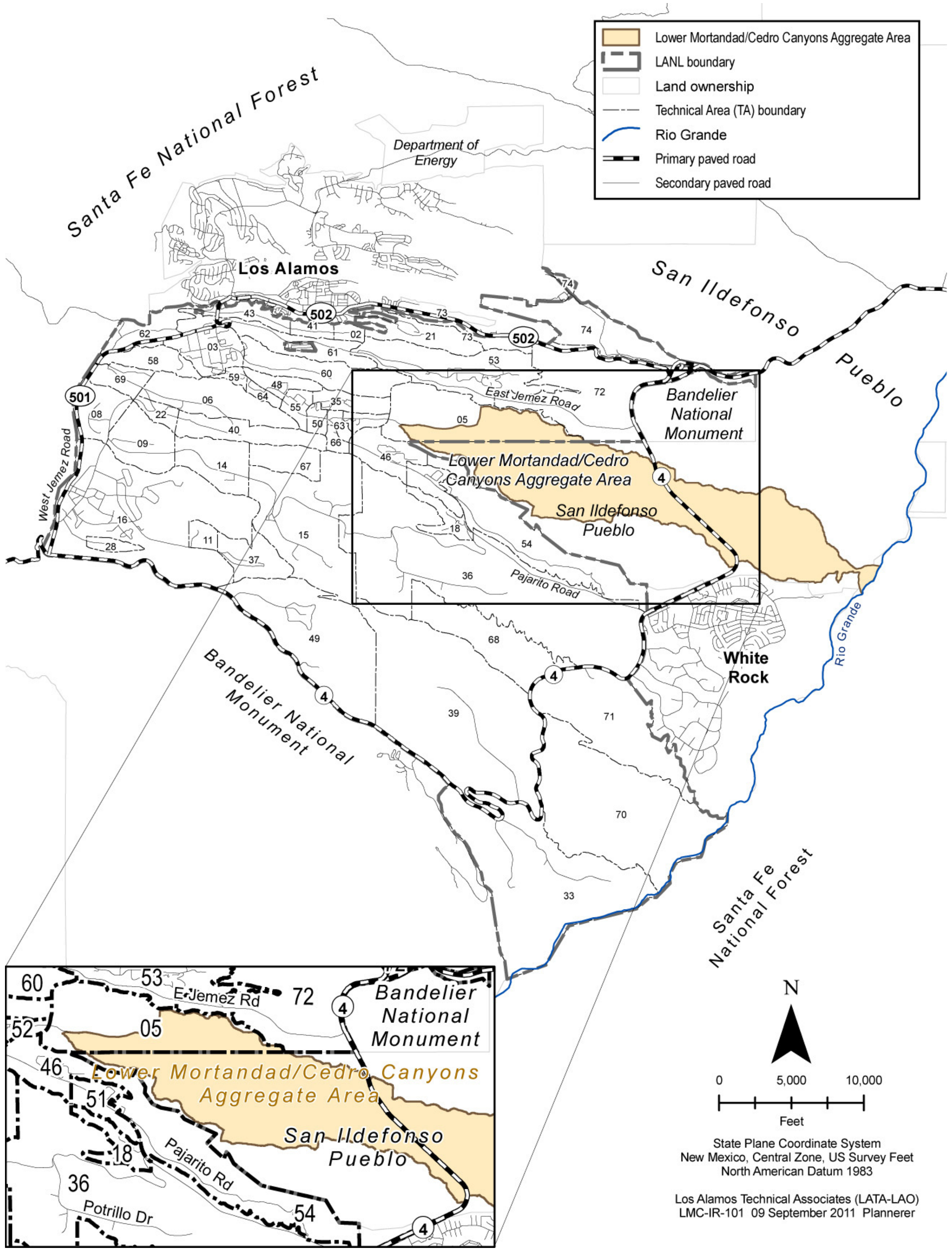


Figure 1.0-1 Location of Lower Mortandad/Cedro Canyons Aggregate Area with respect to Laboratory TAs

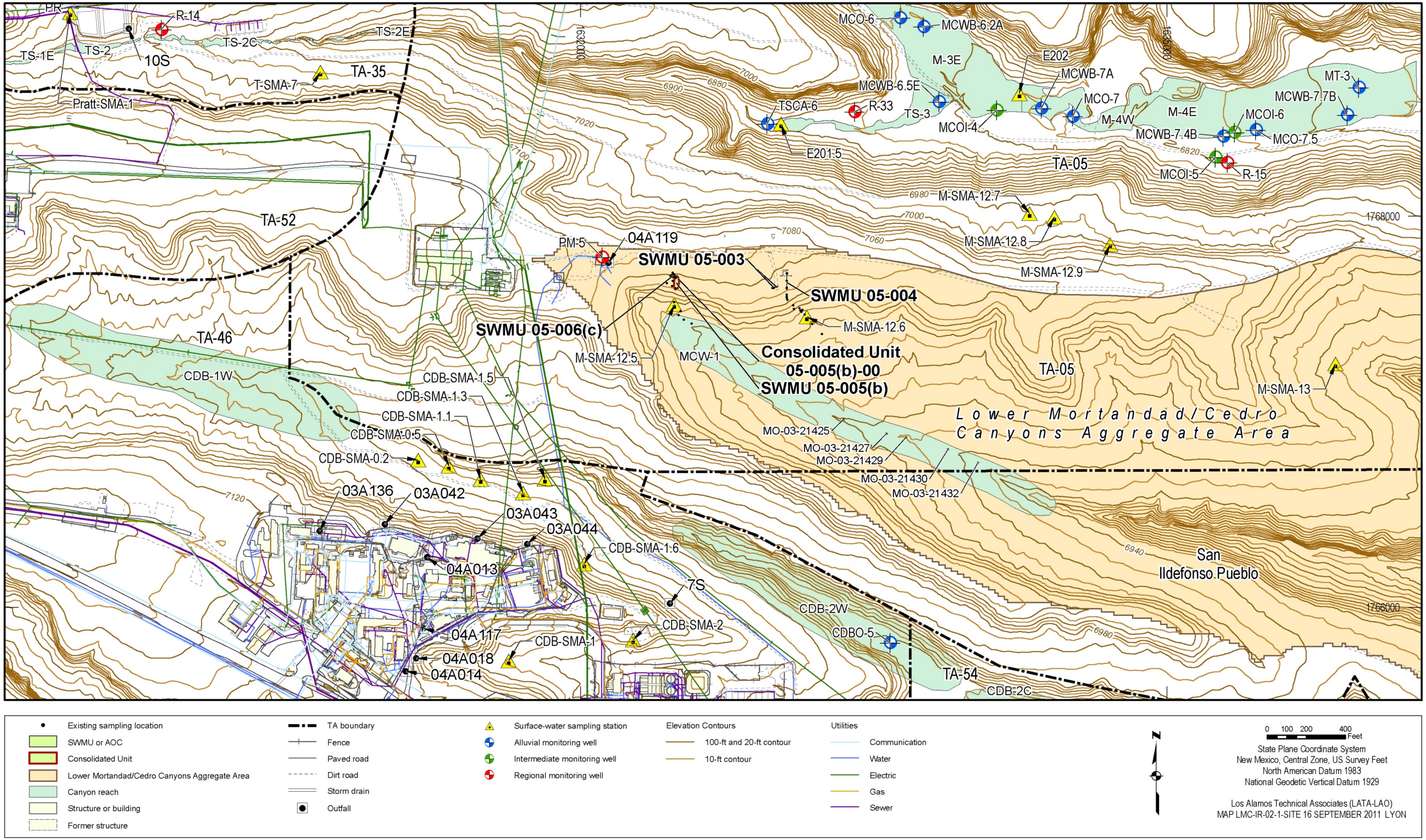


Figure 1.1-1 Sites in Lower Mortandad/Cedro Canyons Aggregate Area

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 and intercalated volcanic rocks	Fanglomerate		Fanglomerate facies includes sand, gravel, conglomerate, and tuffaceous sediments
	Volcanic rocks		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 (called the ”Chaquehui Formation” by Purtymun 1995, 45344)
	Basalt		
	Coarse sediments		
	Basalt		
	Coarse sediments		
	Basalt		
	Coarse sediments		
	Basalt		
	Coarse sediments		
	Arkosic clastic sedimentary deposits		Undivided Santa Fe Group (includes Chamita[?] and Tesuque Formations)

Source: Baltz et al. 1963, 8402; Purtymun 1995, 45344; LANL 1998, 59599; Broxton and Reneau 1995, 49726.

Figure 2.2-1 Generalized stratigraphy of bedrock geologic units of the Pajarito Plateau

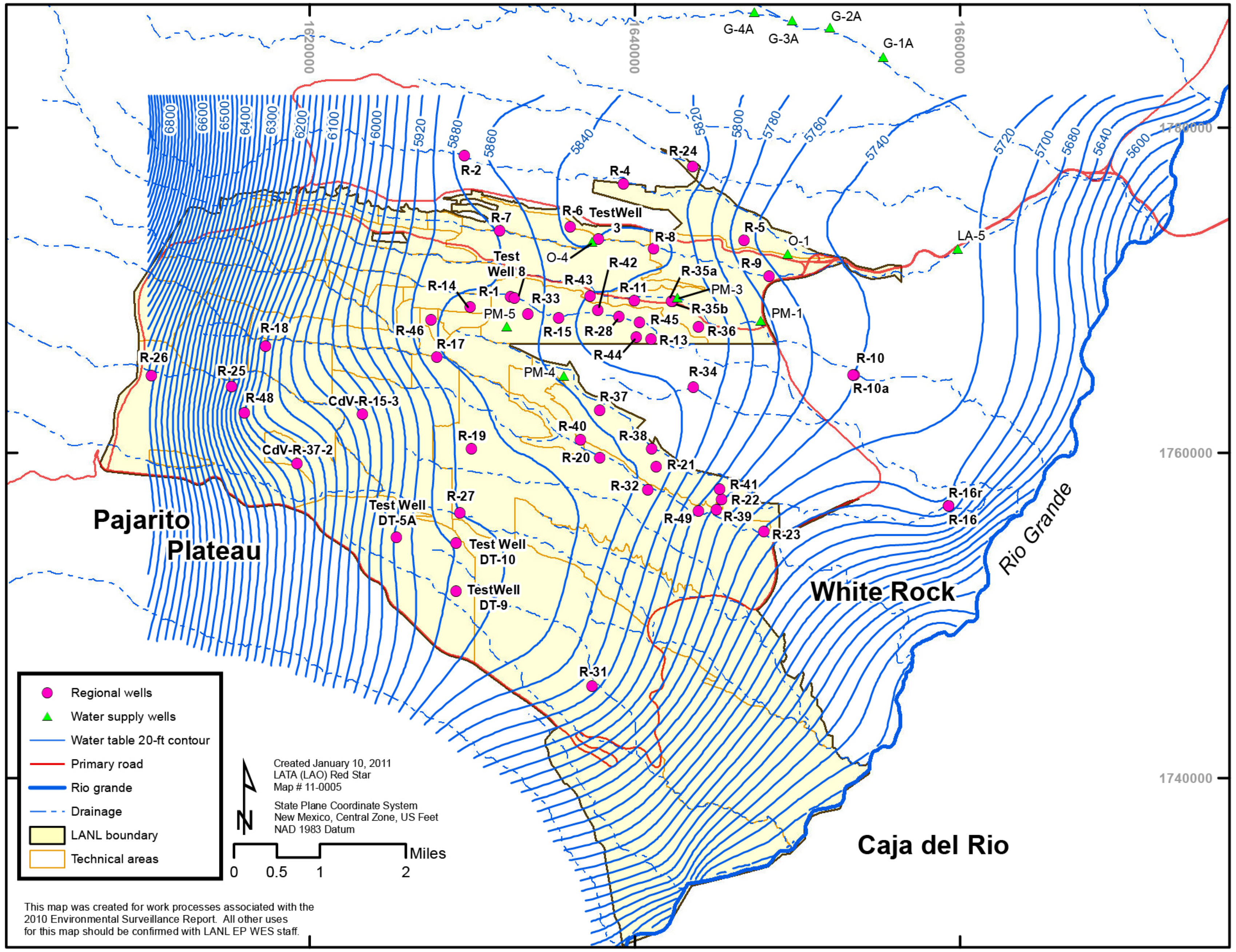


Figure 2.2-2 Elevations of top of regional aquifer across the Laboratory

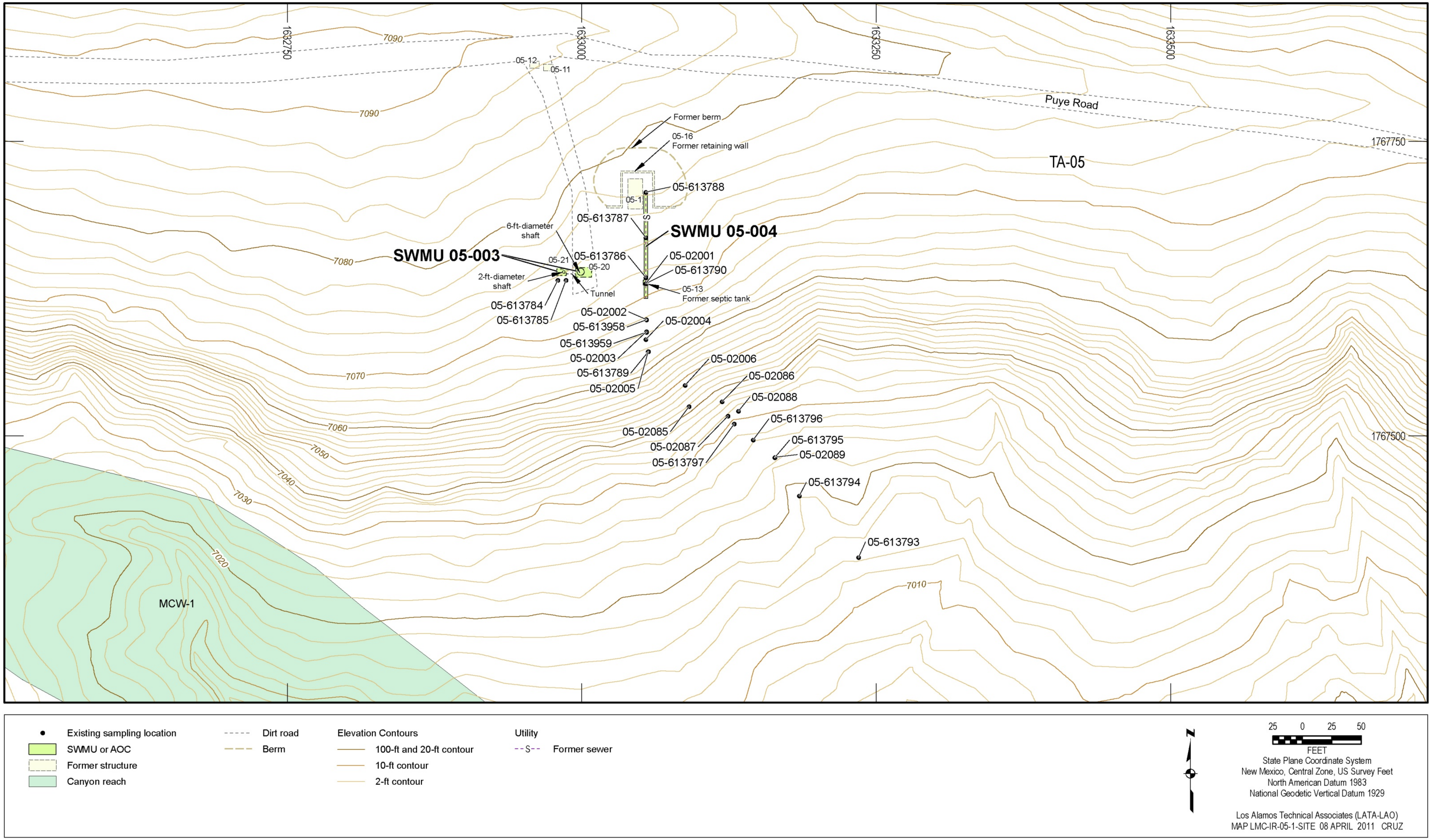


Figure 6.2-1 SWMUs 05-003 and 05-004 site map and sampling locations

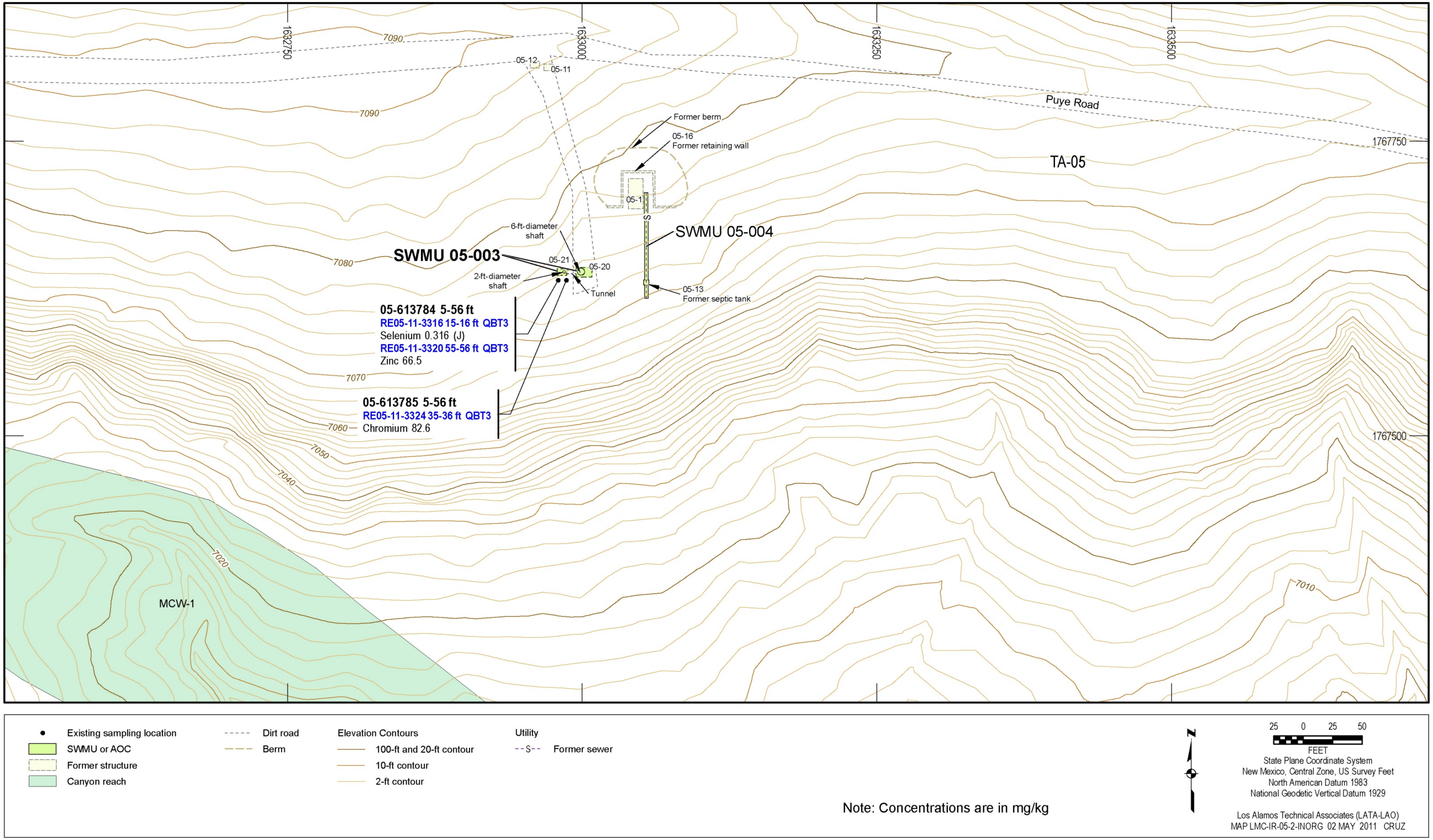


Figure 6.2-2 Inorganic chemicals detected or detected above BVs at SWMU 05-003

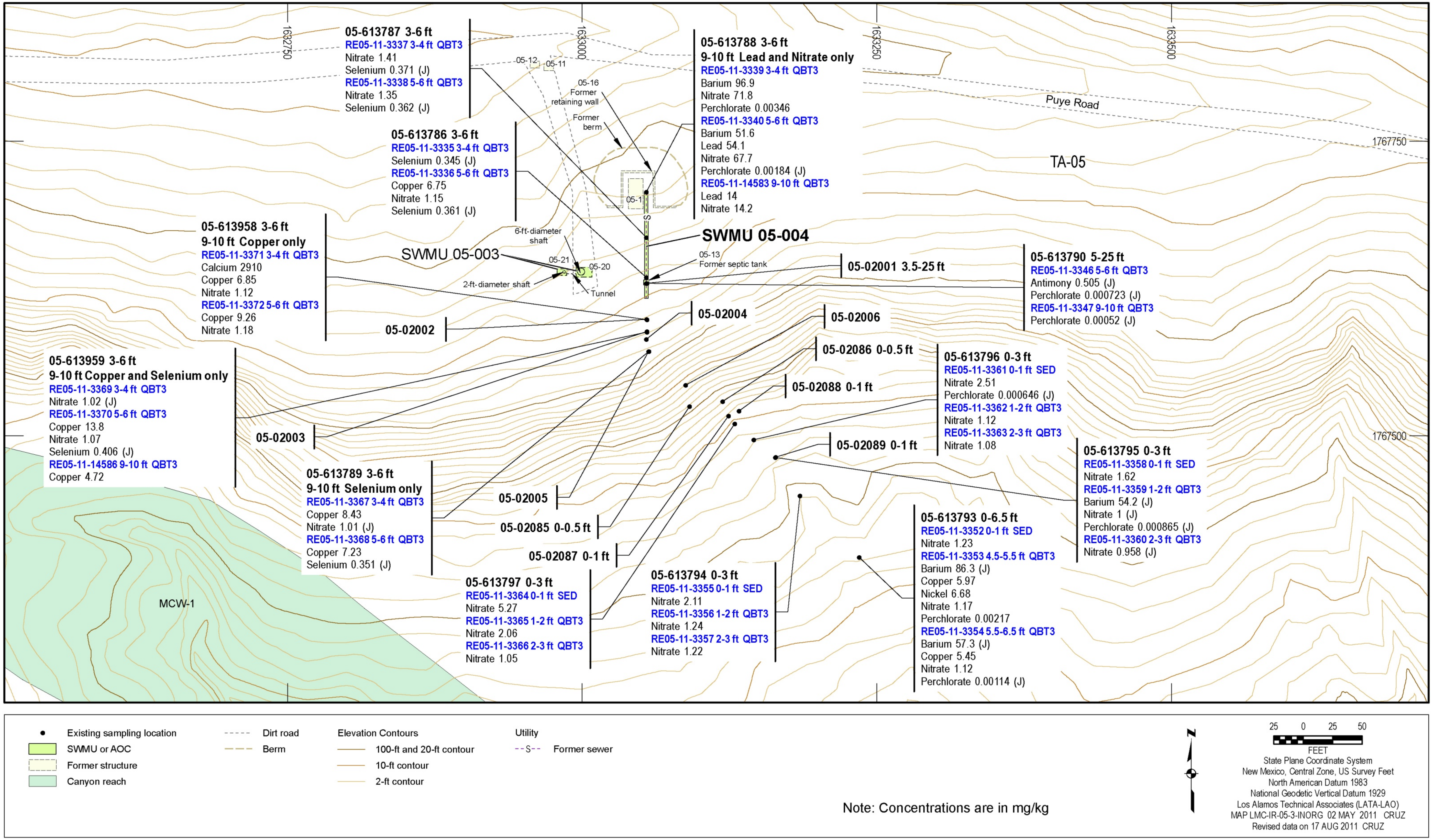


Figure 6.3-1 Inorganic chemicals detected or detected above BVs at SWMU 05-004

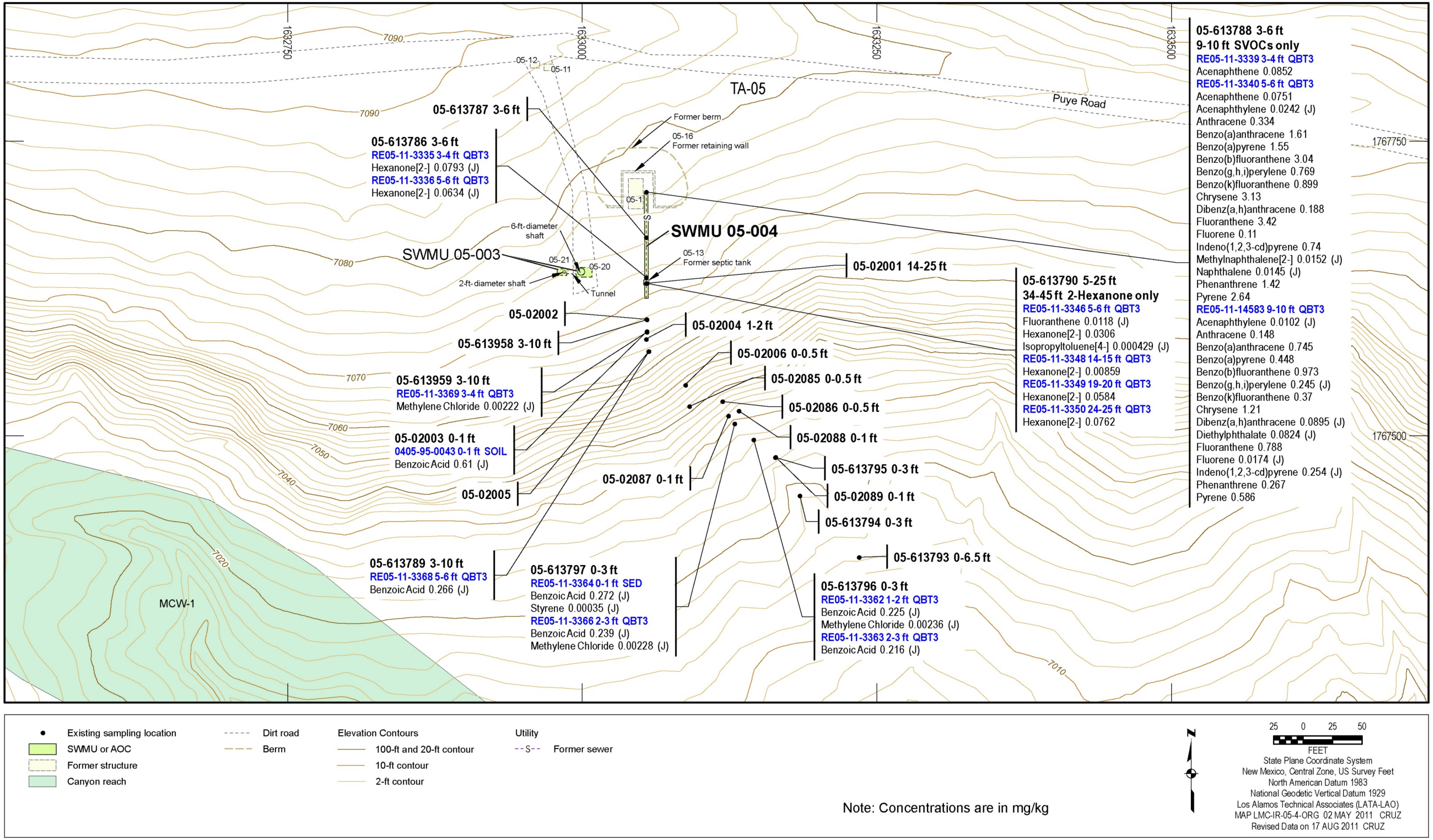


Figure 6.3-2 Organic chemicals detected at SWMU 05-004

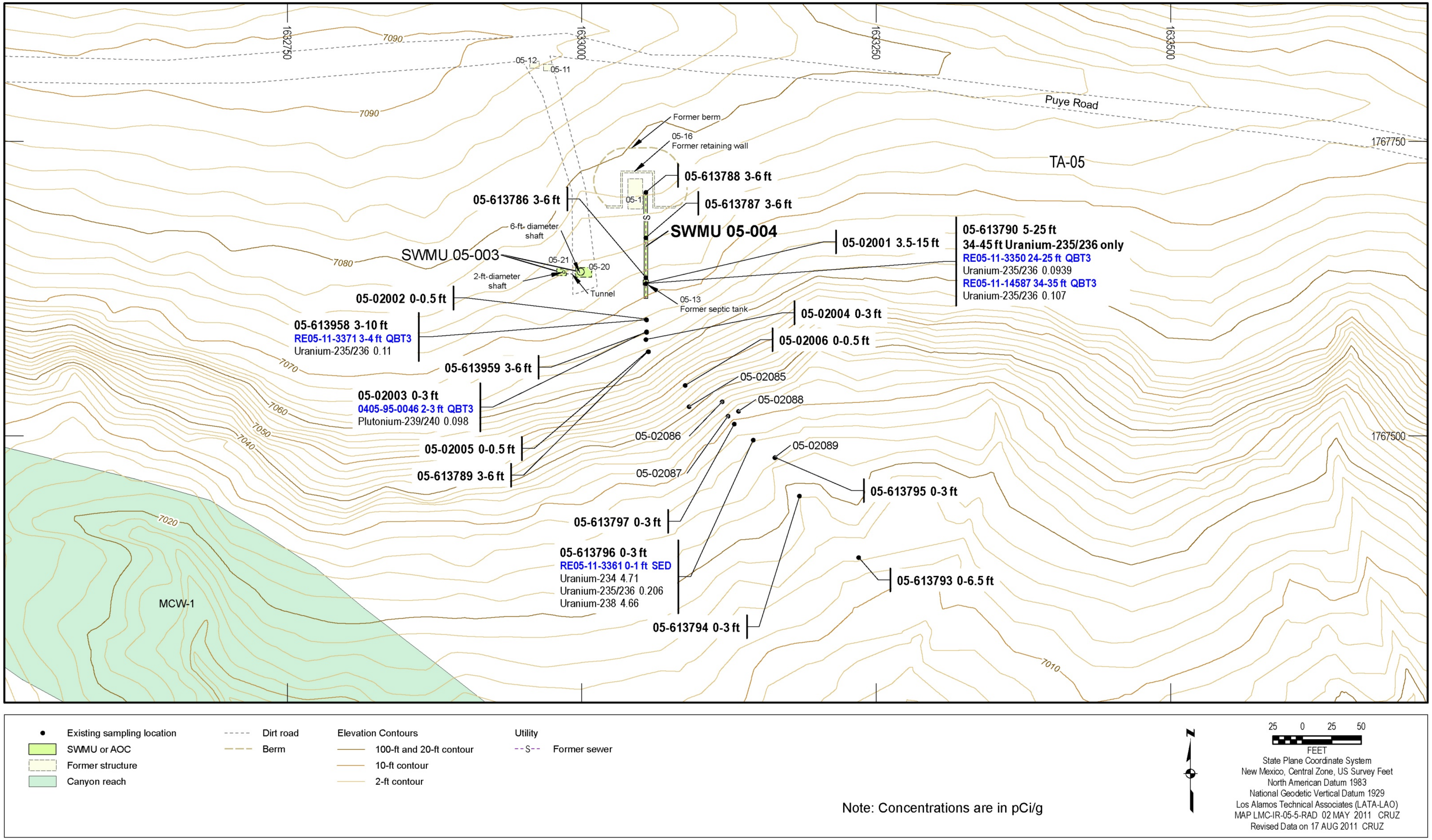


Figure 6.3-3 Radionuclides detected or detected above BVs/FVs at SWMU 05-004

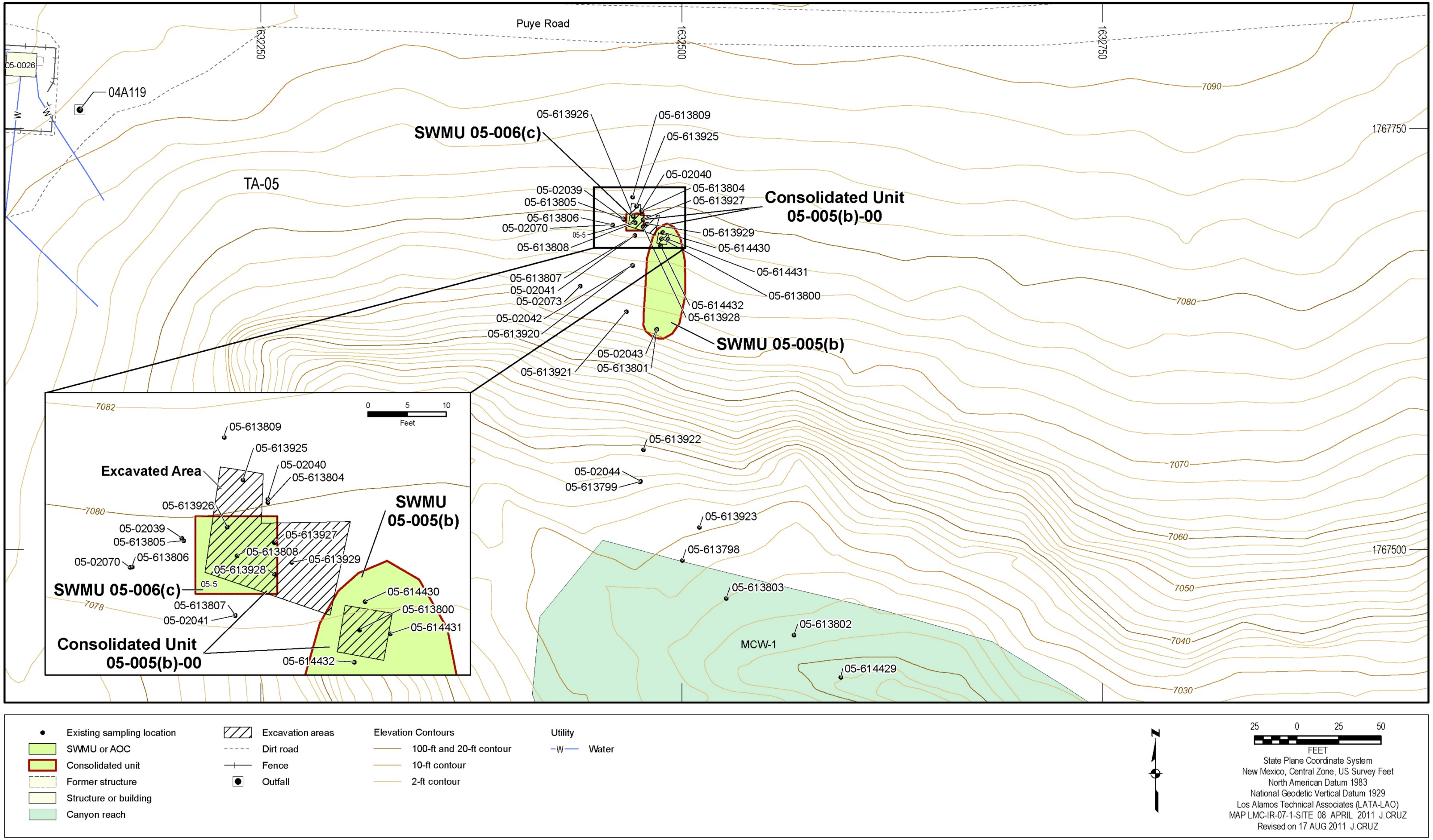


Figure 6.4-1 Consolidated Unit 05-005(b)-00 [SWMUs 05-005(b) and 05-006(c)] site map and sampling locations

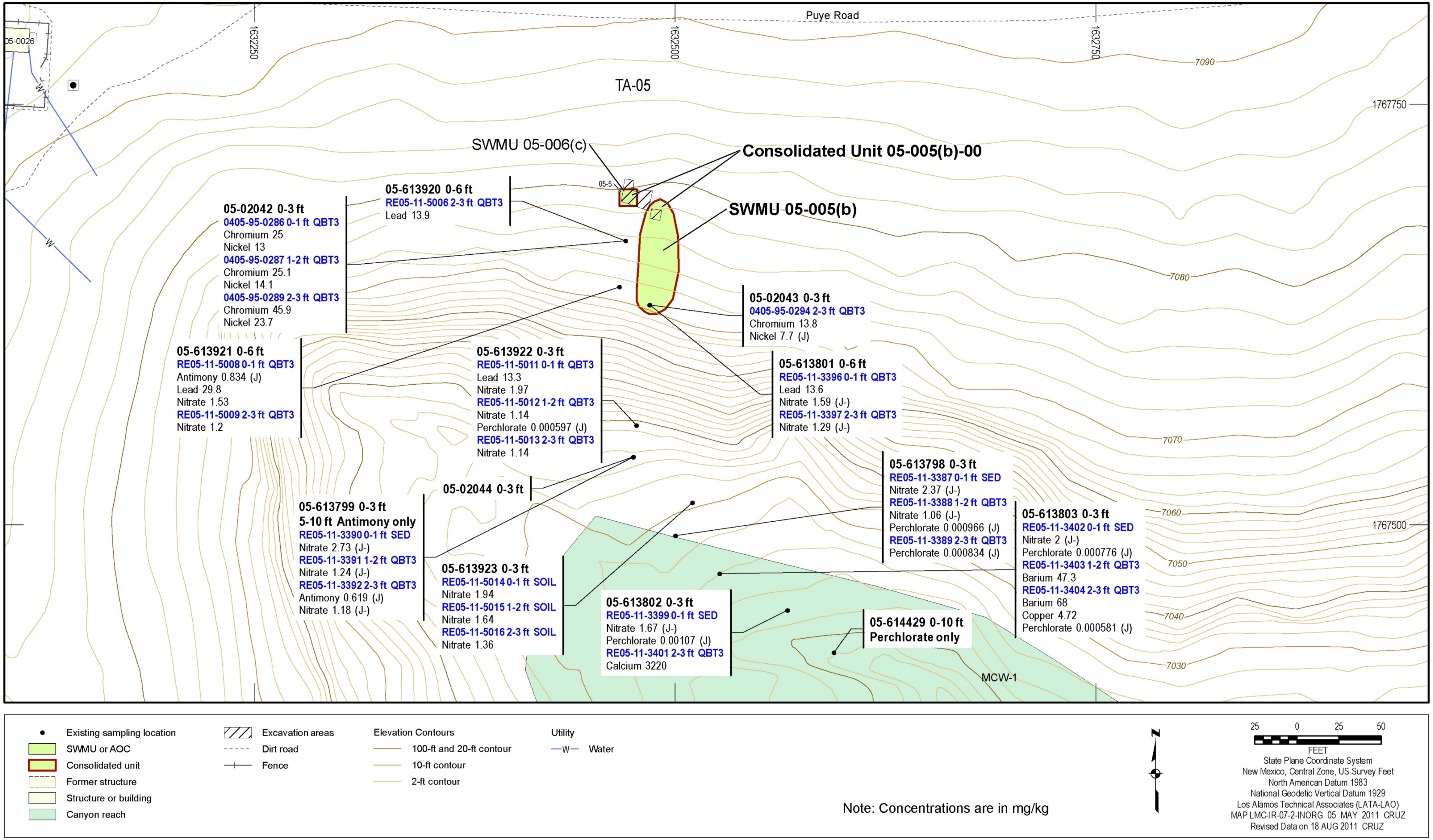


Figure 6.4-2 Inorganic chemicals detected or detected above BVs at SWMU 05-005(b) [Consolidated Unit 05-005(b)-00]

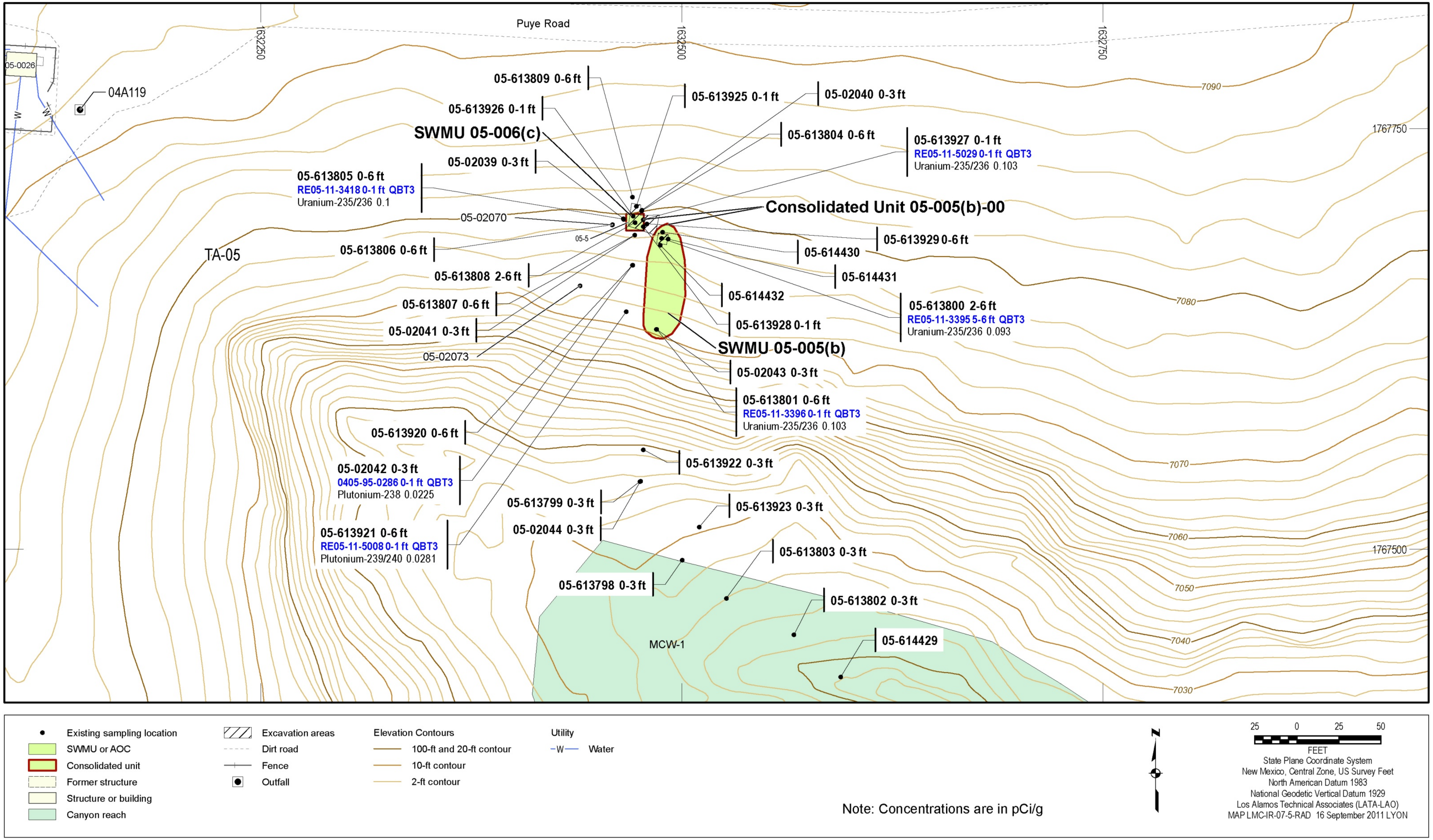


Figure 6.4-3 Radionuclides detected or detected above BVs at Consolidated Unit 05-005(b)-00 [SWMUs 05-005(b) and 05-006(c)]

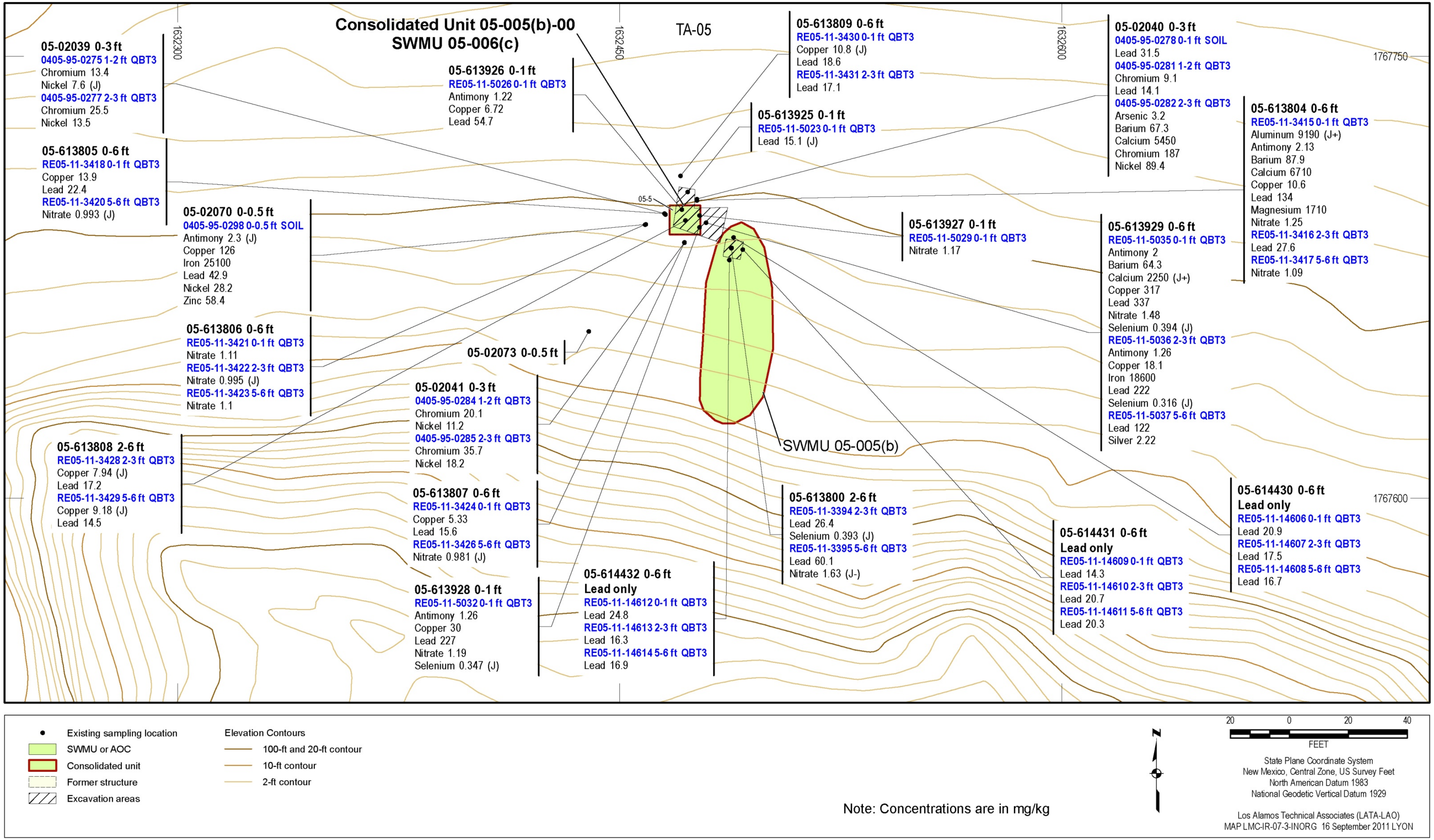


Figure 6.4-4 Inorganic chemicals detected or detected above BVs at SWMU 05-006(c) [Consolidated Unit 05-005(b)-00]

Table 1.1-1
Summary of Lower Mortandad/Cedro Canyons Aggregate Area Sites and Their Status

Consolidated Unit	SWMU/AOC	Brief Description	Previous Investigation(s)	2011 Investigation
	SWMU 05-003	Former calibration chamber	1973, 1976 radiation surveys; 1995 engineering survey	Sampled
	SWMU 05-004	Former septic tank	1988 radiation survey; 1995 RFI; samples collected in 1998	Sampled
05-005(b)-00	SWMU 05-005(b)	Former outfall associated with former building 05-5	1994, 1995 RFIs	Sampled
	SWMU 05-006(c)	Area of potential soil contamination associated with the location of former building 05-5	1985 surface debris cleanup;1994, 1995 RFIs	XRF survey conducted; soil excavated; confirmation samples collected; sampled

Table 3.2-1
Crosswalk of Proposed and Sampled Locations in 2011 Investigation with Surveyed Coordinates

Consolidated Unit/SWMU	Proposed Location in Work Plan	Location ID	Easting (ft)	Northing (ft)
SWMU 05-003	3-1	05-613784	1632979.638	1767632.107
SWMU 05-003	3-2	05-613785	1632986.526	1767632.107
SWUM 05-004	4-1	05-613788	1633054.255	1767706.792
SWUM 05-004	4-2	05-613787	1633054.255	1767668.385
SWUM 05-004	4-3	05-613786	1633054.255	1767634.484
SWUM 05-004	4-4	05-613790	1633054.469	1767629.334
SWUM 05-004	4-5	05-613958	1633054.899	1767598.652
SWUM 05-004	4-6	05-613959	1633054.899	1767588.138
SWUM 05-004	4-7	05-613789	1633056.615	1767571.616
SWUM 05-004	4-8	05-613797	1633129.352	1767510.251
SWUM 05-004	4-9	05-613796	1633145.445	1767496.519
SWUM 05-004	4-10	05-613795	1633163.897	1767481.714
SWUM 05-004	4-11	05-613794	1633184.71	1767449.1
SWUM 05-004	4-12	05-613793	1633234.918	1767396.746
Consolidated Unit 05-005(b)-00				
SWMU 05-005(b)	5b-1	05-613920	1632487.838	1767684.856
SWMU 05-005(b)	5b-2	05-613801	1632485.054	1767630.844
SWMU 05-005(b)	5b-3	05-613799	1632475.032	1767540.319
SWMU 05-005(b)	5b-4	05-613798	1632500.228	1767493.685
SWMU 05-005(b)	5b-5	05-613803	1632526.398	1767470.995
SWMU 05-005(b)	5b-6	05-613802	1632566.629	1767449.251
SWMU 05-005(b)	n/a[a]	05-613921	1632466.96	1767641.394
SWMU 05-005(b)	n/a	05-613922	1632477.122	1767559.254
SWMU 05-005(b)	n/a	05-613923	1632510.361	1767513.22
SWMU 05-005(b)	5b-1[b]	05-614429	1632594.402	1767424.164
SWMU 05-006(c)	6c-1	05-613804	1632476.145	1767701.143
SWMU 05-006(c)	6c-2	05-613805	1632465.426	1767696.271
SWMU 05-006(c)	6c-3	05-613806	1632458.884	1767692.93
SWMU 05-006(c)	6c-4	05-613808	1632472.247	1767694.322
SWMU 05-006(c)	6c-5	05-613929	1632479.208	1767693.487
SWMU 05-006(c)	6c-6	05-613807	1632471.969	1767686.805
SWMU 05-006(c)	6c-7	05-613800	1632470.716	1767668.847
SWMU 05-006(c)	6c-8	05-613809	1632470.621	1767709.436
SWMU 05-006(c)	Confirmation sample	05-613925	1632473.09	1767704.201
SWMU 05-006(c)	Confirmation sample	05-613926	1632470.895	1767697.929
SWMU 05-006(c)	Confirmation sample	05-613927	1632477.201	1767696.214
SWMU 05-006(c)	Confirmation sample	05-613928	1632476.627	1767692.175
SWMU 05-006(c)	6c-1 (north)[b]	05-614430	1632488.539	1767688.518
SWMU 05-006(c)	6c-1 (east)[b]	05-614431	1632491.751	1767684.418
SWMU 05-006(c)	6c-1 (south)[b]	05-614432	1632487.162	1767680.79

[a] n/a = Not applicable; additional sampling not proposed in work plan.

[b] Proposed in LANL 2011, 203593.

Table 3.2-2
Field-Screening Results for Samples Collected in 2011 Investgiation at Lower Mortandad/Cedro Canyons Aggregate Area

Consolidated Unit/SWMU	Location ID	Start Depth (ft)	End Depth (ft)	Sample ID	PID Reading (ppm)	Alpha Reading (dpm)*	Beta/Gamma Reading (dpm)*
SWMU 05-003	05-613784	5.0	6.0	RE05-11-3315	0.0	10	2032
SWMU 05-003	05-613784	15.0	16.0	RE05-11-3316	0.0	10	2032
SWMU 05-003	05-613784	25.0	26.0	RE05-11-3317	0.0	10	2032
SWMU 05-003	05-613784	35.0	36.0	RE05-11-3318	0.0	10	2032
SWMU 05-003	05-613784	45.0	46.0	RE05-11-3319	0.0	10	2032
SWMU 05-003	05-613784	55.0	56.0	RE05-11-3320	0.0	10	2032
SWMU 05-003	05-613785	5.0	6.0	RE05-11-3321	0.0	15	2320
SWMU 05-003	05-613785	15.0	16.0	RE05-11-3322	0.0	15	2320
SWMU 05-003	05-613785	25.0	26.0	RE05-11-3323	0.0	15	2320
SWMU 05-003	05-613785	35.0	36.0	RE05-11-3324	0.0	15	2320
SWMU 05-003	05-613785	45.0	46.0	RE05-11-3325	0.0	15	2320
SWMU 05-003	05-613785	55.0	56.0	RE05-11-3326	0.0	15	2320
SWMU 05-004	05-613788	3.0	4.0	RE05-11-3339	0.0	17	1837
SWMU 05-004	05-613788	5.0	6.0	RE05-11-3340	0.0	17	1837
SWMU 05-004	05-613788	9.0	10.3	RE05-11-14583	0.0	20.2	1732
SWMU 05-004	05-613787	3.0	4.0	RE05-11-3337	0.0	17	1837
SWMU 05-004	05-613787	5.0	6.0	RE05-11-3338	0.0	17	1837
SWMU 05-004	05-613786	3.0	4.0	RE05-11-3335	0.0	17	1837
SWMU 05-004	05-613786	5.0	6.0	RE05-11-3336	0.0	17	1837
SWMU 05-004	05-613790	5.0	6.0	RE05-11-3346	0.0	10	2032
SWMU 05-004	05-613790	9.0	10.0	RE05-11-3347	0.0	10	2032
SWMU 05-004	05-613790	14.0	15.0	RE05-11-3348	0.0	10	2032
SWMU 05-004	05-613790	19.0	20.0	RE05-11-3349	0.0	10	2032
SWMU 05-004	05-613790	24.0	25.0	RE05-11-3350	0.0	10	2032
SWMU 05-004	05-613790	34.0	35.0	RE05-11-14587	0.0	26.7	2333
SWMU 05-004	05-613790	44.0	45.0	RE05-11-14588	0.0	26.7	2333
SWMU 05-004	05-613958	3.0	4.0	RE05-11-3371	0.0	10	2920
SWMU 05-004	05-613958	5.0	6.0	RE05-11-3372	0.0	10	2920
SWMU 05-004	05-613958	9.0	10.0	RE05-11-14585	0.0	30	1435
SWMU 05-004	05-613959	3.0	4.0	RE05-11-3369	0.0	10	2920
SWMU 05-004	05-613959	5.0	6.0	RE05-11-3370	0.0	10	2920
SWMU 05-004	05-613959	9.0	10.0	RE05-11-14586	0.0	39.5	2090
SWMU 05-004	05-613789	3.0	4.0	RE05-11-3367	0.0	10	2920
SWMU 05-004	05-613789	5.0	6.0	RE05-11-3368	0.0	10	2920
SWMU 05-004	05-613789	9.0	10.0	RE05-11-14584	0.0	39.5	2090

Table 3.2-2 (continued)

Consolidated Unit/SWMU	Location ID	Start Depth (ft)	End Depth (ft)	Sample ID	PID Reading (ppm)	Alpha Reading (dpm)*	Beta/Gamma Reading (dpm)*
SWMU 05-004	05-613797	0.0	1.0	RE05-11-3364	0.0	10	2920
SWMU 05-004	05-613797	1.0	2.0	RE05-11-3365	0.0	10	2920
SWMU 05-004	05-613797	2.0	3.0	RE05-11-3366	0.0	10	2920
SWMU 05-004	05-613796	0.0	1.0	RE05-11-3361	0.0	10	2920
SWMU 05-004	05-613796	1.0	2.0	RE05-11-3362	0.0	10	2920
SWMU 05-004	05-613796	2.0	3.0	RE05-11-3363	0.0	10	2920
SWMU 05-004	05-613794	0.0	1.0	RE05-11-3355	0.0	22	1480
SWMU 05-004	05-613794	1.0	2.0	RE05-11-3356	0.0	22	1480
SWMU 05-004	05-613794	2.0	3.0	RE05-11-3357	0.0	22	1480
SWMU 05-004	05-613793	0.0	1.0	RE05-11-3352	0.0	22	1480
SWMU 05-004	05-613793	4.5	5.5	RE05-11-3353	0.0	22	1480
SWMU 05-004	05-613793	5.5	6.5	RE05-11-3354	0.0	22	1480
SWMU 05-004	05-613795	0.0	1.0	RE05-11-3358	0.0	22	1480
SWMU 05-004	05-613795	1.0	2.0	RE05-11-3359	0.0	22	1480
SWMU 05-004	05-613795	2.0	3.0	RE05-11-3360	0.0	22	1480
Consolidated Unit 05-005(b)-00							
SWMU 05-005(b)	05-613920	0.0	1.0	RE05-11-5005	0.0	12	1632
SWMU 05-005(b)	05-613920	2.0	3.0	RE05-11-5006	0.0	12	1632
SWMU 05-005(b)	05-613920	5.0	6.0	RE05-11-5007	0.0	12	1632
SWMU 05-005(b)	05-613801	0.0	1.0	RE05-11-3396	0.0	8.6	1436
SWMU 05-005(b)	05-613801	2.0	3.0	RE05-11-3397	0.0	8.6	1436
SWMU 05-005(b)	05-613801	5.0	6.0	RE05-11-3398	0.0	8.6	1436
SWMU 05-005(b)	05-613799	0.0	1.0	RE05-11-3390	0.0	18	1649
SWMU 05-005(b)	05-613799	1.0	2.0	RE05-11-3391	0.0	18	1649
SWMU 05-005(b)	05-613799	2.0	3.0	RE05-11-3392	0.0	18	1649
SWMU 05-005(b)	05-613799	5.0	6.0	RE05-11-14594	0.0	39.5	2090
SWMU 05-005(b)	05-613799	9.0	10.0	RE05-11-14595	0.0	39.5	2090
SWMU 05-005(b)	05-613798	0.0	1.0	RE05-11-3387	0.0	18	1649
SWMU 05-005(b)	05-613798	1.0	2.0	RE05-11-3388	0.0	18	1649
SWMU 05-005(b)	05-613798	2.0	3.0	RE05-11-3389	0.0	18	1649
SWMU 05-005(b)	05-613803	0.0	1.0	RE05-11-3402	0.0	18	1649
SWMU 05-005(b)	05-613803	1.0	2.0	RE05-11-3403	0.0	18	1649
SWMU 05-005(b)	05-613803	2.0	3.0	RE05-11-3404	0.0	18	1649
SWMU 05-005(b)	05-613802	0.0	1.0	RE05-11-3399	0.0	18	1649
SWMU 05-005(b)	05-613802	1.0	2.0	RE05-11-3400	0.0	18	1649
SWMU 05-005(b)	05-613802	2.0	3.0	RE05-11-3401	0.0	18	1649
SWMU 05-005(b)	05-613921	0.0	1.0	RE05-11-5008	0.0	17	1878

Table 3.2-2 (continued)

Consolidated Unit/SWMU	Location ID	Start Depth (ft)	End Depth (ft)	Sample ID	PID Reading (ppm)	Alpha Reading (dpm)*	Beta/Gamma Reading (dpm)*
SWMU 05-005(b)	05-613921	2.0	3.0	RE05-11-5009	0.0	17	1878
SWMU 05-005(b)	05-613921	5.0	6.0	RE05-11-5010	0.0	17	1878
SWMU 05-005(b)	05-613922	0.0	1.0	RE05-11-5011	0.0	17	1878
SWMU 05-005(b)	05-613922	1.0	2.0	RE05-11-5012	0.0	17	1878
SWMU 05-005(b)	05-613922	2.0	3.0	RE05-11-5013	0.0	17	1878
SWMU 05-005(b)	05-613923	0.0	1.0	RE05-11-5014	0.0	17	1878
SWMU 05-005(b)	05-613923	1.0	2.0	RE05-11-5015	0.0	17	1878
SWMU 05-005(b)	05-613923	2.0	3.0	RE05-11-5016	0.0	17	1878
SWMU 05-005(b)	05-614429	0.0	1.0	RE05-11-14596	0.0	39.5	2090
SWMU 05-005(b)	05-614429	2.0	3.0	RE05-11-14597	0.0	39.5	2090
SWMU 05-005(b)	05-614429	5.0	6.0	RE05-11-14598	0.0	39.5	2090
SWMU 05-005(b)	05-614429	9.0	10.0	RE05-11-14599	0.0	39.5	2090
SWMU 05-006(c)	05-613804	0.0	1.0	RE05-11-3415	0.0	15	2830
SWMU 05-006(c)	05-613804	2.0	3.0	RE05-11-3416	0.0	15	2830
SWMU 05-006(c)	05-613804	5.0	6.0	RE05-11-3417	0.0	15	2830
SWMU 05-006(c)	05-613805	0.0	1.0	RE05-11-3418	0.0	15	2830
SWMU 05-006(c)	05-613805	2.0	3.0	RE05-11-3419	0.0	15	2830
SWMU 05-006(c	05-613805	5.0	6.0	RE05-11-3420	0.0	15	2830
SWMU 05-006(c)	05-613806	0.0	1.0	RE05-11-3421	0.0	15	2830
SWMU 05-006(c)	05-613806	2.0	3.0	RE05-11-3422	0.0	15	2830
SWMU 05-006(c)	05-613806	5.0	6.0	RE05-11-3423	0.0	15	2830
SWMU 05-006(c)	05-613807	0.0	1.0	RE05-11-3424	0.0	15	2830
SWMU 05-006(c)	05-613807	2.0	3.0	RE05-11-3425	0.0	15	2830
SWMU 05-006(c)	05-613807	5.0	6.0	RE05-11-3426	0.0	15	2830
SWMU 05-005(b)	05-613807	9.0	10.0	RE05-11-14604	0.0	20.2	1732
SWMU 05-006(c)	05-613808	0.0	1.0	RE05-11-3427	0.0	8.6	1436
SWMU 05-006(c)	05-613808	2.0	3.0	RE05-11-3428	0.0	8.6	1436
SWMU 05-006(c)	05-613808	5.0	6.0	RE05-11-3429	0.0	8.6	1436
SWMU 05-006(c)	05-613809	0.0	1.0	RE05-11-3430	0.0	8.6	1436
SWMU 05-006(c)	05-613809	2.0	3.0	RE05-11-3431	0.0	8.6	1436
SWMU 05-006(c)	05-613809	5.0	6.0	RE05-11-3432	0.0	8.6	1436
SWMU 05-006(c)	05-613929	0.0	1.0	RE05-11-5035	0.0	10	1875
SWMU 05-006(c)	05-613929	2.0	3.0	RE05-11-5036	0.0	10	1875
SWMU 05-006(c)	05-613929	5.0	6.0	RE05-11-5037	0.0	10	1875
SWMU 05-005(b)	05-613929	9.0	10.0	RE05-11-14605	0.0	20.2	1732
SWMU 05-006(c)	05-613800	2.0	3.0	RE05-11-3394	0.0	8.6	1436
SWMU 05-006(c)	05-613800	5.0	6.0	RE05-11-3395	0.0	8.6	1436

Table 3.2-2 (continued)

Consolidated Unit/SWMU	Location ID	Start Depth (ft)	End Depth (ft)	Sample ID	PID Reading (ppm)	Alpha Reading (dpm)*	Beta/Gamma Reading (dpm)*
SWMU 05-006(c)	05-613925	0.0	1.0	RE05-11-5023	0.0	10	1875
SWMU 05-006(c)	05-613926	0.0	1.0	RE05-11-5026	0.0	10	1875
SWMU 05-006(c)	05-613927	0.0	1.0	RE05-11-5029	0.0	10	1875
SWMU 05-006(c)	05-613928	0.0	1.0	RE05-11-5032	0.0	10	1875
SWMU 05-006(c)	05-614430	0.0	1.0	RE05-11-14606	0.0	20.2	1732
SWMU 05-006(c)	05-614430	2.0	3.0	RE05-11-14607	0.0	30	1435
SWMU 05-006(c)	05-614430	5.0	6.0	RE05-11-14608	0.0	30	1435
SWMU 05-006(c)	05-614431	0.0	1.0	RE05-11-14609	0.0	20.2	1732
SWMU 05-006(c)	05-614431	2.0	3.0	RE05-11-14610	0.0	30	1435
SWMU 05-006(c)	05-614431	5.0	6.0	RE05-11-14611	0.0	30	1435
SWMU 05-006(c)	05-614432	0.0	1.0	RE05-11-14612	0.0	20.2	1732
SWMU 05-006(c)	05-614432	2.0	3.0	RE05-11-14613	0.0	20.2	1732
SWMU 05-006(c)	05-614432	5.0	6.0	RE05-11-14614	0.0	30	1435

* Results reported are site background levels.

Table 6.2-1
Samples Collected and Analyses Requested at SWMU 05-003

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Perchlorate	Gamma-Emitting Radionuclides	Isotopic Uranium
RE05-11-3315	05-613784	5–6	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3316	05-613784	15–16	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3317	05-613784	25–26	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3318	05-613784	35–36	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3319	05-613784	45–46	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3320	05-613784	55–56	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3321	05-613785	5–6	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3322	05-613785	15–16	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3323	05-613785	25–26	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3324	05-613785	35–36	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3325	05-613785	45–46	QBT3	11-1186	11-1186	11-1187	11-1187
RE05-11-3326	05-613785	55–56	QBT3	11-1186	11-1186	11-1187	11-1187

Note: Numbers in analyte columns are request numbers.

Table 6.2-2
Inorganic Chemicals above BVs at SWMU 05-003

Sample ID	Location ID	Depth (ft)	Media	Antimony	Chromium	Selenium	Zinc
Qbt 2, 3, 4 BV[a]				**0.5**	**7.14**	**0.3**	**63.5**
Industrial SSL[b]				**454**	**2920**[c]	**5680**	**341000**
Residential SSL[b]				**31.3**	**219**[c]	**391**	**23500**
RE05-11-3315	05-613784	5–6	QBT3	1.03 (U)	—[d]	0.94 (U)	—
RE05-11-3316	05-613784	15–16	QBT3	—	—	0.316 (J)	—
RE05-11-3317	05-613784	25–26	QBT3	—	—	0.999 (U)	—
RE05-11-3318	05-613784	35–36	QBT3	1.03 (U)	—	1.02 (U)	—
RE05-11-3319	05-613784	45–46	QBT3	1.05 (U)	—	1.02 (U)	—
RE05-11-3320	05-613784	55–56	QBT3	0.934 (U)	—	0.886 (U)	66.5
RE05-11-3321	05-613785	5–6	QBT3	1.03 (U)	—	1.05 (U)	—
RE05-11-3322	05-613785	15–16	QBT3	0.97 (U)	—	0.992 (U)	—
RE05-11-3323	05-613785	25–26	QBT3	1.06 (U)	—	0.985 (U)	—
RE05-11-3324	05-613785	35–36	QBT3	—	82.6	0.999 (U)	—
RE05-11-3325	05-613785	45–46	QBT3	1.03 (U)	—	1.03 (U)	—
RE05-11-3326	05-613785	55–56	QBT3	1.04 (U)	—	1.01 (U)	—

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] BVs are from LANL (1998, 059730).

[b] SSLs are from NMED (2009, 108070), unless otherwise noted.

[c] SSLs are for hexavalent chromium.

[d] — = Not detected or not detected above BV.

Table 6.3-1
Samples Collected and Analyses Requested at SWMU 05-004

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
0405-95-0037	05-02001	3.5–4.5	FILL	540	—[a]	—	—	—	—	—	—	541	541	—
0405-95-0039	05-02001	8.8–9.8	QBT3	—	—	—	—	—	—	—	—	541	541	—
0405-95-0041	05-02001	14–15	QBT3	—	—	—	—	—	—	—	—	541	541	—
RE05-98-0001	05-02001	14–15	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0002	05-02001	15–16	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0003	05-02001	16–17	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0004	05-02001	17–18	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0005	05-02001	18–19	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0006	05-02001	19–20	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0008	05-02001	20–21	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0009	05-02001	21–22	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0010	05-02001	22–23	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0012	05-02001	23–24	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
RE05-98-0013	05-02001	24–25	QBT3	4368R	—	—	—	4367R	—	4366R	—	—	—	—
0405-95-0042	05-02002	0–0.5	SOIL	—	—	—	—	—	—	—	—	541	541	—
0405-95-0043	05-02003	0–1	SOIL	—	—	—	—	—	—	539	—	541	541	—
0405-95-0045	05-02003	1–2	QBT3	—	—	—	—	—	—	—	—	541	541	—
0405-95-0046	05-02003	2–3	QBT3	—	—	—	—	—	—	—	—	541	541	—
0405-95-0047	05-02004	0–1	SOIL	—	—	—	—	—	—	—	—	541	541	—
0405-95-0048	05-02004	1–2	QBT3	—	—	—	—	—	—	—	539	541	541	541
0405-95-0051	05-02004	2–3	QBT3	—	—	—	—	—	—	—	—	541	541	—
0405-95-0053	05-02005	0–0.5	SOIL	—	—	—	—	—	—	—	—	541	541	—

Table 6.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
0405-95-0054	05-02006	0–0.5	SOIL	—	—	—	—	487	—	—	—	541	541	—
RE05-98-0007	05-02085	0–0.5	SOIL	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0011	05-02086	0–0.5	SOIL	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0015	05-02087	0–0.5	SOIL	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0016	05-02087	0.5–1	SOIL	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0019	05-02088	0–0.5	SOIL	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0020	05-02088	0.5–1	SOIL	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0023	05-02089	0–0.5	SED	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-98-0024	05-02089	0.5–1	SED	4348R	—	—	—	4349R	—	4347R	—	—	—	—
RE05-11-3335	05-613786	3–4	QBT3	11-1084	11-1084	11-1084	11-1084	11-1083	11-1083	11-1083	11-1083	11-1085	11-1085	—
RE05-11-3336	05-613786	5–6	QBT3	11-1084	11-1084	11-1084	11-1084	11-1083	11-1083	11-1083	11-1083	11-1085	11-1085	—
RE05-11-3337	05-613787	3–4	QBT3	11-1084	11-1084	11-1084	11-1084	11-1083	11-1083	11-1083	11-1083	11-1085	11-1085	—
RE05-11-3338	05-613787	5–6	QBT3	11-1084	11-1084	11-1084	11-1084	11-1083	11-1083	11-1083	11-1083	11-1085	11-1085	—
RE05-11-3339	05-613788	3–4	QBT3	11-1084	11-1084	11-1084	11-1084	11-1083	11-1083	11-1083	11-1083	11-1085	11-1085	—
RE05-11-3340	05-613788	5–6	QBT3	11-1084	11-1084	11-1084	11-1084	11-1083	11-1083	11-1083	11-1083	11-1085	11-1085	—
RE05-11-14583	05-613788	9–10	QBT3	11-2675[b]	11-2675	—	—	—	—	11-2675	—	—	—	—
RE05-11-3367	05-613789	3–4	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3368	05-613789	5–6	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-14584	05-613789	9–10	QBT3	11-2694[c]	—	—	—	—	—	—	—	—	—	—
RE05-11-3346	05-613790	5–6	QBT3	11-1189	11-1189	11-1189	11-1189	11-1188	11-1188	11-1188	11-1188	11-1189	11-1189	—
RE05-11-3347	05-613790	9–10	QBT3	11-1189	11-1189	11-1189	11-1189	11-1188	11-1188	11-1188	11-1188	11-1189	11-1189	—
RE05-11-3348	05-613790	14–15	QBT3	11-1189	11-1189	11-1189	11-1189	11-1188	11-1188	11-1188	11-1188	11-1189	11-1189	—

Table 6.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
RE05-11-3349	05-613790	19–20	QBT3	11-1189	11-1189	11-1189	11-1189	11-1188	11-1188	11-1188	11-1188	11-1189	11-1189	—
RE05-11-3350	05-613790	24–25	QBT3	11-1189	11-1189	11-1189	11-1189	11-1188	11-1188	11-1188	11-1188	11-1189	11-1189	—
RE05-11-14587	05-613790	34–35	QBT3	—	—	—	—	—	—	—	11-2752[e]	—	11-2752[d]	—
RE05-11-14588	05-613790	44–45	QBT3	—	—	—	—	—	—	—	11-2752[e]	—	11-2752[d]	—
RE05-11-3352	05-613793	0–1	SED	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3353	05-613793	4.5–5.5	QBT3	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3354	05-613793	5.5–6.5	QBT3	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3355	05-613794	0–1	SED	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3356	05-613794	1–2	QBT3	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3357	05-613794	2–3	QBT3	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3358	05-613795	0–1	SED	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3359	05-613795	1–2	QBT3	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3360	05-613795	2–3	QBT3	11-1074	11-1074	11-1074	11-1074	11-1073	11-1073	11-1073	11-1073	11-1075	11-1075	—
RE05-11-3361	05-613796	0–1	SED	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3362	05-613796	1–2	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3363	05-613796	2–3	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3364	05-613797	0–1	SED	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3365	05-613797	1–2	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3366	05-613797	2–3	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3371	05-613958	3–4	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-3372	05-613958	5–6	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-14585	05-613958	9–10	QBT3	11-2686[f]	—	—	—	—	—	—	—	—	—	—
RE05-11-3369	05-613959	3–4	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—

Table 6.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
RE05-11-3370	05-613959	5–6	QBT3	11-1077	11-1077	11-1077	11-1077	11-1076	11-1076	11-1076	11-1076	11-1078	11-1078	—
RE05-11-14586	05-613959	9–10	QBT3	11-2694[g]	—	—	—	—	—	—	—	—	—	—

Note: Numbers in analyte columns are request numbers.

[a] — = Analysis not requested.

[b] Lead only.

[c] Selenium only.

[d] Uranium-235/236 only.

[e] Hexanone(2-) only.

[f] Copper only.

[g] Copper and selenium only.

Table 6.3-2
Inorganic Chemicals above BVs at SWMU 05-004

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Cadmium	Calcium	Copper	Lead	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Qbt 2, 3, 4 BV[a]				**0.5**	**46**	**1.63**	**2200**	**4.66**	**11.2**	**0.1**	**6.58**	**na[b]**	**na**	**0.3**
Sediment BV[a]				**0.83**	**127**	**0.4**	**4420**	**11.2**	**19.7**	**0.1**	**9.38**	**na**	**na**	**0.3**
Soil BV[a]				**0.83**	**295**	**0.4**	**6120**	**14.7**	**22.3**	**0.1**	**15.4**	**na**	**na**	**1.52**
Industrial SSL[c]				**454**	**224000**	**1120**	**na**	**45400**	**800**	**310[d]**	**22700**	**1820000**	**795**	**5680**
Residential SSL[c]				**31.3**	**15600**	**77.9**	**na**	**3130**	**400**	**23[d]**	**1560**	**125000**	**54.8**	**391**
RE05-98-0019	05-02088	0–0.5	SOIL	—[e]	—	—	—	—	—	0.11 (U)	—	NA[f]	NA	—
RE05-98-0020	05-02088	0.5–1	SOIL	—	—	—	—	—	—	0.11 (U)	—	NA	NA	—
RE05-98-0023	05-02089	0–0.5	SED	—	—	—	—	—	—	—	—	NA	NA	0.51 (UJ)
RE05-98-0024	05-02089	0.5–1	SED	—	—	—	—	—	—	0.11 (U)	—	NA	NA	1.1 (UJ)
RE05-11-3335	05-613786	3–4	QBT3	1.03 (U)	—	—	—	—	—	—	—	—	—	0.345 (J)
RE05-11-3336	05-613786	5–6	QBT3	1.02 (U)	—	—	—	6.75	—	—	—	1.15	—	0.361 (J)
RE05-11-3337	05-613787	3–4	QBT3	1 (U)	—	—	—	—	—	—	—	1.41	—	0.371 (J)
RE05-11-3338	05-613787	5–6	QBT3	1.02 (U)	—	—	—	—	—	—	—	1.35	—	0.362 (J)
RE05-11-3339	05-613788	3–4	QBT3	1.04 (U)	96.9	—	—	—	—	—	—	71.8	0.00346	0.947 (U)
RE05-11-3340	05-613788	5–6	QBT3	1.03 (U)	51.6	—	—	—	54.1	—	—	67.7	0.00184 (J)	0.989 (U)
RE05-11-14583	05-613788	9–10	QBT3	NA	NA	NA	NA	NA	14	NA	NA	14.2	NA	NA
RE05-11-3367	05-613789	3–4	QBT3	—	—	—	—	8.43	—	—	—	1.01 (J)	—	0.985 (U)
RE05-11-3368	05-613789	5–6	QBT3	—	—	—	—	7.23	—	—	—	—	—	0.351 (J)
RE05-11-14584	05-613789	9–10	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.896 (U)
RE05-11-3346	05-613790	5–6	QBT3	0.505 (J)	—	—	—	—	—	—	—	—	0.000723 (J)	1 (U)
RE05-11-3347	05-613790	9–10	QBT3	1.01 (U)	—	—	—	—	—	—	—	—	0.00052 (J)	0.975 (U)
RE05-11-3348	05-613790	14–15	QBT3	0.933 (U)	—	—	—	—	—	—	—	—	—	0.969 (U)

Table 6.3-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Cadmium	Calcium	Copper	Lead	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Qbt 2, 3, 4 BV[a]				**0.5**	**46**	**1.63**	**2200**	**4.66**	**11.2**	**0.1**	**6.58**	**na[b]**	**na**	**0.3**
Sediment BV[a]				**0.83**	**127**	**0.4**	**4420**	**11.2**	**19.7**	**0.1**	**9.38**	**na**	**na**	**0.3**
Soil BV[a]				**0.83**	**295**	**0.4**	**6120**	**14.7**	**22.3**	**0.1**	**15.4**	**na**	**na**	**1.52**
Industrial SSL[c]				**454**	**224000**	**1120**	**na**	**45400**	**800**	**310[d]**	**22700**	**1820000**	**795**	**5680**
Residential SSL[c]				**31.3**	**15600**	**77.9**	**na**	**3130**	**400**	**23[d]**	**1560**	**125000**	**54.8**	**391**
RE05-11-3349	05-613790	19–20	QBT3	0.953 (U)	—	—	—	—	—	—	—	—	—	0.984 (U)
RE05-11-3350	05-613790	24–25	QBT3	—	—	—	—	—	—	—	—	—	—	0.885 (U)
RE05-11-3352	05-613793	0–1	SED	—	—	0.527 (U)	—	—	—	—	—	1.23	—	1.04 (U)
RE05-11-3353	05-613793	4.5–5.5	QBT3	0.56 (U)	86.3 (J)	—	—	5.97	—	—	6.68	1.17	0.00217	1.01 (U)
RE05-11-3354	05-613793	5.5–6.5	QBT3	—	57.3 (J)	—	—	5.45	—	—	—	1.12	0.00114 (J)	1.02 (U)
RE05-11-3355	05-613794	0–1	SED	—	—	0.537 (U)	—	—	—	—	—	2.11	—	1.04 (U)
RE05-11-3356	05-613794	1–2	QBT3	—	—	—	—	—	—	—	—	1.24	—	1.03 (U)
RE05-11-3357	05-613794	2–3	QBT3	—	—	—	—	—	—	—	—	1.22	—	0.999 (U)
RE05-11-3358	05-613795	0–1	SED	0.832 (U)	—	0.545 (U)	—	—	—	—	—	1.62	—	1.09 (U)
RE05-11-3359	05-613795	1–2	QBT3	—	54.2 (J)	—	—	—	—	—	—	1 (J)	0.000865 (J)	1.02 (U)
RE05-11-3360	05-613795	2–3	QBT3	0.994 (U)	—	—	—	—	—	—	—	0.958 (J)	—	1.01 (U)
RE05-11-3361	05-613796	0–1	SED	—	—	—	—	—	—	—	—	2.51	0.000646 (J)	1.04 (U)
RE05-11-3362	05-613796	1–2	QBT3	1.02 (U)	—	—	—	—	—	—	—	1.12	—	1 (U)
RE05-11-3363	05-613796	2–3	QBT3	0.983 (U)	—	—	—	—	—	—	—	1.08	—	0.989 (U)
RE05-11-3364	05-613797	0–1	SED	—	—	0.55 (U)	—	—	—	—	—	5.27	—	1.1 (U)
RE05-11-3365	05-613797	1–2	QBT3	—	—	—	—	—	—	—	—	2.06	—	1.04 (U)
RE05-11-3366	05-613797	2–3	QBT3	0.981 (U)	—	—	—	—	—	—	—	1.05	—	1 (U)
RE05-11-3371	05-613958	3–4	QBT3	0.97 (U)	—	—	2910	6.85	—	—	—	1.12	—	0.989 (U)
RE05-11-3372	05-613958	5–6	QBT3	0.996 (U)	—	—	—	9.26	—	—	—	1.18	—	1.02 (U)

Table 6.3-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Cadmium	Calcium	Copper	Lead	Mercury	Nickel	Nitrate	Perchlorate	Selenium
Qbt 2, 3, 4 BV[a]				**0.5**	**46**	**1.63**	**2200**	**4.66**	**11.2**	**0.1**	**6.58**	**na[b]**	**na**	**0.3**
Sediment BV[a]				**0.83**	**127**	**0.4**	**4420**	**11.2**	**19.7**	**0.1**	**9.38**	**na**	**na**	**0.3**
Soil BV[a]				**0.83**	**295**	**0.4**	**6120**	**14.7**	**22.3**	**0.1**	**15.4**	**na**	**na**	**1.52**
Industrial SSL[c]				**454**	**224000**	**1120**	**na**	**45400**	**800**	**310[d]**	**22700**	**1820000**	**795**	**5680**
Residential SSL[c]				**31.3**	**15600**	**77.9**	**na**	**3130**	**400**	**23[d]**	**1560**	**125000**	**54.8**	**391**
RE05-11-3369	05-613959	3–4	QBT3	0.937 (U)	—	—	—	—	—	—	—	1.02 (J)	—	0.984 (U)
RE05-11-3370	05-613959	5–6	QBT3	0.966 (U)	—	—	—	13.8	—	—	—	1.07	—	0.406 (J)
RE05-11-14586	05-613959	9–10	QBT3	NA	NA	NA	NA	4.72	NA	NA	NA	NA	NA	0.908 (U)

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SSLs are from NMED (2009, 108070), unless otherwise noted.

[d] SSLs are from EPA regional screening tables (http://www.epa.gov.earth1r6/6pd/rcra_c/pd-n/screen.htm).

[e] — = Not detected or not detected above BV.

[f] NA = Not analyzed.

Table 6.3-3
Organic Chemicals Detected at SWMU 05-004

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Chrysene	Dibenz(a,h)anthracene	Diethylphthalate	Fluoranthene	Fluorene	Hexanone[2-]	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]	Methylene Chloride	Methylnaphthalene[2-]	Naphthalene	Phenanthrene	Pyrene	Styrene
Industrial SSL[a]				**36700**	**18300**[b]	**183000**	**23.4**	**2.34**	**23.4**	**18300**[b]	**234**	**2500000**[c]	**2340**	**2.34**	**547000**	**24400**	**24400**	**1400**[c]	**23.4**	**14900**[d]	**1090**	**4100**[c]	**252**	**20500**	**18300**	**51200**
Residential SSL[a]				**3440**	**1720**[b]	**17200**	**6.21**	**0.621**	**6.21**	**1720**[b]	**62.1**	**240000**[c]	**621**	**0.621**	**48900**	**2290**	**2290**	**210**[c]	**6.21**	**3210**[d]	**199**	**310**[c]	**45**	**1830**	**1720**	**8970**
0405-95-0043	05-02003	0–1	SOIL	—[e]	—	—	—	—	—	—	—	0.61 (J)	—	—	—	—	—	NA[f]	—	NA	NA	—	—	—	—	NA
RE05-11-3335	05-613786	3–4	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0793 (J)	—	—	—	—	—	—	—	—
RE05-11-3336	05-613786	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0634 (J)	—	—	—	—	—	—	—	—
RE05-11-3339	05-613788	3–4	QBT3	0.0852	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE05-11-3340	05-613788	5–6	QBT3	0.0751	0.0242 (J)	0.334	1.61	1.55	3.04	0.769	0.899	—	3.13	0.188	—	3.42	0.11	—	0.74	—	—	0.0152 (J)	0.0145 (J)	1.42	2.64	—
RE05-11-14583	05-613788	9–10	QBT3	—	0.0102 (J)	0.148	0.745	0.448	0.973	0.245 (J)	0.37	—	1.21	0.0895 (J)	0.0824 (J)	0.788	0.0174 (J)	NA	0.254 (J)	NA	NA	—	—	0.267	0.586	NA
RE05-11-3368	05-613789	5–6	QBT3	—	—	—	—	—	—	—	—	0.266 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE05-11-3346	05-613790	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	0.0118 (J)	—	0.0306	—	0.000429 (J)	—	—	—	—	—	—
RE05-11-3348	05-613790	14–15	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00859	—	—	—	—	—	—	—	—
RE05-11-3349	05-613790	19–20	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0584	—	—	—	—	—	—	—	—
RE05-11-3350	05-613790	24–25	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0762	—	—	—	—	—	—	—	—
RE05-11-3362	05-613796	1–2	QBT3	—	—	—	—	—	—	—	—	0.225 (J)	—	—	—	—	—	—	—	—	0.00236 (J)	—	—	—	—	—
RE05-11-3363	05-613796	2–3	QBT3	—	—	—	—	—	—	—	—	0.216 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE05-11-3364	05-613797	0–1	SED	—	—	—	—	—	—	—	—	0.272 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00035 (J)
RE05-11-3366	05-613797	2–3	QBT3	—	—	—	—	—	—	—	—	0.239 (J)	—	—	—	—	—	—	—	—	0.00228 (J)	—	—	—	—	—
RE05-11-3369	05-613959	3–4	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00222 (J)	—	—	—	—	—

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] SSLs are from NMED (2009, 108070), unless otherwise noted.

[b] Pyrene used as a surrogate based on structural similarity.

[c] SSLs are from EPA regional screening tables (http://www.epa.gov.earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

[e] — = Not detected.

[f] NA = Not analyzed.

Table 6.3-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 05-004

Sample ID	Location ID	Depth (ft)	Media	Plutonium-239/240	Uranium-234	Uranium-235/236	Uranium-238
Qbt 2, 3, 4 BV[a]				**na**[b]	**1.98**	**0.09**	**1.93**
Sediment BV[a]				**0.068**	**2.59**	**0.2**	**2.29**
Industrial SAL[c]				**210**	**1500**	**87**	**430**
Residential SAL[c]				**33**	**170**	**17**	**87**
0405-95-0046	05-02003	2–3	QBT3	0.098	—[d]	—	—
RE05-11-3350	05-613790	24–25	QBT3	—	—	0.0939	—
RE05-11-14587	05-613790	34–35	QBT3	NA[e]	NA	0.107	NA
RE05-11-3361	05-613796	0–1	SED	—	4.71	0.206	4.66
RE05-11-3371	05-613958	3–4	QBT3	—	—	0.11	—

Notes: Results are in pCi/g.

[a] BVs/FVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SALs are from LANL (2009, 107655).

[d] — = Not detected or not detected above BV/FV.

[e] NA = Not analyzed.

Table 6.4-1
Samples Collected and Analyses Requested at SWMU 05-005(b)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	Dioxins and Furans	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium
0405-95-0286	05-02042	0–1	QBT3	647	—[a]	—	—	—	—	—	—	—	648	648
0405-95-0287	05-02042	1–2	QBT3	647	—	—	—	646	—	—	—	—	648	648
0405-95-0289	05-02042	2–3	QBT3	647	—	—	—	—	—	—	—	—	648	648
0405-95-0290	05-02043	0–1	QBT3	647	—	—	—	—	—	—	—	—	648	648
0405-95-0291	05-02043	1–2	QBT3	647	—	—	—	—	—	—	646	—	648	648
0405-95-0294	05-02043	2–3	QBT3	647	—	—	—	—	—	—	—	—	648	648
0405-95-0295	05-02044	0–1	SOIL	647	—	—	—	—	—	—	—	—	648	648
0405-95-0296	05-02044	1–2	SOIL	647	—	—	—	—	—	—	—	—	648	648
0405-95-0297	05-02044	2–3	SOIL	647	—	—	—	—	—	—	—	—	648	648
RE05-11-3387	05-613798	0–1	SED	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3388	05-613798	1–2	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3389	05-613798	2–3	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3390	05-613799	0–1	SED	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3391	05-613799	1–2	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3392	05-613799	2–3	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-14594	05-613799	5–6	QAL	11-2694[b]	—	—	—	—	—	—	—	—	—	—
RE05-11-14595	05-613799	9–10	QBT3	11-2694[b]	—	—	—	—	—	—	—	—	—	—
RE05-11-3396	05-613801	0–1	QBT3	11-1148	11-1148	11-1148	11-1148	11-1146	11-1147	11-1146	11-1146	11-1146	11-1149	11-1149
RE05-11-3397	05-613801	2–3	QBT3	11-1148	11-1148	11-1148	11-1148	11-1146	11-1147	11-1146	11-1146	11-1146	11-1149	11-1149
RE05-11-3398	05-613801	5–6	QBT3	11-1148	11-1148	11-1148	11-1148	11-1146	11-1147	11-1146	11-1146	11-1146	11-1149	11-1149
RE05-11-3399	05-613802	0–1	SED	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3400	05-613802	1–2	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3401	05-613802	2–3	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244

Table 6.4-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	Dioxins and Furans	PCBs	SVOCs	VOCs	Isotopic Plutonium	isotopic Uranium
RE05-11-3402	05-613803	0–1	SED	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3403	05-613803	1–2	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-3404	05-613803	2–3	QBT3	11-1243	11-1243	11-1243	11-1243	11-1241	11-1242	11-1241	11-1241	11-1241	11-1244	11-1244
RE05-11-5005	05-613920	0–1	QBT3	11-1473	11-1473	11-1473	11-1473	11-1471	11-1472	11-1471	11-1471	11-1471	11-1473	11-1473
RE05-11-5006	05-613920	2–3	QBT3	11-1473	11-1473	11-1473	11-1473	11-1471	11-1472	11-1471	11-1471	11-1471	11-1473	11-1473
RE05-11-5007	05-613920	5–6	QBT3	11-1473	11-1473	11-1473	11-1473	11-1471	11-1472	11-1471	11-1471	11-1471	11-1473	11-1473
RE05-11-5008	05-613921	0–1	QBT3	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5009	05-613921	2–3	QBT3	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5010	05-613921	5–6	QBT3	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5011	05-613922	0–1	QBT3	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5012	05-613922	1–2	QBT3	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5013	05-613922	2–3	QBT3	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5014	05-613923	0–1	SOIL	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5015	05-613923	1–2	SOIL	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-5016	05-613923	2–3	SOIL	11-1644	11-1644	11-1644	11-1644	11-1642	11-1643	11-1642	11-1642	11-1642	11-1645	11-1645
RE05-11-14596	05-614429	0–1	QAL	—	—	11-2694	—	—	—	—	11-2694[c]	—	—	—
RE05-11-14597	05-614429	2–3	QAL	—	—	11-2694	—	—	—	—	—	—	—	—
RE05-11-14598	05-614429	5–6	QAL	—	—	11-2694	—	—	—	—	11-2694[c]	—	—	—
RE05-11-14599	05-614429	9–10	QAL	—	—	11-2694	—	—	—	—	11-2694[c]	—	—	—

Note: Numbers in analyte columns are request numbers.

[a] — = Analysis not requested.

[b] Antimony only.

[c] Acenaphthene only.

Table 6.4-2
Inorganic Chemicals above BVs at SWMU 05-005(b)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Cadmium	Calcium	Chromium	Copper	Lead	Nickel	Nitrate	Perchlorate	Selenium	Silver
Qbt 2, 3, 4 BV[a]				**0.5**	**46**	**1.63**	**2200**	**7.14**	**4.66**	**11.2**	**6.58**	**na[b]**	**na**	**0.3**	**1**
Sediment BV[a]				**0.83**	**127**	**0.4**	**4420**	**10.5**	**11.2**	**19.7**	**9.38**	**na**	**na**	**0.3**	**1**
Soil BV[a]				**0.83**	**295**	**0.4**	**6120**	**19.3**	**14.7**	**22.3**	**15.4**	**na**	**na**	**1.52**	**1**
Industrial SSL[c]				**454**	**224000**	**1120**	**na**	**2920[d]**	**45400**	**800**	**22700**	**1820000**	**795**	**5680**	**5680**
Residential SSL[c]				**31.3**	**15600**	**77.9**	**na**	**219[d]**	**3130**	**400**	**1560**	**125000**	**54.8**	**391**	**391**
0405-95-0286	05-02042	0–1	QBT3	—[e]	—	—	—	25	—	—	13	NA[f]	NA	0.45 (U)	—
0405-95-0287	05-02042	1–2	QBT3	0.52 (U)	—	—	—	25.1	—	—	14.1	NA	NA	0.44 (U)	—
0405-95-0289	05-02042	2–3	QBT3	—	—	—	—	45.9	—	—	23.7	NA	NA	0.44 (U)	—
0405-95-0290	05-02043	0–1	QBT3	—	—	—	—	—	—	—	—	NA	NA	0.44 (U)	—
0405-95-0291	05-02043	1–2	QBT3	0.56 (U)	—	—	—	—	—	—	—	NA	NA	0.43 (U)	—
0405-95-0294	05-02043	2–3	QBT3	0.56 (U)	—	—	—	13.8	—	—	7.7 (J)	NA	NA	0.43 (U)	—
RE05-11-3387	05-613798	0–1	SED	1.06 (U)	—	0.532 (U)	—	—	—	—	—	2.37 (J-)	—	1.04 (U)	—
RE05-11-3388	05-613798	1–2	QBT3	0.956 (U)	—	—	—	—	—	—	—	1.06 (J-)	0.000966 (J)	0.99 (U)	—
RE05-11-3389	05-613798	2–3	QBT3	1.01 (U)	—	—	—	—	—	—	—	—	0.000834 (J)	0.953 (U)	—
RE05-11-3390	05-613799	0–1	SED	—	—	0.535 (U)	—	—	—	—	—	2.73 (J-)	—	1.05 (U)	—
RE05-11-3391	05-613799	1–2	QBT3	1.01 (U)	—	—	—	—	—	—	—	1.24 (J-)	—	0.909 (U)	—
RE05-11-3392	05-613799	2–3	QBT3	0.619 (J)	—	—	—	—	—	—	—	1.18 (J-)	—	1.01 (U)	—
RE05-11-14595	05-613799	9–10	QBT3	0.916 (U)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RE05-11-3396	05-613801	0–1	QBT3	—	—	—	—	—	—	13.6	—	1.59 (J-)	—	1.03 (U)	—
RE05-11-3397	05-613801	2–3	QBT3	0.981 (U)	—	—	—	—	—	—	—	1.29 (J-)	—	1.02 (U)	—
RE05-11-3398	05-613801	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	0.999 (U)	—
RE05-11-3399	05-613802	0–1	SED	1.02 (U)	—	0.511 (U)	—	—	—	—	—	1.67 (J-)	0.00107 (J)	1.04 (U)	—
RE05-11-3400	05-613802	1–2	QBT3	1.03 (U)	—	—	—	—	—	—	—	—	—	0.953 (U)	—
RE05-11-3401	05-613802	2–3	QBT3	1.01 (U)	—	—	3220	—	—	—	—	—	—	1.01 (U)	—

Table 6.4-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Cadmium	Calcium	Chromium	Copper	Lead	Nickel	Nitrate	Perchlorate	Selenium	Silver
Qbt 2, 3, 4 BV[a]				**0.5**	**46**	**1.63**	**2200**	**7.14**	**4.66**	**11.2**	**6.58**	**na**[b]	**na**	**0.3**	**1**
Sediment BV[a]				**0.83**	**127**	**0.4**	**4420**	**10.5**	**11.2**	**19.7**	**9.38**	**na**	**na**	**0.3**	**1**
Soil BV[a]				**0.83**	**295**	**0.4**	**6120**	**19.3**	**14.7**	**22.3**	**15.4**	**na**	**na**	**1.52**	**1**
Industrial SSL[c]				**454**	**224000**	**1120**	**na**	**2920**[d]	**45400**	**800**	**22700**	**1820000**	**795**	**5680**	**5680**
Residential SSL[c]				**31.3**	**15600**	**77.9**	**na**	**219**[d]	**3130**	**400**	**1560**	**125000**	**54.8**	**391**	**391**
RE05-11-3402	05-613803	0–1	SED	—	—	0.484 (U)	—	—	—	—	—	2 (J-)	0.000776 (J)	1.07 (U)	—
RE05-11-3403	05-613803	1–2	QBT3	—	47.3	—	—	—	—	—	—	—	—	1.02 (U)	—
RE05-11-3404	05-613803	2–3	QBT3	—	68	—	—	—	4.72	—	—	—	0.000581 (J)	0.961 (U)	—
RE05-11-5005	05-613920	0–1	QBT3	1.05 (U)	—	—	—	—	—	—	—	—	—	1.04 (U)	—
RE05-11-5006	05-613920	2–3	QBT3	1.01 (U)	—	—	—	—	—	13.9	—	—	—	1.03 (U)	—
RE05-11-5007	05-613920	5–6	QBT3	1.02 (U)	—	—	—	—	—	—	—	—	—	0.911 (U)	—
RE05-11-5008	05-613921	0–1	QBT3	0.834 (J)	—	—	—	—	—	29.8	—	1.53	—	1.06 (U)	1.11 (U)
RE05-11-5009	05-613921	2–3	QBT3	0.98 (U)	—	—	—	—	—	—	—	1.2	—	1 (U)	—
RE05-11-5010	05-613921	5–6	QBT3	1.02 (U)	—	—	—	—	—	—	—	—	—	1.02 (U)	—
RE05-11-5011	05-613922	0–1	QBT3	1.01 (U)	—	—	—	—	—	13.3	—	1.97	—	1.05 (U)	—
RE05-11-5012	05-613922	1–2	QBT3	1.02 (U)	—	—	—	—	—	—	—	1.14	0.000597 (J)	1 (U)	—
RE05-11-5013	05-613922	2–3	QBT3	1.02 (U)	—	—	—	—	—	—	—	1.14	—	0.991 (U)	—
RE05-11-5014	05-613923	0–1	SOIL	1.09 (U)	—	0.544 (U)	—	—	—	—	—	1.94	—	—	—
RE05-11-5015	05-613923	1–2	SOIL	0.986 (U)	—	0.493 (U)	—	—	—	—	—	1.64	—	—	—
RE05-11-5016	05-613923	2–3	SOIL	0.987 (U)	—	0.494 (U)	—	—	—	—	—	1.36	—	—	—

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SSLs are from NMED (2009, 108070), unless otherwise noted.

[d] SSLs are for hexavalent chromium.

[e] — = Not detected or not detected above BV.

[f] NA = Not analyzed.

Table 6.4-3
Organic Chemicals Detected at SWMU 05-005(b)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Di-n-butylphthalate	Fluoranthene	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	Heptachlorodibenzodioxins (Total)	Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	Heptachlorodibenzofurans (Total)	Hexachlorodibenzodioxins (Total)
Industrial SSL[a]				**36700**	**2500000[b]**	**1370**	**68400**	**24400**	**na[c]**	**na**	**na**	**na**	**na**
Residential SSL[a]				**3440**	**240000[b]**	**347**	**6110**	**2290**	**na**	**na**	**na**	**na**	**na**
0405-95-0291	05-02043	1–2	QBT3	—[d]	—	0.29 (J)	—	—	NA[e]	NA	NA	NA	NA
RE05-11-3387	05-613798	0–1	SED	—	—	—	—	—	0.00000166 (J)	0.00000349 (J)	—	0.000000535 (J)	—
RE05-11-3388	05-613798	1–2	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3389	05-613798	2–3	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3390	05-613799	0–1	SED	—	—	—	—	—	0.00000718	0.0000149	0.00000157 (J)	0.00000334 (J)	0.00000185 (J)
RE05-11-3391	05-613799	1–2	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3396	05-613801	0–1	QBT3	—	—	—	—	—	0.00000138 (J)	0.00000272 (J)	0.000000676 (J)	0.00000135 (J)	—
RE05-11-3397	05-613801	2–3	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3398	05-613801	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3399	05-613802	0–1	SED	—	—	—	—	—	—	—	—	—	—
RE05-11-3400	05-613802	1–2	QBT3	0.0444	—	—	—	—	—	—	—	—	—
RE05-11-3402	05-613803	0–1	SED	—	0.538 (J)	—	—	—	0.00000179 (J)	0.00000358 (J)	0.000000498 (J)	0.00000105 (J)	—
RE05-11-5005	05-613920	0–1	QBT3	—	—	—	—	—	0.00000132 (J)	0.00000289 (J)	0.00000102 (J)	0.00000168 (J)	—
RE05-11-5006	05-613920	2–3	QBT3	—	—	—	—	—	0.00000206 (J)	0.00000479	0.000000838 (J)	0.00000154 (J)	0.000000509 (J)
RE05-11-5007	05-613920	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-5008	05-613921	0–1	QBT3	—	—	—	0.0774 (J)	—	0.00000375 (J)	0.00000791	0.00000166 (J)	0.00000347 (J)	0.00000134 (J)
RE05-11-5009	05-613921	2–3	QBT3	—	—	—	—	—	0.00000157 (J)	0.00000344 (J)	0.000000567 (J)	0.00000111 (J)	—
RE05-11-5010	05-613921	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-5011	05-613922	0–1	QBT3	—	—	—	—	0.0116 (J)	0.00000374 (J)	0.00000706	0.0000011 (J)	0.00000248 (J)	0.00000135 (J)
RE05-11-5012	05-613922	1–2	QBT3	—	—	—	—	—	0.000000516 (J)	0.00000101 (J)	—	—	—
RE05-11-5013	05-613922	2–3	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-5014	05-613923	0–1	SOIL	—	—	—	—	—	0.00000193 (J)	0.00000373 (J)	—	—	—
RE05-11-5016	05-613923	2–3	SOIL	—	—	—	—	—	—	—	—	—	—

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachlorodibenzofurans (Total)	Isopropyltoluene[4-]	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofuran[2,3,4,7,8-]	Pentachlorodibenzofurans (Totals)	Tetrachlorodibenzodioxins (Total)	Tetrachlorodibenzofurans (Totals)	Toluene
Industrial SSL^a				**na**	**14900^f**	**na**	**na**	**na**	**na**	**na**	**na**	**57900**
Residential SSL^a				**na**	**3210^f**	**na**	**na**	**na**	**na**	**na**	**na**	**5570**
0405-95-0291	05-02043	1–2	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	NA
RE05-11-3387	05-613798	0–1	SED	—	0.000748 (J)	0.0000114 (J)	—	—	—	0.0000039	0.00000102 (J)	—
RE05-11-3388	05-613798	1–2	QBT3	—	—	—	—	—	—	—	0.000000474 (J)	—
RE05-11-3389	05-613798	2–3	QBT3	—	—	—	—	—	—	—	0.000000467 (J)	—
RE05-11-3390	05-613799	0–1	SED	0.000000835 (J)	—	0.0000699 (J)	0.00000285 (J)	—	0.000000581 (J)	—	0.000000915 (J)	—
RE05-11-3391	05-613799	1–2	QBT3	—	—	—	—	—	—	—	0.000000471 (J)	—
RE05-11-3396	05-613801	0–1	QBT3	—	—	0.0000103	0.00000113 (J)	—	—	0.000000234 (J)	0.000000592 (J)	—
RE05-11-3397	05-613801	2–3	QBT3	—	—	0.00000238 (J)	—	—	—	—	—	—
RE05-11-3398	05-613801	5–6	QBT3	—	—	—	—	—	—	—	0.000000422 (J)	—
RE05-11-3399	05-613802	0–1	SED	—	—	—	—	—	—	—	—	0.000326 (J)
RE05-11-3400	05-613802	1–2	QBT3	—	—	—	—	—	—	—	—	—
RE05-11-3402	05-613803	0–1	SED	—	—	0.0000135 (J)	—	—	—	—	0.000000752 (J)	—
RE05-11-5005	05-613920	0–1	QBT3	0.00000054 (J)	—	0.00000884 (J)	—	—	0.00000118 (J)	—	—	—
RE05-11-5006	05-613920	2–3	QBT3	0.000000697 (J)	—	0.0000146	—	—	0.00000123 (J)	—	—	—
RE05-11-5007	05-613920	5–6	QBT3	—	—	0.0000025 (J)	—	—	—	—	—	—
RE05-11-5008	05-613921	0–1	QBT3	0.00000508	—	0.0000249	0.000002 (J)	0.000000665 (J)	0.00000956	0.000000135 (J)	0.00000421 (J)	—
RE05-11-5009	05-613921	2–3	QBT3	0.000000715 (J)	—	0.0000113	—	—	0.00000211 (J)	—	—	—
RE05-11-5010	05-613921	5–6	QBT3	—	—	0.00000217 (J)	—	—	—	—	—	—
RE05-11-5011	05-613922	0–1	QBT3	0.00000055 (J)	—	0.0000299	0.00000218 (J)	—	0.000000874 (J)	0.000000135 (J)	—	—
RE05-11-5012	05-613922	1–2	QBT3	—	—	0.00000346 (J)	—	—	—	—	—	—
RE05-11-5013	05-613922	2–3	QBT3	—	—	0.00000225 (J)	—	—	—	—	—	—

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachlorodibenzofurans (Total)	Isopropyltoluene[4-]	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofuran[2,3,4,7,8-]	Pentachlorodibenzofurans (Totals)	Tetrachlorodibenzodioxins (Total)	Tetrachlorodibenzofurans (Totals)	Toluene
Industrial SSL[a]				**na**	**14900[f]**	**na**	**na**	**na**	**na**	**na**	**na**	**57900**
Residential SSL[a]				**na**	**3210[f]**	**na**	**na**	**na**	**na**	**na**	**na**	**5570**
RE05-11-5014	05-613923	0–1	SOIL	—	—	0.0000136	—	—	—	—	—	—
RE05-11-5016	05-613923	2–3	SOIL	—	—	0.00000139 (J)	—	—	—	—	—	—

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] SSLs are from NMED (2009, 108070), unless otherwise noted.

[b] SSLs are from EPA regional screening tables (http://www.epa.gov.earth1r6/6pd/rcra_c/pd-n/screen.htm).

[c] na = Not available.

[d] — = Not detected.

[e] NA = Not analyzed.

[f] Isopropylbenzene used as surrogate based on structural similarity.

Table 6.4-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 05-005(b)

Sample ID	Location ID	Depth (ft)	Media	Plutonium-238	Plutonium-239/240	Uranium-235/236
Qbt 2, 3, 4 BV[a]				**na**[b]	**na**	**0.09**
Industrial SAL[c]				**240**	**210**	**87**
Residential SAL[c]				**37**	**33**	**17**
0405-95-0286	05-02042	0–1	QBT3	0.0225	—[d]	—
RE05-11-3396	05-613801	0–1	QBT3	—	—	0.103
RE05-11-5008	05-613921	0–1	QBT3	—	0.0281	—

Notes: Results are in pCi/g.

[a] BVs/FVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SALs are from LANL (2009, 107655).

[d] — = Not detected or not detected above BV/FV.

Table 6.4-5
Samples Collected and Analyses Requested at SWMU 05-006(c)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	Dioxins and Furans	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
0405-95-0274	05-02039	0–1	SOIL	647	—[a]	—	—	—	—	—	—	—	648	648	—
0405-95-0275	05-02039	1–2	QBT3	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0277	05-02039	2–3	QBT3	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0278	05-02040	0–1	SOIL	647	—	—	—	—	—	—	—	—	648	648	648
0405-95-0281	05-02040	1–2	QBT3	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0282	05-02040	2–3	QBT3	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0283	05-02041	0–1	SOIL	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0284	05-02041	1–2	QBT3	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0285	05-02041	2–3	QBT3	647	—	—	—	—	—	—	—	—	648	648	—
0405-95-0298	05-02070	0–0.5	SOIL	647	—	—	—	—	—	—	—	—	—	—	—
0405-95-0301	05-02073	0–0.5	SOIL	647	—	—	—	—	—	—	—	—	—	—	—
RE05-11-3394	05-613800	2–3	QBT3	11-1148	11-1148	11-1148	11-1148	11-1146	11-1147	11-1146	11-1146	11-1146	11-1149	11-1149	—
RE05-11-3395	05-613800	5–6	QBT3	11-1148	11-1148	11-1148	11-1148	11-1146	11-1147	11-1146	11-1146	11-1146	11-1149	11-1149	—
RE05-11-3415	05-613804	0–1	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3416	05-613804	2–3	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3417	05-613804	5–6	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3418	05-613805	0–1	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3419	05-613805	2–3	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3420	05-613805	5–6	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3421	05-613806	0–1	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3422	05-613806	2–3	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3423	05-613806	5–6	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—

Table 6.4-5 (continued)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	Dioxins and Furans	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
RE05-11-3424	05-613807	0–1	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3425	05-613807	2–3	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-3426	05-613807	5–6	QBT3	11-1107	11-1107	11-1107	11-1107	11-1109	11-1108	11-1109	11-1109	11-1109	11-1107	11-1107	—
RE05-11-14604	05-613807	9–10	QBT3	—	—	—	—	—	—	—	—	11-2675b	—	—	—
RE05-11-3428	05-613808	2–3	QBT3	11-1152	11-1152	11-1152	11-1152	11-1150	11-1151	11-1150	11-1150	11-1150	11-1153	11-1153	—
RE05-11-3429	05-613808	5–6	QBT3	11-1152	11-1152	11-1152	11-1152	11-1150	11-1151	11-1150	11-1150	11-1150	11-1153	11-1153	—
RE05-11-3430	05-613809	0–1	QBT3	11-1152	11-1152	11-1152	11-1152	11-1150	11-1151	11-1150	11-1150	11-1150	11-1153	11-1153	—
RE05-11-3431	05-613809	2–3	QBT3	11-1152	11-1152	11-1152	11-1152	11-1150	11-1151	11-1150	11-1150	11-1150	11-1153	11-1153	—
RE05-11-3432	05-613809	5–6	QBT3	11-1152	11-1152	11-1152	11-1152	11-1150	11-1151	11-1150	11-1150	11-1150	11-1153	11-1153	—
RE05-11-5023	05-613925	0–1	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-5026	05-613926	0–1	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-5029	05-613927	0–1	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-5032	05-613928	0–1	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-5035	05-613929	0–1	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-5036	05-613929	2–3	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-5037	05-613929	5–6	QBT3	11-1420	11-1420	11-1420	11-1420	11-1418	11-1419	11-1418	11-1418	11-1418	11-1421	11-1421	—
RE05-11-14605	05-613929	9–10	QBT3	11-2675c	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14606	05-614430	0–1	QBT3	11-2675d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14607	05-614430	2–3	QBT3	11-2686d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14608	05-614430	5–6	QBT3	11-2686d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14609	05-614431	0–1	QBT3	11-2675d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14610	05-614431	2–3	QBT3	11-2686d	—	—	—	—	—	—	—	—	—	—	—

Table 6.4-5 (continued)

Sample ID	Location ID	Depth (ft)	Media	TAL Metals	Nitrate	Perchlorate	Cyanide (Total)	Explosive Compounds	Dioxins and Furans	PCBs	SVOCs	VOCs	Isotopic Plutonium	Isotopic Uranium	Gamma-Emitting Radionuclides
RE05-11-14611	05-614431	5–6	QBT3	11-2686d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14612	05-614432	0–1	QBT3	11-2675d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14613	05-614432	2–3	QBT3	11-2675d	—	—	—	—	—	—	—	—	—	—	—
RE05-11-14614	05-614432	5–6	QBT3	11-2686d	—	—	—	—	—	—	—	—	—	—	—

Note: Numbers in analyte columns are request numbers.

[a] — = Analysis not requested.

[b] Toluene only.

[c] Silver only.

[d] Lead only.

Table 6.4-6
Inorganic Chemicals above BVs at SWMU 05-006(c)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Nickel	Nitrate	Selenium	Silver	Zinc
Qbt 2, 3, 4 BV[a]				**7340**	**0.5**	**2.79**	**46**	**2200**	**7.14**	**4.66**	**14500**	**11.2**	**1690**	**6.58**	**na[b]**	**0.3**	**1**	**63.5**
Soil BV[a]				**29200**	**0.83**	**8.17**	**295**	**6120**	**19.3**	**14.7**	**21500**	**22.3**	**4610**	**15.4**	**na**	**1.52**	**1**	**48.8**
Industrial SSL[c]				**1130000**	**454**	**17.7**	**224000**	**na**	**2920[d]**	**45400**	**795000**	**800**	**na**	**22700**	**1820000**	**5680**	**5680**	**341000**
Residential SSL[c]				**78100**	**31.3**	**3.9**	**15600**	**na**	**219[d]**	**3130**	**54800**	**400**	**na**	**1560**	**125000**	**391**	**391**	**23500**
0405-95-0275	05-02039	1–2	QBT3	—[e]	—	—	—	—	13.4	—	—	—	—	7.6 (J)	NA[f]	0.45 (U)	—	—
0405-95-0277	05-02039	2–3	QBT3	—	0.55 (U)	—	—	—	25.5	—	—	—	—	13.5	NA	0.44 (U)	—	—
0405-95-0278	05-02040	0–1	SOIL	—	0.85 (U)	—	—	—	—	—	—	31.5	—	—	NA	—	—	—
0405-95-0281	05-02040	1–2	QBT3	—	0.59 (U)	—	—	—	9.1	—	—	14.1	—	—	NA	0.44 (U)	—	—
0405-95-0282	05-02040	2–3	QBT3	—	1.2 (U)	3.2	67.3	5450	187	—	—	—	—	89.4	NA	0.44 (U)	—	—
0405-95-0284	05-02041	1–2	QBT3	—	0.74 (U)	—	—	—	20.1	—	—	—	—	11.2	NA	0.43 (U)	—	—
0405-95-0285	05-02041	2–3	QBT3	—	—	—	—	—	35.7	—	—	—	—	18.2	NA	0.43 (U)	—	—
0405-95-0298	05-02070	0–0.5	SOIL	—	2.3 (J)	—	—	—	—	126	25100	42.9	—	28.2	NA	—	—	58.4
RE05-11-3394	05-613800	2–3	QBT3	—	—	—	—	—	—	—	—	26.4	—	—	—	0.393 (J)	—	—
RE05-11-3395	05-613800	5–6	QBT3	—	—	—	—	—	—	—	—	60.1	—	—	1.63 (J-)	1.01 (U)	—	—
RE05-11-3415	05-613804	0–1	QBT3	9190 (J+)	2.13	—	87.9	6710	—	10.6	—	134	1710	—	1.25	1.07 (U)	—	—
RE05-11-3416	05-613804	2–3	QBT3	—	—	—	—	—	—	—	—	27.6	—	—	—	1.01 (U)	—	—
RE05-11-3417	05-613804	5–6	QBT3	—	0.975 (U)	—	—	—	—	—	—	—	—	—	1.09	0.983 (U)	—	—
RE05-11-3418	05-613805	0–1	QBT3	—	0.599 (U)	—	—	—	—	13.9	—	22.4	—	—	—	1.02 (U)	—	—
RE05-11-3419	05-613805	2–3	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	0.97 (U)	—	—
RE05-11-3420	05-613805	5–6	QBT3	—	0.984 (U)	—	—	—	—	—	—	—	—	—	0.993 (J)	0.977 (U)	—	—
RE05-11-3421	05-613806	0–1	QBT3	—	1.04 (U)	—	—	—	—	—	—	—	—	—	1.11	1.04 (U)	—	—
RE05-11-3422	05-613806	2–3	QBT3	—	0.944 (U)	—	—	—	—	—	—	—	—	—	0.995 (J)	0.985 (U)	—	—
RE05-11-3423	05-613806	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	1.1	0.91 (U)	—	—
RE05-11-3424	05-613807	0–1	QBT3	—	0.809 (U)	—	—	—	—	5.33	—	15.6	—	—	—	0.97 (U)	—	—
RE05-11-3425	05-613807	2–3	QBT3	—	1.06 (U)	—	—	—	—	—	—	—	—	—	—	0.89 (U)	—	—
RE05-11-3426	05-613807	5–6	QBT3	—	0.915 (U)	—	—	—	—	—	—	—	—	—	0.981 (J)	1.01 (U)	—	—
RE05-11-3428	05-613808	2–3	QBT3	—	—	—	—	—	—	7.94 (J)	—	17.2	—	—	—	0.985 (U)	—	—
RE05-11-3429	05-613808	5–6	QBT3	—	—	—	—	—	—	9.18 (J)	—	14.5	—	—	—	1.02 (U)	—	—
RE05-11-3430	05-613809	0–1	QBT3	—	0.629 (U)	—	—	—	—	10.8 (J)	—	18.6	—	—	—	1.09 (U)	—	—
RE05-11-3431	05-613809	2–3	QBT3	—	—	—	—	—	—	—	—	17.1	—	—	—	0.951 (U)	—	—
RE05-11-3432	05-613809	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	0.962 (U)	—	—
RE05-11-5023	05-613925	0–1	QBT3	—	—	—	—	—	—	—	—	15.1 (J)	—	—	—	1.06 (U)	—	—
RE05-11-5026	05-613926	0–1	QBT3	—	1.22	—	—	—	—	6.72	—	54.7	—	—	—	1.01 (U)	—	—
RE05-11-5029	05-613927	0–1	QBT3	—	0.916 (U)	—	—	—	—	—	—	—	—	—	1.17	0.968 (U)	—	—
RE05-11-5032	05-613928	0–1	QBT3	—	1.26	—	—	—	—	30	—	227	—	—	1.19	0.347 (J)	—	—
RE05-11-5035	05-613929	0–1	QBT3	—	2	—	64.3	2250 (J+)	—	317	—	337	—	—	1.48	0.394 (J)	—	—

Table 6.4-6 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Arsenic	Barium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Nickel	Nitrate	Selenium	Silver	Zinc
Qbt 2, 3, 4 BV[a]				**7340**	**0.5**	**2.79**	**46**	**2200**	**7.14**	**4.66**	**14500**	**11.2**	**1690**	**6.58**	**na[b]**	**0.3**	**1**	**63.5**
Soil BV[a]				**29200**	**0.83**	**8.17**	**295**	**6120**	**19.3**	**14.7**	**21500**	**22.3**	**4610**	**15.4**	**na**	**1.52**	**1**	**48.8**
Industrial SSL[c]				**1130000**	**454**	**17.7**	**224000**	**na**	**2920[d]**	**45400**	**795000**	**800**	**na**	**22700**	**1820000**	**5680**	**5680**	**341000**
Residential SSL[c]				**78100**	**31.3**	**3.9**	**15600**	**na**	**219[d]**	**3130**	**54800**	**400**	**na**	**1560**	**125000**	**391**	**391**	**23500**
RE05-11-5036	05-613929	2–3	QBT3	—	1.26	—	—	—	—	18.1	18600	222	—	—	—	0.316 (J)	—	—
RE05-11-5037	05-613929	5–6	QBT3	—	—	—	—	—	—	—	—	122	—	—	—	0.989 (U)	2.22	—
RE05-11-14606	05-614430	0–1	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	20.9	NA	NA	NA	NA	NA	NA
RE05-11-14607	05-614430	2–3	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	17.5	NA	NA	NA	NA	NA	NA
RE05-11-14608	05-614430	5–6	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	16.7	NA	NA	NA	NA	NA	NA
RE05-11-14609	05-614431	0–1	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	14.3	NA	NA	NA	NA	NA	NA
RE05-11-14610	05-614431	2–3	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	20.7	NA	NA	NA	NA	NA	NA
RE05-11-14611	05-614431	5–6	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	20.3	NA	NA	NA	NA	NA	NA
RE05-11-14612	05-614432	0–1	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	24.8	NA	NA	NA	NA	NA	NA
RE05-11-14613	05-614432	2–3	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	16.3	NA	NA	NA	NA	NA	NA
RE05-11-14614	05-614432	5–6	QBT3	NA	NA	NA	NA	NA	NA	NA	NA	16.9	NA	NA	NA	NA	NA	NA

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] SSLs are from NMED (2009, 108070), unless otherwise noted.

[d] SSLs are for hexavalent chromium.

[e] — = Not detected or not detected above BV.

[f] NA = Not analyzed.

Table 6.4-7
Organic Chemicals Detected at SWMU 05-006(c)

Sample ID	Location ID	Depth (ft)	Media	Acetone	Aroclor-1260	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	Heptachlorodibenzodioxins (Total)	Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	Heptachlorodibenzofurans (Total)	Hexachlorodibenzodioxin[1,2,3,6,7,8-]	Hexachlorodibenzodioxins (Total)	Hexachlorodibenzofurans (Total)	Isopropyltoluene[4-]
Industrial SSL[a]				**851000**	**8.26**	**na**[b]	**na**	**na**	**na**	**na**	**na**	**na**	**14900**[c]
Residential SSL[a]				**67500**	**2.22**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**3210**[c]
RE05-11-3394	05-613800	2–3	QBT3	—[d]	—	0.000000803 (J)	0.00000159 (J)	—	—	—	—	—	—
RE05-11-3395	05-613800	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3415	05-613804	0–1	QBT3	—	—	0.00000427 (J)	0.00000806	0.000000976 (J)	0.00000201 (J)	—	0.00000112 (J)	0.000000649 (J)	—
RE05-11-3416	05-613804	2–3	QBT3	—	—	0.000000956 (J)	0.00000186 (J)	—	—	—	—	—	—
RE05-11-3417	05-613804	5–6	QBT3	—	—	0.000000752 (J)	0.00000137 (J)	—	—	—	—	—	—
RE05-11-3418	05-613805	0–1	QBT3	—	—	0.00000275 (J)	0.00000565	0.00000103 (J)	0.00000178 (J)	—	0.000000584 (J)	0.000000836 (J)	—
RE05-11-3419	05-613805	2–3	QBT3	—	—	0.000000705 (J)	0.00000125 (J)	—	—	—	—	—	—
RE05-11-3420	05-613805	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3421	05-613806	0–1	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3422	05-613806	2–3	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3423	05-613806	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3424	05-613807	0–1	QBT3	—	—	0.00000226 (J)	0.00000437 (J)	0.00000174 (J)	0.00000287 (J)	—	—	0.000000924 (J)	—
RE05-11-3425	05-613807	2–3	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-3426	05-613807	5–6	QBT3	—	—	0.000000511 (J)	0.00000106 (J)	—	—	—	—	—	—
RE05-11-3428	05-613808	2–3	QBT3	—	—	0.00000262 (J)	0.00000491	0.00000107 (J)	0.00000199 (J)	—	—	0.000000707 (J)	0.00115
RE05-11-3429	05-613808	5–6	QBT3	—	—	0.000000567 (J)	0.00000119 (J)	—	—	—	—	—	0.000539 (J)
RE05-11-3430	05-613809	0–1	QBT3	—	—	0.00000317 (J)	0.00000624	0.000000965 (J)	0.00000217 (J)	—	—	0.000000666 (J)	—
RE05-11-3432	05-613809	5–6	QBT3	—	—	—	—	—	—	—	—	—	—
RE05-11-5023	05-613925	0–1	QBT3	—	—	0.00000102 (J)	0.00000219 (J)	—	—	—	—	—	0.00114
RE05-11-5026	05-613926	0–1	QBT3	—	—	0.0000013 (J)	0.00000259 (J)	—	—	—	—	—	—
RE05-11-5029	05-613927	0–1	QBT3	0.00172 (J)	0.0014 (J)	0.000000741 (J)	0.00000141 (J)	—	—	—	—	—	0.00145
RE05-11-5032	05-613928	0–1	QBT3	0.00203 (J)	—	0.00000386 (J)	0.00000774	0.00000126 (J)	0.00000251 (J)	—	0.000000531 (J)	0.000000827 (J)	0.000383 (J)
RE05-11-5035	05-613929	0–1	QBT3	—	0.0015 (J)	0.00000892	0.0000178	0.0000027 (J)	0.00000556	0.000000508 (J)	0.0000034 (J)	0.00000302 (J)	—
RE05-11-5036	05-613929	2–3	QBT3	—	0.0018 (J)	0.00000382 (J)	0.0000078	0.00000113 (J)	0.0000023 (J)	—	0.00000142 (J)	0.00000122 (J)	0.000383 (J)
RE05-11-5037	05-613929	5–6	QBT3	—	—	0.00000202 (J)	0.0000041 (J)	0.000000641 (J)	0.00000132 (J)	—	—	—	—

Table 6.4-7 (continued)

Sample ID	Location ID	Depth (ft)	Media	Methylene Chloride	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofurans (Totals)	Tetrachlorodibenzodioxins (Total)	Tetrachlorodibenzofuran[2,3,7,8-]	Tetrachlorodibenzofurans (Totals)	Toluene	Trimethylbenzene[1,2,4-]
Industrial SSL[a]				**1090**	**na[b]**	**na**	**na**	**na**	**0.00147**	**na**	**57900**	**260[e]**
Residential SSL[a]				**199**	**na**	**na**	**na**	**na**	**0.000374**	**na**	**5570**	**62[e]**
RE05-11-3394	05-613800	2–3	QBT3	—	0.00000497 (J)	—	—	—	—	0.000000498 (J)	—	—
RE05-11-3395	05-613800	5–6	QBT3	0.00213 (J)	0.00000158 (J)	—	—	—	—	0.000000448 (J)	—	—
RE05-11-3415	05-613804	0–1	QBT3	—	0.0000194	0.00000114 (J)	0.000000777 (J)	0.00000115	—	0.00000097 (J)	0.0013	—
RE05-11-3416	05-613804	2–3	QBT3	—	0.00000533 (J)	—	—	0.000000102 (J)	—	0.000000381 (J)	0.00133	—
RE05-11-3417	05-613804	5–6	QBT3	—	0.00000328 (J)	—	—	—	—	0.000000463 (J)	0.000596 (J)	—
RE05-11-3418	05-613805	0–1	QBT3	—	0.0000184	0.000000993 (J)	0.00000162 (J)	0.000000154 (J)	0.000000963 (J)	0.00001	—	0.000461 (J)
RE05-11-3419	05-613805	2–3	QBT3	—	0.0000047 (J)	—	—	—	—	—	—	—
RE05-11-3420	05-613805	5–6	QBT3	—	0.000000996 (J)	—	—	—	—	0.000000419 (J)	0.000327 (J)	—
RE05-11-3421	05-613806	0–1	QBT3	—	0.00000149 (J)	—	—	—	—	0.000000567 (J)	0.000943 (J)	—
RE05-11-3422	05-613806	2–3	QBT3	—	—	—	—	—	—	0.000000331 (J)	0.000948 (J)	—
RE05-11-3423	05-613806	5–6	QBT3	—	—	—	—	—	—	—	0.000897 (J)	—
RE05-11-3424	05-613807	0–1	QBT3	—	0.0000158	0.00000115 (J)	0.00000162 (J)	0.000000141 (J)	—	0.00000146 (J)	0.000991 (J)	—
RE05-11-3425	05-613807	2–3	QBT3	—	0.000003 (J)	—	—	—	—	0.000000553 (J)	—	—
RE05-11-3426	05-613807	5–6	QBT3	—	0.00000435 (J)	—	—	—	—	0.000000455 (J)	0.00164	—
RE05-11-3428	05-613808	2–3	QBT3	0.00343 (J)	0.0000194	0.00000106 (J)	0.0000011 (J)	—	—	0.00000413 (J)	—	—
RE05-11-3429	05-613808	5–6	QBT3	0.00261 (J)	0.00000388 (J)	—	—	—	—	0.0000007 (J)	—	—
RE05-11-3430	05-613809	0–1	QBT3	0.00286 (J)	0.0000238	0.00000167 (J)	0.000000557 (J)	0.000000215 (J)	—	0.000000782 (J)	—	—
RE05-11-3432	05-613809	5–6	QBT3	0.00214 (J)	—	—	—	—	—	0.000000449 (J)	—	—
RE05-11-5023	05-613925	0–1	QBT3	0.00219 (J)	0.00000654 (J)	—	—	0.00000013 (J)	—	—	—	—
RE05-11-5026	05-613926	0–1	QBT3	0.00219 (J)	0.00000746 (J)	—	—	0.000000278 (J)	—	—	—	—
RE05-11-5029	05-613927	0–1	QBT3	—	0.00000452 (J)	—	—	—	—	—	—	—
RE05-11-5032	05-613928	0–1	QBT3	0.00263 (J)	0.0000246	0.0000015 (J)	0.00000129 (J)	0.000000234 (J)	—	0.00000297 (J)	—	—
RE05-11-5035	05-613929	0–1	QBT3	0.00244 (J)	0.0000577	0.00000344 (J)	0.00000259 (J)	0.000000454 (J)	—	0.00000323 (J)	—	—

Table 6.4-7 (continued)

Sample ID	Location ID	Depth (ft)	Media	Methylene Chloride	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofurans (Totals)	Tetrachlorodibenzodioxins (Total)	Tetrachlorodibenzofuran[2,3,7,8-]	Tetrachlorodibenzofurans (Totals)	Toluene	Trimethylbenzene[1,2,4-]
Industrial SSL[a]				**1090**	**na**[b]	**na**	**na**	**na**	**0.00147**	**na**	**57900**	**260**[e]
Residential SSL[a]				**199**	**na**	**na**	**na**	**na**	**0.000374**	**na**	**5570**	**62**[e]
RE05-11-5036	05-613929	2–3	QBT3	0.00271 (J)	0.0000238	0.0000014 (J)	0.000000825 (J)	0.000000199 (J)	—	—	—	—
RE05-11-5037	05-613929	5–6	QBT3	0.00273 (J)	0.0000131	—	—	0.000000117 (J)	—	—	—	—

Notes: Results are in mg/kg. Data qualifiers are presented in Appendix A.

[a] SSLs are from NMED (2009, 108070), unless otherwise noted.

[b] na = Not available.

[c] Isopropylbenzene used as surrogate based on structural similarity.

[d] — = Not detected.

[e] SSLs are from EPA regional screening tables (http://www.epa.gov.earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table 6.4-8
Radionuclides Detected or Detected above BVs/FVs at SWMU 05-006(c)

Sample ID	Location ID	Depth (ft)	Media	Uranium-235/236
Qbt 2, 3, 4 Background Value[a]				**0.09**
Soil Background Value[a]				**0.2**
Industrial SAL[b]				**87**
Residential SAL[b]				**17**
RE05-11-3395	05-613800	5–6	QBT3	0.093
RE05-11-3418	05-613805	0–1	QBT3	0.1
RE05-11-5029	05-613927	0–1	QBT3	0.103

Notes: Results are in pCi/g.

[a] BVs/FVs are from LANL (1998, 059730).

[b] SALs are from LANL (2009, 107655).

Table 8.1-1
Summary of Investigation Results and Recommendations

Consolidated Unit	SWMU/AOC	Site Description	Extent Defined?	Potential Unacceptable Risk/Dose?	Recommendation
	SWMU 05-003	Firing site	Yes	No	Corrective actions complete without controls
	SWMU 05-004	Former calibration chamber	Yes	No	Corrective actions complete without controls
05-005(b)-00	SWMU 05-005(b)	Former septic tank	Yes	No	Corrective actions complete without controls
	SWMU 05-006(c)	Former outfall associated with former building 05-5	Yes	No	Corrective actions complete without controls

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	area use factor
bgs	below ground surface
BMP	best management practice
BV	background value
CMP	corrugated metal pipe
CCV	continuing calibration verification
COC	chain of custody
Consent Order	Compliance Order on Consent
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
D&D	decontamination and decommissioning
DAF	dilution attenuation factor
DL	detection limit
DOE	U.S. Department of Energy (U.S.)
DPGS	differential global-positioning system
dpm	disintegration(s) per minute
EC	effective concentration
Eh	oxidation-reduction potential
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
EQL	estimated quantitation limit
ESL	ecological screening level
FV	fallout value
GNSS	Global Navigation Satellite System
HE	high explosives
HEU	highly enriched uranium
HI	hazard index
HQ	hazard quotient
HR	home range
ICS	interference check sample
ICV	initial calibration verification
I.D.	inside diameter

IDW	investigation-derived waste
IS	internal standard
K_d	soil-water partition coefficient
K_{oc}	organic carbon-water partition coefficient
K_{ow}	octanol-water partition coefficient
LAL	lower acceptance limit
LANL	Los Alamos National Laboratory
LASCP	Los Alamos Site Characterization Program
LCS	laboratory control sample
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
MATC	maximum acceptable toxicant concentration
MDC	minimum detectable concentration
MDL	method detection limit
mm Hg	millimeters of mercury
MS	matrix spike
MSW	municipal solid waste
NFA	no further action
NMED	New Mexico Environment Department
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NPDES	National Pollutant Discharge Elimination System
NFA	no further action
%R	percent recovery
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PAUF	population area use factor
PID	photoionization detector
PRG	preliminary remediation goal
QA	quality assurance
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RESRAD	residual radioactive (a computer model)
RCT	radiation control technician
RDA	recommended daily allowance
RfD	reference dose
RFI	RCRA facility investigation

RL	reporting limit
RME	reasonable maximum exposure
RPF	Records Processing Facility
RPD	relative percent difference
SAL	screening action level
SCL	sample collection log
SF	slope factor
SMO	Sample Management Office
SOP	standard operating procedure
SOW	statement of work
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
T&E	threatened and endangered
TA	technical area
TAL	target analyte list
TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalency factor
TPU	total propagated uncertainty
TRV	toxicity reference value
UAL	upper acceptance limit
UCL	upper confidence limit
VOC	volatile organic compound
WCSF	waste characterization strategy form
XRF	x-ray fluorescence

A-2.0 METRIC CONVERSION TABLE

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

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

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes the field methods implemented during the 2011 investigation at the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (LANL or Laboratory). Table B-1.0-1 summarizes the field investigation methods, and the following sections provide more detailed descriptions of these methods. All activities were conducted in accordance with approved subcontractor procedures that are technically equivalent to Laboratory standard operating procedures (SOPs) listed in Table B-1.0-2 and are available at http://www.lanl.gov/environment/all/qa/adep.shtml.

B-2.0 EXPLORATORY DRILLING CHARACTERIZATION

No exploratory drilling characterization was conducted during the 2011 investigation. All drilling was conducted for the purpose of collecting investigation samples.

B-3.0 FIELD-SCREENING METHODS

This section summarizes the field-screening methods used during the investigation activities. Field screening for organic vapors was performed for health and safety purposes. Field screening for radioactivity was performed on every sample submitted to the Sample Management Office (SMO). Field-screening results for all investigation activities are described in section 3.2.3 and are presented in Table 3.2-2 of the investigation report.

B-3.1 Field Screening for Organic Vapors

Field screening for organic vapors was conducted for all samples at all locations. Screening was conducted using a MiniRAE 2000 photoionization detector (PID) equipped with an 11.7-electron volt lamp. Screening was performed in accordance with the manufacturer's specifications and SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector. Screening was performed on each sample collected, and screening measurements were recorded on the field sample collection logs (SCLs), provided on DVD in Appendix F. The field-screening results are presented in Table 3.2-2 of the investigation report.

B-3.2 Field Screening for Radioactivity

All samples collected were field screened for radioactivity before they were submitted to the SMO, targeting alpha and beta/gamma emitters. A Laboratory radiation control technician (RCT) conducted radiological screening using an Eberline E-600 radiation meter with an SHP-380AB alpha/beta scintillation detector held within 1 in. of the sample. The Eberline E-600 with attachment SHP-380AB 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 used to detect beta and gamma emissions and is thinly coated with zinc sulfide to detect alpha emissions. The operational range varies from trace emissions to 1 million disintegrations per minute. Screening measurements were recorded on the SCLs, which are provided on DVD in Appendix F. The screening results are presented in Table 3.2-2 of the investigation report.

B-3.3 XRF Survey

A survey of lead contamination at Solid Waste Management Unit (SWMU) 05-006(c) was conducted using a field x-ray fluorescence (XRF) instrument to identify areas of elevated lead concentrations. The survey was conducted using a Niton XL3t 600 XRF analyzer with sufficient sensitivity (i.e., 100 mg/kg or less) to identify areas of lead contamination above the industrial soil screening level (SSL). The survey was conducted in accordance with an approved subcontractor procedure technically equivalent to

SOP-5047, X-Ray Fluorescence Analysis. The instrument was operated according to the manufacturer's instructions, including collecting, preparing, and analyzing samples. Details of the XRF survey and the results are presented in Appendix C.

B-4.0 FIELD INSTRUMENT CALIBRATION

Instrument calibration and/or function check was completed daily. Several environmental factors affected the instruments' integrity, including air temperature, atmospheric pressure, wind speed, and humidity. Calibration of the PID was conducted by the site-safety officer. The RCT calibrated the Eberline E-600 instrument according to the manufacturer's specifications and requirements.

B-4.1 MiniRAE 2000 Instrument Calibration

The MiniRAE 2000 PID was calibrated both to ambient air and a standard reference gas (100 ppm isobutylene). The ambient-air calibration determined the zero point of the instrument sensor calibration curve in ambient air. Calibration with the standard reference gas determined a second point of the sensor calibration curve. Each calibration was within 10% of 100 ppm isobutylene, qualifying the instrument for use.

The following calibration information was recorded daily on operational calibration logs:

- instrument identification number
- final span settings
- date and time

concentration and type of calibration gas used (isobutylene at 100 ppm) and name of the personnel performing the calibration

All daily calibration procedures for the MiniRAE 2000 PID met the manufacturer's specifications for standard reference gas calibration.

B-4.2 Eberline E-600 Instrument Calibration

The RCT calibrated the Eberline E-600 daily before local background levels for radioactivity were measured. The instrument was calibrated using plutonium-239 and chloride-36 sources for alpha and beta emissions, respectively. The following five checks were performed as part of the calibration procedures:

- calibration date
- physical damage
- battery
- response to a source of radioactivity
- background

All calibrations performed for the Eberline E-600 met the manufacturer's specifications and the applicable radiation detection instrument manual.

B-4.3 Niton XL3t 600 XRF Analyzer Calibration

The Niton XL3t 600 XRF Analyzer was calibrated by the manufacturer and provided with a certification of calibration. The instrument was checked daily for proper function and calibration using standard aliquots of metals, including lead, as provided by the manufacturer.

B-5.0 SURFACE AND SUBSURFACE SAMPLING

This section summarizes the methods used for collecting surface and subsurface samples, including soil, tuff, and sediment samples, according to the approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451).

B-5.1 Surface Sampling Methods

Surface samples were collected in Technical Area 05 (TA-05) using either hand-auger or spade-and-scoop methods. Surface samples were collected in accordance with approved subcontractor procedures technically equivalent to SOP-06.10, Hand Auger and Thin-Wall Tube Sampler, or SOP-06.09, Spade and Scoop Method for the Collection of Soil Samples. A hand auger or spade and scoop were used to collect material in approximately 6-in. increments. Samples for volatile organic chemical (VOC) analysis were transferred immediately from the sampler to the sample container to minimize the loss of VOCs during the sample-collection process. Containers for VOC samples were filled as completely as possible, leaving no or minimal headspace, and sealed with a Teflon-lined cap. The remaining sample material was placed in a stainless-steel bowl with a stainless-steel scoop, after which it was transferred to sterile sample collection jars or bags. Samples were preserved using coolers to maintain the required temperature and chemical preservatives such as nitric acid in accordance with an approved subcontractor procedure technically equivalent to SOP-5056, Sample Containers and Preservation.

Samples were appropriately labeled, sealed with custody seals, and documented before transporting to the SMO. Samples were managed according to approved subcontractor procedures technically equivalent to SOP-5057, Handling, Packaging, and Transporting Field Samples, and WES-EDA-QP-219, Sample Control and Field Documentation.

Sample collection tools were decontaminated (section B-5.7) immediately before each sample was collected in accordance with a subcontractor procedure technically equivalent to SOP-5061, Field Decontamination of Equipment.

B-5.2 Borehole Logging

Borehole logs were completed for all boreholes drilled at TA-05 with a hollow-stem auger drill rig. The logs were completed in accordance with an approved subcontractor procedure technically equivalent to SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials. Information recorded in field boring logs included footage and percent recovery, lithology and depths of lithologic contacts, depth of samples collected, field screening results, core descriptions, and other relevant observations. The borehole logs are presented in Appendix D.

B-5.3 Subsurface Tuff Sampling Methods

Subsurface samples were collected in accordance with approved subcontractor procedures technically equivalent to SOP-06.10, Hand Auger and Thin-Wall Tube Sampler, or SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials.

Samples for VOC analysis were transferred immediately from the split-spoon core barrel or hand auger to the sample container to minimize the loss of VOCs during the sample-collection process. Containers for VOC samples were filled as completely as possible, leaving no or minimal headspace, and sealed with a Teflon-lined cap. If necessary, pieces small enough to fit into the sample container were removed from the core using a decontaminated rock hammer or stainless-steel spoon to minimize the loss of VOCs. The remaining material was then field screened for radioactivity and visually inspected. After the VOC samples were collected and field screened, the remaining sample material was placed in a stainless-steel bowl, and the material was broken, if necessary, with a decontaminated rock hammer or stainless-steel spoon to fit the material into the sample containers.

A stainless-steel scoop and bowl were used to transfer samples to sterile sample collection jars or bags for transport to the SMO. The sample collection tools were decontaminated immediately before each sample was collected (see section B-5.7) in accordance with an approved subcontractor procedure technically equivalent to SOP-5061, Field Decontamination of Equipment.

A hollow-stem auger drill rig equipped with an unlined split-spoon core barrel sampler was used to collect samples for VOC analysis at one location at SWMU 05-004. The sampling procedure involves some disturbance of the sample during collection and transfer to the sample container.

Samples for VOC analysis were collected at SWMU 05-004 using a hollow-stem auger drill rig at depths of 5–6 ft, 9–10 ft, 14–15 ft, 19–20 ft, 24–25 ft, 34–35 ft, and 44–45 ft below ground surface (bgs) at location 05-613790. Vertical extent of VOC contamination at this location was defined using decreasing concentration trends. Because all samples were collected using the same procedure, potential VOC loss associated with the procedure should not have affected the vertical concentration trends used to define extent.

Four VOC chemicals of potential concern were identified in analytical results at SWMU 05-004: 2-hexanone, 4-isopropyltoluene, methylene chloride, and styrene. The residential soil screening levels (SSLs) for these VOCs are 3 to 7 orders of magnitude greater than the maximum detected concentrations. Therefore, even if significant VOC (e.g., 99%) loss had occurred during sample collection (which is not likely), the actual concentrations of VOCs would still be far less than SSLs, and the determination of acceptable risk is accurate.

B-5.4 Sediment Sampling

Before sediment samples were collected, the field geologist identified sediment accumulation areas within the drainage channel most likely to have received runoff from the sites being investigated. As a result, sediment samples were collected from areas of sediment accumulation that would be representative of historical Laboratory operations. When applicable, sampling locations were biased to areas with the greatest thickness of fine-grained sediments. In addition, sampling was restricted to the drainage channel and all surface samples were collected from 0 to 1 ft bgs.

In the drainage channels downgradient of SWMUs 05-004 and 05-005(b), the sediment cover was thin, and the sediment/tuff interface was typically a foot or less below the ground surface. The shallow depth of sediment accumulation above the tuff indicated the sediment deposits were relatively recent and therefore were representative of geomorphic conditions most likely to have affected by discharges from Laboratory operations at these sites.

B-5.5 Quality Control Samples

Quality control (QC) samples were collected in accordance with an approved subcontractor procedure technically equivalent to SOP-5059, Field Quality Control Samples. The QC samples included field duplicates, field rinsate blanks, and field trip blanks. Field duplicate samples were collected from the same material as the regular investigation samples and submitted for the same analyses. Field duplicate samples were collected at a frequency of at least 1 duplicate sample for every 10 samples.

Field rinsate blanks were collected to evaluate field decontamination procedures. Rinsate blanks were collected by rinsing sampling equipment (i.e., auger buckets and sampling bowls and spoons) after decontamination with deionized water. The rinsate water was collected in a sample container and submitted to the SMO. Field rinsate blank samples were analyzed for inorganic chemicals (target analyte list metals, cyanide, nitrate, and perchlorate) and were collected from sampling equipment at a frequency of at least 1 rinsate sample for every 10 solid samples.

Field trip blanks were collected at a frequency of one per day at the time samples were collected for VOCs. Trip blanks consisted of containers of certified clean sand opened and kept with the other sample containers during the sampling process. Trip blanks were analyzed for VOCs only.

B-5.6 Sample Documentation and Handling

Field personnel completed a SCL form for each sample. Sample containers were sealed with signed custody seals and placed in coolers at approximately 4°C. Samples were handled in accordance with approved subcontractor procedures technically equivalent to SOP-5057, Handling, Packaging, and Transporting Field Samples, and SOP-5056, Sample Containers and Preservation. Swipe samples were collected from the exterior of sample containers and analyzed by the RCT before the sample containers were removed from the site. Samples were transported to the SMO for processing and shipment to off-site contract analytical laboratories. The SMO personnel reviewed and approved the SCLs and accepted custody of the samples.

B-5.7 Borehole Abandonment

All boreholes were abandoned in accordance with an approved subcontractor procedure technically equivalent to SOP-5034, Monitor Well and RFI Borehole Abandonment, by filling the boreholes with bentonite chips up to 1 ft from the ground surface. The chips were hydrated and clean soil placed on top. All cuttings were managed as investigation-derived waste (IDW) as described in Appendix G.

B-5.8 Decontamination of Sampling Equipment

The split-spoon core barrels and all other sampling equipment that came (or could have come) in contact with sample material were decontaminated after each core was retrieved and logged. Decontamination included wiping the equipment with Fantastik and paper towels. Decontamination of the drilling equipment was conducted before mobilization of the drill rig to another borehole to avoid cross-contamination between samples and borehole locations. Residual material adhering to equipment was removed using dry decontamination methods such as the use of wire brushes and scrapers. Decontamination activities were performed in accordance with an approved subcontractor procedure technically equivalent to SOP-5061, Field Decontamination of Equipment. Decontaminated equipment was surveyed by an RCT before it was released from the site.

B-5.9 Site Demobilization and Restoration

Before equipment was removed from the site, a Laboratory RCT screened the equipment for radioactivity to ensure all equipment was clean of site contamination. All temporary fencing and staging areas were dismantled and returned to pre-investigation conditions. All excavated and disturbed areas were re-contoured.

B-6.0 DEBRIS REMOVAL AND EXCAVATION

B-6.1 Debris Removal

The approved work plan called for debris removal at SWMU 05-006(c) (LANL 2010, 108281). A small amount of burned debris (charred wood, melted glass, and metal) was removed from the former location of building 05-5 [SWMU 05-006(c)]. Also present in the debris were fragments of lead from the shielding in building 05-5. XRF field screening identified two sampling locations with lead levels above the industrial SSL (Figure C-2.2-1 and Table C-2.2-1 in Appendix C). Contaminated soil and tuff were excavated and depth of the excavation ranged from 0.5–1 ft bgs to remove media that contained lead exceeding the industrial SSL. The debris and underlying soil or tuff were removed with a combination of hand tools and heavy equipment. The debris was segregated and containerized in accordance with the waste characterization strategy form (WCSF). Confirmation sampling was conducted to define the nature and extent of lead contamination at the excavation at SWMU 05-006(c). The results of confirmation samples are presented in section 6.4.2.4 of the investigation report.

B-6.2 Excavation at Location 05-613800

After evaluating the initial analytical results, the Laboratory proposed to conduct further sampling (LANL 2011, 203592) and NMED approved the additional sampling (NMED 2011, 203618). The additional sampling included excavating the surface soil at location 05-613800 (outside the debris area) associated with SWMU 05-006(c), but located within SWMU 05-005(b), to remove additional lead contamination. The surface soil and underlying tuff at this location were excavated and depth of the excavation ranged from 1–2 ft bgs within the remediated area. Confirmation samples were collected to define the nature and extent of lead contamination. The results of confirmation samples are presented in section 6.4.2.4 of the investigation report.

B-7.0 GEODETIC SURVEYING

Geodetic surveys of all sampling locations were performed using a Trimble R8 Global Navigation Satellite System (GNSS) referenced from published and monumented external Laboratory survey control points in the vicinity. All sampling locations were surveyed in accordance with an approved subcontractor procedure technically equivalent to SOP-5028, Coordinating and Evaluating Geodetic Surveys. Horizontal accuracy of the monumented control points is within 0.1 ft. The Trimble R8 GNSS instrument referenced from Laboratory control points is accurate within 0.2 ft. The surveyed coordinates are presented in Table 3.2-1 of the investigation report.

B-8.0 IDW STORAGE AND DISPOSAL

All IDW generated during the field investigation was managed in accordance with an approved subcontractor procedure technically equivalent to SOP-5238, Characterization and Management of Environmental Program Waste. This procedure incorporates the requirements of all applicable U.S. Environmental Protection Agency (EPA) and NMED regulations, U.S. Department of Energy orders, and Laboratory implementation requirements. IDW was also managed in accordance with the approved

WCSF and the IDW management appendix of the approved investigation work plan (LANL 2010, 108281; NMED 2010, 108451). Details of IDW management for the Lower Mortandad/Cedro Canyons Aggregate Area investigation are presented in Appendix G.

B-9.0 DEVIATIONS FROM THE WORK PLAN

Implementation of investigation activities resulted in the following deviations from the approved investigation work plan:

1. *SWMU 05-005(b):* Nine samples were collected from three new locations in another discernable drainage identified during sampling of the preapproved locations according to the work plan in order to capture the nature and extent of contamination in the drainages downgradient of the site.

2. *SWMU 05-005(b):* Sample RE05-11-14597 from 2–3 ft bgs was inadvertently analyzed for acenaphthylene instead of acenaphthene. However, three other samples, RE05-11-14596, RE05-11-14598, and RE05-11-14599, collected at this location from 0–1 ft, 5–6 ft, and 9–10 ft bgs, respectively, are sufficient to define the lateral and vertical extent of acenaphthene at the site.

3. *SWMU 05-006(c):* Confirmation samples were collected at four locations (05-613925, 05-613926, 05-613927, and 05-613928) from 0–1 ft bgs at the bottom of excavation. Only surface samples were collected (the work plan proposed 0–1 ft, 2–3 ft, and 5–6 ft bgs, Table 4.0-1, LANL 108281) because there were sampling locations with multiple depths within the immediate vicinity of these four locations.

4. *Geomorphic Characterization Report:* In its January 22, 2010, approval with modifications letter (NMED 2010, 108451) NMED added a requirement to include a geomorphic characterization report as an appendix to this investigation report. The investigation work plan (LANL 2010, 108281) indicated that field observation of geomorphic relationships would be considered by the field geologist to aid in selecting locations likely to have been impacted by Laboratory operations. The purpose of these observations was not to perform a detailed geomorphic characterization, such as are performed in canyons investigations and presented in canyons investigation reports. Preparation of a geomorphic characterization report is beyond the scope of investigation activities previously and currently conducted for aggregate area investigations. Therefore, the geomorphic characterization report was not prepared and is not presented as an appendix to this investigation report.

   As indicated in sections 3.2.4 of the report and B-5.4 of this apendix, sediment samples were collected from areas of sediment accumulation that include sediment determined to be representative of the historical period of Laboratory operations. Field screening was also used to identify areas potentially impacted by historical releases from Laboratory operations. There were no deviations from the proposed sampling approach in the investigation work plan to identify sediment sampling locations.

B-10.0 REFERENCES

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

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

LANL (Los Alamos National Laboratory), January 2010. "Investigation Work Plan for Lower Mortandad/Cedro Canyons Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-10-0048, Los Alamos, New Mexico. (LANL 2010, 108281)

LANL (Los Alamos National Laboratory), May 20, 2011. "Extension Request for the Lower Mortandad/Cedro Canyons Aggregate Area Investigation Report," Los Alamos National Laboratory letter (EP2011-0189) to J. Kieling (NMED-HWB) from M.J. Graham (LANL) and G.J. Rael (DOE-LASO), Los Alamos, New Mexico. (LANL 2011, 203592)

NMED (New Mexico Environment Department), January 22, 2010. "Approval with Modifications, Investigation Work Plan for Lower Mortandad/Cedro Canyons Aggregate Area, Revision 1," New Mexico Environment Department letter to M.J. Graham (LANL) and G.J. Rael (DOE-LASO) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 108451)

NMED (New Mexico Environment Department), May 31, 2011. "Approval, Extension Request, Lower Mortandad/Cedro Canyons Aggregate Area Investigation Report," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 203618)

Table B-1.0-1
Summary of Field Investigation Methods

Method	Summary
Spade-and-Scoop Collection of Soil Samples	This method was used to collect shallow (i.e., approximately 0-12 in.) soil or sediment samples. The spade-and-scoop method involved digging a hole to the desired depth, as prescribed in the approved work plan, and collecting a discrete grab sample. Samples for VOC analysis were transferred immediately into sample containers. Containers for VOC analysis were filled as completely as possible and sealed with Teflon-lined caps. Remaining sample material was placed in a clean stainless-steel bowl for transfer into various sample containers.
Hand-Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but in some cases may be used to collect samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in.-inside diameter [I.D.]), creating a vertical hole that can be advanced to the desired sampling depth. When the desired depth was reached, the auger was decontaminated before the hole was advanced through the sampling depth. Samples for VOC analysis were transferred immediately into sample containers. Containers for VOC analysis were filled as completely as possible and sealed with Teflon-lined caps. The remaining sample material was transferred from the auger bucket to a stainless-steel sampling bowl before the various required sample containers were filled.
Split-Spoon Core-Barrel Sampling	A stainless-steel core barrel was advanced using a hollow-stem auger drilling rig. The core barrel extracted a continuous length of soil and/or rock. The split-spoon core barrel is a cylindrical barrel split length-wise so the two halves can be separated to expose the core sample. Once the core barrel was extracted and opened, a sample for VOC analysis was transferred immediately to a sample container. If necessary, pieces small enough to fit into the sample container were removed from the core using a decontaminated rock hammer or stainless-steel spoon. Containers for VOC analysis were filled as completely as possible and sealed with Teflon-lined caps. The section of core in the core barrel was then screened for radioactivity and organic vapors, and described in a geologic log. A portion of the core was then collected as a discrete sample from the desired depth for remaining analyses.
Handling, Packaging, and Shipping of Samples	Field team members sealed and labeled samples before packing to ensure the sample and the transport containers were free of external contamination. Field team members packaged all samples to minimize the possibility of breakage during transport. After all environmental samples were collected, packaged, and preserved, a field team member transported them to the SMO. The SMO arranged to ship the samples to the analytical laboratories.
Sample Control and Field Documentation	The collection, screening, and transport of samples were documented on standard forms generated by the SMO. These included SCLs and sample container labels. SCLs were completed at the time of sample collection, and the logs were signed by the sampler and a reviewer who verified the logs for completeness and accuracy. Corresponding labels were initialed and applied to each sample container, and custody seals were placed around each sample container. SCLs were completed and signed to verify that the samples were not left unattended.
Field QC Samples	Field QC samples were collected as follows: *Field Duplicates*: At a frequency of 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment Rinsate Blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water, which was 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 blank containers of certified clean sand were opened and kept with the other sample containers during the sampling process.

Table B-1.0-1 (continued)

Method	Summary
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination was used to minimize the generation of liquid waste. Dry decontamination included 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.
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 were printed on the SCL provided by the SMO (size and type of container [e.g., glass, amber glass, or polyethylene]). All samples were preserved by placing them in insulated containers with ice to maintain a temperature of 4°C.
Coordinating and Evaluating Geodetic Surveys	Geodetic surveys focused on obtaining survey data of acceptable quality to use during project investigations. Geodetic surveys were conducted with a Trimble R8 GNSS. The survey data conformed to Laboratory Information Architecture project standards IA-CB02, GIS Horizontal Spatial Reference System, and IA-D802, Geospatial Positioning Accuracy Standards for A/E/C/ and Facility Management. All coordinates were expressed as State Plane Coordinate System 83, NM Central, U.S. feet. All elevation data were reported relative to the National Geodetic Vertical Datum of 1983.
Management of Environmental Restoration Project Waste, Waste Characterization	IDW was managed, characterized, and stored in accordance with an approved WCSF that documents the site history, field activities, and characterization approach for each waste stream managed. Waste characterization complied with on- or off-site waste acceptance criteria. All stored IDW was marked with appropriate signage and labels. Drummed IDW was stored on pallets to prevent the containers from deteriorating. A waste storage area was established before waste was generated. Waste storage areas were located in controlled areas of the Laboratory to prevent unauthorized personnel from inadvertently adding or managing wastes. Each container of waste generated was individually labeled with waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste was segregated by classification and compatibility to prevent cross-contamination. Management of IDW is described in Appendix G.

Table B-1.0-2
SOPs Used for Investigation Activities Conducted at the Lower Mortandad/Cedro Canyons Aggregate Area

SOP-5018, Integrated Fieldwork Planning and Authorization
SOP-5028, Coordinating and Evaluating Geodetic Surveys
SOP-5034, Monitor Well and RFI Borehole Abandonment
SOP-5047, X-Ray Fluorescence Analysis
SOP-5055, General Instructions for Field Investigations
SOP-5056, Sample Containers and Preservation
SOP-5057, Handling, Packaging, and Transporting Field Samples
WES-EDA-QP-219, Sample Control and Field Documentation
SOP-5059, Field Quality Control Samples
SOP-5061, Field Decontamination of Equipment
SOP-5181, Notebook and Logbook Documentation for Environmental Directorate Technical and Field Activities
SOP-5238, Characterization and Management of Environmental Program Waste
SOP-01.12, Field Site Closeout Checklist
SOP-06.09, Spade and Scoop Method for Collection of Soil Samples
SOP-06.10, Hand Auger and Thin-Wall Tube Sampler
SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials
SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector
SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials
EP-DIR-QAP-0001, Quality Assurance Plan for the Environmental Programs

Note: Procedures used were approved subcontractor procedures technically equivalent to the procedures listed.

Appendix C

X-Ray Fluorescence Survey

C-1.0 INTRODUCTION

This appendix summarizes the results the of x-ray fluorescence (XRF) survey conducted at Solid Waste Management Unit (SWMU) 05-006(c) during the 2011 investigation at the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory).

SWMU 05-006(c) is an area of potentially contaminated soil associated with the location of former building 05-5. During the 1995 Resource Conservation and Recovery Act facility investigation at SWMU 05-006(c), lead was detected above the industrial soil screening level (SSL) at concentrations of 1740 mg/kg and 43,900 mg/kg in two surface samples collected at two locations (LANL 2010, 108281, Table 4.0-3). As a result, the approved work plan proposed removing the debris at the site (LANL 2010, 108281, p. 19; NMED 2010, 108451).

C-2.0 XRF SURVEY

A Niton XL3t 600 XRF analyzer was used to screen for concentrations of lead at SWMU 05-006(c) on February 7, 2011. The objectives were to identify areas of lead contamination, to remove soil containing lead above the industrial SSL, and to conduct confirmation sampling beneath the area where soil was removed to define the nature and extent of lead contamination.

C-2.1 Methodology

The Niton XL3t 600 XRF analyzer uses compact sealed-radioactive sources iron-55, cadmium-109, and americium-241 to identify and quantify certain inorganic chemicals. The instrument is equipped with a high-resolution mercury-12 detector connected to a sealed electronic module. The survey was conducted in accordance with an approved subcontractor procedure technically equivalent to SOP-5047, X-Ray Fluorescence Analysis. The soil samples collected were analyzed in accordance with the manufacturer’s specifications.

C-2.2 Results and Discussion

The areas of soil selected for XRF analysis were beneath the removed debris piles. The screening locations are shown in Figure C-2.2-1. The XRF survey results are presented in Table C-2.2-1. Lead was detected at levels above the industrial SSL in surface soil samples from two locations at concentrations of 1174 ppm and 2735 ppm (Table C-2.2-1).

Based on results from the XRF field-screening survey and visible observation of lead material on the ground surface at SWMU 05-006(c), areas where lead concentrations exceeded the industrial SSL were excavated to depth ranged from 0.5–1.0 ft below ground surface (bgs). Confirmation samples were collected at the bottom of the excavation and analyzed in accordance with applicable field methods described in Appendix B. Management of the waste generated from the excavation and associated investigation-derived waste is described in Appendix G.

C-2.3 Conclusions

All objectives of the XRF survey at SWMU 05-006(c) were met. Two sampling locations with lead levels above the industrial SSL were identified. Contaminated soil and tuff were excavated to remove the media that contained lead at levels exceeding the industrial SSL. Confirmation sampling was conducted to define the extent of lead contamination at SWMU 05-006(c). The results of confirmation samples are presented in section 6.4.2.4 of the investigation report.

C-3.0 REFERENCE

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

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

LANL (Los Alamos National Laboratory), January 2010. "Investigation Work Plan for Lower Mortandad/Cedro Canyons Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-10-0048, Los Alamos, New Mexico. (LANL 2010, 108281)

NMED (New Mexico Environment Department), January 22, 2010. "Approval with Modifications, Investigation Work Plan for Lower Mortandad/Cedro Canyons Aggregate Area, Revision 1," New Mexico Environment Department letter to M.J. Graham (LANL) and G.J. Rael (DOE-LASO) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 108451)

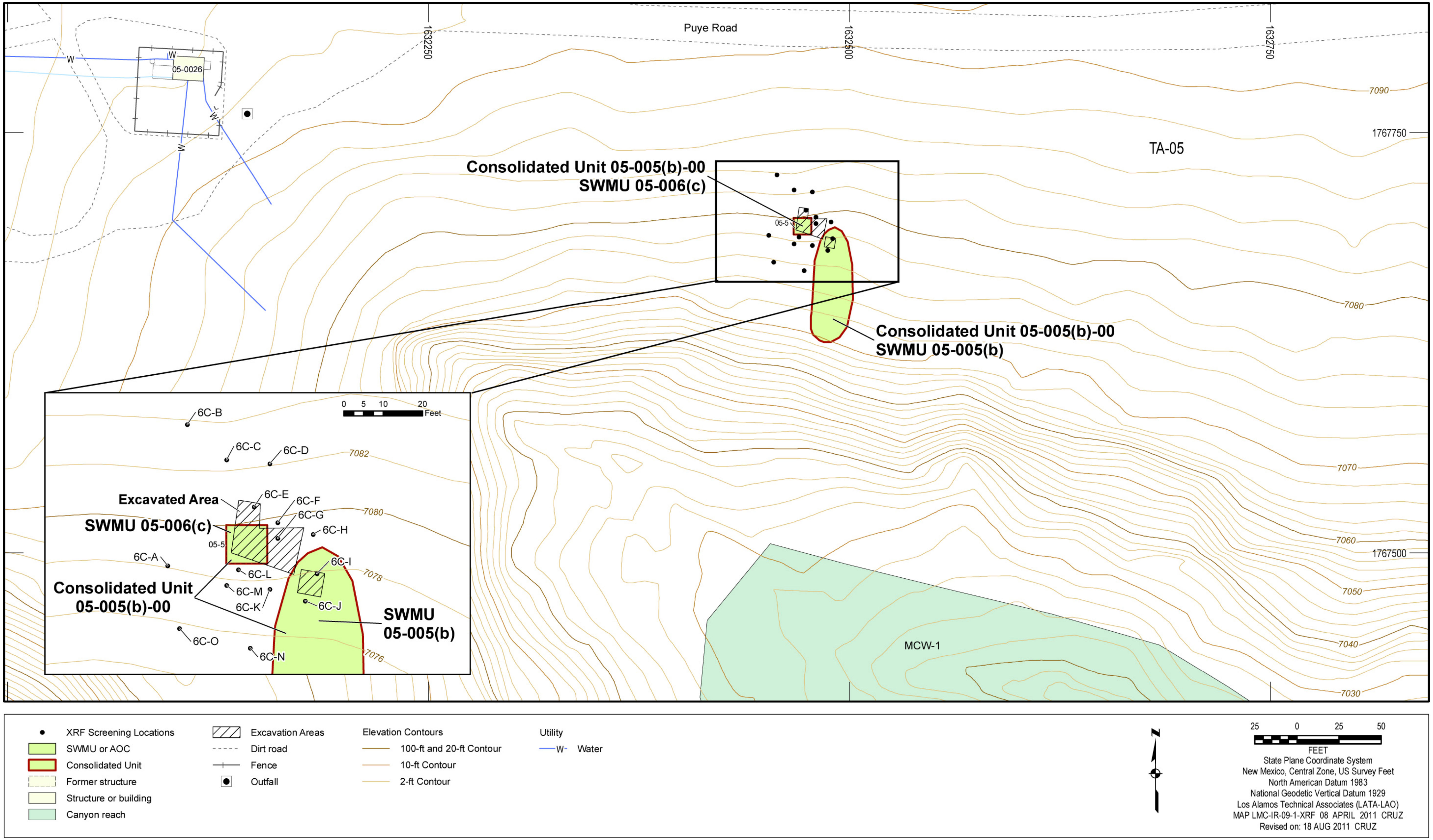


Figure C-2.2-1 XRF screening locations at SWMU 05-006(c)

Table C-2.2-1
XRF Survey Results at SWMU 05-006(c)

Location	Copper at 0.5 ft bgs (ppm)	Lead at 0.5 ft bgs (ppm)	Zinc at 0.5 ft bgs (ppm)
6c-A	0	0	30
6c-B	0	34	104
6c-C	0	0	47
6c-D	0	54	94
6c-E	0	1774	403
6c-F	156	382	268
6c-G	0	2735	125
6c-H	0	68	78
6c-I	0	190	0
6c-J	0	132	41
6c-K	0	91	0
6c-L	0	96	51
6c-M	0	50	71
6c-N	0	57	71
6c-O	0	30	0

Appendix D

Borehole Logs

Los Alamos Technical Associates, Inc.
Borehole Log

Project: Lower Mortendad/Cedro Canyon AA IWP **Page 1 of 1**

Borehole Location ID: 05-613784 **IWP Location ID:** 3-1 **Date:** 01/20/2011

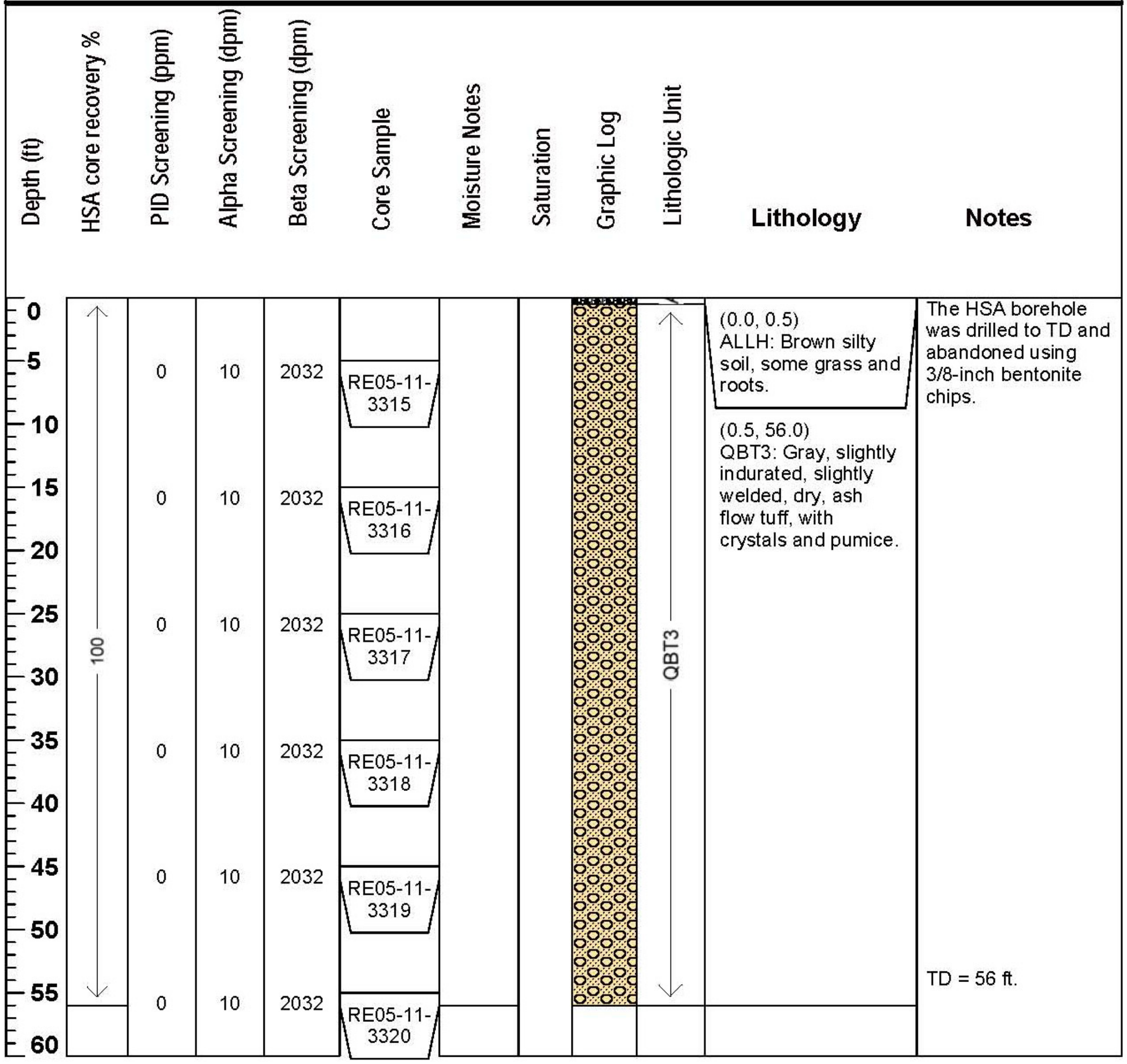
TA- 5 **SWMU/AOC:** 05-003 **Attitude:** Vertical

Drilling Company: Stewart Bros. Drilling Co. **Drill Operator:** Stanley Johnson

Drilling equipment: Failing F-10 **Depth to saturation (ft):** NA

LATA Sampler: Jacinto Garduno **Depth to soil/tuff interface (ft):** 0.5

Sampling equipment: HSA core barrel **Total Depth (ft):** 56



Depth (ft)	HSA core recovery %	PID Screening (ppm)	Alpha Screening (dpm)	Beta Screening (dpm)	Core Sample	Moisture Notes	Saturation	Graphic Log	Lithologic Unit	Lithology	Notes
0–0.5	100 (0–56)									(0.0, 0.5) ALLH: Brown silty soil, some grass and roots.	The HSA borehole was drilled to TD and abandoned using 3/8-inch bentonite chips.
0.5–56									QBT3	(0.5, 56.0) QBT3: Gray, slightly indurated, slightly welded, dry, ash flow tuff, with crystals and pumice.	
5–10		0	10	2032	RE05-11-3315						
15–20		0	10	2032	RE05-11-3316						
25–30		0	10	2032	RE05-11-3317						
35–40		0	10	2032	RE05-11-3318						
45–50		0	10	2032	RE05-11-3319						
55–60		0	10	2032	RE05-11-3320						TD = 56 ft.

ALLH = Soil, all horizons, CME = Central Mine Equipment, dpm = disintegrations per minute, HSA = hollow stem auger, NA = not applicable or not encountered, PID = photo-ionization detector, ppm = parts per million, QAL = Quaternary Alluvium, QBO = Quaternary Bandelier Tuff Otowi Member, QBT = Quaternary Bandelier Tuff Tshirege Member, QBT1v = Quaternary Bandelier Tuff Tshirege Member Cooling Unit 1 devitrified, QBT3 = Quaternary Bandelier Tuff Tshirege Member Cooling Unit 3, Sat. = saturated, TA = Technical Area, TD = Total Depth.

Los Alamos Technical Associates, Inc.
Borehole Log

Project: **Lower Mortendad/Cedro Canyon AA IWP** **Page 1 of 1**

Borehole Location ID: 05-613785 **IWP Location ID:** 3-2 **Date:** 01/19/2011

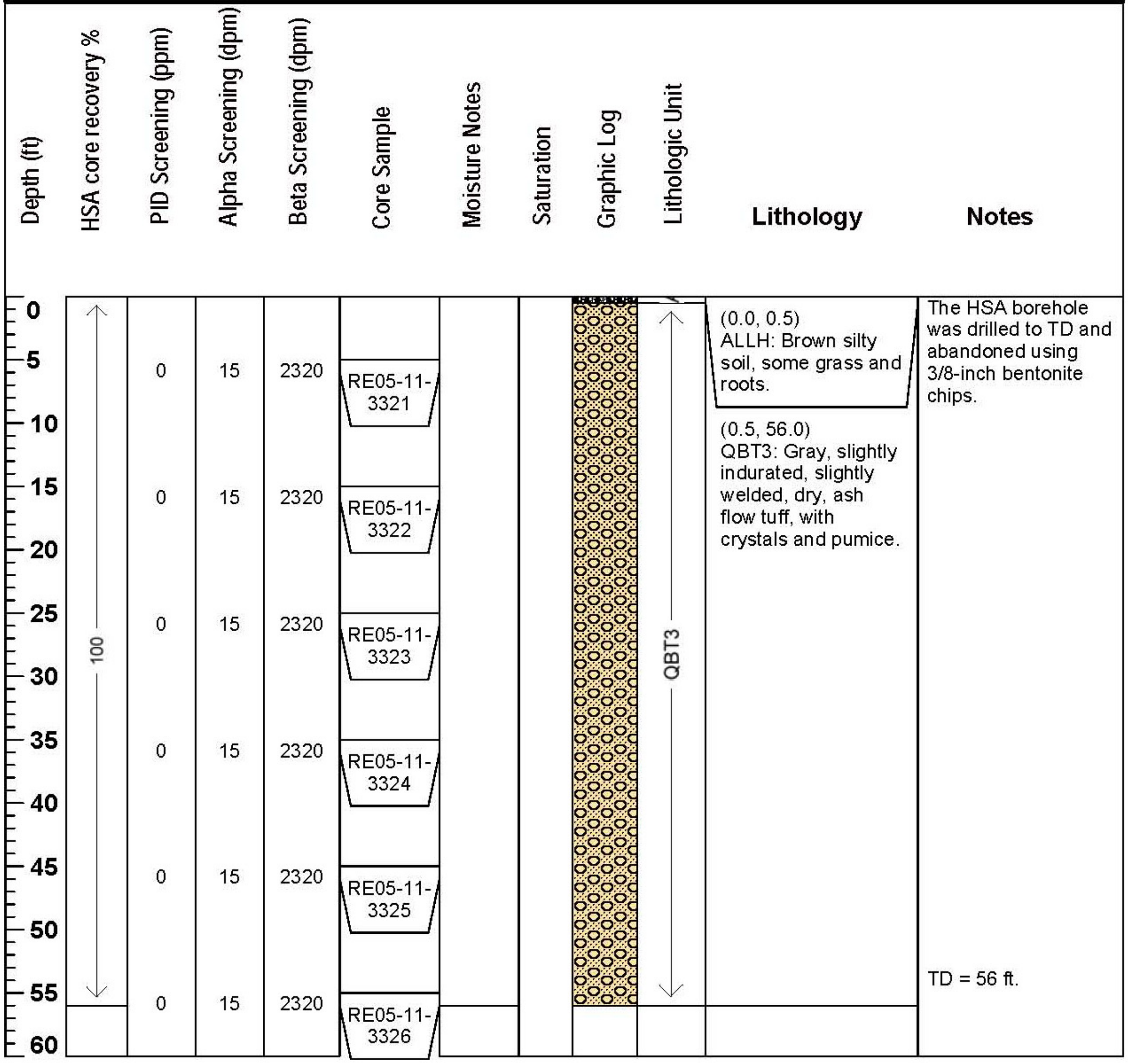
TA- 5 **SWMU/AOC:** 05-003 **Attitude:** Vertical

Drilling Company: Stewart Bros. Drilling Co. **Drill Operator:** Stanley Johnson

Drilling equipment: Failing F-10 **Depth to saturation (ft):** NA

LATA Sampler: Jacinto Garduno **Depth to soil/tuff interface (ft):** 0.5

Sampling equipment: HSA core barrel **Total Depth (ft):** 56



Depth (ft)	HSA core recovery %	PID Screening (ppm)	Alpha Screening (dpm)	Beta Screening (dpm)	Core Sample	Moisture Notes	Saturation	Graphic Log	Lithologic Unit
0–56	100								QBT3
5		0	15	2320	RE05-11-3321				
15		0	15	2320	RE05-11-3322				
25		0	15	2320	RE05-11-3323				
35		0	15	2320	RE05-11-3324				
45		0	15	2320	RE05-11-3325				
55		0	15	2320	RE05-11-3326				

Lithology

(0.0, 0.5)
ALLH: Brown silty soil, some grass and roots.

(0.5, 56.0)
QBT3: Gray, slightly indurated, slightly welded, dry, ash flow tuff, with crystals and pumice.

Notes

The HSA borehole was drilled to TD and abandoned using 3/8-inch bentonite chips.

TD = 56 ft.

ALLH = Soil, all horizons, CME = Central Mine Equipment, dpm = disintegrations per minute, HSA = hollow stem auger, NA = not applicable or not encountered, PID = photo-ionization detector, ppm = parts per million, QAL = Quaternary Alluvium, QBO = Quaternary Bandelier Tuff Otowi Member, QBT = Quaternary Bandelier Tuff Tshirege Member, QBT1v = Quaternary Bandelier Tuff Tshirege Member Cooling Unit 1 devitrified, QBT3 = Quaternary Bandelier Tuff Tshirege Member Cooling Unit 3, Sat. = saturated, TA = Technical Area, TD = Total Depth.

Los Alamos Technical Associates, Inc.
Borehole Log

Project: Lower Mortendad/Cedro Canyon AA IWP **Page 1 of 1**

Borehole Location ID: 05-613790 **IWP Location ID:** 4-4 **Date:** 06/23/2011

TA- 5 **SWMU/AOC:**05-004 **Attitude:** Vertical

Drilling Company: Stewart Bros. Drilling Co. **Drill Operator:** Craig Johnson

Drilling equipment: CME 750 **Depth to saturation (ft):** NA

LATA Sampler: Ali Furmall **Depth to soil/tuff interface (ft):** 0.5

Sampling equipment: HSA core barrel **Total Depth (ft):** 45

Depth (ft)	HSA core recovery %	PID Screening (ppm)	Alpha Screening (dpm)	Beta Screening (dpm)	Core Sample	Moisture Notes	Saturation	Graphic Log	Lithologic Unit	Lithology	Notes
0	100								QBT3	(0.0, 0.5) ALLH: Brown silty soil, some grass and roots.	The HSA borehole was drilled to TD and abandoned using 3/8-inch bentonite chips.
5		0	10	2032	RE05-11-3346						
10		0	10	2032	RE05-11-3347					(0.5, 45.0) QBT3: Gray, slightly indurated, slightly welded, dry, ash flow tuff, with crystals and pumice.	
15		0	10	2032	RE05-11-3348						
20		0	10	2032	RE05-11-3349						
25		0	10	2032	RE05-11-3350						
30											
35		0	26.7	2333	RE05-11-14587						
40											
45		0	26.7	2333	RE05-11-14588						TD = 45 ft.

ALLH = Soil, all horizons, CME = Central Mine Equipment, dpm = disintegrations per minute, HSA = hollow stem auger, NA = not applicable or not encountered, PID = photo-ionization detector, ppm = parts per million, QAL = Quaternary Alluvium, QBO = Quaternary Bandelier Tuff Otowi Member, QBT = Quaternary Bandelier Tuff Tshirege Member, QBT1v = Quaternary Bandelier Tuff Tshirege Member Cooling Unit 1 devitrified, QBT3 = Quaternary Bandelier Tuff Tshirege Member Cooling Unit 3, Sat. = saturated, TA = Technical Area, TD = Total Depth.

Appendix E

Analytical Program

E-1.0 INTRODUCTION

This appendix discusses the analytical methods and data-quality review for samples collected during investigations at the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). Additionally, this appendix summarizes the effects of data-quality issues on the acceptability of the analytical data.

Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the Quality Assurance Project Plan Requirements for Sampling and Analysis (LANL 1996, 054609) and the Laboratory's statements of work (SOWs) for analytical laboratories (LANL 1995, 049738; LANL 2008, 109962). The results of the QA/QC procedures were used to estimate the accuracy, bias, and precision of the analytical measurements. Samples for QC include method blanks, matrix spikes (MSs), laboratory control samples (LCSs), internal standards (IS), initial calibration verifications (ICVs) and continuing calibration verifications (CCVs), surrogates, and tracers.

The type and frequency of laboratory QC analyses are described in the SOWs for analytical laboratories (LANL 1995, 049738; LANL 2008, 109962). Other QC factors, such as sample preservation and holding times, were also assessed in accordance with the requirements outlined in Standard Operating Procedure (SOP) 5056, Sample Containers and Preservation.

The following SOPs, available at http://www.lanl.gov/environment/all/qa/adep.shtml, were used for data validation:

- SOP-5161, Routine Validation of Volatile Organic (VOC) Analytical Data
- SOP-5162, Routine Validation of Semivolatile Organic Compound (SVOC) Analytical Data
- SOP-5163, Routine Validation of Organochlorine Pesticides (PEST) and Polychlorinated Biphenyl (PCB) Analytical Data
- SOP-5164, Routine Validation of High Explosives (HE) Analytical Data
- SOP-5165, Routine Validation of Metals Analytical Data
- SOP-5166, Routine Validation of Gamma Spectroscopy, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data
- SOP-5168, Routine Validation of LC/MS/MS High Explosive Analytical Data
- SOP-5169, Routine Validation Of Dioxin Furan Analytical Data (EPA Method 1618 and SW-846 EPA Method 8290)
- SOP-5191, Routine Validation of LC/MS/MS Perchlorate Analytical Data (SW-846 EPA Method 6850)

Routine data validation was performed for each data package (also referred to as request numbers), and analytical data were reviewed and evaluated based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines, where applicable (EPA 1994, 048639; EPA 1999, 066649). As a result of the data validation and assessment efforts, qualifiers are assigned to the analytical records as appropriate. The data-qualifier definitions are provided in Appendix A. Sample collection logs (SCLs) and chain-of-custody (COC) forms are provided in Appendix F (on DVD included with this document). The analytical data, instrument printouts, and data validation reports are also provided in Appendix F.

E-2.0 ANALYTICAL DATA ORGANIZATION

Historical data evaluated in this report were collected during Resource Conservation and Recovery Act facility investigations. All historical investigation samples were submitted to and analyzed by approved off-site laboratories. These data are determined to be of sufficient quality for decision-making purposes and have been reviewed and revalidated to current QA standards.

E-3.0 INORGANIC CHEMICAL ANALYSES

A total of 157 samples (plus 29 field duplicates) collected within the Lower Mortandad/Cedro Canyons Aggregate Area were analyzed for inorganic chemicals. A total of 153 samples (plus 29 field duplicates) were analyzed for target analyte list (TAL) metals; 86 samples (plus 10 field duplicates) were analyzed for nitrate; 101 samples (plus 23 field duplicates) were analyzed for perchlorate; and 84 samples (plus 18 field duplicates) were analyzed for total cyanide. The analytical methods used for inorganic chemicals are listed in Table E-1.0-1.

Tables in the investigation report summarize all samples collected and the analyses requested for the investigation of the four sites in the Lower Mortandad/Cedro Canyons Aggregate Area. All the analytical results are presented in Appendix F (on DVD included with this document).

E-3.1 Inorganic Chemical QA/QC Samples

QA/QC samples are used to measure the reliability of the data. The results of the QA/QC analyses performed on a sample provide confidence about whether the analyte is present and whether the concentration reported is accurate. To assess the accuracy and precision of inorganic chemical analyses, this investigation included analyses of LCSs, preparation blanks, method blanks, MSs, laboratory duplicate samples, interference check samples (ICSs), and serial dilution samples. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2008, 109962) and is described briefly in the paragraphs below.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. For inorganic chemicals in soil or tuff, LCS percent recoveries (%R) should fall within the control limits of 75% to 125% (LANL 1995, 049738; LANL 2008, 109962).

The preparation blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing; it is extracted and analyzed in the same manner as the corresponding environmental samples. Preparation blanks are used to measure bias and potential cross-contamination. All inorganic chemical results should be below the method detection limit (MDL).

MS samples assess the accuracy of inorganic chemical analyses. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS acceptance criterion is 75% to 125%, inclusive, for all spiked analytes (LANL 1995, 049738; LANL 2008, 109962).

Laboratory duplicate samples assess the precision of inorganic chemical analyses. All relative percent differences (RPDs) between the sample and laboratory duplicate should be ±35% for soil (LANL 1995, 049738; LANL 2008, 109962).

The ICSs assess the accuracy of the analytical laboratory's interelement and background correction factors used for inductively coupled plasma emission spectroscopy. The ICS %R should be within the acceptance range of 80% to 120%. The QC acceptance limits are ±20%.

Serial dilution samples measure potential physical or chemical interferences and correspond to a sample dilution ratio of 1:5. The chemical concentration in the undiluted sample must be at least 50 times the MDL (100 times for inductively coupled plasma mass spectroscopy) for valid comparison. For sufficiently high concentrations, the RPD should be within 10%.

E-3.2 Data-Quality Results for Inorganic Chemicals

The majority of the analytical results for inorganic chemicals either were not assigned a qualifier or were qualified as not detected (U) because the analytes were not detected by the respective analytical methods. No quality issues are associated with this data.

Seven nitrate, 12 perchlorate, 211 TAL metals, and 3 total cyanide results were qualified as estimated (J) because the analytical laboratory qualified the detected result as estimated.

E-3.2.1 Maintenance of COC

SCL/COC forms were maintained properly for all samples analyzed for inorganic chemicals (see Appendix F, on DVD included with this document).

E-3.2.2 Sample Documentation

All samples analyzed for inorganic chemicals were properly documented on SCL/COC forms in the field (see Appendix F, on DVD included with this document).

E-3.2.3 Sample Dilutions

Some samples were diluted for inorganic chemical analyses. No qualifiers were applied to any inorganic chemical sampling results because of dilutions.

E-3.2.4 Sample Preservation

Preservation criteria were met for all samples analyzed for inorganic chemicals.

E-3.2.5 Holding Times

All inorganic chemical analyses were performed within prescribed holding time requirements. No qualifiers were applied to any inorganic chemical sampling results because of holding time issues.

E-3.2.6 ICVs and CCVs

Twenty-two TAL metals results were qualified as not detected (U) because the sampling result was less than or equal to 5 times the concentration of the related analyte in the initial calibration blank/continuous calibration blank.

E-3.2.7 Interference Check Sample and/or Serial Dilutions

One TAL metal result was qualified as estimated (J) because a serial dilution sample was not analyzed with the samples

E-3.2.8 Laboratory Duplicate Samples

Fifty-two TAL metals results were qualified as estimated (J) because the sample and the duplicate sampling results were greater than or equal to 5 times the reporting limit (RL) and the duplicate RPD was greater than 35% for soil samples.

E-3.2.9 Blanks

Sixty-nine TAL metals results were qualified as not detected (U) because the sampling results were less than or equal to 5 times the concentration of the related analytes in the equipment rinsate blank.

Forty-eight TAL metals results were qualified as estimated (J) because the analyte was identified in the method blank but was greater than 5 times the RL.

A total of 105 TAL metals results were qualified as not detected (U) because the results were less than 5 times the amount in the preparation blank.

Twenty-three cyanide and 26 TAL metals results were qualified as not detected (U) because the sampling result was less than or equal to 5 times the concentration of the related analyte in the method blank.

E-3.2.10 MS Samples

Seven nitrate and 27 TAL metals results were qualified as estimated not detected (UJ) because the associated MS recovery was below the lower acceptance limit (LAL) but greater than 10%.

Ten nitrate results were qualified as estimated and biased low (J-) because the associated MS recovery was below the LAL but greater than 10%.

Sixty-nine TAL metals results were qualified as estimated and biased low (J-) because the analyte was recovered below the LAL but greater than 30% in the associated MS sample.

A total of 121 TAL metals results were qualified as estimated and biased high (J+) because the associated MS recovery was above the upper acceptance level (UAL).

E-3.2.11 LCS Recoveries

No qualifiers were applied to any inorganic chemical results because of LCS recovery issues.

E-3.2.12 Detection Limits

A total of 217 TAL metals results were qualified as estimated (J) because the results were between the estimated detection limit and MDL.

E-3.2.13 Rejected Results

Eight antimony results were qualified as rejected (R) because the associated spike sample recovery was less than 30%.

One total cyanide result was qualified as rejected (R) because the extraction holding time was exceeded by 2 times the acceptable holding time.

The rejected data were not used to determine the nature and extent of contamination or to assess the potential human and ecological risks. However, sufficient data of good quality are available to characterize the site(s). The results of other qualified data were used as reported and do not affect the usability of the data.

E-4.0 ORGANIC CHEMICAL ANALYSES

A total of 117 samples (plus 24 field duplicates) collected within the Lower Mortandad/Cedro Canyons Aggregate Area were analyzed for organic chemicals. A total of 89 samples (plus 22 field duplicates) were analyzed for volatile organic chemicals (VOCs); 111 samples (plus 11 field duplicates) were analyzed for semivolatile organic chemicals (SVOCs); 85 samples (plus 9 field duplicates) were analyzed for polychlorinated biphenyls (PCBs); 106 samples (plus 10 field duplicates) were analyzed for explosives compounds, and 53 samples (plus five field duplicates) were analyzed for dioxins/furans. All QC procedures were followed as required by the analytical laboratory SOWs (LANL 1995, 049738; LANL 2008, 109962). The analytical methods used for organic chemicals are listed in Table E-1.0-1.

Tables within the investigation report summarize all samples collected and the analyses requested from the Lower Mortandad/Cedro Canyons Aggregate Area sites. All organic chemical results are provided on DVD in Appendix F.

E-4.1 Organic Chemical QA/QC Samples

QA/QC samples are used to measure the reliability of the data. The results of the QA/QC analyses performed on a sample provide confidence about whether the analyte is present and whether the concentration reported is accurate. To assess the accuracy and precision of organic chemical analyses, this investigation included calibration verifications and the analysis of LCSs, method blanks, MSs, surrogates, and ISs. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2008, 109962) and described briefly in the paragraphs below.

Calibration verification is the establishment of a quantitative relationship between the response of the analytical procedure and the concentration of the target analyte. There are two aspects of calibration verification: initial and continuing. The initial calibration verifies the accuracy of the calibration curve as well as the individual calibration standards used to perform the calibration. The continuing calibration ensures that the initial calibration is still holding and correct as the instrument is used to process samples. The continuing calibration also serves to determine that analyte identification criteria such as retention times and spectral matching are being met.

The LCS is a sample of a known matrix that has been spiked with compounds that are representative of the target analytes, and it serves as a monitor of overall performance on a “controlled” sample. The LCS is the primary demonstration, on a daily basis, of the ability to analyze samples with good qualitative and quantitative accuracy. The LCS recoveries should be within the method specific acceptance criteria.

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing; it is extracted and analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during extraction and analysis. All target analytes should be below the contract-required detection limit in the method blank.

MS samples are used to measure the ability to recover prescribed analytes from a native sample matrix and consist of aliquots of the submitted samples spiked with a known concentration of the target analyte(s). Spiking typically occurs before sample preparation and analysis. The spike sample recoveries should be between the LAL and UAL.

A surrogate compound (surrogate) is an organic compound used in the analyses of target analytes that is similar in composition and behavior to the target analytes but not normally found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which analytes are recovered during extraction and analysis. The recovery percentage of the surrogates must be within specified ranges or the sample may be rejected or assigned a qualifier.

ISs are chemical compounds added to every blank, sample, and standard extract at a known concentration. They are used to compensate for (1) analyte concentration changes that might occur during storage of the extract, and (2) quantitation variations that can occur during analysis. Internal standards are used as the basis for quantitation of target analytes. The %R for ISs should be within the range of 50%–200%.

E-4.2 Data-Quality Results for Organic Chemicals

The majority of the analytical results for organic chemicals were either not assigned a qualifier or qualified as not detected (U) because the analytes were not detected by the respective analytical methods. These data do not have any quality issues associated with the values presented.

A total of 161 dioxin/furan, 3 PCB, 11 SVOC, and 30 VOC results were qualified as estimated (J) because the analytical laboratory qualified the detected result as estimated.

Seven dioxin/furan results were qualified as not detected (U) because the project chemist identified quality deficiencies in the reported data that requires further qualification.

E-4.2.1 Maintenance of COC

SCL/COC forms were maintained properly for all samples analyzed for organic chemicals (see Appendix F, on DVD included with this document).

E-4.2.2 Sample Documentation

All samples analyzed for organic chemicals were properly documented on the SCL in the field (see Appendix F, on DVD included with this document).

E-4.2.3 Sample Dilutions

Some samples were diluted for organic chemical analyses. No qualifiers were applied to any organic chemical sampling results because of dilutions.

E-4.2.4 Sample Preservation

Preservation criteria were met for all samples analyzed for organic chemicals.

E-4.2.5 Holding Times

A total of 124 VOC results were qualified as estimated not detected (UJ) because the holding time was less than or equal to 2 times the applicable holding time requirement.

E-4.2.6 ICVs and CCVs

Eighty-five high explosives (HE) results were qualified as estimated not detected (UJ) because the affected analytes were analyzed with a relative response factor of less than 0.05 in the initial calibration and/or CCV.

A total of 86 HE, 324 SVOC, and 187 VOC results were qualified as estimated not detected (UJ) because the ICV and/or CCV were recovered outside the method-specific limits.

Nine SVOC and two VOC results were qualified as estimated (J) because the ICV and/or CCV were recovered outside the method-specific limits.

E-4.2.7 Surrogate Recoveries

Surrogate recovery criteria were met for all samples analyzed for organic chemicals.

E-4.2.8 IS Responses

IS response criteria were met for all samples analyzed for organic chemicals.

E-4.2.9 Blanks

Thirty dioxin/furan results were qualified as estimated (J) because the sampling result was greater than 5 times the amount in the method blank.

Seventy-eight dioxin/furan and two SVOC results were qualified as not detected (U) because the sampling result was less than or equal to 5 times the concentration of the related analyte in the method blank.

One VOC result was qualified as not detected (U) because the associated sample concentration is less than or equal to 5 times the amount in the method blank.

Five VOC results were qualified as not detected (U) because the sampling result was less than or equal to the concentration of the related analyte in the trip blank or equipment rinsate blank.

E-4.2.10 MS Samples

MS criteria were met for all samples analyzed for organic chemicals.

E-4.2.11 Laboratory Duplicate Samples

Laboratory duplicates collected for organic chemical analyses indicated acceptable precision for all samples.

E-4.2.12 LCS Recoveries

Five HE and 10 SVOC results were qualified as estimated not detected (UJ) because the LCS %R was less than the LAL but greater than 10%.

E-4.2.13 Rejected Data

No organic data was rejected. The results of other qualified data were used as reported and do not affect the usability of the sampling results.

E-5.0 RADIONUCLIDE ANALYSES

A total of 129 samples (plus 12 field duplicates) collected within the Lower Mortandad/Cedro Canyons Aggregate Area were analyzed for radionuclides. A total of 14 samples (plus 2 field duplicates) were analyzed for gamma-emitting radionuclides; 115 samples (plus 10 field duplicates) were analyzed for isotopic plutonium; and 129 samples (plus 12 field duplicates) were analyzed for isotopic uranium. The analytical methods used for radionuclides are listed in Table E-1.0-1.

Tables in the investigation report summarize all samples collected and the analyses requested from the Lower Mortandad/Cedro Canyons Aggregate Area sites. All radionuclide results are provided on DVD in Appendix F.

E-5.1 Radionuclide QA/QC Samples

To assess the accuracy and precision of radionuclide analyses, this investigation included analyses of LCSs, method blanks, MS samples, laboratory duplicate samples, and tracers. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2008, 109962) and is described briefly in the paragraphs below.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. For radionuclides in soil or tuff, LCS %R should fall between the control limits of 80% and 120%.

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing; it is analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during analysis. All radionuclide results should be below the minimum detectable concentration (MDC).

MS samples assess the accuracy of inorganic chemical analyses. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS acceptance criterion is 75% to 125%.

Tracers are radioisotopes added to a sample for the purposes of monitoring losses of the target analyte. The tracer is assumed to behave in the same manner as the target analytes. The tracer recoveries should fall between the LAL and UAL.

Laboratory duplicate samples assess the precision of radionuclide analyses. All RPDs between the sample and laboratory duplicate should be ±35% for soil (LANL 1995, 049738; LANL 2008, 109962).

E-5.2 Data-Quality Results for Radionuclides

The majority of the analytical results for radionuclides either were not assigned a qualifier or were qualified as not detected (U) because the analytes were not detected by the respective analytical methods. These data do not have any quality issues associated with the values presented.

All procedures were followed as required by the analytical services SOWs (LANL 1995, 049738; LANL 2008, 109962). Some sampling results were qualified as not detected (U) because the associated sample concentration was less than or equal to the MDC. Some sampling results were qualified as not detected (U) because the associated sample concentration was less than or equal to 3 times the total propagated uncertainty (TPU). This data qualification is related to detection status only, not to the quality of the data.

E-5.2.1 Maintenance of COC

SCL/COC forms were maintained properly for all samples (see Appendix F, on DVD included with this document).

E-5.2.2 Sample Documentation

All samples were properly documented on the SCL/COC forms in the field (see Appendix F, on DVD included with this document).

E-5.2.3 Sample Dilutions

Some samples were diluted for radionuclide analyses. No qualifiers were applied to any radionuclide sampling results because of dilutions.

E-5.2.4 Sample Preservation

Preservation criteria were met for all samples analyzed for radionuclides.

E-5.2.5 Holding Times

Holding-time criteria were met for all samples analyzed for radionuclides.

E-5.2.6 Method Blanks

Method blank criteria were met for all samples analyzed for radionuclides.

E-5.2.7 MS Samples

MS criteria were met for all samples analyzed for radionuclides.

E-5.2.8 Tracer Recoveries

Three isotopic uranium results were qualified as estimated and biased low (J-) because the tracer was less than the LAL but greater than or equal to 10%.

Two isotopic plutonium results were qualified as estimated not detected (UJ) because the tracer was less than the LAL but greater than or equal to 10%.

E-5.2.9 LCS Recoveries

LCS recovery criteria were met for all samples analyzed for radionuclides.

E-5.2.10 Laboratory Duplicate Samples Recoveries

Laboratory duplicate sample recovery criteria were met for all samples analyzed for radionuclides.

E-5.2.11 Rejected Data

Seven cesium-134 results were qualified as rejected (R) because the MDC and/or TPU documentation was missing.

The rejected data were not used to determine the nature and extent of contamination or to assess the potential human and ecological risks. However, sufficient data of good quality are available to characterize the sites. The results of other qualified data were used as reported and do not affect the usability of the data.

E-6.0 REFERENCES

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

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

EPA (U.S. Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA-540/R-94/013, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1994, 048639)

EPA (U.S. Environmental Protection Agency), October 1999. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," EPA540/R-99/008, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1999, 066649)

LANL (Los Alamos National Laboratory), July 1995. "Statement of Work (Formerly Called "Requirements Document") - Analytical Support, (RFP number 9-XS1-Q4257), (Revision 2 - July, 1995)," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 049738)

LANL (Los Alamos National Laboratory), March 1996. “Quality Assurance Project Plan Requirements for Sampling and Analysis,” Los Alamos National Laboratory document LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 054609)

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

Table E-1.0-1
Inorganic Chemical, Organic Chemical, and Radionuclide Analytical Methods for Samples Collected in the Lower Mortandad/Cedro Canyons Aggregate Area

Analytical Method	Analytical Description	Analytical Suite
Inorganic Chemicals		
EPA 300.0	Ion chromatography	Anions (nitrate)
EPA SW-846: 6010/6010B	Inductively coupled plasma emission spectroscopy—atomic emission spectroscopy	Aluminum, antimony, arsenic, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc (TAL metals)
EPA SW-846:6020	Inductively coupled plasma mass spectrometry	Aluminum, antimony, arsenic, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, uranium, vanadium, and zinc
EPA SW-846:9012A	Automated colorimetric/off-line distillation	Total cyanide
EPA SW-846:6850	Liquid chromatography–mass spectrometry/mass spectrometry	Perchlorate
EPA SW-846:7471A	Cold vapor atomic absorption	Mercury
Organic Chemicals		
EPA SW-846: 8082	Gas chromatography	PCBs
EPA SW-846:8240 EPA SW-846:8260 EPA SW-846:8260B	Gas chromatography mass spectrometry	VOCs
EPA SW-846:8270C	Gas chromatography mass spectrometry	SVOCs
EPA SW-846:8290	High-resolution gas chromatography/high-resolution mass spectrometry	Dioxins/furans
EPA SW-846: 8321A _MOD	High performance liquid chromatography	Explosive compounds
Radionuclides		
EPA 901.1	Gamma spectroscopy	Cesium-134, cesium-137, cobalt-60, and sodium-22
HASL Method 300:ISOPU HASL Method 300:ISOU	Chemical separation alpha spectrometry	Isotopic plutonium Isotopic uranium

Appendix F

Analytical Suites and Results and Analytical Reports
(on DVD included with this document)

Appendix G

Investigation-Derived Waste Management

G-1.0 INTRODUCTION

This appendix contains the waste management records for the investigation-derived waste (IDW) generated during the implementation of the investigation work plan for the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (the Laboratory). IDW generated during the field investigation was managed in accordance with Standard Operating Procedure (SOP) 5238, Characterization and Management of Environmental Program Waste. This procedure incorporates the requirements of applicable U.S. Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) regulations, U.S. Department of Energy orders, and Laboratory policies and procedures.

Consistent with Laboratory procedures, a waste characterization strategy form (WCSF) was prepared to address characterization approaches, on-site management, and final disposition options for wastes. Analytical data and information on wastes generated during previous investigations and/or acceptable knowledge (AK) were used to complete the WCSF. All available waste documentation, including WCSFs, waste profile forms, and land application packages are provided in Attachment G-1 (on CD).

The selection of waste containers was based on appropriate U.S. Department of Transportation requirements, waste types, and estimated volumes of IDW to be generated. Immediately following containerization, each waste container was individually labeled with a unique identification number and with information regarding waste classification, contents, and radioactivity, if applicable.

Wastes were staged in clearly marked, appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements were based on the type of IDW and its classification. Container and storage requirements were detailed in the WCSF and approved before waste was generated.

Investigation activities were conducted in a manner that minimized the generation of waste. Waste minimization was accomplished by implementing the most recent version of the annual Los Alamos National Laboratory Hazardous Waste Minimization Report.

G-2.0 WASTE STREAMS

The IDW streams generated and managed during the investigation of Lower Mortandad/Cedro Canyons Aggregate Area are described below and are summarized in Table G-2.0-1. The waste numbers correspond with those identified in the WCSF.

- *WCSF Waste Stream #1: Drill Cuttings*—Drill cuttings consisted of sediment, soil, and tuff removed during investigation sampling activities. Approximately 1.89 yd^3 of drill cuttings was generated during this investigation and stored in 55-gal. drums. The cuttings were characterized per the WCSF and met the criteria in ENV-RCRA-QP-11.2, Land Application of Drill Cuttings, and were land applied at the point of generation.
- *WCSF Waste Stream #2: Contact Waste*—Contact waste consisted of spent personal protective equipment, material used in dry decontamination of sampling equipment (e.g., paper towels), and sampling equipment and other materials that contacted, or potentially contacted, contaminated environmental media and could not be decontaminated. This waste included, but was not limited to, plastic sheeting (e.g., tarps and liners), gloves, paper towels, plastic and glass sample bottles, and disposable sampling supplies. These wastes were containerized at the point of generation and were characterized based on AK of the waste materials, the methods of generation, and

analytical data for the media with which they came into contact. Approximately 0.25 yd^3 of contact waste was generated and was recycled through the Laboratory's Green Is Clean program.

- *WCSF Waste Stream #4: Excavated Media*—Contaminated soil and tuff were excavated from Solid Waste Management Unit (SWMU) 05-006(c) to remove media that exceeded industrial soil screening level for lead. The amount of excavated environmental media, plus all associated contact waste, was approximately 2.04 yd^3. These media were both nonradioactive hazardous and industrial (1.02 yd^3 of each type) and were disposed of at Clean Harbors Deer Trail, an authorized off-site disposal facility in Colorado.
- *WCSF Waste Stream #5: Excavated Man-Made Debris*—Man-made debris was generated when debris was removed at SWMU 05-006(c). Items such as nails, wire, pieces of metal, and melted glass were collected from the surface and removed from the excavated media. The amount of man-made debris was approximately 0.005 yd^3. These items were nonhazardous, nonradioactive industrial waste and were disposed of at Clean Harbors Deer Trail in Colorado.

  Additionally, elemental lead was present in SWMU 05-006(c), the remains of shielding from former building 05-5. The elemental lead was segregated and packaged separately from other man-made debris. The amount of elemental lead was approximately 0.015 yd^3. This debris was hazardous and nonradioactive and was disposed of at Clean Harbors Deer Trail in Colorado.
- *WCSF Waste Stream #6: Municipal Solid Waste (MSW)*—MSW consisted of noncontact trash and debris such as sample marking flags, wooden stakes, and pallets. Approximately 2 yd^3 of MSW was generated. This waste was determined to be nonhazardous and nonradioactive and was stored in plastic-lined trash cans and disposed of at the Los Alamos County, New Mexico, landfill.
- *WCSF Waste Streams #3, #7 and #8*—No decontamination fluids were generated, no petroleum-contaminated soil was found, and no excess samples were generated or returned.

Table G-2.0-1
Summary of IDW Generation and Management

WCSF Waste Stream No.	Waste Stream	Waste Type	Volume	Characterization Method	On-Site Management	Disposition
1	Drill cuttings	Land Applied	1.89 yd^3	Direct container sampling	55-gal. drum	Land application
2	Contact waste	Industrial	0.25 yd^3	AK and analytical results of site characterization	5 gal. poly container	Recycled through Green-Is-Clean
4	Excavated media	Hazardous, Industrial	2.04 yd^3	Direct container sampling	55-gal. drum	Disposal path: Clean Harbors Deer Trail, CO
5	Excavated man-made debris	Industrial	0.005 yd^3	AK and field screening	5-gal. poly container	Disposal path: Clean Harbors Deer Trail, CO
5	Excavated man-made debris (elemental lead)	Hazardous	0.015 yd^3	AK and field screening	5-gal. poly container	Disposal path: Clean Harbors Deer Trail, CO
6	MSW	MSW	2 yd^3	AK	Plastic bags	Disposal path: Los Alamos County, NM, landfill

Attachment G-1

Waste Characterization Strategy Form, Waste Profile Forms,
and Land Application Packages
(on CD included with this document)

Appendix H

Box Plots and Statistical Results

H-1.0 BOX PLOTS FOR SWMU 05-003

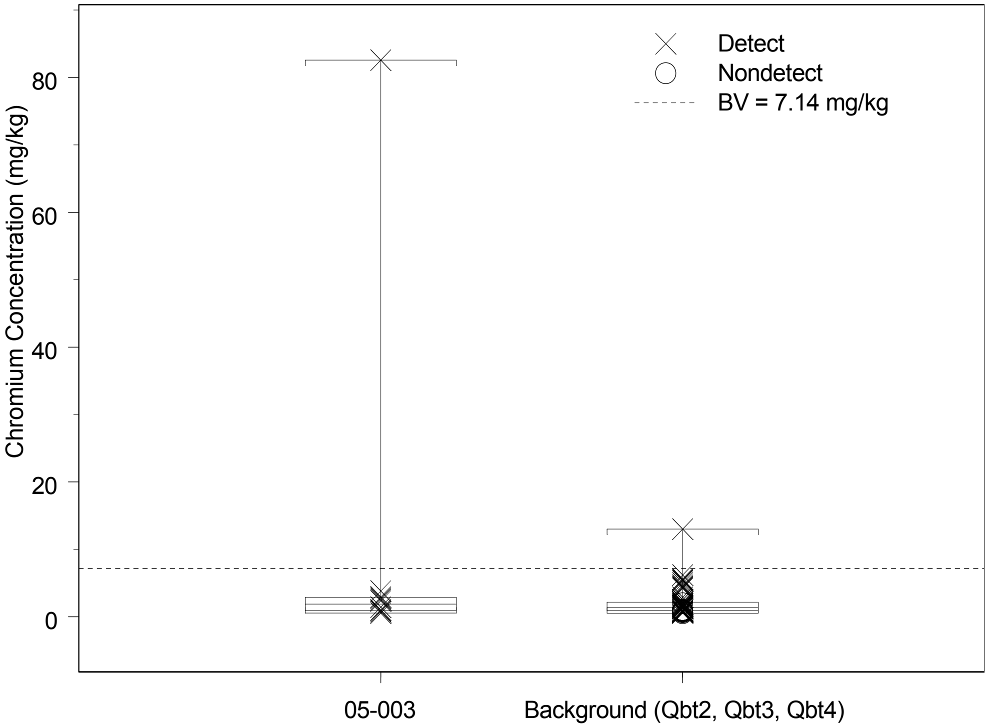


Figure H-1.0-1 Box plot of chromium in tuff at SWMU 05-003

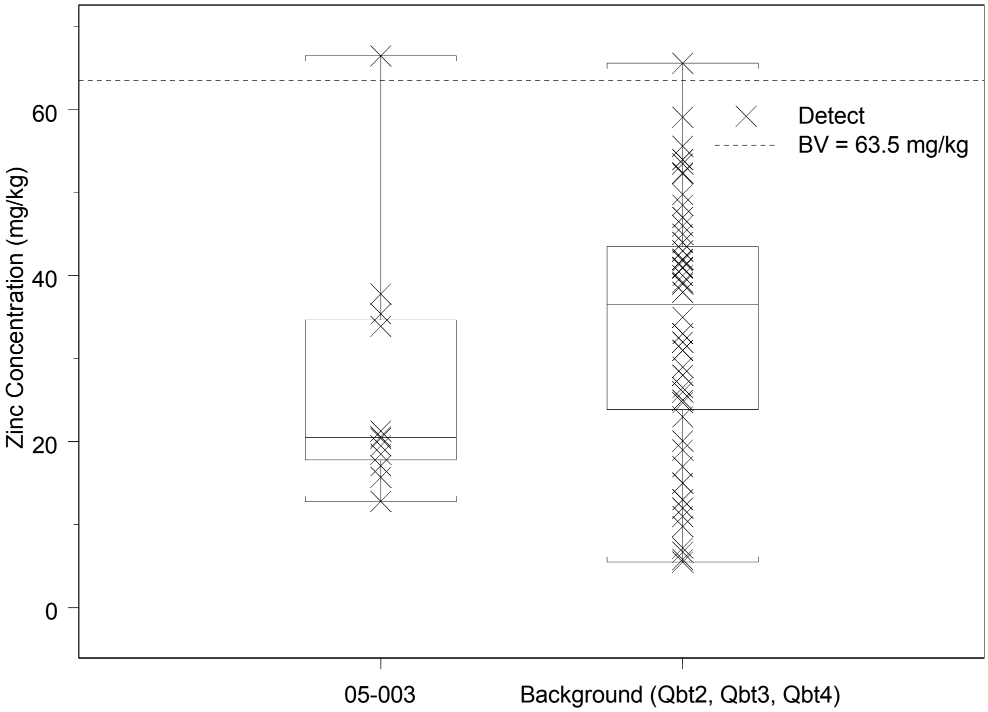


Figure H-1.0-2 Box plot of zinc in tuff at SWMU 05-003

H-2.0 BOX PLOTS FOR SWMU 05-004

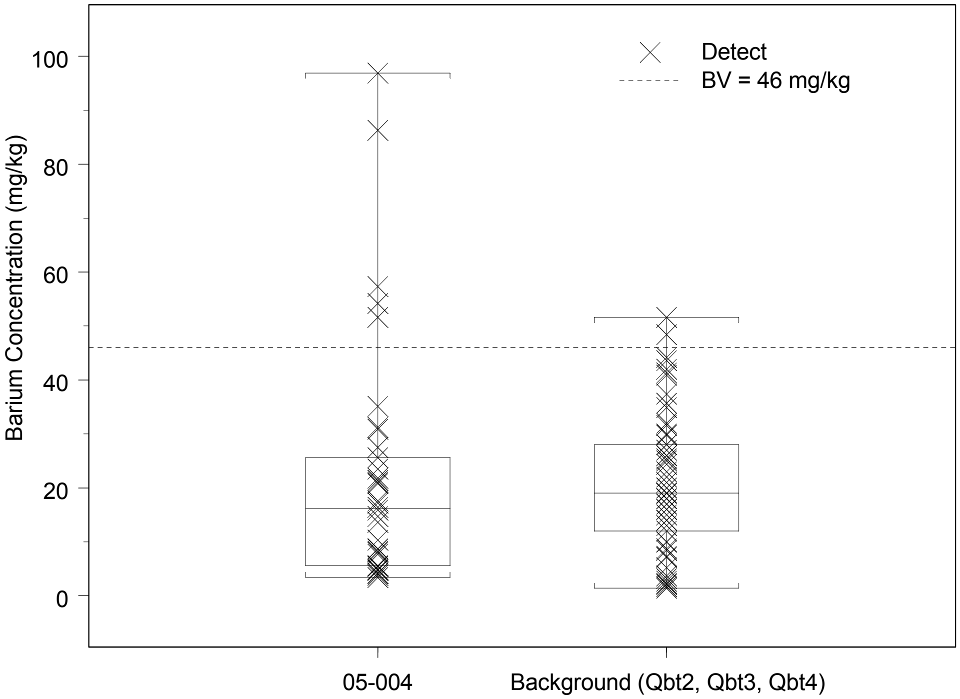


Figure H-2.0-1 Box plot of barium in tuff at SWMU 05-004

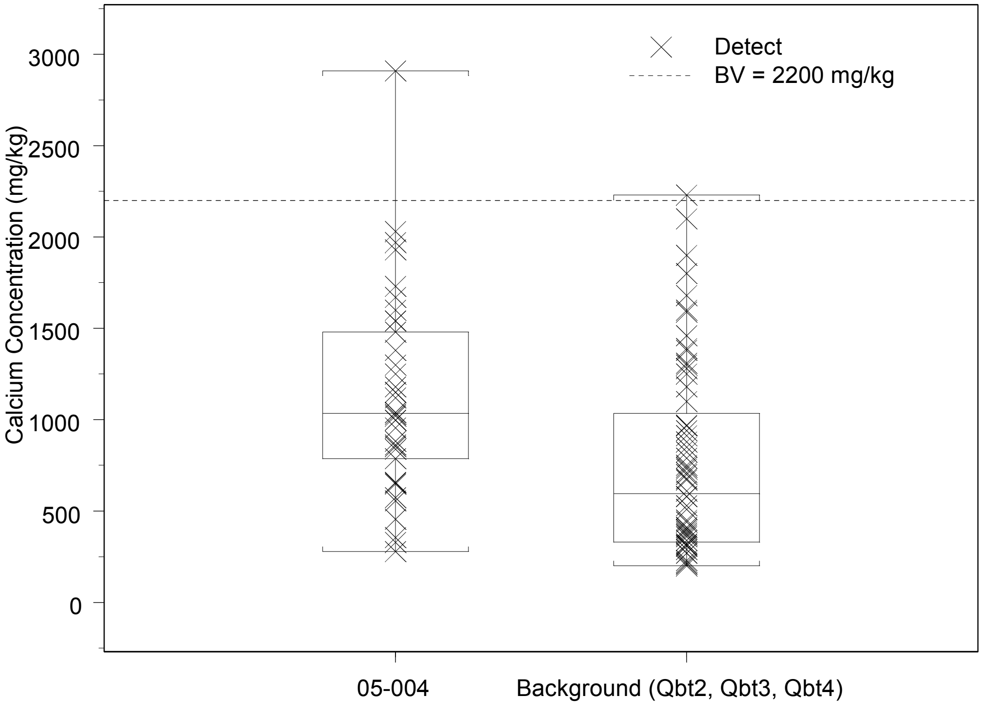


Figure H-2.0-2 Box plot of calcium in tuff at SWMU 05-004

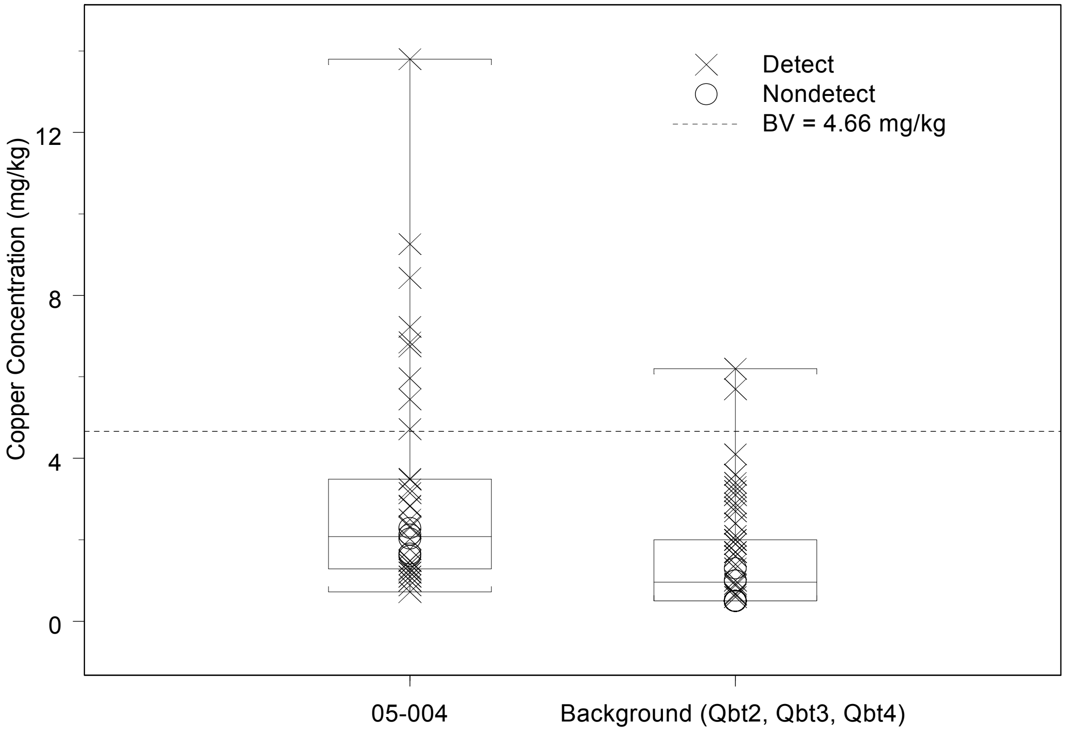


Figure H-2.0-3 Box plot of copper in tuff at SWMU 05-004

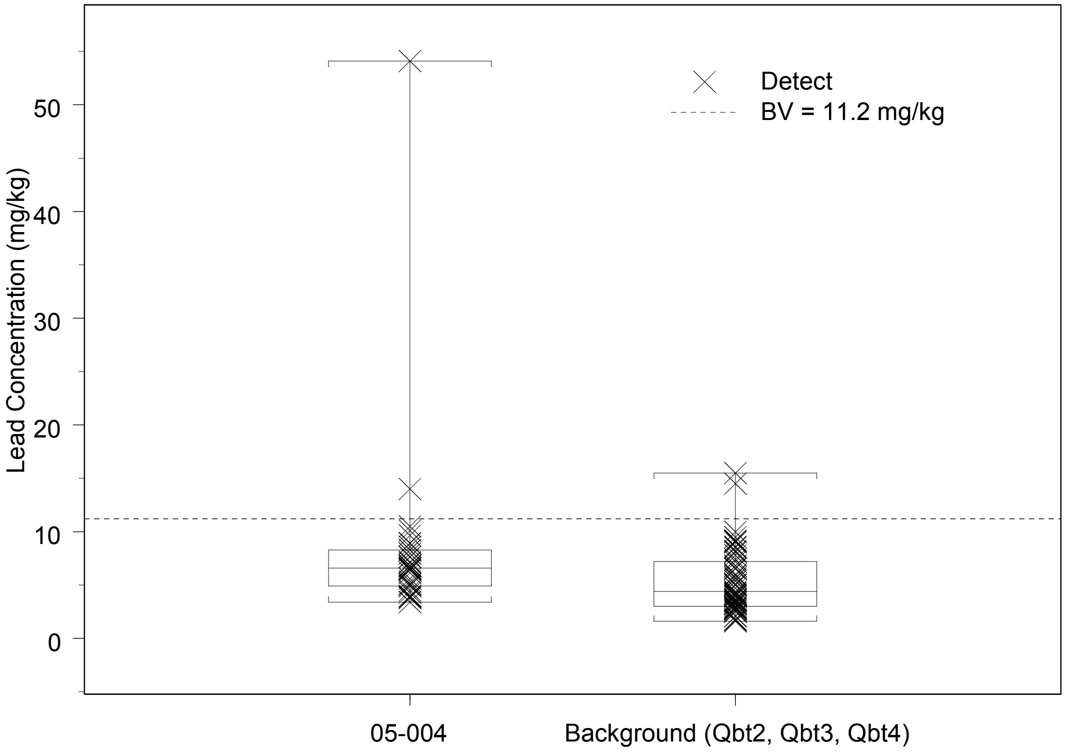


Figure H-2.0-4 Box plot of lead in tuff at SWMU 05-004

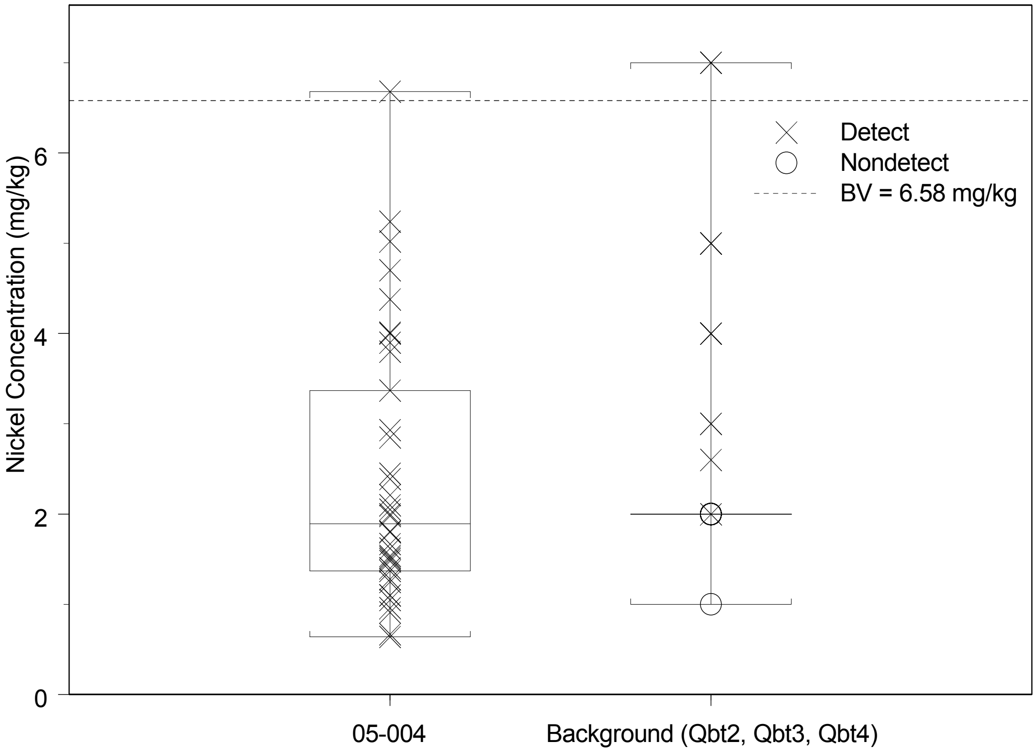


Figure H-2.0-5 Box plot of nickel in tuff at SWMU 05-004

H-3.0 BOX PLOTS FOR SWMU 05-005(b)

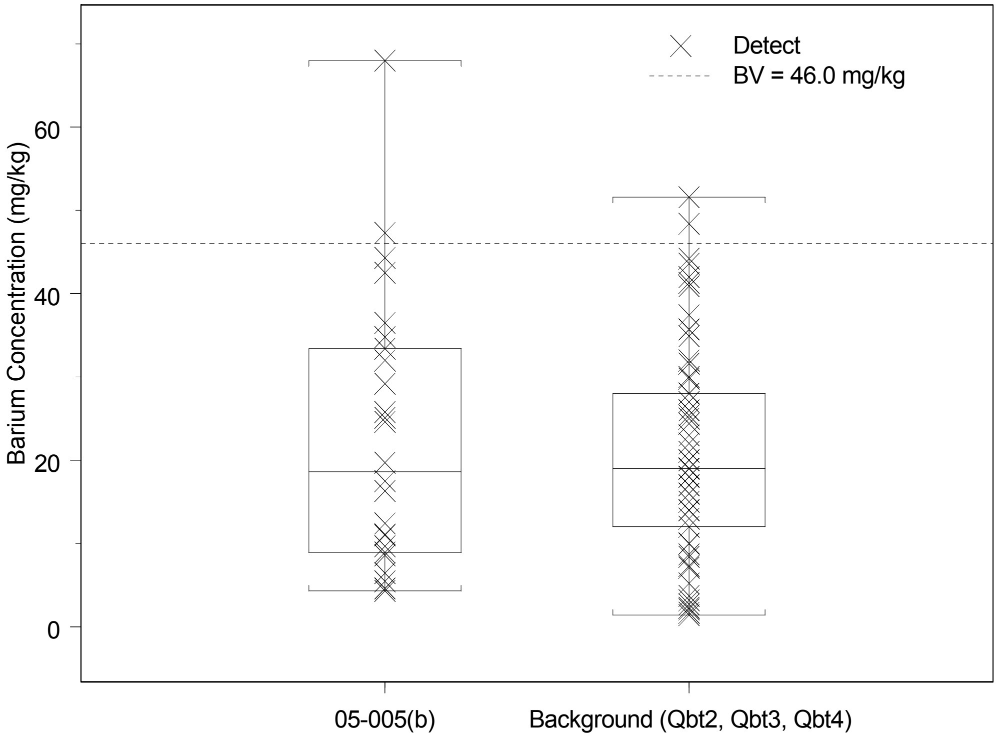


Figure H-3.0-1 Box plot of barium in tuff at SWMU 05-005(b)

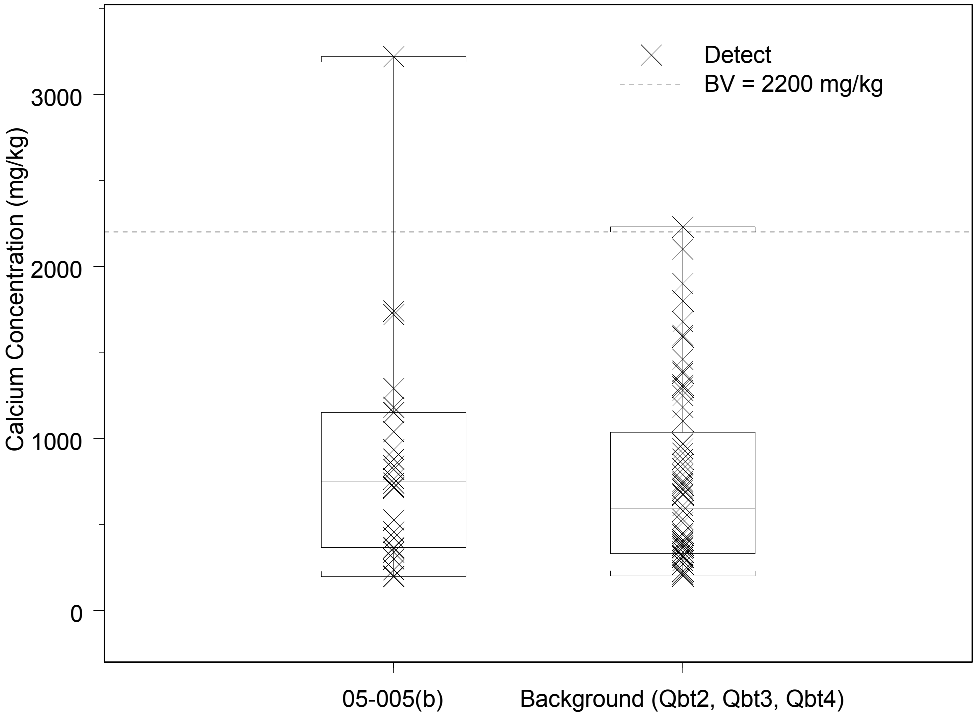


Figure H-3.0-2 Box plot of calcium in tuff at SWMU 05-005(b)

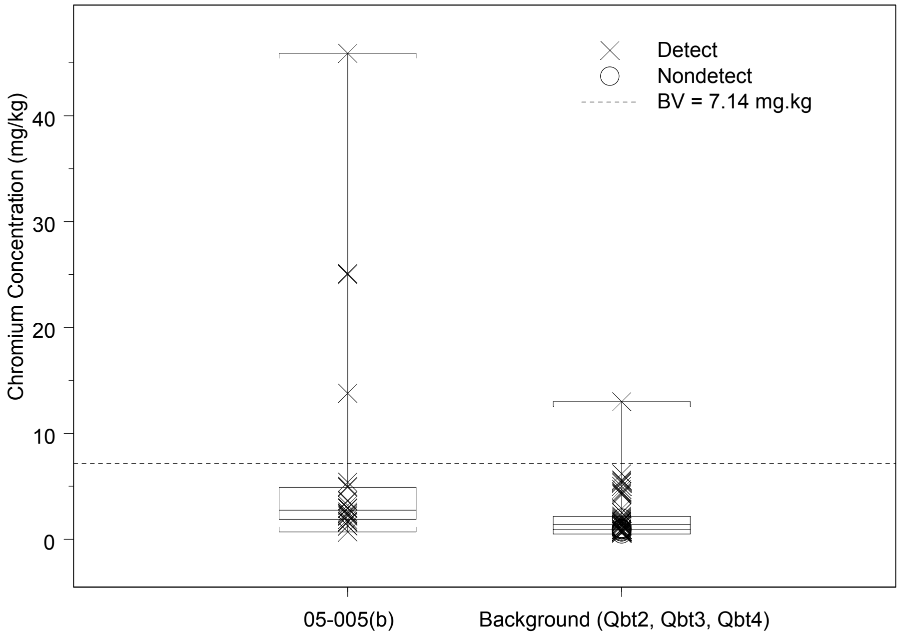


Figure H-3.0-3 Box plot of chromium in tuff at SWMU 05-005(b)

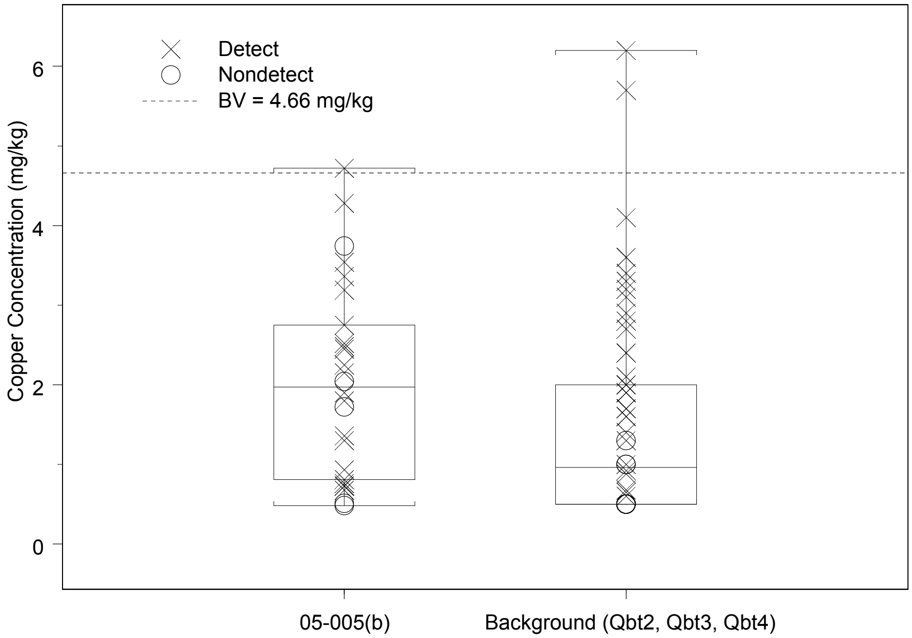


Figure H-3.0-4 Box plot of copper in tuff at SWMU 05-005(b)

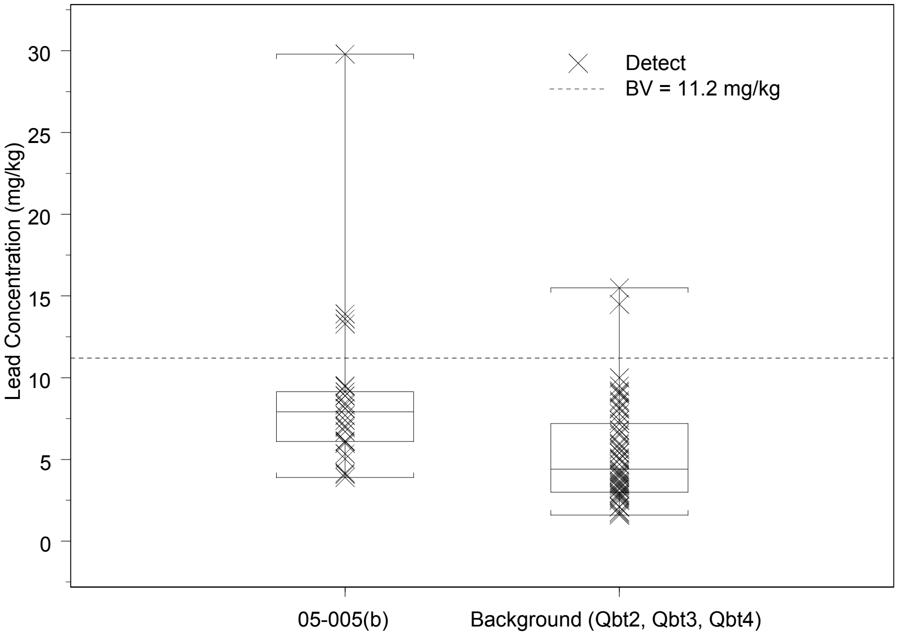


Figure H-3.0-5 Box plot of lead in tuff at SWMU 05-005(b)

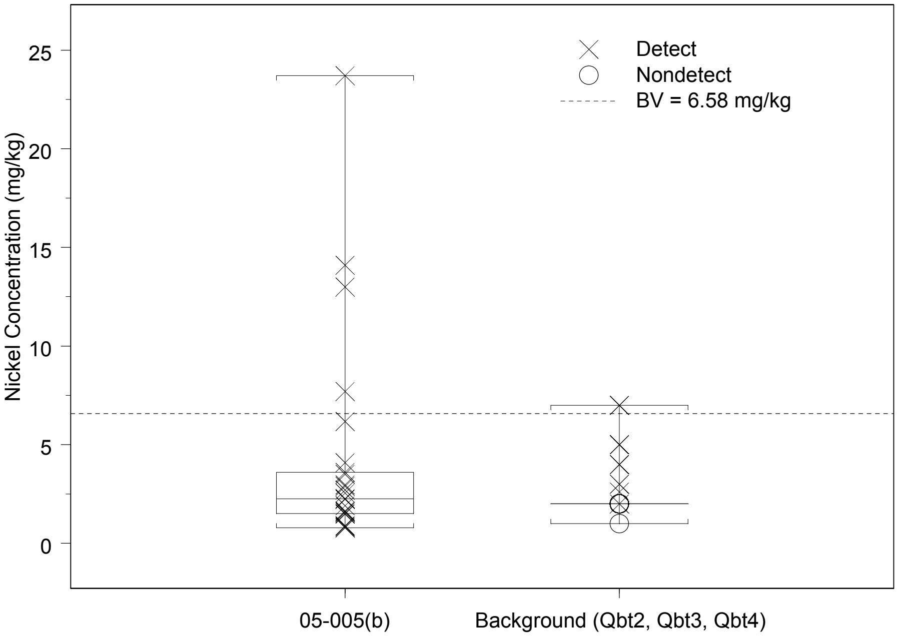


Figure H-3.0-6 Box plot of nickel in tuff at SWMU 05-005(b)

H-4.0 BOX PLOTS FOR SWMU 05-006(C)

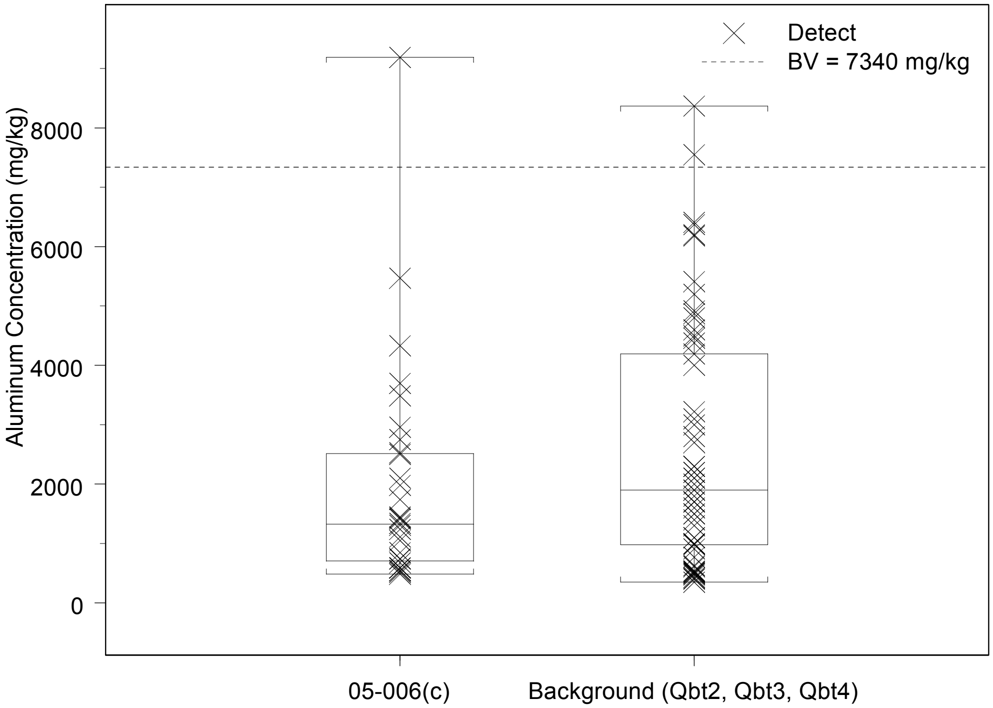


Figure H-4.0-1 Box plot of aluminum in tuff at SWMU 05-006(c)

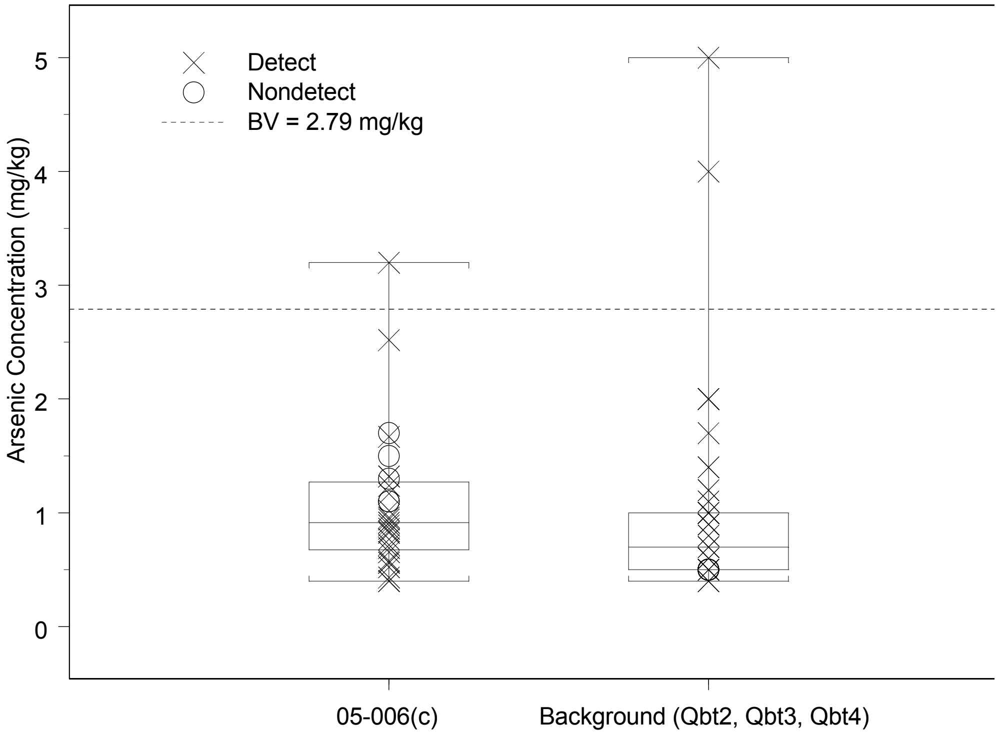


Figure H-4.0-2 Box plot of arsenic in tuff at SWMU 05-006(c)

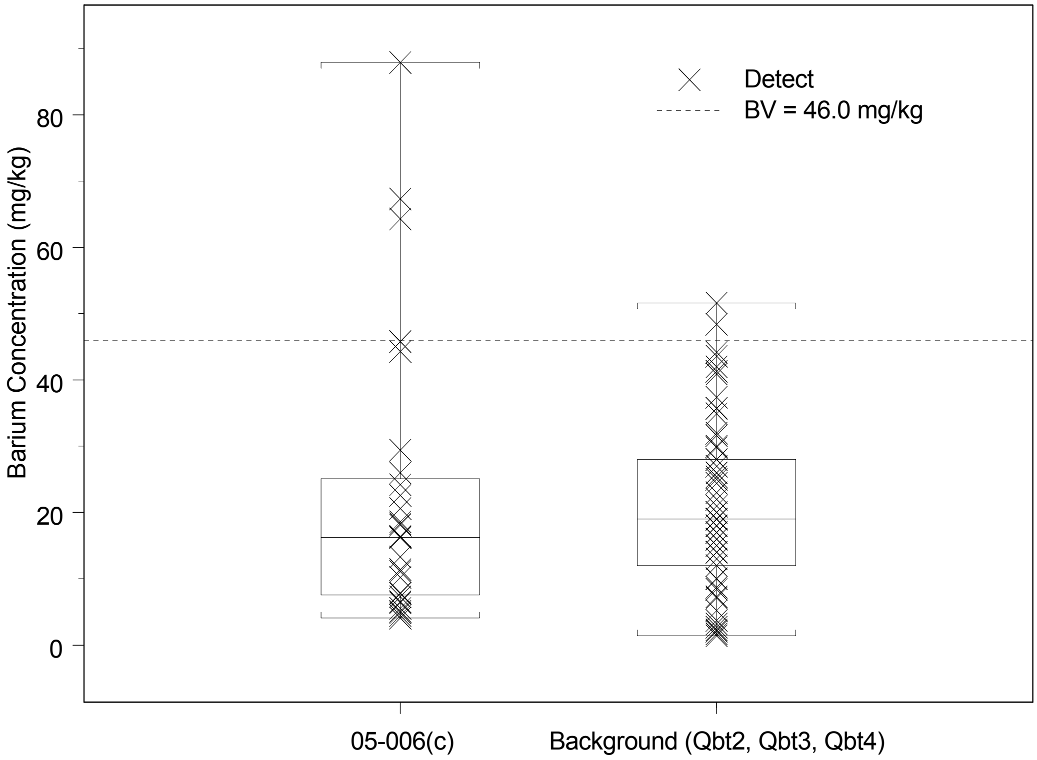


Figure H-4.0-3 Box plot of barium in tuff at SWMU 05-006(c)

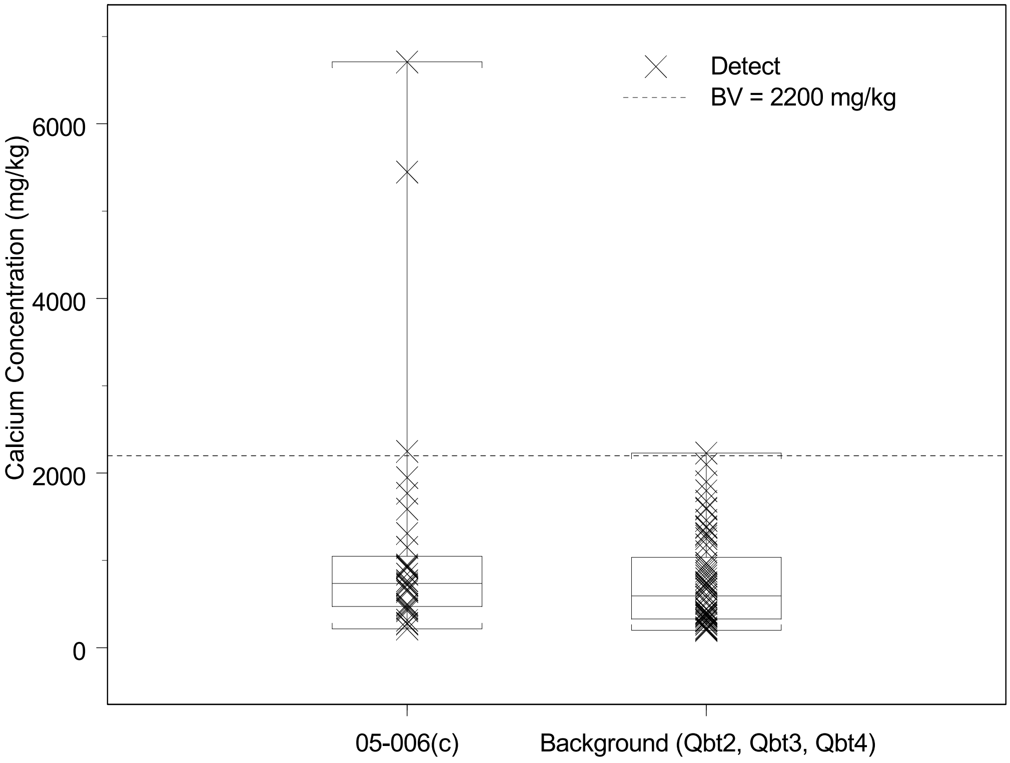


Figure H-4.0-4 Box plot of calcium in tuff at SWMU 05-006(c)

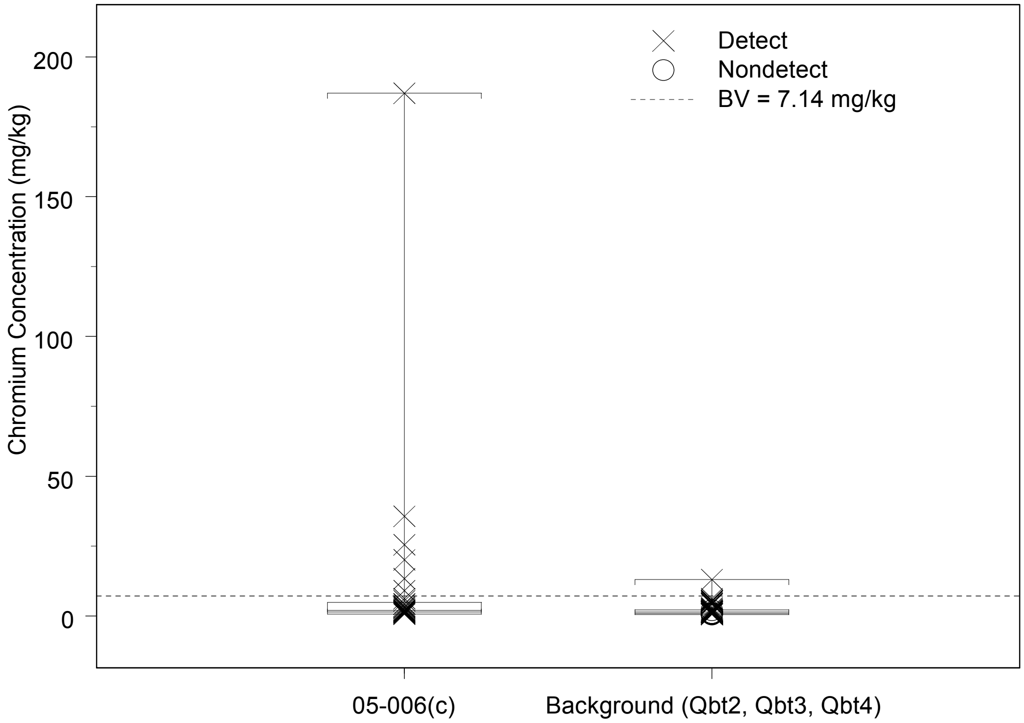


Figure H-4.0-5 Box plot of chromium in tuff at SWMU 05-006(c)

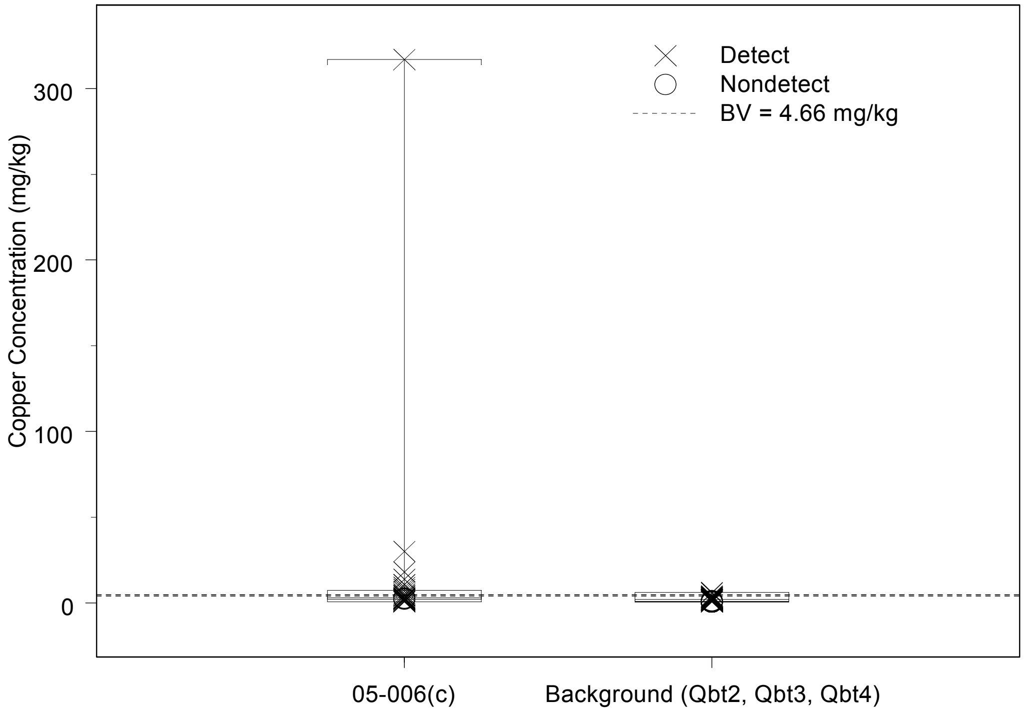


Figure H-4.0-6 Box plot of copper in tuff at SWMU 05-006(c)

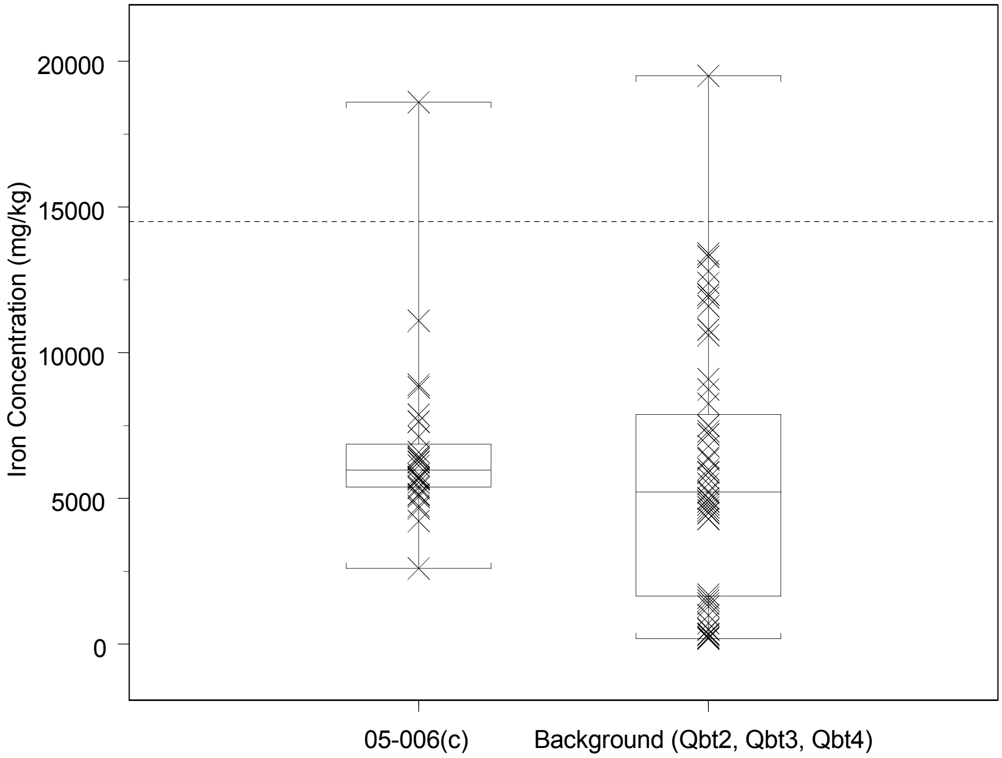


Figure H-4.0-7 Box plot of iron in tuff at SWMU 05-006(c)

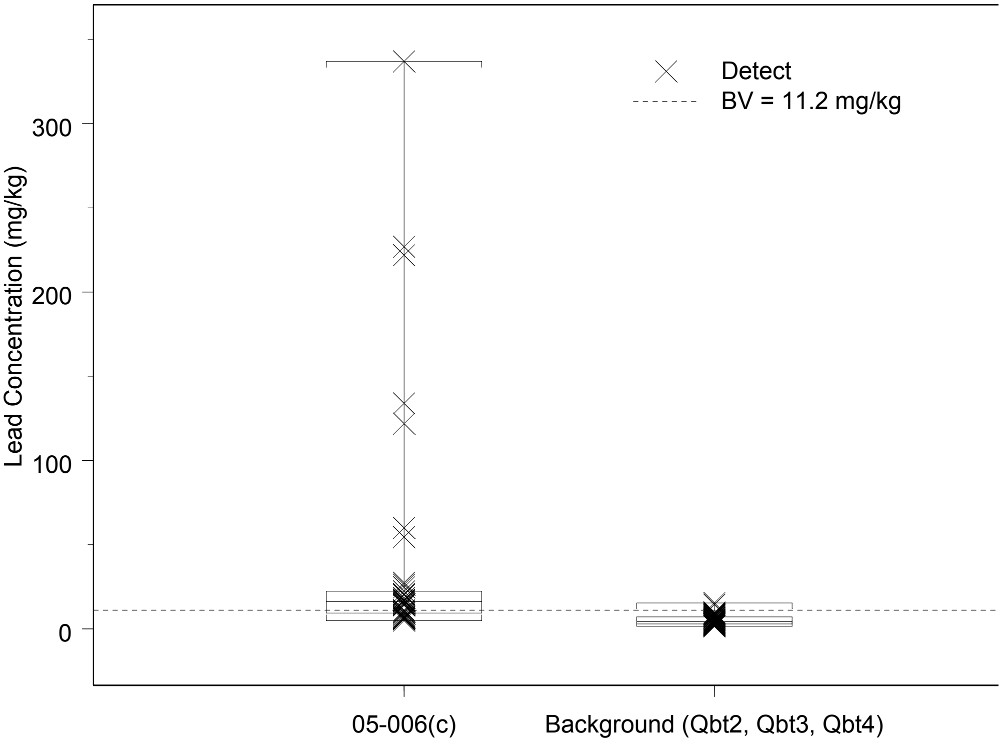


Figure H-4.0-8 Box plot of lead in tuff at SWMU 05-006(c)

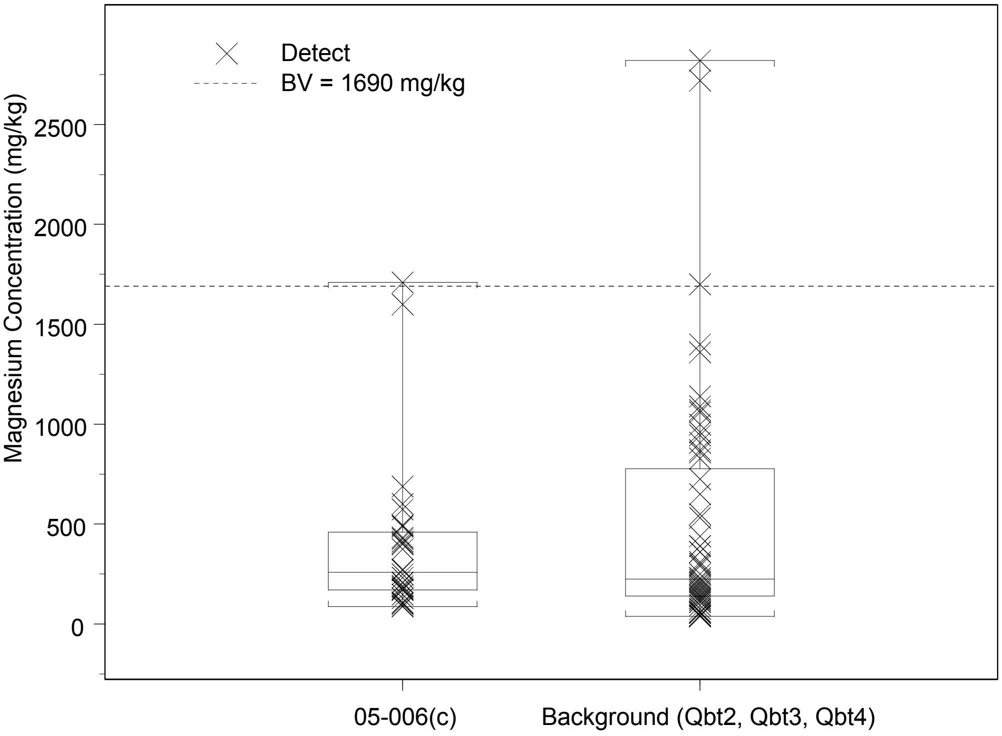


Figure H-4.0-9 Box plot of magnesium in tuff at SWMU 05-006(c)

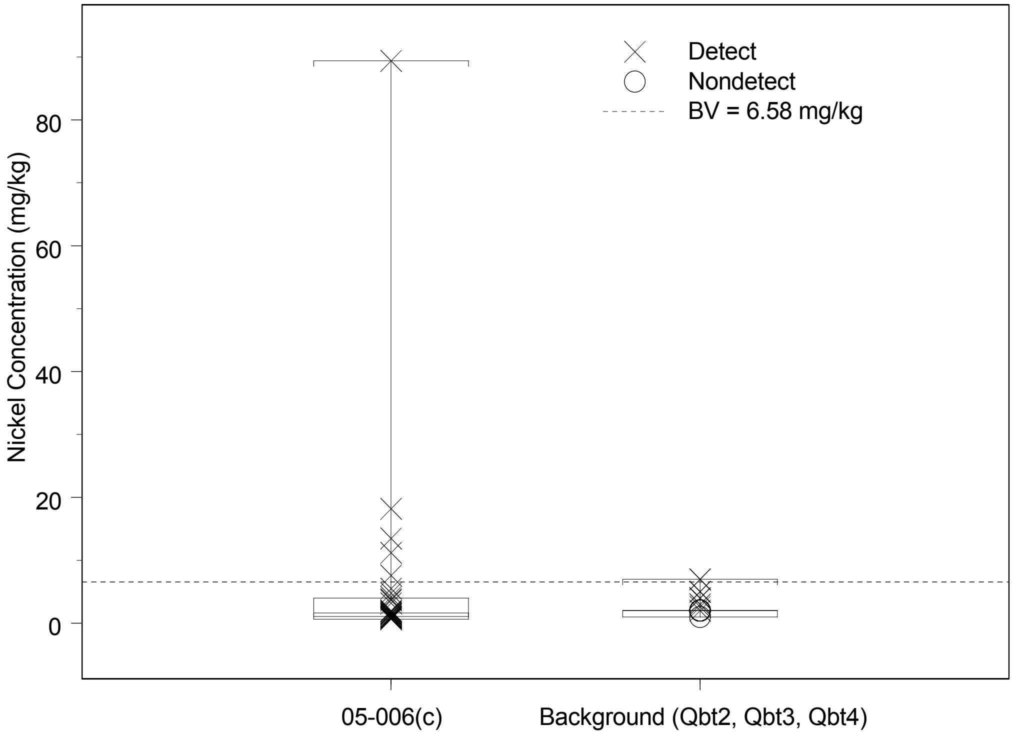


Figure H-4.0-10 Box plot of nickel in tuff at SWMU 05-006(c)

Table H-1.0-1
Results of Statistical Tests for Inorganic Chemicals in Qbt 3 Tuff at SWMU 05-003

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-value	Retain as COPC?
Chromium	4.11E-01	4.36E-01	n/a*	No
Zinc	8.73E-02	9.44E-01	n/a	No

* n/a = Not applicable.

Table H-2.0-1
Results of Statistical Tests for Inorganic Chemicals in Qbt 3 Tuff at SWMU 05-004

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-value	Retain as COPC?
Barium	3.23E-01	6.97E-01	n/a[a]	No
Calcium	4.21E-04	—[b]	—	Yes
Copper	3.34E-04	—	—	Yes
Lead	1.59E-03	—	—	Yes
Nickel	n/a	5.00E-01	1	No

[a] n/a = Not applicable.

[b] — = Test not performed because the first test indicated site samples are significantly different from background.

Table H-3.0-1
Results of Statistical Tests for Inorganic Chemicals in Qbt 3 Tuff at SWMU 05-005(b)

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-value	Retain as COPC?
Barium	9.25E-01	3.67E-01	n/a[a]	No
Calcium	5.21E-01	8.38E-01	n/a	No
Chromium	1.04E-04	—[b]	—	Yes
Copper	3.44E-01	—	—	Yes
Lead	6.05E-05	—	—	Yes
Nickel	n/a	4.35E-01	6.12E-03	Yes

[a] n/a = Not applicable.

[b] — = Test not performed because the first test indicated site samples are significantly different from background.

Table H-4.0-1
Results of Statistical Tests for Inorganic Chemicals in Qbt 3 Tuff at SWMU 05-006(c)

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-value	Retain as COPC?
Aluminum	1.67E-01	9.87E-01	n/a[a]	No
Arsenic	5.83E-01	1.21E-01	n/a	No
Barium	3.39E-01	6.82E-01	n/a	No
Calcium	1.44E-01	4.57E-01	n/a	No
Chromium	2.19E-03	—[b]	—	Yes
Copper	1.14E-06	—	—	Yes
Iron	1.41E-01	9.42E-01	n/a	No
Lead	1.66E-13	—	—	Yes
Magnesium	8.76E-01	9.98E-01	n/a	No
Nickel	n/a	3.37E-01	3.48E-03	Yes

[a] n/a = Not applicable.

[b] — = Test not performed because the first test indicated site samples are significantly different than background.

Appendix I

Risk Assessments

CONTENTS

Figures

Tables

I-1.0 INTRODUCTION

This appendix presents the results of the human health and ecological risk-screening assessments for the investigations conducted at sites within the Lower Mortandad/Cedro Canyons Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). Sites include four solid waste management units (SWMUs) located within Technical Area (TA-05).

Human health and ecological risk-screening assessments were conducted for Solid Waste Management Units (SWMUs) 05-003, 05-004, 05-005(b), and 05-006(c). The SWMUs are described in section 6 of the investigation report and are summarized below.

I-2.0 TA-05 BACKGROUND

TA-05, also known as Beta Site, was established in 1944 as an adjunct test firing site to TA-04 (Alpha Site). Firing activities were conducted at two small firing sites located within the Middle Mortandad/Ten Site portion of TA-05 and one large firing site, known as Far Point Site within the Lower Mortandad/Cedro portion of TA-05. Far Point Site was used briefly during 1944 and 1945 for half-scale mockup tests of the Trinity device. TA-05 was used as a firing site for implosion studies until 1947. After firing activities were halted, several Laboratory groups used the site for a variety of experiments, including the study of hydrogen fires, animal radiation experiments, and beryllium combustion experiments. In late 1959, two experimental reactors known as “Little Eva” and “Godiva” were brought to TA-05 and operated briefly. Little Eva was located inside a trailer, and Godiva was located in an underground chamber (SWMU 05-003). TA-05 was taken out of service in 1959 and underwent decontamination and demolition in 1985 as part of the Los Alamos Site Characterization Program (LASCP).

I-2.1 Site Descriptions and Operational History

I-2.1.1 SWMU 05-003

SWMU 05-003 is a former underground calibration facility (structures 05-20 and 05-21) located at the west end of TA-05 near the edge of Mortandad Canyon. The calibration facility consisted of an aboveground shed (structure 05-20) constructed over a 6-ft-diameter, 35-ft deep access shaft equipped with a ladder to provide facility personnel access to the calibration chamber (structure 05-21), located belowground to the west of the access shaft. The aboveground shed (structure 05-20) was a wooden building that measured 8 ft wide × 12 ft long × 8 ft high. The belowground chamber (structure 05-21) measured 10 ft^2 × 10 ft deep and was used to calibrate neutron detector systems for experiments at TA-49. The base of the access shaft was connected to the calibration chamber by an 8-ft-tall, 9.5-ft-long tunnel. A second 24-in.-diameter shaft extended from the center of the chamber to the surface. The shafts were separated by 15 ft (center to center). The smaller shaft was lined with a 16-in.-diameter casing and capped with concrete, with a 3-in.-diameter opening in the concrete cap. The small shaft was used to direct neutrons from the underground chamber to detectors located above the shaft.

The neutron source used in the calibration facility was a critical assembly called Godiva. This assembly used highly enriched uranium (HEU) and was operated in the underground chamber beneath the smaller shaft. Neutron detectors were placed on the ground surface above the opening in the small shaft. The Godiva assembly could be pulsed every 2 h and produced 2×10^{16} fissions per pulse. Small amounts of HEU would spall off the source with each pulse. Borated paraffin and lead bricks were used as shielding and heavy water was used to moderate the energy and intensity of the neutrons.

The Godiva assembly was installed in the TA-05 underground chamber on November 16, 1959. The chamber was used for approximately 1 mo only. TA-05 officially ceased operation on December 18, 1959. The Godiva assembly was moved to TA-49 where it became operational on January 12, 1960.

The underground calibration chamber (structure 05-21) and the corrugated metal pipe (CMP) liner for the large access shaft are still present at the site. The CMP extends approximately 2.5 ft above the ground surface. The inside of the CMP contains backfill and some vegetation is presently growing in the backfill. An 8.75-ft-wide × 12.5-ft-long concrete pad extends around the CMP. Currently, the area of the smaller shaft is covered with dirt.

I-2.1.2 SWMU 05-004

SWMU 05-004 is a former septic tank (structure 05-13), associated drainlines, and outfall that were located at the west end of TA-05 near the edge of Mortandad Canyon. The tank was constructed in May 1948 to serve building 05-1 (a laboratory) and was decommissioned in place in December 1959. It was constructed of reinforced concrete and was 5 ft^2 × 7 ft deep. As-built drawings show an inlet line running from building 05-1 to the septic tank and an outlet line discharging south into an unnamed tributary of Mortandad Canyon.

From 1948 to 1949, the tank received industrial waste from a laboratory (building 05-1). A 1952 memorandum states that septic tank 05-13 was no longer needed to support the use of building 05-1 and the structure was being returned to Engineering Division for disposition. Historical information shows the tank was free of radiation and high explosive (HE) contamination but notes it contained unspecified toxic chemicals. The types of materials used in building 05-1 are not known. Building 05-1 was inspected in 1959 and found to be free of contamination by toxic materials. A radiation survey of building 05-1 in 1973 detected no radioactive contamination. During the 1985 LASCP, building 05-1 was determined to be free of radioactive and HE contamination and was removed. The septic tank and associated drainlines had been removed before the 1985 LASCP activities. The removal of the tank and piping was confirmed by excavation of the area.

The outfall, a 2-ft wide by 1-ft deep trench cut into the tuff, is located at the edge of the mesa. Stormwater best management practices (BMPs), including straw wattles, are in place above and downslope of the site.

I-2.1.3 SWMU 05-005(b)

SWMU 05-005(b) is an area of potentially contaminated soil associated with a former outfall that was located in TA-05 at the edge of Mortandad Canyon. The outfall served building 05-5 (a shop and darkroom). The outfall is believed to have operated during the same time period as the building, which operated from 1944 to 1959. Building 05-5 supported TA-05 firing site activities, including shop work and processing photographs of experiments conducted at the firing sites. For a brief period in 1952, the calibration of high-range radiation meters was also conducted in the building.

The site currently contains no evidence of the outfall. A capped pipe was present at the ground surface at the former location of building 05-5. The pipe, about 18 in. long, was removed with the debris at SWMU 05-006(c). A drainage channel that collects most of the runoff from the site is present at the edge of the mesa. Stormwater BMPs, including straw wattles, are in place above and downslope of the site.

I-2.1.4 SWMU 05-006(c)

SWMU 05-006(c) is an area of potentially contaminated soil associated with the location of former building 05-5, a shop and darkroom. The shop was 16 ft^2 and the darkroom was 6 wide × 9 ft long. The building was operational from about 1944 to 1959. The structure was originally used to support firing site activities, including processing photographs of experiments conducted at the TA-05 firing sites. In 1952, J Division temporarily used the building to calibrate high-range radiation meters. A 1959 memorandum indicates this structure was contaminated with HE, as does a 1959 list generated by the Laboratory's H-3 Group. Potential soil contamination associated with SWMU 05-006(c) was reported to also include uranium. Building 05-5 was destroyed by intentional burning on March 5, 1960.

During the 2011 investigation activities, a small amount of burned debris (charred wood, melted glass, and metal) was removed from the former location of building 05-5. An 18 in.-long capped pipe was also removed. Stormwater BMPs, including a soil berm with straw wattles, are in place south of the site.

I-2.2 Sampling Results and Determination of Chemicals of Potential Concern

The data used to identify chemicals of potential concern (COPCs) and to evaluate potential risks or doses to human health and the environment for the Lower Mortandad/Cedro Canyons Aggregate Area sites consisted of all qualified analytical results compiled from both historical sampling activities and the 2011 investigation. Only those data determined to be of decision-level quality following the data-quality assessment (Appendix E) are included in the data sets evaluated in this risk appendix. The data are present in Appendix F (on DVD).

Tables I-2.2-1 to I-2.2-10 summarize the COPCs evaluated for potential risk for each site. Section 5.1 of the investigation report summarizes the COPC selection process. Inorganic chemicals and radionuclides above background values (BVs) or fallout values (FVs) and detected organic chemicals or radionuclides in tuff are retained as COPCs. The risk-screening assessment(s) for a site included all COPCs detected within the depth interval relevant for each exposure scenario. The depth intervals are 0–10 ft below ground surface (bgs) for the residential scenario, 0–5 ft bgs for ecological risk, and 0–1 ft bgs for the industrial scenario. Therefore, the COPCs evaluated for each scenario may differ for the site depending on the depth at which the COPC was identified. Because sampling depths often overlapped during multiple investigations, all samples with a starting depth less than the lower bound of the interval for each scenario were included in the risk assessments.

I-3.0 CONCEPTUAL SITE MODEL

Potential contaminant sources at TA-05 include an underground chamber that housed an experimental reactor, past discharges from outfalls and a septic system, and residual soil contamination associated with decontamination and decommissioning of a former building by burning. COPCs may be found in surface material and may have also migrated into subsurface.

I-3.1 Receptors and Exposure Pathways

The current and reasonably foreseeable future land use for the sites in the Lower Mortandad/Cedro Canyons Aggregate Area is industrial; the receptor being a Laboratory worker. The residential scenario was also evaluated. The construction worker and recreational scenarios are not current and reasonably foreseeable future land uses at any of the sites and were therefore not evaluated.

The primary exposure pathway for human receptors is surface soil and subsurface soil or tuff that may be brought to the surface through intrusive activities. Human receptors may be exposed through direct contact with soil or suspended particulates by ingestion, inhalation, dermal contact, and external irradiation pathways. Direct contact exposure pathways from subsurface contamination to human receptors are complete for a resident. The exposure pathways are the same as those for surface soil. Sources, exposure pathways, and receptors are shown in the conceptual site model (Figure I-3.1-1).

The sites within the Lower Mortandad/Cedro Canyons Aggregate Area are in a former industrial area, which provides potential habitat for ecological receptors. Exposure pathways are complete to surface soil and tuff for ecological receptors. Exposure is assessed across the site to a depth of 0–5 ft. Weathering of tuff is the only viable natural process that may result in the exposure of receptors to COPCs in tuff. However, because of the slow rate of weathering expected for tuff, exposure to COPCs in tuff is negligible, although it is included in the assessments. Exposure pathways to subsurface contamination below 5 ft are not complete unless contaminated soil or tuff were excavated and brought to the surface. The potential pathways are root uptake by plants, inhalation of dust, dermal contact, incidental ingestion of soil, external irradiation, and food-web transport. Pathways from subsurface releases may be complete for plants. Surface water was not evaluated because of the lack of surface water features. Sources, exposure pathways, and receptors are presented in the conceptual site model (Figure I-3.1-1).

I-3.2 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes affecting the persistence of a chemical in the environment; the evaluation of transport addresses the physical processes affecting mobility of a contaminant along a migration pathway. Migration through soil and tuff depends on properties such as soil pH, rate of precipitation or snowmelt, soil moisture content, soil-tuff hydraulic properties, and properties of the COPCs. Migration into and through tuff also depends on the unsaturated flow properties of the tuff and the presence of joints and fractures.

The most important factor with respect to the potential for COPCs to migrate to groundwater is the presence of saturated conditions. Downward migration in the vadose zone is limited also by a lack of hydrostatic pressure as well as lack of a source for the continued release of contamination. Without sufficient moisture and a source, little or no potential migration of materials through the vadose zone to groundwater occurs.

Contamination at depth is addressed in the discussion of nature and extent presented in the report. Results from the deepest samples collected showed either no detected concentrations of COPCs or low or trace-level concentrations of only a few inorganic, radionuclide, and/or organic COPCs in tuff. The limited extent of contamination is related to the absence of the key factors that facilitate migration, as mentioned above. Given how long the contamination has been present in the subsurface, physical and chemicals properties of the COPCs, and the lack of saturated conditions, the potential for contaminant migration to groundwater is very low.

New Mexico Environment Department (NMED) guidance (NMED 2009, 108070) contains screening levels that consider the potential for contaminants in soil to result in groundwater contamination. These screening levels consider equilibrium partitioning of contaminants among solid, aqueous, and vapor phases and account for dilution and attenuation in groundwater through the use of dilution attenuation factors (DAFs). These DAF soil screening levels (SSLs) can be used to identify chemical concentrations in soil that have the potential to contaminate groundwater (EPA 1996, 059902). Screening contaminant concentrations in soil against these DAF SSLs does not, however, provide an indication of the potential for contaminants to migrate to groundwater. The assumptions used in the development of these DAF SSLs include an assumption of uniform contaminant concentrations from the contaminant source to the water table (i.e., it is assumed that migration to groundwater has already occurred). For these reasons, screening of contaminant concentrations in soil against the DAF SSLs was not performed.

The relevant release and transport processes of the COPCs are a function of chemical-specific properties that include the relationship between the physical form of the constituents and the nature of the constituent transport processes in the environment. Specific properties include the degree of saturation, the potential for ion exchange or sorption, and the potential for natural bioremediation. The transport of volatile organic compounds (VOCs) occurs primarily in the vapor phase by diffusion or advection in subsurface air. The chemical and physical properties of the Lower Mortandad/Cedro Canyons Aggregate Area COPCs are presented in Tables I-3.2-1 through I-3.2-3.

The primary release and transport mechanisms that may lead to the potential exposure of receptors include:

- dissolution and/or particulate transport of surface contaminants from precipitation and runoff,
- airborne transport of contaminated surface soil or particulates,
- continued dissolution and advective/dispersive transport of chemical and radiological contaminants contained in subsurface soil and bedrock,
- biotic perturbation and/or translocation of contaminants in subsurface contaminated media, and
- uptake of contaminants from soil and water by biota.

Contaminant distributions at the sites indicate that after the initial deposition of contaminants from operational activities and historical remediation efforts, elevated levels of contaminants tend to remain concentrated near the original release points.

I-3.2.1 Inorganic Chemicals

In general, and particularly in a semiarid climate such as that found at the sites within the Lower Mortandad/Cedro Canyons Aggregate Area, inorganic chemicals are not highly soluble or mobile in the environment. The primary physical and chemical factors that determine and describe the distribution of inorganic COPCs within the soil and tuff are the water solubility of the inorganic chemical and the soil-water partition coefficient (K_d). Other factors besides the K_d values, such as speciation in soil and oxidation-reduction potential (Eh) and pH, also play a role in the likelihood that inorganic chemicals will migrate. The K_d values provide a general assessment of the potential for migration through the subsurface; chemicals with higher K_d values are less likely to be mobile than those with lower K_d values. Inorganic chemicals with K_d values greater than 40 are very unlikely to migrate through soil towards the water table (Kincaid et al. 1998, 093270). Table I-3.2-1 presents the K_d values for the inorganic COPCs identified at the Lower Mortandad/Cedro Canyons Aggregate Area. Based on this criterion, antimony, cadmium, chromium, lead, and nickel have a low potential to mobilize and migrate through soil and the vadose zone. The K_d values for copper, nitrate, perchlorate, selenium, and silver are less than 40 and may indicate these inorganic chemicals have a greater potential to mobilize and migrate through soil and the vadose zone. These COPCs are discussed further in the following sections. Information about the fate and transport properties of inorganic chemicals was obtained from individual chemical profiles published by the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR 1997, 056531). Information for these inorganic chemicals is also available from the ATSDR website at http://www.atsdr.cdc.gov/toxprofiles/index.asp.

- Copper movement in soil is determined by physical and chemical interactions with the soil components. Most copper deposited in soil is strongly adsorbed and remains in the upper few centimeters. Copper will adsorb to organic matter, carbonate minerals, clay minerals, hydrous iron, and manganese oxides. In most temperate soil, pH, organic matter, and ionic strength of the soil solutions are the key factors affecting adsorption. Copper binds to soil much more strongly than other divalent cations, and the distribution of copper in the soil solution is less affected by pH than other metals. Copper is expected to be bound to the soil and move in the system by way of transport of soil particles by water as opposed to movement as dissolved species. The average soil pH at the four sites in TA-05 is 7.7, so leaching of copper is unlikely.

- Nitrate (and to a lesser degree perchlorate) is highly soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath the Lower Mortandad/Cedro Canyons Aggregate Area sites has low moisture content, which inhibits the mobility of nitrate and perchlorate as well as most other inorganic chemicals.
- Selenium is not often found in the environment in its elemental form but is usually combined with sulfide minerals or with silver, copper, lead, and nickel minerals. In soil, pH and Eh are determining factors in the transport and partitioning of selenium. In soil with a pH of greater than 7.5, selenates, which have high solubility and a low tendency to adsorb onto soil particles, are the major selenium species and are very mobile. The average soil pH at the four sites in TA-05 is 7.7, which indicates that selenium has limited tendency to migrate.
- Silver sorbs onto soil and sediment and tends to form complexes with inorganic chemicals and humic substances in soil. Organic matter complexes with silver and reduces its mobility. Silver compounds tend to leach from well-drained soil so silver may potentially migrate into the subsurface. The extent of silver is defined at depth.

I-3.2.2 Organic Chemicals

Table I-3.2-2 presents the physical and chemical properties (water solubility, organic carbon-water partition coefficient [K_{oc}], logarithm to the base 10 octanol-water partition coefficient [log K_{ow}], and vapor pressure) of the organic COPCs identified for the Lower Mortandad/Cedro Canyons Aggregate Area. Physical and chemical properties of organic chemicals are important when evaluating their fate and transport. The following physiochemical property information illustrates some aspects of the fate and transport tendencies of the Lower Mortandad/Cedro Canyons Aggregate Area COPCs. The information is summarized from Ney (1995, 058210).

Water solubility may be the most important chemical characteristic used to assess mobility of organic chemicals. The higher the water solubility of a chemical, the more likely it is to be mobile and the less likely it is to accumulate, bioaccumulate, volatilize, or persist in the environment. A highly soluble chemical (water solubility greater than 1000 mg/L) is prone to biodegradation and metabolism that may detoxify the parent chemical. Acetone, benzoic acid, diethylphthalate, di-n-butyl phthalate, 2-hexanone, and methylene chloride have water solubilities greater than 1000 mg/L.

The lower the water solubility of a chemical, especially below 10 mg/L, the more likely it will be immobilized by adsorption. Chemicals with lower water solubilities are more likely to accumulate or bioaccumulate and persist in the environment, to be slightly prone to biodegradation, and to be metabolized in plants and animals. The COPCs identified as having water solubilities less than 10 mg/L are acenaphthene; anthracene; Aroclor-1260; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; phenanthrene; pyrene; and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

The K_{oc} measures the tendency of a chemical to adsorb to organic carbon in soil. K_{oc} values above 500 L/kg indicate a strong tendency to adsorb to soil, leading to low mobility (NMED 2009, 108070). Acenaphthene; acenaphthylene; anthracene; Aroclor-1260; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene;

dibenz(a,h)anthracene; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; styrene; 2,3,7,8-TCDD; and 1,2,4-trimethylbenzene have K_{oc} values above 500 L/kg, indicating a very low potential to migrate toward groundwater. The COPCs with K_{oc} values less than 500 L/kg are acetone; benzoic acid; diethylphthalate; di-n-butylphthalate; 2-hexanone; methylene chloride; and toluene.

The K_{ow} is an indicator of a chemical's potential to bioaccumulate or bioconcentrate in the fatty tissues of living organisms. The unitless K_{ow} value is an indicator of water solubility, mobility, sorption, and bioaccumulation. The higher the K_{ow}, the greater the affinity the chemical has for bioaccumulation in the food chain, the greater its potential for sorption in the soil, and the lower its mobility (Ney 1995, 058210). The COPCs with a K_{ow} greater than 1000 include acenaphthene; acenaphthylene; anthracene; Aroclor-1260; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; di-n-butyl phthalate; fluoranthene; fluorene; indeno[1,2,3-cd]pyrene; 4-isopropyltoluene; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; and 1,2,4-trimethylbenzene. A K_{ow} of less than 500 indicates high water solubility, high mobility, little to no affinity for bioaccumulation, and degradability by microbes, plants, and animals. Acetone, benzoic acid, diethylphthalate, 2-hexanone, and methylene chloride have K_{ow} values less than 500.

Vapor pressure is a chemical characteristic used to evaluate the tendency of organic chemicals to volatilize. Chemicals with vapor pressure greater than 0.01 millimeters of mercury (mm Hg) are likely to volatilize, and therefore, concentrations at the site are reduced over time; vapors of these chemicals are more likely to travel toward the atmosphere and not migrate toward groundwater. Acetone; 2-hexanone; 4-isopropyltoluene; methylene chloride; 2-methylnaphthalene; naphthalene; styrene; toluene; and 1,2,4-trimethylbenzene have vapor pressures greater than 0.01 mm Hg.

Chemicals with vapor pressures less than 0.00001 mm Hg are less likely to volatilize and, therefore, tend to remain immobile. Anthracene; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; fluoranthene; indeno[1,2,3-cd]pyrene; and pyrene have vapor pressures less than 0.00001 mm Hg.

In summary, anthracene; benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[g,h,i]perylene; benzo[k]fluoranthene; bis[2-ethylhexyl]phthalate; chrysene; dibenz(a,h)anthracene; fluoranthene; indeno[1,2,3-cd]pyrene; and pyrene are the least mobile and the most likely to bioaccumulate. The more soluble and volatile COPCs acetone, benzoic acid, diethylphthalate, 2-hexanone, methylene chloride, and toluene are more mobile but are also more likely to travel toward the atmosphere and not migrate toward groundwater. Because the organic COPCs were detected at low concentrations and the extent is defined, they are not likely to migrate to groundwater.

I-3.2.3 Radionuclides

Radionuclides are generally not highly soluble or mobile in the environment, particularly in the semiarid climate of the Laboratory. The physical and chemical factors that determine the distribution of radionuclides within soil and tuff are the K_d, the pH of the soil and other soil characteristics (e.g., sand or clay content), and the Eh. The interaction of these factors is complex, but K_d values provide a general assessment of the potential for migration through the subsurface: chemicals with higher K_d values are less likely to be mobile than those with lower values. Radionuclides with K_d values greater than 40 are very unlikely to migrate through soil towards the water table (Kincaid et al. 1998, 093270).

Table I-3.2-3 presents physical and chemical properties of the radionuclide COPCs identified at the Lower Mortandad/Cedro Canyons Aggregate Area sites. Based on K_d values, plutonium-238 and plutonium-239/240 have a very low potential to migrate towards groundwater. The K_d values for uranium-234, uranium-235/236, and uranium-238 are less than 40 and indicate a potential to migrate towards groundwater.

Uranium isotopes were retained as COPCs at the Lower Mortandad/Cedro Canyons Aggregate Area sites. In general, the actinide nuclides form comparatively insoluble compounds in the environment and are therefore not considered biologically mobile. The actinides are transported in ecosystems mainly by physical and sometimes chemical processes. They tend to attach, sometimes strongly, to surfaces, and they tend to accumulate in soil and sediment. Subsequent movement is largely associated with geological processes such as erosion and sometimes leaching. The extent of isotopic uranium is defined.

I-3.3 Exposure Point Concentration Calculations

The exposure point concentrations (EPCs) represent upper bound concentrations of COPCs. For comparison to risk-screening levels, the upper confidence limit (UCL) of the arithmetic mean was calculated when possible and used as the EPC. If an appropriate UCL of the mean could not be calculated or if the UCL exceeded the maximum concentration, the maximum detected concentration (or the maximum detection limit) of the COPC was used as the EPC. Calculation of UCLs of the mean concentration was done using the U.S. Environmental Protection Agency (EPA)'s ProUCL, Version 4.1 (EPA 2010, 109944), which is based on EPA guidance (EPA 2002, 085640, Section 15.4-1). The ProUCL program calculates 95%, 97.5%, and 99% UCLs and recommends a distribution and a UCL. The ProUCL software performs distributional tests on the data set for each COPC and calculates the most appropriate UCL based on the distribution of the data set. The UCL for the recommended calculation method was used as the EPC, and the 95% UCL was selected as the representative UCL. Environmental data may have a normal, lognormal, or gamma distribution but are often nonparametric (no definable shape to the distribution). The ProUCL documentation strongly recommends against using the maximum detected concentration for the EPC. However, the maximum detected concentration was used to represent the EPC when data did not allow a UCL to be calculated.

The summary statistics including the EPC for each COPC for the human health and the ecological risk-screening assessments and the distribution used for the calculation are presented in Tables I-2.2-1 to I-2.2-10. Input and output data files for ProUCL calculations are provided on CD as Attachment I-1.

I-4.0 HUMAN HEALTH RISK-SCREENING ASSESSMENTS

The human health risk-screening assessments were conducted for the four sites within the Lower Mortandad/Cedro Canyons Aggregate Area where extent was defined. All sites were screened for the industrial scenario using data from 0–1 ft bgs and for the residential scenario using data from 0–10 ft bgs. The human health risk-screening assessments compare the EPC of each COPC with SSLs (for inorganic and organic chemicals) or with screening action levels (SALs) (for radionuclides).

I-4.1 SSLs and SALs

Human health risk-screening assessments were conducted using the SSLs obtained from NMED guidance (NMED 2009, 108070) or the EPA regional tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The SSLs are based on either a cancer risk of 1 × 10^{-5} or a hazard quotient (HQ) of 1. The EPA SSLs for carcinogens were multiplied by 10 to adjust from a 10^{-6} cancer risk level to the NMED target cancer risk level of 10^{-5}. Surrogate chemicals were used for some COPCs without a screening value based on structural similarity or because the COPC is a breakdown product (NMED 2003, 081172). Exposure parameters used to calculate the SSLs are presented in Table I-4.1-1.

Radionuclide SALs are used for comparison with radionuclide COPC's EPCs and were derived using the residual radioactive (RESRAD) model, Version 6.5 (LANL 2009, 107655). The SALs are based on a 15-mrem/yr dose (Soden 2000, 067489). Exposure parameters used to calculate the SALs are presented in Table I-4.1-2.

In addition, vapor intrusion of VOCs into a building was evaluated for the residential scenario at SWMUs 05-004 and 05-006(c). For SWMU 05-004, the vapor-intrusion pathway was evaluated for the locations at the edge of the mesa top where 2-hexanone and 4-isopropyltoluene were detected (locations 05-613786 and 05-613790). Naphthalene and 2-methylnaphthalene were detected only at location 05-613788, which is the location of the inlet line near former building 05-1. However, this location is where all 17 polycyclic aromatic hydrocarbons (PAHs) were detected. The PAHs were not detected below the locations of the former drainlines and septic tank or in the drainage. Therefore, PAHs were not discharged from the building to the septic system. An engineering drawing (LASL 1947, 206411) indicates the access road to building 05-1 was gravel-surfaced with one coat of hot oil penetration, the most likely source of the PAHs detected next to former building 05-1. Because the PAHs are not related to SWMU 05-004, naphthalene and 2-methylnaphthalene were not evaluated under the vapor-intrusion pathway. Because these locations are on the canyon slope, they were not included in the vapor-intrusion pathway. VOCs were not associated with operations at SWMU 05-003, and samples from this site were not analyzed for VOCs. Therefore, the vapor-intrusion pathway at SWMU 05-003 is not applicable and was not evaluated. At SWMU 05-005(b), only two VOCs were detected in one sample each at or near the canyon bottom. Therefore, no complete pathway exists for the vapor intrusion at SWMU 05-005(b), and it is not evaluated for this site.

The potential risk from the vapor-intrusion pathway was assessed using the Johnson and Ettinger model (http://www.epa.gov/swerrims/riskassessment/airmodel/johnson_ettinger.htm) for subsurface vapor intrusion into buildings (EPA 2002, 094114). Because only soil data are available, the advanced soil model (SL-ADV-Feb04.xls) was used to calculate risk-based soil concentrations for VOCs at sites, where appropriate. The maximum detected concentration of each VOC was compared with the risk-based concentration generated by the model for each site. The model inputs and risk-based concentrations generated are provided in Attachment I-2. The HQs and hazard indexes (HIs) were calculated for noncarcinogenic COPCs and total excess cancer risks for carcinogenic COPCs. The NMED target cancer risk level of 1×10^{-5} and a target HI of 1 was applied.

I-4.2 Results of the Human Health Risk-Screening Evaluations

The EPC of each COPC was compared with the SSL/SAL for the appropriate scenario. The EPCs for carcinogenic COPCs were divided by the SSL and multiplied by 1×10^{-5}. The sums of the cancer risks were compared with the NMED target cancer risk level of 1×10^{-5} (NMED 2009, 108070). An HQ is generated for each noncarcinogenic COPC by dividing the EPC by the SSL. The HQs were summed to generate a hazard index (HI). The HI was compared with the NMED target HI of 1 (NMED 2009, 108070). The radionuclide EPCs were divided by the SAL and multiplied by 15 mrem/yr. The total doses were compared with the U.S. Department of Energy (DOE) target level of 15 mrem/yr (Soden 2000, 067489). The results of the human health screening evaluations are presented in Tables I-4.2-1 to I-4.2-24.

I-4.2.1 SWMU 05-003

SWMU 05-003 is a former underground calibration chamber located 35 ft bgs. No potential exposure pathways exist, and samples were not collected between 0–1 ft bgs. A risk-screening assessment was not performed for the industrial scenario.

The result of the human health screening evaluation for the residential scenario at SWMU 05-003 is presented in Table I-4.2-1. No carcinogens or radionuclides were retained as COPCs at the site. The HI is 0.04 for the residential scenario, which is below the NMED target HI of 1 (NMED 2009, 108070). The vapor-intrusion pathway was not evaluated for this site.

I-4.2.2 SWMU 05-004

Calcium does not have a published toxicity value, but is among those elements identified in section 5.9.4 of the Risk Assessment Guidance for Superfund (RAGS) (EPA 1989, 008021) as an essential macronutrient. As an essential nutrient, calcium may be compared with the recommended daily allowance (RDA) for adults and children. The RDA is 1200 mg/d of calcium for an adult and 800 mg/d for a child (National Research Council 1989, 064000, pp. 179–181). If all the daily incidental ingestion of soil were to occur at the location of the maximum concentration detected between 0–10 ft at SWMU 05-004 of 2910 mg/kg, at the EPA default adult soil ingestion rate of 100 mg/d of soil, an adult would ingest approximately 0.42 mg/d of calcium. At the intake level of 0.42 mg/d of calcium, the adult's ingestion of calcium is less than the RDA for calcium of 1200 mg/d. If all the daily incidental ingestion of soil were to occur at the location of the maximum concentration detected between 0–10 ft at SWMU 05-004 of 2910 mg/kg, at the EPA default child soil ingestion rate of 200 mg/d of soil, a child would ingest approximately 0.97 mg/d of calcium. At the intake level of 0.97 mg/d of calcium, the child's ingestion of calcium is less than the RDA for calcium of 800 mg/d. Therefore, no adverse health effects are expected from calcium at the site, and calcium is eliminated as a COPC.

The results of the risk-screening assessments for the industrial scenario are presented in Tables I-4.2-2 and I-4.2-3. No carcinogens were retained as COPCs. The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The results of the risk-screening assessments for the residential scenario are presented in Tables I-4.2-4 to I-4.2-6. The total excess cancer risk is approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The elevated cancer risk is due to PAHs that were detected adjacent to former building 05-1. The HI is 0.06, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.5 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The result of the residential vapor-intrusion screening assessment is presented in Table I-4.2-7. No carcinogenic VOCs were detected on the mesa-top portion of the site. The HI is approximately 0.000000002, which is less than the NMED target HI of 1. The vapor intrusion HI did not affect the residential HI presented above.

The cancer risk for the residential scenario is from polycyclic aromatic hydrocarbons (PAHs) detected next to former building 05-1. PAHs were not detected below the locations of the former drainlines and septic tank or at the outfall and in the drainage. Therefore, PAHs were not discharged from the building to the septic system. An engineering drawing (LASL 1947, 206411) indicates the access road to building 05-1 was gravel surfaced with one coat of hot oil penetration. This is most likely the source of the PAHs detected next to former building 05-1. Because the PAHs are not related to SWMU 05-004, the residential cancer risk and HI were recalculated without the PAHs (Tables I-4.2-8 and I-4.2-9). The total excess cancer risk is approximately 1 × 10^{-10}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.05, which is below the NMED target HI of 1 (NMED 2009, 108070).

I-4.2.3 SWMU 05-005(b)

The dioxin and furan congener toxicity equivalency factor (TEF) calculations for the industrial scenario are presented in Table I-4.2-10. The results of the risk-screening assessments for the industrial scenario are presented in Tables I-4.2-11 to I-4.2-13. The total excess cancer risk is 1 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The dioxin and furan congener TEF calculations for the residential scenario are presented in Table I-4.2-14. The results of the risk-screening assessments for the residential scenario are presented in Tables I-4.2-15 and I-4.2-17. The vapor-intrusion pathway was not evaluated for this site. The total excess cancer risk is 6 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

I-4.2.4 SWMU 05-006(c)

The dioxin and furan congener TEF calculations for the industrial scenario are presented in Table I-4.2-18. The results of the risk-screening assessments for the industrial scenario are presented in Tables I-4.2-19 to I-4.2-21. The total excess cancer risk is 1 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The dioxin and furan congener TEF calculations for the residential scenario are presented in Table I-4.2-22. The results of the risk-screening assessments for the residential scenario are presented in Tables I-4.2-23 to I-4.2-25. The total excess cancer risk is approximately 5 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.3, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.04 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489).

The results of the residential vapor-intrusion screening assessment are presented in Tables I-4.2-26 and I-4.2-27. The total excess cancer risk is approximately 3 × 10^{-8}, which is less than the NMED target cancer risk level of 1 × 10^{-5}. The HI is approximately 0.0004, which is less than the NMED target HI of 1. The addition of the vapor-intrusion cancer risk to the cancer risk presented above results in a total excess cancer risk for the site of 8 × 10^{-8}, which is less than the NMED target cancer risk level of 1 × 10^{-5}. The HI above is not affected by the vapor intrusion HI.

I-4.3 Uncertainty Analysis

The human health risk-screening assessments are subject to varying degrees and types of uncertainty. Aspects of data evaluation and COPC identification, exposure assessment, toxicity assessment, and the additive approach all contribute to uncertainties in the risk assessment process. Each or all of these uncertainties may affect the evaluation results.

I-4.3.1 Data Evaluation and COPC Identification Process

A primary uncertainty associated with the COPC identification process is the possibility that a chemical may be inappropriately identified as a COPC when it is actually not a COPC or that a chemical may not be identified as a COPC when it actually should be identified as a COPC. Inorganic chemicals are appropriately identified as COPCs because only those chemicals that are either detected or have detection limits above background are retained for further analysis. However, established BVs may not accurately represent certain subunits of the Bandelier Tuff (e.g., fractured, clay-rich material) that may be encountered during sampling because such data are not included in the background data set. Some inorganic chemicals and radionuclides may also have been retained as COPCs that are not site-related. There are no established BVs for organic chemicals; therefore, all detected organic chemicals are identified as COPCs and are retained for further analysis.

Other uncertainties associated with inorganic and organic chemicals may include errors in sampling, laboratory analysis, and data analysis. However, because some concentrations used in the risk-screening assessments are less than EQLs, data evaluation uncertainties are expected to have little effect on the risk-screening results.

I-4.3.2 Exposure Assessment

The following exposure assessment uncertainties were identified for the risk assessment: (1) the applicability of the standard scenarios, (2) the assumptions underlying the exposure pathways, and (3) the derivation of EPCs.

The current and reasonably foreseeable future land use is industrial. To the degree actual activity patterns are not represented by those activities assumed by the industrial scenario, uncertainties are introduced in the assessment, and the evaluation presented in this assessment overestimates potential risk. An individual may be subject to exposures in a different manner than the exposure assumptions used to derive the SSLs. For the site evaluated, individuals are not on-site at present or in the future for that frequency and duration. The industrial assumptions for the SSLs are that the potentially exposed individual is outside on-site for 8 h/d, 225 d/yr, for 25 yr, and the residential SSLs are based on exposure of 24 h/d, 350 d/yr, and 30 yr (NMED 2009, 108070). As a result, the industrial and residential scenarios evaluated at these sites likely overestimate the exposure and risk.

A number of assumptions are made relative to exposure pathways, including input parameters, whether or not a given pathway is complete, the contaminated media to which an individual may be exposed, and intake rates for different routes of exposure. In the absence of site-specific data, the exposure assumptions used were consistent with default values (NMED 2009, 108070). When several upper-bound values (such as those found in NMED guidance [NMED 2009, 108070]) are combined to estimate exposure for any one pathway, the resulting risk can exceed the 99th percentile and, therefore, can exceed the range of risk that may be reasonably expected. Also, the assumption that residual concentrations of chemicals in the tuff are available and cause exposure in the same manner as if they were in soil overestimates the potential risk to receptors.

Uncertainty is introduced in the concentration aggregation of data for estimating the EPCs at a site. The use of a UCL is intended to provide a protective, upper-bound estimate of the COPC concentration and is assumed to be representative of average exposure to a COPC across the entire site. Potential risk and exposure from a single location or area with relatively high COPC concentrations may be overestimated if a representative, sitewide value is used. The use of the maximum detected concentration for the EPC overestimates the exposure to contamination because receptors are not consistently exposed to the maximum detected concentration across the site.

SWMU 05-004

The total excess cancer risk for the residential scenario is approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The cancer risk is primarily from PAHs detected next to former building 05-1. The source of the PAHs is most likely the former access road to building 05-1 that was surfaced with a coat of hot oil penetration and not the former septic tank, associated drainlines, and outfall, which comprise the SWMU (section I-4.2-2). Because the PAHs are not site-related, the residential cancer risk and HI were recalculated without the PAHs (section I-4.2-2). The total excess cancer risk is approximately 1×10^{-10}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is approximately 0.05, which is below the NMED target HI of 1 (NMED 2009, 108070).

I-4.3.3 Toxicity Assessment

The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the screening values used in this screening evaluation (NMED 2009, 108070). Uncertainties were identified in five areas with respect to the toxicity values: (1) extrapolation from other animals to humans, (2) individual variability in the human population, (3) the derivation of SFs and RfDs, (4) the chemical form of the COPC, and (5) the use of surrogate chemicals.

Extrapolation from Animals to Humans

The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist between other animals and humans in chemical absorption, metabolism, excretion, and toxic response. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.

Individual Variability in the Human Population

For noncarcinogenic effects, the degree of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the no observed adverse effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a factor of 10 to reflect the possible interindividual variability in the human population that can contribute to uncertainty in the risk evaluation. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

Derivation of SFs and RfDs

The SFs and RfDs for different chemicals are derived from experiments conducted by different laboratories that may have different accuracy and precision that could lead to an over- or underestimation of the risk.

The uncertainty associated with the toxicity factors for noncarcinogens is measured by the uncertainty factor, the modifying factor, and the confidence level. For carcinogens, the weight of evidence classification indicates the likelihood that a contaminant is a human carcinogen. Toxicity values with high uncertainties may change as new information is evaluated.

Chemical Form of the COPC

COPCs may be bound to the environmental matrix and not available for absorption into the human body. However, the exposure scenarios default to the assumption that the COPCs are bioavailable. This assumption can lead to an overestimation of the total risk.

Use of Surrogate Chemicals

The use of surrogates for chemicals that do not have EPA-approved or provisional toxicity values also contributes to uncertainty in risk assessment. Surrogates were used to establish toxicity values for acenaphthylene; benzo[g,h,i]perylene; and 4-isopropyltoluene based on structural similarity (NMED 2003, 081172). The overall impact of surrogates on the risk assessment is minimal because the COPCs were detected at low concentrations, and the HQs were less than 0.1.

I-4.3.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally not known, and possible interactions could be synergistic or antagonistic, resulting in either an over- or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

I-4.4 Interpretation of Human Health Risk-Screening Results

I-4.4.1 Interpretation for SWMU 05-003

Industrial Scenario

SWMU 05-003 is a former underground calibration chamber located 35 ft bgs. No potential exposure pathway exists, and samples were not collected between 0–1 ft bgs. A risk-screening assessment was not performed for the industrial scenario.

Residential Scenario

No carcinogens or radionuclides were retained as COPCs from 0–10 ft at the site. The HI is 0.04 for the residential scenario, which is below the NMED target HI of 1 (NMED 2009, 108070).

Based on the risk-screening assessment results, no potential unacceptable risk and dose exist for the industrial and residential scenarios at SWMU 05-003.

I-4.4.2 Interpretation for SWMU 05-004

Industrial Scenario

No carcinogens were retained as COPCs from 0–1 ft at the site. The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 1×10^{-6}, based on a comparison with EPA's outdoor worker preliminary remediation goals (PRGs) for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Residential Scenario

The total excess cancer risk is approximately 4 × 10^{-5}, which is above the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is approximately 0.06, which is below the NMED target HI of 1 (NMED 2009, 108070). The residential HI includes the contribution from the vapor-intrusion pathway. The total dose is 0.5 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 2 × 10^{-6}, based on a comparison with EPA's residential PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

The cancer risk for the residential scenario is due to PAHs that are not site-related (section I-4.2-2). Therefore, the residential carcinogenic and noncarcinogenic screening evaluations were subsequently conducted without the PAHs. The total excess cancer risk is approximately 1 × 10^{-10}, and the HI is approximately 0.05, which are below the NMED target levels (NMED 2009, 108070).

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMU 05-004.

I-4.4.3 Interpretation for SWMU 05-005(b)

Industrial Scenario

The total excess cancer risk is 1 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.02, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 6 × 10^{-9}, based on a comparison with EPA's outdoor worker PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Residential Scenario

The total excess cancer risk is 6 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.07, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the residential scenario is 0.1 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 3 × 10^{-8} based on a comparison with EPA's residential PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Based on the risk-screening assessment results, no potential unacceptable risk and dose exist for the industrial and residential scenarios at SWMU 05-005(b).

I-4.4.4 Interpretation for SWMU 05-006(c)

Industrial Scenario

The total excess cancer risk is 1 × 10^{-8}, which is below the NMED target risk level of 1 × 10^{-5} (NMED 2009, 108070). The HI is 0.2, which is below the NMED target HI of 1 (NMED 2009, 108070). The total dose for the industrial scenario is 0.02 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 3 × 10^{-9}, based on a comparison with EPA's outdoor worker PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Residential Scenario

The total excess cancer risk is approximately 8×10^{-8}, which is below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). The HI is 0.3, which is below the NMED target HI of 1 (NMED 2009, 108070). The residential cancer risk and HI includes the contribution from the vapor-intrusion pathway. The total dose for the residential scenario is 0.04 mrem/yr, which is below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489). The total dose is equivalent to a total risk of 1×10^{-8}, based on a comparison with EPA's residential PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

Based on the risk-screening assessment results, no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMU 05-006(c).

I-5.0 ECOLOGICAL RISK-SCREENING ASSESSMENT

The approach for conducting ecological risk-screening assessments is described in the "Screening Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630). The assessment consists of the following four parts: (1) a scoping evaluation, (2) a screening evaluation, (3) an uncertainty analysis, and (4) an interpretation of the results.

I-5.1 Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening assessment. The ecological scoping checklists for the four sites evaluated within this aggregate area are useful tools for organizing existing ecological information (Attachment I-2). The information in the scoping checklists is used to determine whether ecological receptors may be affected, identify the types of receptors that may be present, and develop the ecological conceptual site model for each site. The sites are in industrially developed areas.

The scoping portion of the assessment indicated that terrestrial receptors were appropriate for evaluating the concentrations of contaminants in soil and tuff samples. Aquatic receptors were not evaluated because no aquatic communities and no aquatic habitat or perennial source of water exist at any of the sites evaluated. The potential exposure pathways for terrestrial receptors in soil and tuff are root uptake, inhalation, soil ingestion, dermal contact, external irradiation, and food-web transport (Figure I-3.1-1). The weathering of tuff is the only viable natural process that may result in the exposure of receptors to contaminants in tuff. Because of the slow rate of weathering expected for tuff, exposure in tuff is negligible, although it is included in the assessment. Plant exposure in tuff is largely limited to fractures near the surface, which does not produce sufficient biomass to support an herbivore population. Consequently, the contaminants in tuff are not available to receptors.

The potential risk was evaluated in the risk-screening assessments for the following ecological receptors representing several trophic levels:

- a plant,
- soil-dwelling invertebrates (represented by the earthworm),
- the deer mouse (mammalian omnivore),
- the Montane shrew (mammalian insectivore),
- the desert cottontail (mammalian herbivore),

- the red fox (mammalian carnivore),
- the American robin (avian insectivore, avian omnivore, and avian herbivore), and
- the American kestrel (avian intermediate carnivore and avian carnivore (surrogate for threatened and endangered [T&E] species).

The rationale for these receptors is presented in “Screening-Level Ecological Risk Assessment Methods, Revision 2” (LANL 2004, 087630). The ecological screening levels (ESLs) are derived for each of these receptors where information was available. The ESLs are based on similar species and are derived from experimentally determined NOAELs, lowest observed adverse effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values (TRVs), are presented in the ECORISK Database, Release 2.5 (LANL 2010, 110846).

I-5.2 Assessment Endpoints

An assessment endpoint is an explicit expression of the environmental value to be protected. These endpoints are ecologically relevant and help sustain the natural structure, function, and biodiversity of an ecosystem or its components (EPA 1998, 062809). In a screening-level assessment, assessment endpoints are attributes of ecological receptors that may be adversely affected by exposure to hazardous wastes from past operations (EPA 1997, 059370), wherein receptors are populations and communities (EPA 1999, 070086).

The ecological screening assessment is designed to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species or treaty-protected species (EPA 1999, 070086). The protection of individual organisms within these designated protected species could also be achieved at the population level; the populations of these species tend to be small, and the loss of an individual adversely affects the species.

In accordance with this guidance, the Laboratory developed generic assessment endpoints to ensure that values at all levels of the food chain are considered in the ecological screening process (LANL 1999, 064137). These general assessment endpoints can be measured using impacts on reproduction, growth, and survival to represent categories of effects that may adversely impact populations. In addition, specific receptor species were chosen to represent each functional group. The receptor species were chosen because of their presence at the site, their sensitivity to the COPCs, and their potential for exposure to those COPCs. These categories of effects and the chosen receptor species were used to select the types of effects seen in toxicity studies considered in the development of the TRVs. Toxicity studies used in the development of TRVs included only those in which the evaluated adverse effect affected reproduction, survival, and/or growth.

The selection of receptors and assessment endpoints is designed to be protective of both the representative species used as screening receptors and the other species within their feeding guilds and the overall food web for the terrestrial and aquatic ecosystems. Focusing the assessment endpoints on the general characteristics of species that affect populations (rather than the biochemical and behavioral changes that may affect only the studied species) also ensures applicability to the ecosystem of concern.

I-5.3 Screening Evaluation

The ecological risk-screening assessments identify chemicals of potential ecological concern (COPECs) based on the comparison of EPCs with ESLs in accordance with Laboratory guidance (LANL 2004, 087630). The EPCs are presented in Tables I-2.2-3, I-2.2-6, and I-2.2-9. The ESLs for all COPCs and receptors evaluated were obtained from the ECORISK Database, Release 2.5 (LANL 2010, 110846) and are presented in Table I-5.3-1.

The risk-screening assessments involve the calculation of HQs for all COPECs and all screening receptors (LANL 2004, 087630). The HQs are the ratios of the EPCs (UCLs, maximum detected concentrations, or maximum detection limits) to the ESLs. The analysis begins with a comparison of the minimum ESL with the EPC for each COPC. The COPCs with HQs greater than 0.3 are identified as COPECs and are evaluated further. The COPECs are evaluated by receptor with individual HQs for a receptor summed to produce an HI. For the purposes of the ecological screening, it is assumed nonradionuclides have common toxicological effects. An HI greater than 1 requires further assessment to determine if exposure to multiple COPECs results in potential adverse impacts to a given receptor population. The HQ and HI analysis is a conservative indication of potential adverse effects and is designed to minimize the potential of overlooking possible COPECs at the site. COPCs without ESLs are retained as COPECs and are evaluated further in the uncertainty section.

I-5.3.1 SWMU 05-003

The ecological scoping checklist for SWMU 05-003 is provided in Attachment I-2. SWMU 05-003 is located in a former industrial area that is currently not in use. The area provides some habitat for ecological receptors. However, samples were collected below 5 ft bgs, and no potential exposure pathways to terrestrial receptors exist. Therefore, an ecological risk screening assessment was not performed at SWMU 05-003.

I-5.3.2 SWMU 05-004

The results of the minimum ESL comparisons are presented in Table I-5.3-2. Antimony, cadmium, lead, selenium, acenaphthene, and benzoic acid have HQs greater than 0.3 and are retained as COPECs.

Table I-5.3-3 presents the HQs and HIs for each receptor/COPEC at SWMU 05-004. The HI analysis indicates that the robin (insectivore), shrew, deer mouse, and plant have HIs greater than 1.

Nitrate and perchlorate do not have ESLs for any receptors. As a result, nitrate and perchlorate are retained as COPECs and discussed in the uncertainty section.

I-5.3.3 SWMU 05-005(b)

The dioxin and furan congener TEF calculations for the ecological receptors are presented in Table I-5.3-4. The results of the minimum ESL comparisons are presented in Table I-5.3-5. Antimony, cadmium, chromium, lead, nickel, selenium, benzoic acid, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and 2,3,7,8-TCDD have HQs greater than 0.3 and are retained as COPECs.

Table I-5.3-6 presents the HQs and HIs for each receptor/COPEC at SWMU 05-005(b). The HI analysis indicates all receptors, except the red fox and cottontail, have HIs greater than 1.

Perchlorate does not have ESLs for any receptors. As a result, perchlorate is retained as a COPEC and discussed in the uncertainty section.

I-5.3.4 SWMU 05-006(c)

The dioxin and furan congener TEF calculations for the ecological receptors are presented in Table I-5.3-7. The results of the minimum ESL comparisons are presented in Table I-5.3-8. Antimony, chromium, copper, lead, nickel, selenium, and 2,3,7,8-TCDD have HQs greater than 0.3 and are retained as COPECs.

Table I-5.3-9 presents the HQs and HIs for each receptor/COPEC at SWMU 05-006(c). The HI analysis indicates all receptors, except the red fox and kestrel (top carnivore), have HIs greater than 1 and are discussed in the uncertainty analysis.

I-5.4 Uncertainty Analysis

The uncertainty analysis describes the key sources of uncertainty related to the screening evaluations. This analysis can result in either adding or removing chemicals from the list of COPECs. The following is a qualitative uncertainty analysis of the issues relevant to evaluating potential ecological risk at each site.

I-5.4.1 Chemical Form

The assumptions used in the ESL derivations are conservative and not necessarily representative of actual conditions. These assumptions include maximum chemical bioavailability, maximum receptor ingestion rates, minimum bodyweight, and additive effects of multiple COPECs. These factors tend to result in conservative ESL estimates, which may lead to an overestimation of the potential risk. The assumption of additive effects for multiple COPECs may result in an over- or underestimation of the potential risk to receptors.

The chemical form of the individual COPCs was not determined as part of the investigation. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not typically found in the environment. Inorganic, organic, and radionuclide COPECs are generally not 100% bioavailable to receptors in the natural environment because of interference from other natural processes, such as the adsorption of chemical constituents to matrix surfaces (e.g., soil) or rapid oxidation or reduction changes that render harmful chemical forms unavailable to biotic processes. The ESLs were calculated to ensure a conservative indication of potential risk (LANL 2004, 087630), and the values are biased toward overestimating the potential risk to receptors.

I-5.4.2 Exposure Assumptions

The EPCs used in the HQ calculations are UCLs, maximum detected concentrations, or maximum detection limits in the soil, fill, or tuff to depths of 5 ft bgs and are conservative estimates of exposure to each COPEC. The sampling efforts focused on areas of known contamination, and receptors were assumed to ingest 100% of their food and spend 100% of their time at the site. These exposure assumptions for terrestrial receptors in the Lower Mortandad/Cedro Canyons Aggregate Area are likely to overestimate potential ecological exposure and risk.

I-5.4.3 Toxicity Values

The HQs were calculated using ESLs, which are based on NOAELs as threshold effect levels; actual risk for a given COPEC/receptor combination occurs at a higher level, somewhere between the NOAEL-based threshold and the threshold based on the LOAEL. The use of NOAELs leads to an overestimation of potential risk to ecological receptors. ESLs are based on laboratory studies requiring extrapolation to wildlife receptors. Laboratory studies are typically based on artificial and maintained populations with genetically similar individuals and are limited to single chemical exposures in isolated and controlled conditions using a single exposure pathway. Wild species are concomitantly exposed to a variety of chemical and environmental stressors, potentially rendering them more susceptible to chemical stress.

On the other hand, wild populations are probably more genetically diverse than laboratory populations, making wild populations, as a whole, less sensitive to chemical exposure than laboratory populations. The uncertainties associated with the ESLs tend to lead to an overestimation of potential risk.

I-5.4.4 Comparison with Background Concentrations

Although inorganic chemicals have been identified as COPCs, a reevaluation of some of the inorganic COPCs is warranted because the EPCs for the depth interval of 0 to 5 ft bgs are maximum detected concentrations or maximum detection limits. The comparison of these EPCs with the range of background concentrations indicates some concentrations were similar to background, and no potential risk exists from exposure. This relationship is presented in Tables I-5.4-1 to I-5.4-3.

SWMU 05-004

The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for antimony and selenium are the maximum detected concentrations from 0 to 5 ft bgs (Table I-2.2-3). Antimony and selenium are eliminated as COPECs because their EPCs are similar to background concentrations (Table I-5.4-1).

SWMU 05-005(b)

The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for antimony, cadmium, and selenium are the maximum detected concentration or maximum detection limits (no detected concentrations) from 0 to 5 ft bgs (Table I-2.2-6). Antimony, cadmium, and selenium are eliminated as COPECs because their EPCs are similar to background concentrations (Table I-5.4-2).

SWMU 05-006(c)

The ecological screening assessment for this site is based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs for antimony and selenium are the maximum detected concentrations from 0 to 5 ft bgs (Table I-2.2-9). Antimony is retained as a COPEC because it is different from background concentrations, while selenium is eliminated as a COPEC because the EPC is similar to background concentrations (Table I-5.4-3).

I-5.4.5 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUFs) are used to account for the amount of time that a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUFs for individual organisms were developed by dividing the size of the site by the HR for that receptor. Because T&E species must be assessed on an individual basis (EPA 1999, 070086), the AUF is used for the Mexican spotted owl based on an HR of 366 ha. The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl.

The site area for SWMU 05-004 is 0.016 ha, which results in an AUF of 0.00004 for the Mexican spotted owl (Table I-5.4-4). The unadjusted HI for the kestrel (top carnivore) is 0.02 (Table I-5.3-3). Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) results in an adjusted HI 0.0000008. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

The site area for SWMU 05-005(b) is 0.018 ha, which results in an AUF of 0.00005 for the Mexican spotted owl (Table I-5.4-4). The unadjusted HI for the kestrel (top carnivore) is 9 (Table I-5.3-6). Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) results in an adjusted HI of 0.0005. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

The site area for SWMU 05-006(c) is 0.006 ha, which results in an AUF of 0.00002 for the Mexican spotted owl (Table I-5.4-4). The unadjusted HI for the kestrel (top carnivore) is 0.2 (Table I-5.3-9). Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) results in an adjusted HI of 0.000004. Therefore, there are no potential adverse impacts to the Mexican spotted owl.

I-5.4.6 Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of T&E species (EPA 1999, 070086). One approach to address the potential effects on populations is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for each receptor is based on the individual receptor HR and its dispersal distance (Bowman et al. 2002, 073475). Bowman et al. (2002, 073475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the HR (i.e., the square root of the HR area). If only the dispersal distances for the mammals with HRs within the range of the screening receptors are used, the median dispersal distance becomes 3.6 times the square root of the HR (R^2=0.91) (Bowman et al. 2002, 073475). If it is assumed that the receptors can disperse over the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area for each receptor can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The population area use factor (PAUF) is calculated by dividing the site area by the population area of the receptor. The PAUFs for the sites are presented in Table I-5.4-4. The HQs are recalculated minus the COPECs eliminated based on similarity to background (section I-5.4.4) and adjusted by multiplying by the PAUFs. If the PAUF is greater than 1, the HQs are not adjusted for that receptor. The HQs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs. The adjusted HIs are presented in Tables I-5.4-5 to I-5.4-7.

I-5.4.7 LOAEL Analysis

SWMUs 05-005(b) and 05-006(c) have HIs greater than 1 for the earthworm and plant (Tables I-5.4-6 and I-5.4-7). To address the HIs and reduce the associated uncertainties, LOAEL analyses were conducted using ESLs calculated based on a LOAEL rather than a NOAEL. The LOAEL-based ESLs were calculated based on toxicity information in the ECORISK Database, Release 2.5 (LANL 2010, 110846) and are presented in Table I-5.4-8, along with the basis for each LOAEL used in the ESL calculations. The analyses address some of the uncertainties and conservativeness of the ESLs used in the initial screening assessments.

I-5.4.8 Site Discussions

SWMU 05-005(b)

The adjusted HIs for SWMU 05-005(b) (Table I-5.4-6) are less than 1 for the kestrel (intermediate and top carnivore); robin (herbivore, omnivore, and insectivore); cottontail; deer mouse; montane shrew; and red fox. The adjusted HIs are greater than 1 for the earthworm and plant, with chromium being the primary COPEC. The LOAEL analysis results in HQs of 0.6 for the earthworm and approximately 1 for the plant

(Table I-5.4-9). The LOAEL-based chromium ESL for the plant (12 mg/kg) is less than the maximum Qbt 2,3,4 background concentration (13 mg/kg), indicating the potential ecological risk to the plant is overestimated. In addition, the chromium HQs are not different from the HQs associated with naturally occurring concentrations of chromium.

Field observations made during the site visit found no indication of adverse effects on the plant community (Attachment I-3). Field observations indicated no adverse effects of any kind, and the ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals, appears to be functioning. Therefore, the HI is not consistent with field observations and does not indicate potential risk to the receptor.

SWMU 05-006(c)

The adjusted HIs for SWMU 05-006(c) (Table I-5.4-7) are less than 1 for the kestrel (intermediate and top carnivore); robin (herbivore, omnivore, and insectivore); cottontail; deer mouse; montane shrew; and red fox. The adjusted HIs are greater than 1 for the earthworm and plant, with chromium being the primary COPEC for the earthworm, and antimony and chromium being the primary COPECs for the plant. The antimony EPC of 2.3 mg/kg is the maximum detected concentration (Table I-2.2-9). Instead of using the maximum detected concentration as the EPC, a 95% UCL of 0.887 mg/kg was calculated using ProUCL (Attachment I-1). The LOAEL analysis using the 95% UCL results in an HQ of 1.8 for antimony for the plant (Table I-5.4-10). The LOAEL-based antimony ESL for the plant (0.5 mg/kg) is equivalent to the Qbt 3 BV (0.5 mg/kg) and less than the maximum soil background concentration (1 mg/kg), indicating the potential ecological risk to the plant is overestimated. The antimony HQ is also not different from an HQ associated with naturally occurring concentrations of antimony. In addition, the LOAEL-based chromium ESLs for the earthworm (23 mg/kg) and the plant (12 mg/kg) are less than less than the maximum soil background concentration (36.5 mg/kg) and the maximum Qbt 2,3,4 background concentration (13 mg/kg), respectively, indicating the potential ecological risks to the earthworm and plant are overestimated.

Field observations made during the site visit found no indication of adverse effects on the plant community (Attachment I-3). Field observations indicated no adverse effects of any kind, and the ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals, appears to be functioning. Therefore, the HIs are not consistent with field observations and do not indicate potential risk to these receptors.

I-5.4.9 COPECs without ESLs

Several COPECs do not have ESLs for any receptor in release 2.5 of the ECORISK Database (LANL 2010, 110846) because literature searches for relevant toxicity data for these chemicals have not been completed. In an effort to address this uncertainty and provide a quantitative assessment of potential ecological risk, several online toxicity databases have been searched to determine if any relevant toxicity information is available. The online databases searched were EPA Ecotox Database, EPA Office of Pesticide Programs Aquatic Life Benchmarks, U.S. Army Corps of Engineers/EPA Environmental Residue-Effects, California Cal/Ecotox Database, Pesticide Action Network Pesticide Database, U.S. Army Wildlife Toxicity Assessment Program, USDA Integrated Pesticide Management Database, American Bird Conservancy Pesticide Toxicity Database, and Oak Ridge National Laboratory Risk Assessment Information System. Toxicity data were obtained for several COPECs and receptors as a result of this online database search. However, several COPECs did not have any relevant toxicity data in the online databases listed above.

In the absence of a chemical-specific ESL, COPEC concentrations can be compared with the ESLs for a surrogate chemical. Comparison to surrogate ESLs provides an estimate of potential effects of a chemically related compound and a line of evidence to indicate the likelihood that ecological receptors are potentially impacted.

Some COPECs without ESLs do not have chemical-specific toxicity data or surrogate chemicals to be used in the screening assessments and cannot be assessed quantitatively for potential ecological risk. These COPECs are often infrequently detected across the site. In these cases, comparisons to residential human health SSLs are presented as part of a qualitative assessment. The comparison of COPEC concentrations to residential human health SSLs is a viable alternative for several reasons. Animal studies are used to infer effects on humans and is the basic premise of modern toxicology (EPA 1989, 008021). In addition, toxicity values derived for the calculation of human health SSLs are often based on potential effects that are more sensitive than the ones used to derive ESLs (e.g., cellular effects for humans versus survival or reproductive effects for terrestrial animals). The EPA also applies uncertainty factors or modifying factors to ensure the toxicity values are protective (i.e., they are adjusted by uncertainty factors to values much lower than the study results). COPEC concentrations compared with these values are an order of magnitude or more below the SSLs, which corresponds to uncertainty factors of 10 or more. Therefore, it is assumed the differences in toxicity would not be more than an order of magnitude for any given chemical. The relative difference between values provides a weight of evidence that the potential toxicity of the COPC is likely to be low or very low to the receptor(s).

I-5.4.9.1 SWMU 05-004

No ESLs are available in the ECORISK Database, Release 2.5 (LANL 2010, 110846) for nitrate and perchlorate. In addition, no toxicity data were found as a result of the online database searches.

Nitrate was detected in 26 samples with a maximum concentration of 71.8 mg/kg. The NMED residential SSL for nitrate is 125,000 mg/kg, indicating that potential toxicity is low. Because of the potential low toxicity, nitrate is eliminated as a COPEC.

Perchlorate was detected in eight samples with a maximum concentration of 0.00346 mg/kg. The NMED residential SSL for perchlorate is 54.8 mg/kg, indicating that potential toxicity is low. Because of the potential low toxicity, perchlorate is eliminated as a COPEC.

I-5.4.9.2 SWMU 05-005(b)

No ESL is available in the ECORISK Database, Release 2.5 (LANL 2010, 110846) for perchlorate. In addition, no toxicity data were found as a result of the online database searches.

Perchlorate was detected in six samples with a maximum detected concentration of 0.00107 mg/kg. The NMED residential SSL for perchlorate is 54.8 mg/kg, indicating that potential toxicity is low. Because of the potential low toxicity, perchlorate is eliminated as a COPEC.

I-5.5 Interpretation of Ecological Risk-Screening Results

I-5.5.1 Receptor Lines of Evidence

Based on the ecological risk-screening assessments, several COPECs were identified at SWMUs 05-004, 05-005(b), and 05-006(c). Receptors were evaluated using several lines of evidence: minimum ESL comparisons, HI analyses, comparison with background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analysis.

Red Fox (Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the red fox, were less than 0.3.
- The HI analysis indicated that the HI for the red fox was less than 1 at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the red fox exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Kestrel (Top Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the kestrel (top carnivore), were less than 0.3.
- The HI analysis indicated that the HIs for the kestrel (top carnivore) were less than 1 at SWMUs 05-004 and 05-006(c).
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HI for SWMU 05-005(b) was adjusted by the PAUF, which is the ratio of the site area to the kestrel's population area. The adjusted HI was less than 1 for the kestrel (top carnivore).
- The kestrel (top carnivore) is a surrogate for the Mexican spotted owl. The HIs were adjusted by the AUF, which is the ratio of the site area to the individual HR. The AUF-adjusted HIs were less than 1 at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (top carnivore) or the Mexican spotted owl exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Kestrel (Intermediate Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the kestrel, were less than 0.3.
- The HI analysis indicated that the HI for the kestrel (top carnivore) was less than 1 at SWMU 05-004.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs for SWMUs 05-005(b) and 05-006(c) were adjusted by the PAUFs, which is the ratio of the site area to the kestrel's population area. The adjusted HIs were less than 1 for the kestrel (intermediate carnivore).

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (intermediate carnivore) exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Robin (Herbivore, Omnivore, Insectivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the robin (herbivore, omnivore, insectivore), were less than 0.3.
- The HI analysis indicated that the HI for the robin (herbivore) was less than 1 at SWMU 05-004.

- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs were adjusted by the PAUFs, which is the ratio of the site area to the robin's population area. The adjusted HIs were less than 1 for the robin (herbivore, omnivore, insectivore).

These lines of evidence support the conclusion that no potential ecological risk to the robin (herbivore, omnivore, insectivore) exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Deer Mouse (Omnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the deer mouse, were less than 0.3.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the deer mouse's population area. The adjusted HI was less than 1 for the deer mouse at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the deer mouse exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Desert Cottontail (Herbivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the cottontail, were less than 0.3.
- The HI analysis indicated that the HI for the cottontail was less than 1 at SWMU 05-004 and equivalent to 1 at SWMU 05-005(b).
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HI for SWMU 05-006(c) was adjusted by the PAUF, which is the ratio of the site area to the cottontail's population area. The adjusted HI was less than 1 for the cottontail.

These lines of evidence support the conclusion that no potential ecological risk to the cottontail exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Montane Shrew (Insectivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the shrew, were less than 0.3.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The HIs were adjusted by the PAUFs, which is the ratio of the site area to the shrew's population area. The adjusted HI was less than 1 for the shrew at all three sites.

These lines of evidence support the conclusion that no potential ecological risk to the Montane shrew exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Earthworm (Invertebrate)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the earthworm, were less than 0.3.
- The HI analysis indicated that the HI for the earthworm was less than 1 at SWMU 05-004.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- A LOAEL analysis conducted resulted in an HI less than 1 at SWMU 05-005(b) and an HI of approximately 2 at SWMU 05-006(c). The LOAEL-based chromium ESL for the earthworm (23 mg/kg) is less than less than the maximum soil background concentration (36.5 mg/kg), indicating the potential ecological risk to the earthworm is overestimated. In addition, the chromium HQs are not different from HQs associated with naturally occurring concentrations of chromium.

These lines of evidence support the conclusion that no potential ecological risk to the earthworm exists at SWMUs 05-004, 05-005(b), and 05-006(c).

Plant

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the plant, were less than 0.3.
- Several COPECs were eliminated because their EPCs were similar to background concentrations.
- The adjusted HI for the plant at SWMU 05-004 was less than 1.
- A LOAEL analysis conducted resulted in an HQ of approximately 1 for the plant at SWMU 05-005(b). The LOAEL-based chromium ESL for the plant (12 mg/kg) is less than the maximum Qbt 2,3,4 background concentration (13 mg/kg), indicating the potential ecological risk to the plant is overestimated. In addition, the chromium HQs are not different from HQs associated with naturally occurring concentrations of chromium.
- For the LOAEL analysis at SWMU 05-006(c), a 95% UCL was calculated for antimony, which resulted in an HQ of 1.8 for antimony. The LOAEL-based antimony ESL for the plant (0.5 mg/kg) is equivalent to the Qbt 3 BV (0.5 mg/kg) and is less than the maximum soil background concentration (1 mg/kg), indicating the potential ecological risk to the plant is overestimated. In addition, the LOAEL-based chromium ESL for the plant (12 mg/kg) is less than the maximum soil background concentration (36.5 mg/kg) and the maximum Qbt 2,3,4 background concentration (13 mg/kg), respectively, indicating the potential ecological risk to the plant is overestimated.
- The plant communities were evaluated at all sites during site visits. No evidence of adverse impacts of contamination to the plant community based on field observations was found during site visits; the plant community is typical of the surrounding area and appears healthy. Field observations indicated no adverse effects of any kind, and there appears to be functioning ecological habitat for all terrestrial receptors, including plants, invertebrates, birds, and mammals.

These lines of evidence support the conclusion that no potential ecological risk to the plant exists at SWMUs 05-004, 05-005(b), and 05-006(c).

I-5.5.2 COPECs with No ESLs

The COPECs with no ESLs were evaluated and were eliminated. The analysis of COPECs with no ESLs supports the conclusion that no potential ecological risk to any receptor exists at SWMUs 05-004, 05-005(b), and 05-006(c).

I-5.5.3 Summary

No potential ecological risk exists at SWMU 05-003 because no potential exposure pathways for ecological receptors exist at SWMU 05-003.

Based on evaluations of the minimum ESL, HI analysis, comparisons to background, potential effects to populations (individuals for T&E species), and LOAEL analysis, no potential ecological risk exists at SWMUs 05-004, 05-005(b), and 05-006(c).

I-6.0 CONCLUSIONS AND RECOMMENDATIONS

I-6.1 Human Health

The human health risk-screening assessments indicated no potential unacceptable risks or doses exist for the industrial and residential scenarios at SWMUs 05-003, 05-005(b) and 05-006(c). The total excess cancer risks were below the NMED target risk level of 1×10^{-5} (NMED 2009, 108070), the HIs were less than the NMED target HI of 1 (NMED 2009, 108070), and the total doses were below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489) for both scenarios at these sites.

The human health risk-screening assessments indicated no potential unacceptable risks or dose exist for the industrial scenario at SWMU 05-004. The HI (0.06) was below the NMED target HI of 1 (NMED 2009, 108070) and the total dose (0.1 mrem/yr) was below the DOE target dose limit of 15 mrem/yr (Soden 2000, 067489) for the residential scenario. The total excess cancer risk for the residential scenario at SWMU 05-004 was approximately 4×10^{-5}, which is above the NMED target risk level of 1×10^{-5} (NMED 2009, 108070). Because the cancer risk was primarily from non-site-related PAHs, the risk was recalculated without these organic chemicals. The recalculated total excess cancer risk for the residential scenario was approximately 1×10^{-10}, which is below the NMED target risk level (NMED 2009, 108070). Therefore, there were no potential unacceptable risks or dose for the residential scenario at SWMU 05-004.

No radionuclides were identified as COPCs at SWMU 05-003. The total doses at SWMUs 05-004, 05-005(b), and 05-006(c) were equivalent to total risks ranging from 3×10^{-9} to 2×10^{-6}, based on a comparison with EPA's PRGs for radionuclides (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

I-6.2 Ecology

No potential ecological risk exists at SWMU 05-003 because there are no potential exposure pathways to ecological receptors at SWMU 05-003.

No potential ecological risks exist for any receptor at SWMUs 05-004, 05-005(b), and 05-006(c) based on minimum ESL comparisons, HI analyses, comparisons to background concentrations, potential effects to populations (individuals for T&E species), and LOAEL analysis.

I-7.0 REFERENCES

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

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

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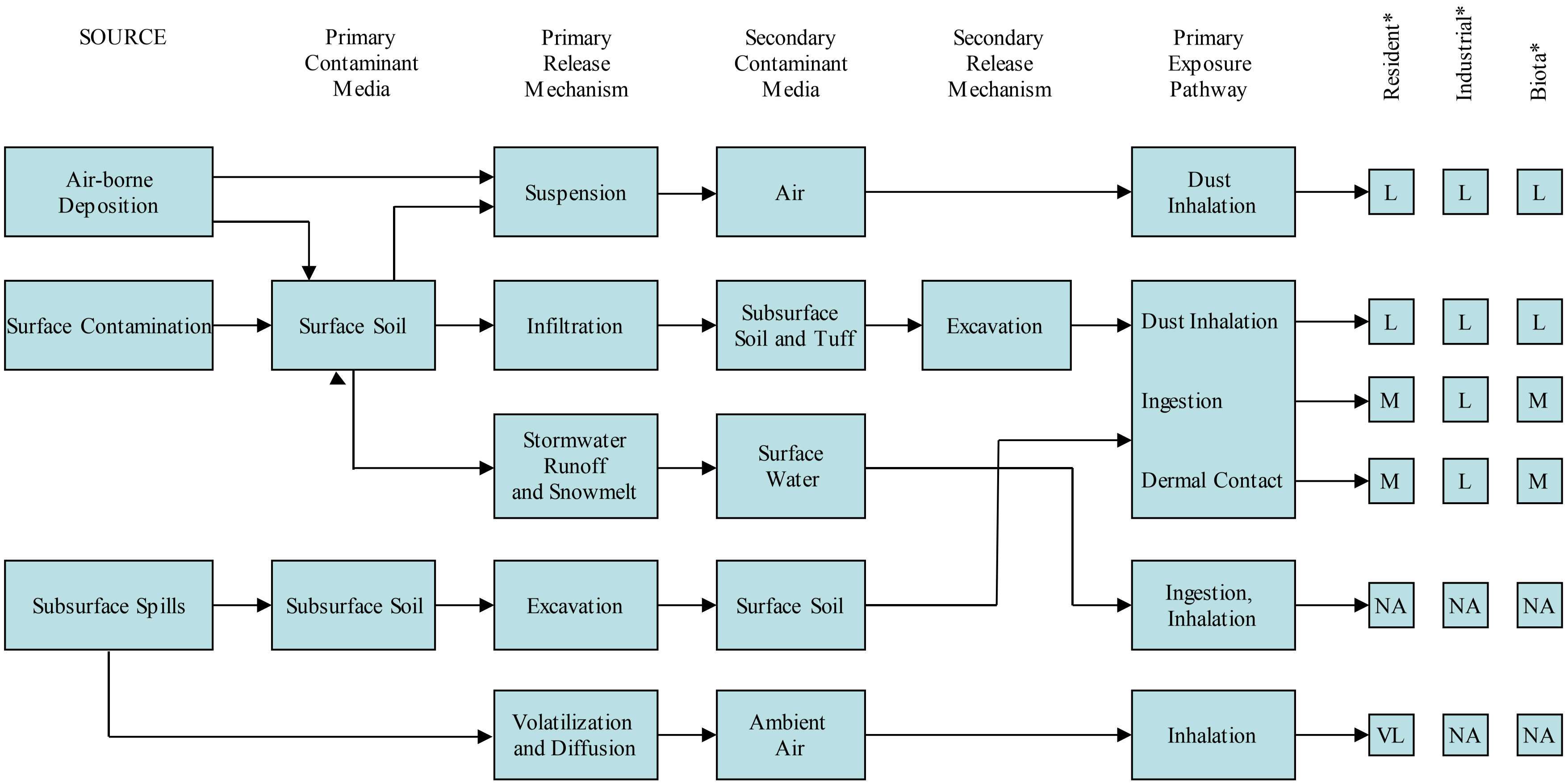


* Very Low (VL), Low (L), and Moderate (M) designations indicate the pathway is a potentially complete pathway and is evaluated in the risk assessments. Not Applicable (NA) indicates the pathway is incomplete and is not evaluated in the risk assessments.

Figure I-3.1-1 Conceptual site model for Lower Mortandad/Cedro Canyons Aggregate Area

Table I-2.2-1
EPCs for SWMU 05-003 for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	2	0	1.03(U)	1.03(U)	n/a*	1.03(U)	Maximum detection limit
Selenium	2	0	0.94(U)	1.05(U)	n/a	1.05(U)	Maximum detection limit

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table I-2.2-2
EPCs for SWMU 05-004 for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	5	0	0.385(U)	0.832(U)	n/a[a]	0.832(U)	Maximum detection limit
Cadmium	13	9	0.029	0.55(U)	Normal	0.0911	95% KM(t)
Calcium	13	13	680	3700	Normal	2255	95% Student’s-t
Copper	13	13	1.1	6.2	Normal	4.313	95% Student’s-t
Lead	13	13	5	16.4	Normal	12.67	95% Student’s-t
Nitrate	5	5	1.23	5.27	n/a	5.27	Maximum detected concentration
Perchlorate	5	1	0.000646	0.00226(U)	n/a	0.000646[b]	Maximum detected concentration
Selenium	13	0	0.51(U)	1.1(U)	n/a	1.1(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Benzoic acid	14	2	0.272	3.5(U)	n/a	0.61[b]	Maximum detected concentration
Styrene	5	1	0.00035	0.00109(U)	n/a	0.00035[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	10	4	-0.00303(U)	0.041	n/a	0.041	Maximum detected concentration
Uranium-234	10	10	0.772	4.71	Nonparametric	2.161	95% Student’s-t
Uranium-235/236	10	1	0.0206(U)	0.206	n/a	0.206	Maximum detected concentration
Uranium-238	10	10	0.878	4.66	Nonparametric	2.234	95% Student’s-t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-3
EPCs for SWMU 05-004 for Ecological Risk

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	21	1	0.12	1.04(U)	n/a[a]	0.12[b]	Maximum detected concentration
Cadmium	29	11	0.029	0.55(U)	Gamma	0.147	95% KM(t)
Calcium	29	29	278	3700	Normal	1755	95% Student's-t
Copper	29	29	0.69	8.43	Normal	3.79	95% Student's-t
Lead	29	29	4.7	16.4	Gamma	10.01	95% Approximate gamma
Nitrate	20	19	0.958	71.8	Nonparametric	20.41	95% KM(Chebyshev)
Perchlorate	20	4	0.000646	0.00346	n/a	0.00346	Maximum detected concentration
Selenium	29	3	0.345	1.11(U)	n/a	0.371[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acenaphthene	29	1	0.0339(U)	0.36(U)	n/a	0.0852[b]	Maximum detected concentration
Benzoic acid	29	5	0.216	3.5(U)	n/a	0.61[b]	Maximum detected concentration
2-Hexanone	21	1	0.00508(U)	0.0793	n/a	0.0793	Maximum detected concentration
Methylene chloride	21	3	0.00222	0.011(U)	n/a	0.00236[b]	Maximum detected concentration
Styrene	21	1	0.00035	0.005(U)	n/a	0.00035[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	30	5	-0.00361(U)	0.098	n/a	0.098	Maximum detected concentration
Uranium-234	30	30	0.764	4.71	Nonparametric	1.461	95% Student's-t
Uranium-235/236	30	7	0.0206(U)	0.206	n/a	0.206	Maximum detected concentration
Uranium-238	30	30	0.734	4.66	Nonparametric	1.498	95% Student's-t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-4
EPCs for SWMU 05-004 for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	30	2	0.12	1.04(U)	n/a[a]	0.505[b]	Maximum detected concentration
Cadmium	38	12	0.029	0.55(U)	Gamma	0.144	95% KM(t)
Calcium	38	38	278	3700	Normal	1636	95% Student's-t
Copper	40	38	0.69	13.8	Gamma	4.408	95% KM(BCA)
Lead	39	39	3.78	54.1	Nonparametric	12	95% Student's-t
Nitrate	30	26	0.958	71.8	Nonparametric	20.28	95% KM(Chebyshev)
Perchlorate	29	8	0.00052	0.00346	Normal	0.00144	95% KM(t)
Selenium	40	7	0.345	1.1(U)	n/a	0.406[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acenaphthene	39	2	0.0336(U)	0.36(U)	n/a	0.0852[b]	Maximum detected concentration
Acenaphthylene	39	2	0.0102	0.36(U)	n/a	0.0242[b]	Maximum detected concentration
Anthracene	39	2	0.0336(U)	0.36(U)	n/a	0.334[b]	Maximum detected concentration
Benzo(a)anthracene	39	2	0.0336(U)	1.61	n/a	1.61	Maximum detected concentration
Benzo(a)pyrene	39	2	0.0336(U)	1.55	n/a	1.55	Maximum detected concentration
Benzo(b)fluoranthene	39	2	0.0336(U)	3.04	n/a	3.04	Maximum detected concentration
Benzo(g,h,i)perylene	39	2	0.0336(U)	0.769	n/a	0.769	Maximum detected concentration
Benzo(k)fluoranthene	39	2	0.0336(U)	0.899	n/a	0.899	Maximum detected concentration
Benzoic acid	39	6	0.216	3.5(U)	n/a	0.61[b]	Maximum detected concentration
Chrysene	39	2	0.0336(U)	3.13	n/a	3.13	Maximum detected concentration
Dibenz(a,h)anthracene	39	2	0.0336(U)	0.36(U)	n/a	0.188	Maximum detected concentration
Diethylphthalate	39	1	0.0824	0.377(U)	n/a	0.0824[b]	Maximum detected concentration
Fluoranthene	39	3	0.0118	3.42	n/a	3.42	Maximum detected concentration
Fluorene	39	2	0.0174	0.36(U)	n/a	0.11[b]	Maximum detected concentration
2-Hexanone	30	3	0.00505(U)	0.0793	n/a	0.0793	Maximum detected concentration
Indeno(1,2,3-cd)pyrene	39	2	0.0336(U)	0.74	n/a	0.74	Maximum detected concentration
4-Isopropyltoluene	30	1	0.000429	0.005(U)	n/a	0.000429[b]	Maximum detected concentration
Methylene chloride	30	3	0.00222	0.011(U)	n/a	0.00236[b]	Maximum detected concentration
2-Methylnaphthalene	39	1	0.0152	0.36(U)	n/a	0.0152[b]	Maximum detected concentration

Table I-2.2-4 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Naphthalene	39	1	0.0145	0.36(U)	n/a	0.0145[b]	Maximum detected concentration
Phenanthrene	39	2	0.0336(U)	1.42	n/a	1.42	Maximum detected concentration
Pyrene	39	2	0.0336(U)	2.64	n/a	2.64	Maximum detected concentration
Styrene	30	1	0.00035	0.005(U)	n/a	0.00035[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	40	5	-0.0111(U)	0.098	n/a	0.098	Maximum detected concentration
Uranium-234	40	40	0.764	4.71	Nonparametric	1.345	95% Student's-t
Uranium-235/236	40	11	0.0206(U)	0.206	Nonparametric	0.0747	95% KM(t)
Uranium-238	40	40	0.734	4.66	Nonparametric	1.369	95% Student's-t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-5
EPCs for SWMU 05-005(b) for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	12	3	0.348	1.09(U)	n/a[a]	0.834[b]	Maximum detected concentration
Cadmium	12	0	0.02(U)	0.544(U)	n/a	0.544(U)	Maximum detection limit
Chromium	12	12	1.88	25	Nonparametric	12.87	95% Chebyshev (Mean, Sd)
Copper	12	11	0.81	5.25	Normal	3.944	95% KM (t)
Lead	12	12	7.7	29.8	Gamma	16.08	95% Approximate gamma
Nickel	12	12	1.57	13	Nonparametric	7.27	95% Chebyshev (Mean, Sd)
Perchlorate	10	2	0.000776	0.00222(U)	n/a	0.00107[b]	Maximum detected concentration
Selenium	12	0	0.44(U)	1.07(U)	n/a	1.07(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Benzoic acid	9	1	0.538	0.739(U)	n/a	0.538[b]	Maximum detected concentration
Di-n-butylphthalate	9	1	0.0774	0.369(U)	n/a	0.0774[b]	Maximum detected concentration
Fluoranthene	9	1	0.0116	0.0369(U)	n/a	0.0116[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	9	8	4.9E-07(U)	7.18E-06	Gamma	3.884E-06	95% KM (BCA)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	9	6	4.82E-07(U)	1.66E-06	n/a	1.66E-06	Maximum detected concentration
Isopropyltoluene[4-]	9	1	0.000748	0.00111	n/a	0.000748[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	9	8	1.18E-06(U)	6.99E-05	Approximate Gamma	3.536E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	9	4	9.64E-07(U)	2.85E-06	n/a	2.85E-06	Maximum detected concentration
Pentachlorodibenzofuran [2,3,4,7,8-]	9	1	4.39E-07(U)	6.65E-07	n/a	6.65E-07	Maximum detected concentration
Toluene	9	1	0.000326	0.00111 (U)	n/a	0.000326[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-238	12	1	-0.00722(U)	0.0225	n/a	0.0225	Maximum detected concentration
Plutonium-239/240	12	2	-0.00139(U)	0.0282	n/a	0.0282	Maximum detected concentration
Uranium-235/236	12	7	0.02	0.103	n/a	0.103	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-6
EPCs for SWMU 05-005(b) for Ecological Risk

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	33	6	0.346	1.09(U)	n/a[a]	0.834[b]	Maximum detected concentration
Cadmium	32	0	0.02(U)	0.544(U)	n/a	0.544(U)	Maximum detection limit
Chromium	33	33	0.687	45.9	Nonparametric	12.77	95% Chebyshev (Mean, Sd)
Copper	33	29	0.48(U)	5.25	Normal	2.693	95% KM (t)
Lead	33	33	3.9	29.8	Lognormal	10.72	95% Student's t
Nickel	33	33	0.783	23.7	Nonparametric	7.471	95% Chebyshev (Mean, Sd)
Perchlorate	26	6	0.000581	0.00222(U)	n/a	0.00107[b]	Maximum detected concentration
Selenium	33	0	0.43(U)	1.07(U)	n/a	1.07(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Acenaphthene	27	1	0.0334(U)	0.34(U)	n/a	0.0444[b]	Maximum detected concentration
Benzoic acid	25	1	0.538	3.4(U)	n/a	0.538[b]	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	25	1	0.29	0.369(U)	n/a	0.29[b]	Maximum detected concentration
Di-n-butylphthalate	25	1	0.0774	0.369(U)	n/a	0.0774[b]	Maximum detected concentration
Fluoranthene	25	1	0.0116	0.34(U)	n/a	0.0116[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	24	11	4.8E-07(U)	7.18E-06	Gamma	1.962E-06	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	24	8	4.8E-07(U)	1.66E-06	Normal	7.864E-07	95% KM (t)
Isopropyltoluene[4-]	24	1	0.000748	0.00111	n/a	0.000748[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	24	14	9.64E-07(U)	6.99E-05	Gamma	1.638E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	24	4	9.5E-07(U)	2.85E-06	n/a	2.85E-06	Maximum detected concentration
Pentachlorodibenzofuran [2,3,4,7,8-]	24	1	4.39E-07(U)	6.65E-07	n/a	6.65E-07	Maximum detected concentration
Toluene	24	1	0.000326	0.00111 (U)	n/a	0.000326[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-238	33	1	-0.00958(U)	0.0225	n/a	0.0225	Maximum detected concentration
Plutonium-239/240	33	2	-0.012(U)	0.0282	n/a	0.0282	Maximum detected concentration
Uranium-235/236	33	11	0.01(U)	0.103	Normal	0.04	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-7
EPCs for SWMU 05-005(b) for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	38	6	0.327(U)	1.09(U)	n/a[a]	0.834[b]	Maximum detected concentration
Cadmium	36	0	0.02(U)	0.544(U)	n/a	0.544(U)	Maximum detection limit
Chromium	36	36	0.687	45.9	Nonparametric	11.9	95% Chebyshev (Mean, Sd)
Copper	36	31	0.48(U)	5.25	Normal	2.589	95% KM (t)
Lead	36	36	3.9	29.8	Lognormal	10.41	95% Student's t
Nickel	36	36	0.783	23.7	Nonparametric	6.988	95% Chebyshev (Mean, Sd)
Perchlorate	31	6	0.000581	0.00222(U)	n/a	0.00107[b]	Maximum detected concentration
Selenium	36	0	0.43(U)	1.07(U)	n/a	1.07(U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Acenaphthene	31	1	0.0334(U)	0.34(U)	n/a	0.0444[b]	Maximum detected concentration
Benzoic acid	28	1	0.538	3.4(U)	n/a	0.538[b]	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	28	1	0.29	0.369(U)	n/a	0.29[b]	Maximum detected concentration
Di-n-butylphthalate	28	1	0.0774	0.369(U)	n/a	0.0774[b]	Maximum detected concentration
Fluoranthene	28	1	0.0116	0.34(U)	n/a	0.0116[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	27	11	4.31E-07(U)	7.18E-06	Gamma	1.808E-06	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	27	8	4.31E-07(U)	1.66E-06	Normal	7.553E-07	95% KM (t)
Isopropyltoluene[4-]	27	1	0.000748	0.00111	n/a	0.000748[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	27	16	8.61E-07(U)	6.99E-05	Gamma	1.435E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	27	4	8.61E-07(U)	2.85E-06	n/a	2.85E-06	Maximum detected concentration
Pentachlorodibenzofuran [2,3,4,7,8-]	27	1	4.39E-07(U)	6.65E-07	n/a	6.65E-07	Maximum detected concentration
Toluene	27	1	0.000326	0.00111 (U)	n/a	0.000326[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-238	36	1	-0.00958(U)	0.0225	n/a	0.0225	Maximum detected concentration
Plutonium-239/240	36	2	-0.012(U)	0.0282	n/a	0.0282	Maximum detected concentration
Uranium-235/236	36	14	0.01(U)	0.103	Normal	0.0428	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a= Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-8
EPCs for SWMU 05-006(c) for the Industrial Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	15	6	0.39(U)	2.3	n/a[a]	2.3	Maximum detected concentration
Chromium	15	15	0.64	10.8	Normal	5.338	95% Student's-t
Copper	15	15	1.27	317	Lognormal	130.7	95% Chebyshev (Mean, Sd)
Lead	18	18	9.29	337	Nonparametric	148	95% Chebyshev (Mean, Sd)
Nickel	15	15	1.14	28.2	Nonparametric	12.13	95% Chebyshev (Mean, Sd)
Selenium	15	3	0.347	1.1	n/a	1.1	Maximum detected concentration
Silver	15	4	0.1(U)	0.511(U)	n/a	0.31[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acetone	10	2	0.00172	0.0056(U)	n/a	0.00203[b]	Maximum detected concentration
Aroclor-1260	10	2	0.0014	0.00372(U)	n/a	0.0015[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	10	9	4.62E-07(U)	8.92E-06	Normal	4.3446E-06	95% KM (t)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	10	6	4.62E-07(U)	2.7E-06	n/a	2.7E-06	Maximum detected concentration
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	10	1	4.62E-07(U)	5.08E-07	n/a	5.08E-07	Maximum detected concentration
Isopropyltoluene[4-]	10	3	0.000383	0.00145	n/a	0.00145	Maximum detected concentration
Methylene chloride	10	5	0.00219	0.00545(U)	n/a	0.00286[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	10	10	1.49E-06	5.77E-05	Gamma	3.271E-05	95% Approximate gamma
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	10	6	9.24E-07(U)	3.44E-06	n/a	3.44E-06	Maximum detected concentration
Tetrachlorodibenzofuran[2,3,7,8-]	10	1	2.67E-07(U)	9.63E-07	n/a	9.63E-07	Maximum detected concentration
Toluene	10	3	0.000943	0.00136(U)	n/a	0.0013[b]	Maximum detected concentration
Trimethylbenzene[1,2,4-]	10	1	0.000461	0.00112(U)	n/a	0.000461[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Uranium-235/236	13	5	0.03(U)	0.103	n/a	0.103	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-9
EPCs for SWMU 05-006(c) for Ecological Risk

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	29	7	0.34(U)	2.3	n/a[a]	2.3	Maximum detected concentration
Chromium	29	29	0.64	187	Nonparametric	40.69	95% Chebyshev (Mean, Sd)
Copper	29	27	0.63	317	Nonparametric	70.5	95% KM (Chebyshev)
Lead	35	35	5.1	337	Nonparametric	95.91	95% Chebyshev (Mean, Sd)
Nickel	29	29	0.731	89.4	Nonparametric	21.46	95% Chebyshev (Mean, Sd)
Selenium	29	5	0.316	1.1	n/a	1.1	Maximum detected concentration
Silver	29	7	0.1(U)	0.511(U)	n/a	0.31[b]	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acetone	18	2	0.00172	0.0056(U)	n/a	0.00203[b]	Maximum detected concentration
Aroclor-1260	18	3	0.0014	0.00372(U)	n/a	0.0018[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	18	14	4.41E-07(U)	8.92E-06	Gamma	3.1436E-06	95% KM (BCA)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	18	8	4.41E-07(U)	2.7E-06	Approximate Gamma	1.3246E-06	95% KM (t)
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	18	1	4.41E-07 (U)	5.08E-07	n/a	5.08E-07	Maximum detected concentration
Isopropyltoluene[4-]	18	5	0.000383	0.00145	n/a	0.00145	Maximum detected concentration
Methylene chloride	18	7	0.00219	0.00545(U)	n/a	0.00343[b]	Maximum detected concentration
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	18	16	8.81E-07(U)	5.77E-05	Gamma	2.0191E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	18	8	8.81E-07(U)	3.44E-06	Approximate Gamma	1.4876E-06	95% KM (t)
Tetrachlorodibenzofuran[2,3,7,8-]	18	1	1.66E-07(U)	9.63E-07	n/a	9.63E-07	Maximum detected concentration
Toluene	18	5	0.000937(U)	0.00133	n/a	0.00133	Maximum detected concentration
Trimethylbenzene[1,2,4-]	18	1	0.000461	0.00112(U)	n/a	0.000461[b]	Maximum detected concentration

Table I-2.2-9 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Radionuclides (pCi/g)							
Uranium-235/236	27	10	0.01(U)	0.103	Normal	0.0443	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-2.2-10
EPCs for SWMU 05-006(c) for the Residential Scenario

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	37	8	0.34(U)	2.3	Normal	0.794	95% KM (t)
Chromium	37	37	0.64	187	Nonparametric	32.36	95% Chebyshev (Mean, Sd)
Copper	37	34	0.63	317	Nonparametric	56.24	95% KM (Chebyshev)
Lead	46	46	5.1	337	Nonparametric	80.76	95% Chebyshev (Mean, Sd)
Nickel	37	37	0.657	89.4	Nonparametric	17.2	95% Chebyshev (Mean, Sd)
Selenium	37	5	0.316	1.1	n/a[a]	1.1	Maximum detected concentration
Silver	38	9	0.1(U)	2.22	Nonparametric	0.287	95% KM (t)
Organic Chemicals (mg/kg)							
Acetone	26	2	0.00172(U)	0.0056(U)	n/a	0.00203[b]	Maximum detected concentration
Aroclor-1260	26	3	0.0014	0.00372(U)	n/a	0.0018[b]	Maximum detected concentration
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	26	18	4.41E-07(U)	8.92E-06	Gamma	2.413E-06	95% KM (Percentile Bootstrap)
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	26	9	4.41E-07(U)	2.7E-06	Gamma	1.0231E-06	95% KM (t)
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	26	1	4.41E-07(U)	5.08E-07	n/a	5.08E-07	Maximum detected concentration
Isopropyltoluene[4-]	26	6	0.000383	0.00145	n/a	0.00145	Maximum detected concentration

Table I-2.2-10 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Methylene chloride	26	11	0.00213	0.00545(U)	Normal	0.00275	95% KM (t)
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	26	22	8.81E-07(U)	5.77E-05	Gamma	1.5288E-05	95% KM (BCA)
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	26	8	8.81E-07(U)	3.44E-06	Approximate Gamma	1.3371E-06	95% KM (t)
Tetrachlorodibenzofuran[2,3,7,8-]	26	1	1.66E-07(U)	9.63E-07	n/a	9.63E-07	95% KM(Chebyshev)
Toluene	27	9	0.000327	0.00164	Normal	0.00101	95% KM (t)
Trimethylbenzene[1,2,4-]	26	1	0.000461	0.00112(U)	n/a	0.000461[b]	Maximum detected concentration
Radionuclides (pCi/g)							
Uranium-235/236	35	16	0.01(U)	0.103	Normal	0.0483	95% KM (t)

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] The maximum concentration of the data set is a nondetect (U or UJ); thus, the maximum detected concentration is less than the maximum concentration.

Table I-3.2-1
Physical and Chemical Properties of Inorganic COPCs

COPC	Soil-Water Partition Coefficient, K_d[a] (cm^3/g)	Water Solubility[a] (g/L)
Antimony	45	Insoluble
Cadmium	75	Insoluble
Chromium	850	Insoluble
Copper	35	Insoluble
Lead	900	Insoluble
Nickel	65	Insoluble
Nitrate	0.0356	Soluble
Perchlorate	na[b]	245
Selenium	5	Insoluble
Silver	8.3	Insoluble

[a] Information from http://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef.

[b] na = Not available.

Table I-3.2-2
Physical and Chemical Properties of Organic COPCs

COPC	Water Solubility[a] (mg/L)	Organic Carbon Coefficient K_{oc}[a] (L/kg)	Log Octanol-Water Partition Coefficient, Log K_{ow}[a]	Vapor Pressure[a] (mm Hg at 25°C)
Acenaphthene	3.6E+00[b]	6.12E+03	3.92E+00[b]	2.5E-03[b]
Acenaphthylene	1.61E+01	5.03E+03	3.94E+00	6.68E-03
Acetone	1.00E+06[b]	1.98E+00	-2.40E-01[b]	2.31E+02[b]
Anthracene	4.34E-02[b]	2.04E+04	4.45E+00[b]	2.67E-06[b]
Aroclor-1260	2.84E-04[b]	5.30E+05[c]	8.27E+00[b]	4.05E-05[b]
Benzo(a)anthracene	9.40E-03[b]	2.31E+05	5.76+00[b]	1.90E-06[b]
Benzo(a)pyrene	1.62E-03[b]	7.87E+05	6.13E+00[b]	5.49E-09[b]
Benzo(b)fluoranthene	1.50E-03[b]	8.03E+05	5.78E+00[b]	5.00E-07[b]
Benzo(g,h,i)perylene	2.60E-04[b]	2.68E+06	6.63E+00[b]	1.00E-10[b]
Benzo(k)fluoranthene	8.00E-04[b]	7.87E+05	6.1E+00[b]	9.65E-10[b]
Benzoic acid	3.40E+03[b]	1.45E+01	1.87E+00[b]	7.00E-04[b]
Bis(2-ethylhexyl)phthalate	2.70E-01[b]	1.65E+05	7.60E+00[b]	1.42E-07[b]
Chrysene	6.30E-03[b]	2.36E+05	5.81E+00[b]	6.23E-09[b]
Dibenz(a,h)anthracene	1.03E-03	2.62E+06	6.54E+00	1.39E-11
Diethylphthalate	1.08E+03	1.05E+02	2.42E+00	2.10E-03
Di-n-butyl phthalate	1.46E+03	4.50E+00	4.7E+00[b]	2.01E-05
Fluoranthene	2.06E-01[c]	7.09E+04[c]	5.16E+00[c]	9.22E-06[c]
Fluorene	1.89E+00[b]	1.13E+04	4.18E+00[b]	8.42E-04[b]

Table I-3.2-2 (continued)

COPC	Water Solubility[a] (mg/L)	Organic Carbon Coefficient K_{oc}[a] (L/kg)	Log Octanol-Water Partition Coefficient, Log K_{ow}[a]	Vapor Pressure[a] (mm Hg at 25°C)
Hexanone[2-]	1.72E+04	1.50E+01	1.38E+00	1.16E+01
Indeno(1,2,3-cd)pyrene	1.90E-04[b]	2.68E+06	6.70E+00[b]	1.25E-10[b]
Isopropyltoluene[4-]	2.34E+01[b]	na[d]	4.10E+00[b]	1.64E+00[b]
Methylene chloride	1.30E+04[b]	2.37E+01	1.30E+00[b]	4.30E+02[b]
Methylnaphthalene[2-]	2.46E+01	2.98E+03	3.86E+00	5.50E-02
Naphthalene	3.10E+01	1.84E+03	3.30E+00	8.50E-02
Phenanthrene	1.15E+00[b]	2.08E+04	4.46E+00[b]	1.12E-04[b]
Pyrene	1.35E-01[b]	6.94E+04	4.88E+00[b]	4.50E-06[b]
Styrene	3.10E+02	5.18E+02	2.95E+00	6.4E+00
TCDD[2,3,7,8-]	2.00E-04	1.46E+05	na	na
Toluene	5.26E+02	2.68E+02	2.73E+00	2.84E+01
Trimethylbenzene[1,2,4-]	5.70E+01	7.18E+02	3.63E+00	2.10E+00

[a] Information from http://rais.ornl.gov/cgi-bin/tools/TOX_search, unless noted otherwise.

[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

[c] Information from NMED (2009, 108070).

[d] na = Not available.

Table I-3.2-3
Physical and Chemical Properties of Radionuclide COPCs

COPC	Soil-Water Partition Coefficient, K_d[a] (cm^3/g)	Water Solubility[b] (g/L)
Plutonium-238	4500	Insoluble
Plutonium-239/240	4500	Insoluble
Uranium-234	0.4	Insoluble
Uranium-235/236	0.4	Insoluble
Uranium-238	0.4	Insoluble

[a] Superfund Chemical Data Matrix (EPA 1996, 064708).

[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

Table I-4.1-1
Exposure Parameter Values Used to Calculate Chemical SSLs for the Residential and Industrial Scenarios

Parameter	Residential Values	Industrial Values
Target HQ	1	1
Target cancer risk	10^{-5}	10^{-5}
Averaging time (carcinogen)	70 yr × 365 d	70 yr × 365 d
Averaging time (noncarcinogen)	Exposure duration × 365 d	Exposure duration × 365 d
Skin absorption factor	Semivolatile organic compound = 0.1	Semivolatile organic compound = 0.1
	Chemical-specific	Chemical-specific
Adherence factor–child	0.2 mg/cm^2	n/a[a]
Body weight–child	15 kg (0–6 yr of age)	n/a
Cancer slope factor–oral (chemical-specific)	(mg/kg-d)$^{-1}$	(mg/kg-d)$^{-1}$
Cancer slope factor–inhalation (chemical-specific)	(mg/kg-d)$^{-1}$	(mg/kg-d)$^{-1}$
Exposure frequency	350 d/yr	225 d/yr
Exposure duration–child	6 yr	n/a
Age-adjusted ingestion factor	114 mg-yr/kg-d	n/a
Age-adjusted inhalation factor	11 m^3-yr/kg-d	n/a
Inhalation rate–child	10 m^3/d	n/a
Soil ingestion rate–child	200 mg/d	n/a
Particulate emission factor	6.61 × 10^9 m^3/kg	6.61 × 109 m^3/kg
Reference dose–oral (chemical-specific)	(mg/kg-d)	(mg/kg-d)
Reference dose–inhalation (chemical-specific)	(mg/kg-d)	(mg/kg-d)
Exposed surface area–child	2800 cm^2/d	n/a
Age-adjusted skin contact factor for carcinogens	361 mg-yr/kg-d	n/a
Volatilization factor for soil (chemical-specific)	(m^3/kg)	(m^3/kg)
Body weight–adult	70 kg	70 kg
Exposure duration[b]	30 yr	25 yr
Adherence factor–adult	0.07 mg/cm^2	0.2 mg/cm^2
Soil ingestion rate–adult	100 mg/d	100 mg/d
Exposed surface area–adult	5700 cm^2/d	3300 cm^2/d
Inhalation rate–adult	20 m^2/d	20 m^2/d

Note: Parameter values are from NMED (2009, 108070).

[a] n/a = Not applicable.

[b] Exposure duration for lifetime resident is 30 yr. For carcinogens, the exposures are combined for child (6 yr) and adult (24 yr).

Table I-4.1-2
Parameters Values Used to Calculate Radionuclide SALs for the Residential and Industrial Scenarios

Parameters	Residential, Adult	Residential, Child	Industrial, Adult
Inhalation rate (m^3/yr)	7305[a]	3652.5[b]	19,481[c]
Mass loading (g/m^3)	1.5×10^{-7}[d]	1.5×10^{-7}[d]	1.5×10^{-7}[d]
Outdoor time fraction	0.0599[e]	0.2236[f]	0.2053[g]
Indoor time fraction	0.8984[h]	0.7347[i]	0
Soil ingestion (g/yr)	36.5[j]	73[k]	97.4[l]

[a] Calculated as [10 m^3/d × 350 d/yr] / [indoor + outdoor time fractions], where 10 m^3/d is the daily inhalation rate of a child (NMED 2009, 108070).

[b] Calculated as [20 m^3/d × 350 d/yr] / [indoor + outdoor time fractions], where 20 m^3/d is the daily inhalation rate of an adult (NMED 2009, 108070).

[c] Calculated as [20 m^3/d × 225 d/yr] / [indoor + outdoor time fractions], where 20 m^3/d is the daily inhalation rate of an adult and 225 d/yr is the exposure frequency (NMED 2009, 108070).

[d] Calculated as [1/ $6.6 \times 10^{+9}$ m^3/kg) × 1000 g/kg, where $6.6 \times 10^{+9}$ m^3/kg is the particulate emission factor (NMED 2009, 108070).

[e] Calculated as [1.5 h/d × 350 d/yr] / 8766 h/yr, where 1.5 h/d is an estimate of time spent outdoors for an adult 12 yr and older (EPA 1997, 066598, Section 15.4-1).

[f] Calculated as [5.6 h/d × 350 d/yr] / 8766 h/yr, where 5.6 h/d is an estimate of time spent outdoors for a 3–11-yr-old child (EPA 1997, 066598, Section 15.4-1).

[g] Calculated as [8 h/d × 225 d/yr] / 8766 h/yr, where 8 h/d is an estimate of the average length of the work day.

[h] Calculated as [24-1.5 h/d × 350 d/yr] / 8766 h/yr.

[I] Calculated as [24-5.6 h/d × 350 d/yr] / 8766 h/yr.

[j] Calculated as [0.1 g/d × 225 d/yr] / [indoor + outdoor time fractions], where 0.1 g/d is the adult soil ingestion rate (NMED 2009, 108070).

[k] Calculated as [0.2 g/d × 350 d/yr] / [indoor + outdoor time fractions], where 0.2 g/d is the child soil ingestion rate (NMED 2009, 108070).

[l] Calculated as [0.1 g/d× 225 d/yr] / [indoor + outdoor time fractions], where 0.1 g/d is the adult soil ingestion rate (NMED 2009, 108070).

Table I-4.2-1
Residential Noncarcinogenic Screening Evaluation for SWMU 05-003

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	HQ
Antimony	1.03(U)	31.3	3.3E-02
Selenium	1.05(U)	391	2.7E-03
		HI	**0.04**

Note: Data qualifiers are defined in Appendix A.

* SSLs are from NMED (2009, 108070).

Table I-4.2-2
Industrial Noncarcinogenic Screening Evaluation for SWMU 05-004

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	HQ
Antimony	0.832(U)	454	1.8E-03
Cadmium	0.0911	1120	8.1E-05
Copper	4.313	45400	9.5E-05
Lead	12.67	800	1.6E-02
Nitrate	5.27	1820000	2.9E-06
Perchlorate	0.000646	795	8.1E-07
Selenium	1.1(U)	5680	1.9E-04
Benzoic acid	0.61	2500000[b]	2.4E-07
Styrene	0.00035	51200	6.8E-09
		HI	**0.02**

Note: Data qualifiers are defined in Appendix A.

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table I-4.2-3
Industrial Radionuclide Screening Evaluation for SWMU 05-004

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-239/240	0.041	210	0.003
Uranium-234	2.161	1500	0.022
Uranium-235/236	0.206	87	0.036
Uranium-238	2.234	430	0.078
		Total Dose	**0.1**

* SALs from LANL (2009, 107655).

Table I-4.2-4
Residential Carcinogenic Screening Evaluation for SWMU 05-004

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Benzo(a)anthracene	1.61	6.21	2.6E-06
Benzo(a)pyrene	1.55	0.621	2.5E-05
Benzo(b)fluoranthene	3.04	6.21	4.9E-06
Benzo(k)fluoranthene	0.899	62.1	1.4E-07
Chrysene	3.13	621	5.0E-08
Dibenz(a,h)anthracene	0.188	0.621	3.0E-06
Indeno(1,2,3-cd)pyrene	0.74	6.21	1.2E-06
Methylene chloride	0.00236	199	1.2E-10
Naphthalene	0.0145	45	3.2E-09
		Total Excess Cancer Risk	**4E-05**

* SSLs from NMED (2009, 108070).

Table I-4.2-5
Residential Noncarcinogenic Screening Evaluation for SWMU 05-004

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.505	31.3	1.6E-02
Cadmium	0.144	77.9	1.8E-03
Copper	4.408	3130	1.4E-03
Lead	12	400	3.0E-02
Nitrate	20.28	125000	1.6E-04
Perchlorate	0.00144	54.8	2.6E-05
Selenium	0.406	391	1.0E-03
Acenaphthene	0.0852	3440	2.5E-05
Acenaphthylene	0.0242	1720[b]	1.4E-05
Anthracene	0.334	17200	1.9E-05
Benzo(g,h,i)perylene	0.769	1720[b]	4.5E-04
Benzoic acid	0.61	240000[c]	2.5E-06
Diethylphthalate	0.0824	48900	1.7E-06
Fluoranthene	3.42	2290	1.5E-03
Fluorene	0.11	2290	4.8E-05
Hexanone[2-]	0.0793	210[c]	3.8E-04
Isopropyltoluene[4-]	0.000429	3210[d]	1.3E-07
Methylnaphthalene[2-]	0.0152	310[c]	4.9E-05
Phenanthrene	1.42	1830	7.8E-04
Pyrene	2.64	1720	1.5E-03
Styrene	0.00035	8970	3.9E-08
		HI	**0.06**

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] Pyrene used as a surrogate based on structural similarity.

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-6
Residential Radionuclide Screening Evaluation for SWMU 05-004

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-239/240	0.098	33	0.045
Uranium-234	1.345	170	0.119
Uranium-235/236	0.0747	17	0.066
Uranium-238	1.369	87	0.236
		Total Dose	**0.5**

* SALs from LANL (2009, 107655).

Table I-4.2-7
Residential Noncarcinogenic Screening Evaluation of Vapor Intrusion for SWMU 05-004

COPC	EPC (mg/kg)	Vapor-Intrusion Risk-Based Concentration[a] (mg/kg)	HQ
Hexanone[2-]	0.0793	271[b]	1.5E-09
Isopropyltoluene[4-]	0.000429	125[c]	3.4E-11
		HI	**0.000000002**

[a] Vapor-intrusion risk values generated by the Johnson and Ettinger advanced soil model.

[b] Butanone(2-) used as a surrogate based on structural similarity.

[c] Isopropylbenzene used as a surrogate base on structural similarity.

Table I-4.2-8
Residential Carcinogenic Screening Evaluation for SWMU 05-004 without PAHs

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Methylene Chloride	0.00236	199	1.2E-10
		Total Excess Cancer Risk	**1E-10**

* SSLs from NMED (2009, 108070).

Table I-4.2-9
Residential Noncarcinogenic Screening Evaluation for SWMU 05-004 without PAHs

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.505	31.3	1.6E-02
Cadmium	0.144	77.9	1.8E-03
Copper	4.408	3130	1.4E-03
Lead	12	400	3.0E-02
Nitrate	20.28	125000	1.6E-04
Perchlorate	0.00144	54.8	2.6E-05
Selenium	0.406	391	1.0E-03
Benzoic acid	0.61	240000[b]	2.5E-06
Diethylphthalate	0.0824	48900	1.7E-06
Hexanone[2-]	0.0793	210[b]	3.8E-04
Isopropyltoluene[4-]	0.000429	3210[c]	1.3E-07
Methylnaphthalene[2-]	0.0152	310[b]	4.9E-05
Stylene	0.00035	8970	3.9E-08
		HI	**0.05**

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[c] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-10
Dioxin/Furan Calculation for SWMU 05-005(b) for the Industrial Scenario

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	3.88E-06	0.01	3.88E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.66E-06	0.01	1.66E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	3.54E-05	0.0003	1.06E-08
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2.85E-06	0.0003	8.55E-10
Pentachlorodibenzofuran[2,3,4,7,8-]	6.65E-07	0.3	2.00E-07
		TCDD[2,3,7,8-] Sum	**2.66E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-11
Industrial Carcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	Cancer Risk
TCDD[2,3,7,8-]	2.66E-07	0.000204	1.3E-08
		Total Excess Cancer Risk	**1E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-12
Industrial Noncarcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	HQ
Antimony	0.834	454	1.8E-03
Cadmium	0.544(U)	1120	4.8E-04
Chromium	12.87	1570000[b]	8.2E-06
Copper	3.944	45400	8.7E-05
Lead	16.08	800	2.0E-02
Nickel	7.27	22700	3.2E-04
Perchlorate	0.00107	795	1.3E-06
Selenium	1.07(U)	5680	1.9E-04
Benzoic acid	0.538	2500000[c]	2.2E-07
Di-n-butylphthalate	0.0774	68400	1.1E-06
Fluoranthene	0.0116	24400	4.8E-07
Isopropyltoluene[4-]	0.000748	14900[d]	5.0E-08
Toluene	0.000326	57900	5.6E-09
		HI	**0.02**

Note: Data qualifiers are defined in Appendix A.

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL for chromium(III).

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-13
Industrial Radionuclide Screening Evaluation for SWMU 05-005(b)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-238	0.0225	240	1.4E-03
Plutonium-239/240	0.0282	210	2.0E-03
Uranium-235/236	0.103	87	1.8E-02
		Total Dose	**0.02**

* SALs from LANL (2009, 107655).

Table I-4.2-14
Dioxin/Furan Calculation for SWMU 05-005(b) for the Residential Scenario

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	1.81E-06	0.01	1.81E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	7.55E-07	0.01	7.55E-09
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	1.44E-05	0.0003	4.31E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2.85E-06	0.0003	8.55E-10
Pentachlorodibenzofuran[2,3,4,7,8-]	6.65E-07	0.3	2.00E-07
		TCDD[2,3,7,8-] Sum	**2.30E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-15
Residential Carcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Bis(2-ethylhexyl)phthalate	0.29	347	8.4E-09
TCDD[2,3,7,8-]	2.30E-07	0.000045	5.1E-08
		Total Excess Cancer Risk	**6E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-16
Residential Noncarcinogenic Screening Evaluation for SWMU 05-005(b)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.834	31.3	2.7E-02
Cadmium	0.544(U)	77.9	7.0E-03
Chromium	11.9	113000[b]	1.1E-04
Copper	2.589	3130	8.3E-04
Lead	10.41	400	2.6E-02
Nickel	6.988	1560	4.5E-03
Perchlorate	0.00107	54.8	2.0E-05
Selenium	1.07(U)	391	2.7E-03
Acenaphthene	0.0444	3440	1.3E-05
Benzoic acid	0.538	240000[c]	2.2E-06
Di-n-butylphthalate	0.0774	6110	1.3E-05
Fluoranthene	0.0116	2290	5.1E-06
Isopropyltoluene[4-]	0.000748	3210[d]	2.3E-07
Toluene	0.000326	5570	5.9E-08
		HI	**0.07**

Note: Data qualifiers are defined in Appendix A.

[a] SSLs from NMED (2009, 108070), unless otherwise noted.

[b] SSL for chromium(III).

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Isopropylbenzene used as surrogate based on structural similarity.

Table I-4.2-17
Residential Radionuclide Screening Evaluation for SWMU 05-005(b)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Total Dose (mrem/yr)
Plutonium-238	0.0225	37	9.1E-03
Plutonium-239/240	0.0282	33	1.3E-02
Uranium-235/236	0.0428	17	3.8E-02
		Total Dose	**0.1**

* SALs from LANL (2009, 107655).

Table I-4.2-18
Dioxin/Furan Calculation for SWMU 05-006(c) for the Industrial Scenario

	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	4.34E-06	0.01	4.34E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	2.70E-06	0.01	2.70E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	5.08E-07	0.1	5.08E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	3.27E-05	0.0003	9.81E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	3.44E-06	0.0003	1.03E-09
Tetrachlorodibenzofuran[2,3,7,8-]	9.63E-07	0.1	9.63E-08
		TCDD[2,3,7,8-] Sum	**2.28E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-19
Industrial Carcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	Cancer Risk
Aroclor-1260	0.0015	8.26	1.8E-09
Methylene chloride	0.00286	1090	2.6E-11
TCDD[2,3,7,8-]	2.28E-07	0.000204	1.1E-08
		Total Excess Cancer Risk	**1E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-20
Industrial Noncarcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Industrial SSL[a] (mg/kg)	HQ
Antimony	2.3	454	5.1E-03
Chromium	5.338	1570000[b]	3.4E-06
Copper	130.7	45400	2.9E-03
Lead	148	800	1.9E-01
Nickel	12.13	22700	5.3E-04
Selenium	1.1	5680	1.9E-04
Silver	0.31	5680	5.5E-05
Acetone	0.00203	851000	2.4E-09
Isopropyltoluene[4-]	0.00145	14900[c]	9.7E-08
Toluene	0.0013	57900	2.2E-08
Trimethylbenzene[1,2,4-]	0.000461	260[d]	1.8E-11
		HI	**0.2**

[a] SSLs from NMED (2009, 108070).

[b] SSL for chromium(III).

[c] Isopropylbenzene used as surrogate based on structural similarity.

[d] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table I-4.2-21
Industrial Radionuclide Screening Evaluation for SWMU 05-006(c)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Total Dose (mrem/yr)
Uranium-235/236	0.103	87	0.018
		Total Dose	**0.02**

* SALs from LANL (2009, 107655).

Table I-4.2-22
Dioxin/Furan Calculation for SWMU 05-006(c) for the Residential Scenario

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	2.41E-06	0.01	2.41E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.02E-06	0.01	1.02E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	5.08E-07	0.1	5.08E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	1.53E-05	0.0003	4.59E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	1.34E-06	0.0003	4.01E-10
Tetrachlorodibenzofuran[2,3,7,8-]	9.63E-07	0.1	9.63E-08
		TCDD[2,3,7,8-] Sum	**1.86E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-4.2-23
Residential Carcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Aroclor-1260	0.0018	2.22	8.1E-09
Methylene chloride	0.00275	199	1.4E-10
TCDD[2,3,7,8-]	1.86E-07	0.000045	4.1E-08
		Total Excess Cancer Risk	**5E-08**

* SSLs from NMED (2009, 108070).

Table I-4.2-24
Residential Noncarcinogenic Screening Evaluation for SWMU 05-006(c)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.794	31.3	2.5E-02
Chromium	32.36	113000[b]	2.9E-04
Copper	56.24	3130	1.8E-02
Lead	80.76	400	2.0E-01
Nickel	17.2	1560	1.1E-02
Selenium	1.1	391	2.8E-03
Silver	0.287	391	7.3E-04
Acetone	0.00203	67500	3.0E-08
Isopropyltoluene[4-]	0.00145	3210[c]	4.5E-07
Toluene	0.00101	5570	1.8E-07
Trimethylbenzene[1,2,4-]	0.000461	62[d]	7.4E-11
		HI	**0.3**

[a] SSLs from NMED (2009, 108070).

[b] SSL for chromium(III).

[c] Isopropylbenzene used as surrogate based on structural similarity.

[d] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

Table I-4.2-25
Residential Radionuclide Screening Evaluation for SWMU 05-006(c)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Total Dose (mrem/yr)
Uranium-235/236	0.0483	17	0.043
		Total Dose	**0.04**

* SALs from LANL (2009, 107655).

Table I-4.2-26
Residential Noncarcinogenic
Screening Evaluation of Vapor Intrusion for SWMU 05-006(c)

COPC	EPC (mg/kg)	Vapor-Intrusion Risk-Based Concentration[a] (mg/kg)	HQ
Acetone	0.00203	10700	1.9E-07
Isopropyltoluene[4-]	0.00145	22.3[b]	6.5E-05
Toluene	0.00164	22.3	7.4E-05
Trimethylbenzene[1,2,4-]	0.000461	2.04	2.3E-04
		HI	**0,0004**

[a] Vapor-intrusion risk values generated by the Johnson and Ettinger advanced soil model.

[b] Isopropylbenzene used as a surrogate base on structural similarity.

Table I-4.2-27
Residential Carcinogenic
Screening Evaluation of Vapor Intrusion for SWMU 05-006(c)

COPC	EPC (mg/kg)	Vapor-Intrusion Risk-Based Concentration* (mg/kg)	Cancer Risk
Methylene Chloride	0.00343	1.3	2.6E-08
		Total Excess Cancer Risk	**3E-08**

* Vapor-intrusion risk values generated by the Johnson and Ettinger advanced soil model.

Table I-5.3-1
ESLs for Terrestrial Receptors

Analyte	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Inorganic Chemicals (mg/kg)											
Antimony	45	na*	na	na	na	na	2.9	0.26	0.48	78	5.00E-02
Cadmium	510	5.80E+02	2	4.4	0.54	0.29	9.9	0.27	0.51	140	32
Chromium	3.00E+04	3.70E+04	7.70E+03	1.90E+03	1.10E+03	830	1.30E+04	750	1.90E+03	2.3	2.40
Copper	3.80E+03	1.60E+03	110	38	22	15	270	38	64	80	70
Lead	3.70E+03	810	120	21	16	14	370	72	120	1700	120
Nickel	1.20E+03	2.90E+03	160	160	38	21	5.00E+02	9.7	20	280	38
Selenium	84	97	5.6	1	0.87	0.75	2.1	0.66	0.83	4.10	0.52
Silver	4.10E+03	8.40E+02	19	11	4.3	2.6	150	14	24	na	560.00
Organic Chemicals (mg/kg)											
Acenaphthene	6.20E+03	na	na	na	na	na	490	120	160	na	0.25
Acenaphthylene	5.20E+03	na	na	na	na	na	500	120	160	na	na
Acetone	2.90E+03	30000.00	1200.00	7.50	14.00	170.00	1.4	15	1.2	na	na
Anthracene	5.80E+03	na	na	na	na	na	1.10E+03	210	310	na	6.80
Aroclor-1260	0.14	4.60	3.70	46	1.7	0.88	3.00E+03	10	20	na	na
Benzo(a)anthracene	32	na	na	na	na	na	6.2	3	3.4	na	18
Benzo(a)pyrene	380	na	na	na	na	na	280	53	85	na	na
Benzo(b)fluoranthene	250	na	na	na	na	na	130	38	52	na	18
Benzo(g,h,i)perylene	94	na	na	na	na	na	540	24	47	na	na
Benzo(k)fluoranthene	400	na	na	na	na	na	350	62	100	na	na
Benzoic Acid	350	na	na	na	na	na	4.2	1.0	1.3	na	na
Bis(2-ethylhexyl)phthalate	1.2	3.30E-02	4.50E-02	20	4.00E-02	0.02	2.70E+03	0.59	1.1	na	na
Chrysene	25	na	na	na	na	na	6.5	2.4	3.1	na	na
Dibenzo(a,h)anthracene	54	na	na	na	na	na	95	12	22	na	na

Table I-5.3-1 (continued)

Analyte	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Diethylphthalate	6.50E+05	na	na	na	na	na	8.00E+03	3.60E+03	3.60E+03	na	100
Di-n-butyl phthalate	5.00E+03	0.24	6.80E-02	0.39	2.10E-02	1.10E-02	1.60E+04	180	370	na	160
Fluoranthene	360	na	na	na	na	na	260	22	38	10	na
Fluorene	9.30E+03	na	na	na	na	na	1.10E+03	250	340	3.7	na
Hexanone[2-]	na	500	2.6	0.47	0.41	0.36	na	na	na	na	na
Indeno(1,2,3-cd)pryene	270	na	na	na	na	na	590	62	110	na	na
Isopropyltoluene[4-]	3.10E+03	na	na	na	na	na	61	23	25	na	na
Methylene Chloride	1.70E+03	na	na	na	na	na	3.4	9	2.6	na	1.60E+03
Methylnaphthalene[2-]	130	na	na	na	na	na	16	2.5	3.8	na	na
Naphthalene	1.20E+03	590	100	3.4	5.7	16	12	27	9.7	na	1
Phenanthrene	290	na	na	na	na	na	59	10	15	5.5	na
Pyrene	360	na	na	na	na	na	110	22	32	10	na
Styrene	na	na	na	na	na	na	na	na	na	1.2	300
Tetrachlorodibenzodioxin[2,3,7,8-]	1.20E-06	na	na	na	na	na	4.80E-05	2.90E-07	5.80E-07	5	na
Toluene	3.10E+03	na	na	na	na	na	61	23	25	na	200
Trimethylbenzene[1,2,4-]	7.60E+03	na	na	na	na	na	35	47	24	na	na
Radionuclides (pCi/g)											
Plutonium-238	3.00E+04	1.30E+05	3.20E+04	8.30E+03	2.10E+03	2.00E+03	1.20E+05	9.20E+04	1.10E+05	44	1.10E+05
Plutonium-239/240	3.30E+04	1.60E+05	3.40E+04	8.60E+03	2.10E+03	2.10E+03	1.70E+05	1.10E+05	1.50E+05	47	1.60E+05
Uranium-234	4.50E+04	1.90E+05	1.20E+05	4.80E+04	1.40E+04	1.40E+04	9.60E+04	9.40E+04	9.10E+04	51	1.40E+04
Uranium-235/236	4.80E+03	1.00E+04	1.00E+04	9.00E+03	6.40E+03	6.40E+03	5.10E+03	5.10E+03	5.10E+03	55	4.00E+03
Uranium-238	2.00E+03	4.20E+03	4.10E+03	3.90E+03	3.40E+03	3.40E+03	2.10E+03	2.10E+03	2.10E+03	55	1.80E+03

Note: Values from ECORISK Database, Release 2.5 (LANL 2010, 110846).

* na = Not available.

Table I-5.3-2
Minimum ESL Comparison for SWMU 05-004

COPCs	EPC	Minimum ESL	Receptor	HQ	COPEC
Inorganic Chemicals (mg/kg)					
Antimony	0.12	0.05	Plant	**2.40**	**Yes**
Cadmium	0.147	0.27	Shrew	**0.54**	**Yes**
Copper	3.79	15	Robin (Insectivore)	0.25	No
Lead	10.01	14	Robin (Insectivore)	**0.72**	**Yes**
Selenium	0.371	0.52	Plant	**0.71**	**Yes**
Organic Chemicals (mg/kg)					
Acenaphthene	0.0852	0.25	Plant	**0.34**	**Yes**
Benzoic acid	0.61	1	Shrew	**0.61**	**Yes**
2-Hexanone	0.0793	0.36	Robin (Insectivore)	0.22	No
Methylene chloride	0.00236	2.6	Deer Mouse	0.001	No
Styrene	0.00035	1.2	Earthworm	0.0003	No
Radionuclides (pCi/g)					
Plutonium-239/240	0.098	47	Earthworm	0.002	No
Uranium-234	1.461	51	Earthworm	0.029	No
Uranium-235/236	0.206	55	Earthworm	0.004	No
Uranium-238	1.498	55	Earthworm	0.027	No

Note: Bolded values indicate HQ greater than 0.3.

Table I-5.3-3
HI Analysis for SWMU 05-004

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	0.12	2.7E-03	na*	na	na	na	na	4.1E-02	**4.6E-01**	2.5E-01	1.5E-03	**2.4E+00**
Cadmium	0.147	2.9E-04	2.5E-04	7.4E-02	3.3E-02	2.7E-01	**5.1E-01**	1.5E-02	**5.4E-01**	2.9E-01	1.1E-03	4.6E-03
Lead	10.01	2.7E-03	1.2E-02	8.3E-02	**4.8E-01**	**6.3E-01**	**7.2E-01**	2.7E-02	1.4E-01	8.3E-02	5.9E-03	8.3E-02
Selenium	0.371	4.4E-03	3.8E-03	6.6E-02	**3.7E-01**	**4.3E-01**	**4.9E-01**	1.8E-01	**5.6E-01**	**4.5E-01**	9.0E-02	**7.1E-01**
Acenaphthene	0.0852	1.4E-05	na	na	na	na	na	1.7E-04	7.1E-04	5.3E-04	na	**3.4E-01**
Benzoic acid	0.61	1.7E-03	na	na	na	na	na	1.5E-01	**6.1E-01**	**4.7E-01**	na	na
HI		0.01	0.02	0.2	0.9	1	**2**	0.4	**2**	**2**	0.1	**4**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

Table I-5.3-4
Dioxin/Furan Calculation for SWMU 05-005(b) for the Ecological Receptors

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	1.96E-06	0.01	1.96E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	7.86E-07	0.01	7.86E-09
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	1.64E-05	0.0003	4.91E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	2.85E-06	0.0003	8.55E-10
Pentachlorodibenzofuran[2,3,4,7,8-]	6.65E-07	0.3	2.00E-07
		TCDD[2,3,7,8-] Sum	**2.33E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-5.3-5
Minimum ESL Comparison for SWMU 05-005(b)

COPCs	EPC	Minimum ESL	Receptor	HQ	COPEC
Inorganic Chemicals (mg/kg)					
Antimony	0.834	0.05	Plant	**16.68**	**Yes**
Cadmium	0.544(U)	0.27	Shrew	**2.01**	**Yes**
Chromium	12.77	2.3	Earthworm	**5.55**	**Yes**
Copper	2.693	15	Robin (Insectivore)	0.18	No
Lead	10.72	14	Robin (Insectivore)	**0.77**	**Yes**
Nickel	7.471	9.7	Shrew	**0.77**	**Yes**
Selenium	1.07(U)	0.52	Plant	**2.06**	**Yes**
Organic Chemicals (mg/kg)					
Acenaphthene	0.0444	0.25	Plant	0.18	No
Benzoic acid	0.538	1	Shrew	**0.54**	**Yes**
Bis(2-ethylhexyl)phthalate	0.29	0.02	Robin (Insectivore)	**14.5**	**Yes**
Di-n-butylphthalate	0.0774	0.011	Robin (Insectivore)	**7.04**	**Yes**
Fluoranthene	0.0116	10	Earthworm	0.00116	No
4-Isopropyltoluene	0.000748	23	Shrew	0.00003	No
Toluene	0.000326	23	Shrew	0.00001	No
2,3,7,8-TCDD	2.33E-07	2.90E-07	Shrew	**0.80**	**Yes**
Radionuclides (pCi/g)					
Plutonium-238	0.0225	44	Earthworm	0.00051	No
Plutonium-239/240	0.0282	47	Earthworm	0.0006	No
Uranium-235/236	0.04	55	Earthworm	0.00073	No

Notes: Bolded values indicate HQ greater than 0.3. Data qualifiers are defined in Appendix A..

Table I-5.3-6
HI Analysis for SWMU 05-005(b)

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	0.834	0.019	na*	na	na	na	na	0.288	**3.208**	**1.738**	0.011	**16.68**
Cadmium	0.544(U)	0.001	0.001	0.272	0.124	**1.007**	**1.876**	0.055	**2.015**	**1.067**	0.004	0.017
Chromium	12.77	0.0004	0.008	0.002	0.007	0.012	0.015	0.001	0.017	0.007	**5.552**	**5.321**
Lead	10.72	0.003	0.013	0.089	**0.510**	**0.670**	**0.766**	0.029	0.149	0.089	0.006	0.089
Nickel	7.471	0.006	0.003	0.047	0.047	0.197	**0.356**	0.015	**0.770**	**0.374**	0.027	0.197
Selenium	1.07(U)	0.013	0.011	0.191	**1.070**	**1.230**	**1.427**	**0.510**	**1.621**	**1.289**	0.261	**2.058**
Benzoic acid	0.538	0.002	na	na	**na**	**na**	**na**	0.128	**0.538**	**0.414**	na	na
Bis(2-ethylhexyl)phthalate	0.29	0.242	**8.788**	**6.444**	0.015	**7.250**	**14.50**	1.07E-04	**0.492**	0.264	na	na
Di-n-butyl phthalate	0.0774	1.55E-05	**0.323**	**1.138**	0.198	**3.686**	**7.036**	4.84E-06	0.0004	0.0002	na	0.0005
2,3,7,8-TCDD	2.33E-07	0.194	na	na	na	na	na	0.005	**0.803**	**0.402**	4.66E-08	na
HI		0.5	**9**	**8**	**2**	**14**	**26**	1	**10**	**6**	**6**	**24**

Notes: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0. Data qualifiers are defined in Appendix A.

* na = Not available.

Table I-5.3-7
Dioxin/Furan Calculation for SWMU 05-006(c) for the Ecological Receptors

COPCs	EPC (mg/kg)	TEF*	Toxic Equivalency Calculation
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	3.14E-06	0.01	3.14E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.32E-06	0.01	1.32E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	5.08E-07	0.1	5.08E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	2.02E-05	0.0003	6.06E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	1.49E-06	0.0003	4.46E-10
Tetrachlorodibenzofuran[2,3,7,8-]	9.63E-07	0.1	9.63E-08
		TCDD[2,3,7,8-] Sum	**1.98E-07**

* TEFs from www.who.int/ipcs/assessment/tef_update/en/print.html.

Table I-5.3-8
Minimum ESL Comparison for SWMU 05-006(c)

COPCs	EPC	Minimum ESL	Receptor	HQ	COPEC
Inorganic Chemicals (mg/kg)					
Antimony	2.3	0.05	Plant	**46**	**Yes**
Chromium	40.69	2.3	Earthworm	**17.69**	**Yes**
Copper	70.5	15	Robin (Insectivore)	**4.70**	**Yes**
Lead	95.91	14	Robin (Insectivore)	**6.85**	**Yes**
Nickel	21.46	9.7	Shrew	**2.21**	**Yes**
Selenium	1.1	0.52	Plant	**2.12**	**Yes**
Silver	0.31	2.6	Robin (Insectivore)	0.12	No
Organic Chemicals (mg/kg)					
Acetone	0.00203	1.2	Deer Mouse	0.002	No
Aroclor-1260	0.0018	0.14	Red Fox	0.013	No
4-Isopropyltoluene	0.00145	23	Shrew	0.0001	No
Methylene chloride	0.00343	2.6	Deer Mouse	0.001	No
Toluene	0.00133	23	Shrew	0.0001	No
1,2,4-Trimethylbenzene	0.000461	24	Deer Mouse	0.00002	No
2,3,7,8-TCDD	1.98E-07	2.90E-07	Shrew	**0.68**	**Yes**
Radionuclides (pCi/g)					
Uranium-235/236	0.0443	55	Earthworm	0.001	No

Note: Bolded values indicate HQ greater than 0.3.

Table I-5.3-9
HI Analysis for SWMU 05-006(c)

COPECs	**EPC (mg/kg)**	**Red Fox**	**Carnivorous Kestrel**	**Omnivorous Kestrel**	**Robin (Herbivore)**	**Robin (Omnivore)**	**Robin (Insectivore)**	**Cottontail**	**Shrew**	**Deer Mouse**	**Earthworm**	**Plant**
Antimony	2.3	0.05	na*	na	na	na	na	**0.79**	**8.85**	**4.79**	0.03	**46.0**
Chromium	40.69	0.001	0.001	0.01	0.02	0.04	0.05	0.003	0.05	0.02	**17.69**	**16.95**
Copper	70.5	0.02	0.04	**0.64**	**1.86**	**3.20**	**4.70**	0.26	**1.86**	**1.10**	**0.88**	**1.01**
Lead	95.91	0.03	0.12	**0.80**	**4.57**	**5.99**	**6.85**	0.26	**1.33**	**0.80**	0.06	**0.80**
Nickel	21.46	0.02	0.01	0.13	0.13	**0.56**	**1.02**	0.04	**2.21**	**1.07**	0.08	**0.56**
Selenium	1.1	0.01	0.01	0.20	**1.10**	**1.26**	**1.47**	**0.52**	**1.67**	**1.33**	0.27	**2.12**
2,3,7,8-TCDD	1.98E-07	0.17	na	na	na	na	na	0.004	**0.68**	**0.34**	3.96E-08	na
HI		0.3	0.2	**2**	**8**	**11**	**14**	**2**	**17**	**9**	**19**	**67**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

Table I-5.4-1
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-004

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Sediment Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	0.12	0.1–1.0	0.83[b]	0.5[b]
Selenium	0.371	0.1–1.7	0.3[b]	0.3[b]

[a] Background concentrations from LANL (1998, 059730).

[b] BV used.

Table I-5.4-2
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-005(b)

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Sediment Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	0.834	0.1–1.0	0.83[b]	0.5[b]
Cadmium	0.544(U)	0.2–2.6	0.4[b]	0.1–1.5
Selenium	1.07(U)	0.1–1.7	0.3[b]	0.3[b]

Note: Data qualifiers are defined in Appendix A.

[a] Background concentrations from LANL (1998, 059730).

[b] BV used.

Table I-5.4-3
Comparison of EPCs with Background Concentrations for Inorganic COPECs at SWMU 05-006(c)

COPEC	EPC (mg/kg)	Soil Background Concentrations[a] (mg/kg)	Tuff Background Concentrations[a] (mg/kg)
Antimony	2.3	0.1–1.0	0.5[b]
Selenium	1.1	0.1–1.7	0.3[b]

Note: Bolded COPEC is retained.

[a] Background concentrations from LANL (1998, 059730).

[b] BV used.

Table I-5.4-4
PAUFs and AUFs for Ecological Receptors at SWMUs 05-004, 05-005(b), and 05-006(c)

Receptor	HR[a] (ha)	Population Area (ha)	PAUF for SWMU 05-004 Site area = 0.016 ha	PAUF for SWMU 05-005(b) Site area = 0.018 ha	PAUF for SWMU 05-006(c) Site area = 0.006 ha
American Kestrel	106	4240	4E-06	4E-06	1E-06
American Robin	0.42	16.8	1E-03	1E-03	4E-04
Deer Mouse	0.077	3.1	5E-03	6E-03	2E-03
Montane Shrew	0.39	15.6	1E-03	1E-03	4E-04
Desert Cottontail	3.1	124	1E-04	1E-04	5E-05
Red Fox	1038	41,520	4E-07	4E-07	1E-07
Mexican Spotted Owl[b]	366	n/a[c]	4E-05	5E-05	2E-05

Note: PAUF is calculated as the area of the site divided by the population area.

[a] Values from EPA (1993, 059384).

[b] Value for Mexican spotted owl is the AUF based on individual HR.

[c] n/a = Not applicable.

Table I-5.4-5
Adjusted HIs at SWMU 05-004

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Cadmium	0.147	1.2E-10	1.0E-09	3.0E-07	3.3E-05	2.7E-04	5.1E-04	1.5E-06	5.4E-04	1.5E-03	1.1E-03	4.6E-03
Lead	10.01	1.1E-09	4.8E-08	3.3E-07	4.8E-04	6.4E-04	7.2E-04	2.7E-06	1.4E-04	4.2E-04	5.9E-03	8.3E-02
Acenaphthene	0.0852	5.6E-12	na*	na	na	na	na	1.7E-08	7.1E-07	2.7E-06	na	**0.34**
Benzoic Acid	0.61	6.8E-10	na	na	na	na	na	1.5E-05	6.1E-04	2.4E-03	na	na
Adjusted HI		2E-09	5E-08	6E-07	5E-04	9E-04	1E-03	2E-05	1E-03	4E-03	7E-03	0.4

Note: Bolded values indicate HQ greater than 0.3.

* na = Not available.

Table I-5.4-6
Adjusted HIs at SWMU 05-005(b)

COPECs	EPC (mg/kg)	Red fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Chromium	12.77	1.6E-10	1.2E-09	8.0E-09	7.0E-06	1.2E-05	1.5E-05	1.0E-07	1.7E-05	4.2E-05	**5.552**	**5.321**
Lead	10.72	1.2E-09	5.2E-08	3.6E-07	5.1E-04	6.7E-04	7.7E-04	2.9E-06	1.5E-04	5.3E-04	0.0063	0.089
Nickel	7.47	2.4E-09	1.2E-08	1.9E-07	4.7E-05	2.0E-04	3.6E-04	1.5E-06	7.7E-04	2.2E-03	0.027	0.197
Benzoic acid	0.538	8.0E-10	na*	na	na	na	na	1.3E-05	5.4E-04	2.5E-03	na	na
Bis(2-ethylhexyl)phthalate	0.29	9.7E-08	3.5E-05	2.6E-05	1.5E-05	7.3E-03	1.5E-02	1.1E-08	4.9E-04	1.6E-03	na	na
Di-n-butyl phthalate	0.0774	6.2E-12	1.3E-06	4.6E-06	2.0E-04	3.7E-03	7.0E-03	4.8E-10	4.0E-07	1.2E-06	na	5.0E-04
2,3,7,8-TCDD	2.33E-07	7.8E-08	na	na	na	na	na	5.0E-07	8.0E-04	2.4E-03	4.7E-08	na
Adjusted HI		2E-07	4E-05	3E-05	8E-04	0.01	0.02	2E-05	0.003	0.009	**6**	**6**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

Table I-5.4-7
Adjusted HIs at SWMU 05-006(c)

COPECs	EPC (mg/kg)	Red Fox	Carnivorous Kestrel	Omnivorous Kestrel	Robin (Herbivore)	Robin (Omnivore)	Robin (Insectivore)	Cottontail	Shrew	Deer Mouse	Earthworm	Plant
Antimony	2.3	5.0E-09	na*	na	na	na	na	4.0E-05	3.5E-03	1.0E-02	0.03	**46**
Chromium	40.69	1.0E-10	1.0E-09	1.0E-08	8.0E-06	1.6E-05	2.0E-05	1.5E-07	2.0E-05	4.0E-05	**17.69**	**16.95**
Copper	70.5	2.0E-09	4.0E-08	6.4E-07	7.4E-04	1.3E-03	1.9E-03	1.3E-05	7.4E-04	2.2E-03	**0.88**	**1.01**
Lead	95.91	6.6E-09	2.5E-07	1.7E-06	2.5E-03	3.2E-03	3.7E-03	1.9E-05	7.7E-04	2.3E-03	0.06	**0.8**
Nickel	21.46	2.0E-09	1.0E-08	1.3E-07	5.2E-05	2.2E-04	4.1E-04	2.0E-06	8.8E-04	2.1E-03	0.08	**0.56**
2,3,7,8-TCDD	1.98E-07	1.7E-08	na	na	na	na	na	2.0E-07	2.7E-04	6.8E-04	4.0E-08	na
	Adjusted HI	3E-08	3E-07	2E-06	0.003	0.005	0.006	7E-05	0.006	0.02	**19**	**65**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.0.

* na = Not available.

Table I-5.4-8
Summary of LOAEL-Based ESL for Terrestrial Receptors

COPEC	Receptor	LOAEL-Based TRV	TRV Unit	LOAEL-Based ESL (mg/kg soil)	Approach to Deriving the LOAELs/LOECs
Antimony	Plant	0.5	mg/kg	5.00E-01	The lowest observed effect concentration (LOEC) is derived from a LOEC with an unspecified exposure duration by applying an uncertainty factor of 0.1. The no observed effect concentration (NOEC) was derived from the same LOEC, except an uncertainty factor of 0.01 was applied.
Chromium	Earthworm	23.94	mg/kg soil	2.30E+01	The total chromium LOEC is equal to the chromium(VI) LOEC multiplied by 7. The chromium(VI) LOEC is the geometric mean calculated from the same data set as the geometric mean NOEC for chromium(VI).
	Plant	12.6	mg/kg soil	1.20E+01	The total chromium LOEC is equal to the chromium(VI) LOEC multiplied by 7. The chromium(VI) LOEC is the geometric mean calculated from the same data set as the geometric mean NOEC for chromium(VI).
Copper	Earthworm	530	mg/kg soil	5.30E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf). An uncertainty factor of 5 is applied for the maximum allowable toxicity concentrations (MATCs) and 10 for effective concentrations (EC) 20s and the geometric mean was calculated.
	Plant	497	mg/kg soil	4.97E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf). An uncertainty factor of 5 is applied for the MATCs and 10 for EC for 20% of the population ($EC_{20)}$ and the geometric mean was calculated.
Lead	Plant	576	mg/kg soil	5.70E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf). An uncertainty factor of 5 is applied for MATCs and the geometric mean was calculated.
Nickel	Plant	276	mg/kg soil	2.70E+02	The LOEC is extrapolated from the EPA geometric mean NOEC data set (http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf). An uncertainty factor of 5 is applied for MATCs and the geometric mean was calculated.

Notes: Some COPECs (e.g., inorganic chemicals from EPA Eco-SSL documents) do not have LOAELs or LOECs. In these cases, an uncertainty factor of 10 was applied to the NOAEL/NOEC (i.e., EC_{10} and EC_{20}) data in accordance with the acknowledged uncertainty between the LOAEL/LOEC and NOAEL/NOEC in Dourson and Stara (1983, 073474), Calbrese and Baldwin (1993, 110405), and EPA (http://www.epa.gov/epawaste/hazard/tsd/td/combust/ecorisk.htm). In the cases where EPA used MATCs for the NOAEL/NOEC data, an uncertainty factor of 5 was used to adjust to the LOAEL/LOEC because the MATC is between the NOAEL/NOEC and the LOAEL/LOEC.

Table I-5.4-9
HI Analysis Using LOAEL-Based ESL for SWMU 05-005(b)

COPECs	EPC (mg/kg)	Earthworm	Plant
Chromium	12.77	**0.6**	**1.1**
HI		0.6	1

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.

Table I-5.4-10
HI Analysis Using LOAEL-Based ESL for SWMU 05-006(c)

COPECs	EPC (mg/kg)	Earthworm	Plant
Antimony	0.887	n/a*	**1.8**
Chromium	40.69	**1.8**	**3.4**
Copper	70.5	0.13	0.14
Lead	95.91	n/a	0.17
Nickel	21.46	n/a	0.08
HI		**2**	**6**

Note: Bolded values indicate HQ greater than 0.3 or HI greater than 1.

*n/a = Not applicable.

Attachment I-1

ProUCL Files
(on CD included with this document)

Attachment I-2

Ecological Scoping Checklist for
Lower Mortandad/Cedro Canyons Aggregate Area

Part A—Scoping Meeting Documentation

Site ID	**Solid Waste Management Unit 05-003**
Form of site releases (solid, liquid, vapor). Describe all relevant known or suspected mechanisms of release (spills, dumping, material disposal, outfall, explosive testing, etc.) and describe potential areas of release. Reference locations on a map as appropriate.	Solid Waste Management Unit (SWMU) 05-003 is a former underground calibration facility (structures 05-20 and 05-21) located at the west end of Technical Area 05 (TA-05) near the edge of Mortandad Canyon. The calibration facility consisted of an aboveground shed (structure 05-20) constructed over a 6-ft-diameter, 35-ft deep access shaft equipped with a ladder to provide facility personnel access to the calibration chamber (structure 05-21), located belowground to the west of the access shaft. The aboveground shed (structure 05-20) was a wooden building that measured 8 ft wide × 12 ft long × 8 ft high. The belowground chamber (structure 05-21) measured 10ft square × 10 ft deep and was used to calibrate neutron detector systems for experiments at TA-49. The base of the access shaft was connected to the calibration chamber by an 8-ft-tall, 9.5-ft-long tunnel. A second 24-in.-diameter shaft extended from the center of the chamber to the surface. The smaller shaft was lined with a 16-in.-diameter casing and capped with concrete, with a 3-in.-diameter opening in the concrete cap. This small shaft was used to direct neutrons from the underground chamber to detectors located above the shaft. The neutron source used in the calibration facility was a critical assembly called Godiva. This assembly used highly enriched uranium (HEU) and was operated in the underground chamber beneath the smaller shaft. Neutron detectors were placed on the ground surface above the opening in the small shaft. The Godiva assembly could be pulsed every 2 h and produced 2 × 10^{16} fissions per pulse. Small amounts of HEU would spall off the source with each pulse. Borated paraffin and lead bricks were used as shielding and heavy water was used to moderate the energy and intensity of the neutrons.
List of Primary Impacted Media **(Indicate all that apply.)**	**Surface soil** – X **Surface water/sediment** – Not applicable **Subsurface** – X **Groundwater –** Not applicable **Other, explain** – Not applicable
FIMAD vegetation class based on Arcview vegetation coverage **(Indicate all that apply.)**	**Water –** Not applicable **Bare Ground/Unvegetated** – X **Spruce/fir/aspen/mixed conifer** – Not applicable **Ponderosa pine** – X **Piñon juniper/juniper savannah** – X **Grassland/shrubland** – X **Developed** – X
Is T&E Habitat Present? **If applicable, list species known or suspected to use the site for breeding or foraging.**	Yes. Location information maintained by the FIMAD was intersected with threatened and endangered (T&E) species habitat using GIS databases. The sites are within Mexican spotted owl nesting habitat and within an area where the owl can conservatively be assumed to forage at a high frequency.

Provide list of Neighboring/ Contiguous/ Up-gradient sites, include a brief summary of COPCs and form of releases for relevant sites and reference map as appropriate. **(Use information to evaluate need to aggregate sites for screening.)**	Although the SWMU 05-004 is located approximately 50 ft east of SWMU 05-003, these two SWMUs are not associated. No other SWMUs or AOCs are associated with SWMU 05-003.
Surface Water Erosion Potential	Surface water transport and erosion potential on the mesa top is considered low because of the relatively flat terrain (<10% slope). Runoff terminates in Mortandad Canyon.

Part B—Site Visit Documentation for SWMU 05-003

Site ID	SWMU 05-003
Date of Site Visit	02/07/2011
Site Visit Conducted by	John Branch

Receptor Information:

Estimate cover	**Relative vegetative cover (high, medium, low, none)** = low **Relative wetland cover (high, medium, low, none)** = none **Relative structures/asphalt, etc. cover (high, medium, low, none)** = low
Field notes on the FIMAD vegetation class to assist in ground-truthing the Arcview information	The SWMU exhibits a low-moderate amount of vegetative cover. The vegetative class is from a transitional zone between the piñon-juniper and ponderosa pine zone. The locations also exhibit a moderate amount of native bunch grasses and shrub species.
Field notes on T&E Habitat, if applicable. Consider the need for a site visit by a T&E subject matter expert to support the use of the site by T&E receptors.	Based on the size and vegetative cover within the SWMU 05-003 habitat, it is unlikely to provide an ideal foraging environment for T&E species.
Are ecological receptors present at the site? **(yes/no/uncertain)** **Describe the general types of receptors present at the site (terrestrial and aquatic), and make notes on the quality of habitat present at the site.**	No. Ecological pathways are not present. The contaminants are at depths greater than 5 ft below ground surface (bgs).

Contaminant Transport Information:

Surface water transport **Field notes on the erosion potential, including a discussion of the terminal point of surface water transport (if applicable).**	Surface water transport and erosion potential on the mesa top is considered low because of the relatively flat terrain (<10% slope). Runoff terminates in Mortandad Canyon.
Are there any off-site transport pathways (surface water, air, or groundwater)? **(yes/no/uncertain)** **Provide explanation**	Yes. Storm events may produce runoff downgradient. No air or groundwater transport pathways exist. Groundwater is greater than 1200 ft bgs.

Interim action needed to limit off-site transport? **(yes/no/uncertain)** **Provide explanation/ recommendation to project lead for IA SMDP.**	No. The contaminants for these areas are at low levels and at 35 ft bgs.

Ecological Effects Information:

Physical Disturbance **(Provide list of major types of disturbances, including erosion and construction activities, review historical aerial photos where appropriate.)**	The site has a low amount of physical disturbance. The disturbance is mainly the result of erosion, the installation of a dirt road, and a former structure.
Are there obvious ecological effects? **(yes/no/uncertain)** **Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).**	No.
Interim action needed to limit apparent ecological effects? **(yes/no/uncertain)** **Provide explanation and recommendations to mitigate apparent exposure pathways to project lead for IA SMDP.**	No. BMPs are in place for stormwater erosion control.

No Exposure/Transport Pathways:

If there are no complete exposure pathways to ecological receptors onsite and no transport pathways to offsite receptors, the remainder of the checklist should not be completed. Stop here and provide additional explanation/justification for proposing an ecological No Further Action recommendation (if needed). At a minimum, the potential for future transport should include likelihood that future construction activities could make contamination more available for exposure or transport.

No potential unacceptable risk for ecological receptors is expected at the site because the contamination source was 35 ft bgs. Therefore, there is no exposure to receptors, and a risk screening assessment was not performed for ecological receptors.

Adequacy of Site Characterization:

Do existing or proposed data provide information on the nature, rate and extent of contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if the maximum value was captured by existing sample data.)**	Yes. Nature and extent defined.
Do existing or proposed data for the site address potential transport pathways of site contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if other sites should aggregated to characterize potential ecological risk.)**	Yes.

Signatures and certifications:

Checklist completed by (provide name, organization and phone number):

Name (printed): John P. Branch
Name (signature): John Branch
Organization: Los Alamos Technical Associates
Phone number: 505-662-1822
Date Completed: January 24, 2011

Verification by another party (provide name, organization and phone number):

Name (printed): Richard Mirenda
Name (signature): Richard Mirenda
Organization: Los Alamos National Laboratory, EP-ET-ER
Phone number: 505-665-6953

Part A—Scoping Meeting Documentation

Site ID	**SWMU 05-004**
Form of site releases (solid, liquid, vapor). Describe all relevant known or suspected mechanisms of release (spills, dumping, material disposal, outfall, explosive testing, etc.) and describe potential areas of release. Reference locations on a map as appropriate.	SWMU 05-004 is a former septic tank (structure 05-13), associated drainlines, and outfall that were located at the west end of TA-05 near the edge of Mortandad Canyon. The tank was constructed in May 1948 to serve building 05-1 (a laboratory) and was decommissioned in place in December 1959. It was constructed of reinforced concrete and was 5 ft square × 7 ft deep. As-built drawings show an inlet line running from building 05-1 to the septic tank and an outlet line discharging south into an unnamed tributary of Mortandad Canyon. From 1948 to 1949, the tank received industrial waste from a laboratory (building 05-1). A 1952 memorandum states that septic tank 05-13 was no longer needed to support use of building 05-1 and the structure was being returned to Engineering Division for disposition. Historical information shows the tank was free of radiation and high explosives (HE) contamination but notes it contained unspecified toxic chemicals. The types of materials used in building 05-1 are not known. Building 05-1 was inspected in 1959 and found to be free of contamination by toxic materials. A radiation survey of building 05-1 in 1973 detected no radioactive contamination. During the 1985 Los Alamos Site Characterization Program (LASCP), building 05-1 was determined to be free of radioactive and HE contamination and was removed. The septic tank and associated drainlines had been removed prior to the 1985 LASCP activities. The removal of the tank and piping was confirmed during excavation of the area.
List of Primary Impacted Media **(Indicate all that apply.)**	**Surface soil** – X **Surface water/sediment** – Not applicable **Subsurface** – X **Groundwater –** Not applicable **Other, explain** – Not applicable
FIMAD vegetation class based on Arcview vegetation coverage **(Indicate all that apply.)**	**Water –** Not applicable **Bare Ground/Unvegetated** – X **Spruce/fir/aspen/mixed conifer** – Not applicable **Ponderosa pine** – X **Piñon juniper/juniper savannah** – X **Grassland/shrubland** – X **Developed** – X
Is T&E Habitat Present? **If applicable, list species known or suspected to use the site for breeding or foraging.**	Yes. Location information maintained by the FIMAD was intersected with T&E species habitat using GIS databases. The sites are within Mexican spotted owl nesting habitat and within an area where the owl can conservatively be assumed to forage at a high frequency.
Provide list of Neighboring/ Contiguous/ Up-gradient sites, include a brief summary of COPCs and form of releases for relevant sites and reference map as appropriate. **(Use information to evaluate need to aggregate sites for screening.)**	Although the SWMU 05-003 is located approximately 50 ft west of SWMU 05-004, these two SWMUs are not associated. No other SWMUs or AOCs are associated with SWMU 05-004.
Surface Water Erosion Potential	Surface water transport and erosion potential on the mesa top is considered low because of the relatively flat terrain (<10% slope). Runoff terminates in Mortandad Canyon.

Part B—Site Visit Documentation for SWMU 05-004

Site ID	SWMU 05-004
Date of Site Visit	08/30/2011
Site Visit Conducted by	Ali Furmall

Receptor Information:

Estimate cover	**Relative vegetative cover (high, medium, low, none)** = medium **Relative wetland cover (high, medium, low, none)** = none **Relative structures/asphalt, etc. cover (high, medium, low, none)** = low
Field notes on the FIMAD vegetation class to assist in ground-truthing the Arcview information	The SWMU exhibits a low-moderate amount of vegetative cover. The vegetative class is from a transitional zone between the piñon-juniper and ponderosa pine zone. The locations also exhibit a moderate amount of native bunch grasses and shrub species.
Field notes on T&E Habitat, if applicable. Consider the need for a site visit by a T&E subject matter expert to support the use of the site by T&E receptors.	Based on the size and vegetative cover within the SWMU 05-004 habitat, it is unlikely to provide an ideal foraging environment for T&E species.
Are ecological receptors present at the site? **(yes/no/uncertain)** **Describe the general types of receptors present at the site (terrestrial and aquatic), and make notes on the quality of habitat present at the site.**	Yes. The site contains terrestrial biota such as reptiles, small mammals, insects, birds, and plants. The quality of habitat at the site is sustainable for native plant and animal species present in the area.

Contaminant Transport Information:

Surface water transport **Field notes on the erosion potential, including a discussion of the terminal point of surface water transport (if applicable).**	Surface water transport and erosion potential on the mesa top is considered low because of the relatively flat terrain (<10% slope). Runoff terminates in Mortandad Canyon.
Are there any off-site transport pathways (surface water, air, or groundwater)? **(yes/no/uncertain)** **Provide explanation**	Yes. Storm events may produce runoff downgradient. No air or groundwater transport pathways exist. Groundwater is greater than 1200 ft bgs.
Interim action needed to limit off-site transport? **(yes/no/uncertain)** **Provide explanation/ recommendation to project lead for IA SMDP.**	No. The contaminants for these areas are at low levels and the erosion potential for the area is low.

Ecological Effects Information:

Physical Disturbance **(Provide list of major types of disturbances, including erosion and construction activities, review historical aerial photos where appropriate.)**	The site has a low amount of physical disturbance. The disturbance is mainly the result of erosion, the installation of a dirt road, installation of stormwater best management practices (BMPs), and a former structure.
Are there obvious ecological effects? **(yes/no/uncertain)** **Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).**	No.
Interim action needed to limit apparent ecological effects? **(yes/no/uncertain)** **Provide explanation and recommendations to mitigate apparent exposure pathways to project lead for IA SMDP.**	No.

No Exposure/Transport Pathways:

If there are no complete exposure pathways to ecological receptors onsite and no transport pathways to offsite receptors, the remainder of the checklist should not be completed. Stop here and provide additional explanation/justification for proposing an ecological No Further Action recommendation (if needed). At a minimum, the potential for future transport should include likelihood that future construction activities could make contamination more available for exposure or transport.

Not applicable.

Adequacy of Site Characterization:

Do existing or proposed data provide information on the nature, rate and extent of contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if the maximum value was captured by existing sample data.)**	Yes. The nature and extent of potential contamination have been defined for SWMU 05-004.
Do existing or proposed data for the site address potential transport pathways of site contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if other sites should aggregated to characterize potential ecological risk.)**	Yes. The extent of contamination has been defined.

Part C—Ecological Pathways Conceptual Exposure Model

Question A:

Could soil contaminants reach receptors via vapors?

- **Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant >10^{-5} atm-me/mol and molecular weight <200 g/mol).**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Volatile organic compounds were not frequently detected, most were in the subsurface, and were at low concentrations.

Question B:

Could the soil contaminants reach receptors through fugitive dust carried in air?

- **Soil contamination would have to be on the actual surface of the soil to become available for dust.**
- **In the case of dust exposures to burrowing animals, the contamination would have to occur in the depth interval where these burrows occur.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Potential for dust entrainment on the mesa top is negligible because of vegetation.

Question C:

Can contaminated soil be transported to aquatic ecological communities (use SOP 2.01 run-off score and terminal point of surface water runoff to help answer this question)?

- **If the SOP 2.01 run-off score* for each SWMU included in the site is equal to zero, this suggests that erosion at the site is not a transport pathway. (* Note that the runoff score is not the entire erosion potential score, rather it is a subtotal of this score with a maximum value of 46 points).**
- **If erosion is a transport pathway, evaluate the terminal point to see if aquatic receptors could be affected by contamination from this site.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: No active aquatic ecological communities exist on or within close proximity to the sites and there is limited runoff from the sites.

Question D:

Is contaminated groundwater potentially available to biological receptors through seeps or springs or shallow groundwater?

- **Known or suspected presence of contaminants in groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**

- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: No seeps or springs are present on the mesa top, and no perched water has been found. The depth to groundwater is greater than 1200 ft bgs.

Question E:

Is infiltration/percolation from contaminated subsurface material a viable transport and exposure pathway?

- **Suspected ability of contaminants to migrate to groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**
- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: Contaminants are not likely to migrate to the regional aquifer given the depth to groundwater. The lack of a significant hydraulic driver (e.g., no pond water on the surface) facilitating infiltration also mitigates the potential for contaminants reaching groundwater.

Question F:

Might erosion or mass wasting events be a potential release mechanism for contaminants from subsurface materials or perched aquifers to the surface?

- **This question is only applicable to release sites located on or near the mesa edge.**
- **Consider the erodability of surficial material and the geologic processes of canyon/mesa edges.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: Surface contamination is minimal across the site. No perched aquifers exist near these sites. Stormwater BMPs have been installed near the mesa edge.

Question G:

Could airborne contaminants interact with receptors through respiration of vapors?

- **Contaminants must be present as volatiles in the air.**
- **Consider the importance of inhalation of vapors for burrowing animals.**
- **Foliar uptake of organic vapors is typically not a significant exposure pathway.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 1

Terrestrial Animals: 1

Provide explanation: Volatile organic compounds were detected infrequently and at low concentrations.

Question H:

Could airborne contaminants interact with plants through deposition of particulates or with animals through inhalation of fugitive dust?

- **Contaminants must be present as particulates in the air or as dust for this exposure pathway to be complete.**
- **Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that would be exposed to dust disturbed by their foraging or burrowing activities or by wind movement.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 1

Terrestrial Animals: 1

Provide explanation: Vegetation/ground cover minimizes particulates and dust.

Question I:

Could contaminants interact with plants through root uptake or rain splash from surficial soils?

- **Contaminants in bulk soil may partition into soil solution, making them available to roots.**
- **Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash).**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 2

Provide explanation: Low concentrations of chemicals of potential concern (COPCs) were detected in surficial soil.

Question J:

Could contaminants interact with receptors through food web transport from surficial soils?

- **The chemicals may bioaccumulate in animals.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Some bioaccumulating contaminants were present but at low enough concentrations that the transport pathway through the food webs to receptors is minimal.

Question K:

Could contaminants interact with receptors via incidental ingestion of surficial soils?

- **Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: COPCs in surface and subsurface are at low levels.

Question L:

Could contaminants interact with receptors through dermal contact with surficial soils?

- **Significant exposure via dermal contact would generally be limited to organic contaminants that are lipophilic and can cross epidermal barriers.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Lipophilic chemicals were detected at low concentrations at this site.

Question M:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 0

Provide explanation: No gamma-emitting radionuclides were detected.

Question N:

Could contaminants interact with plants through direct uptake from water and sediment or sediment rain splash?

- **Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters.**
- **Terrestrial plants may be exposed to particulates deposited on leaf and stem surfaces by rain striking contaminated sediments (i.e., rain splash) in an area that is only periodically inundated with water.**
- **Contaminants in sediment may partition into soil solution, making them available to roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Provide explanation: There are no aquatic environments on-site.

Question O:

Could contaminants interact with receptors through food web transport from water and sediment?

- **The chemicals may bioconcentrate in food items.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question P:

Could contaminants interact with receptors via ingestion of water and suspended sediments?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial receptors may incidentally ingest sediments.**
- **Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question Q:

Could contaminants interact with receptors through dermal contact with water and sediment?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods.**
- **Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question R:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question S:

Could contaminants bioconcentrate in free floating aquatic, attached aquatic plants, or emergent vegetation?

- **Aquatic plants are in direct contact with water.**
- **Contaminants in sediment may partition into pore water, making them available to submerged roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Plants/Emergent Vegetation: 0

Provide explanation: There are no aquatic environments on-site.

Question T:

Could contaminants bioconcentrate in sedimentary or water column organisms?

- **Aquatic receptors may actively or incidentally ingest sediment while foraging.**
- **Aquatic receptors may be directly exposed to contaminated sediments or may be exposed to contaminants through osmotic exchange, respiration, or ventilation of sediment pore waters.**
- **Aquatic receptors may be exposed through osmotic exchange, respiration, or ventilation of surface waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question U:

Could contaminants bioaccumulate in sedimentary or water column organisms?

- **Lipophilic organic contaminants and some metals may concentrate in an organism's tissues**
- **Ingestion of contaminated food items may result in contaminant bioaccumulation through the food web.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question V:

Could contaminants interact with aquatic plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **The water column acts to absorb radiation, thus external irradiation is typically more important for sediment dwelling organisms.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

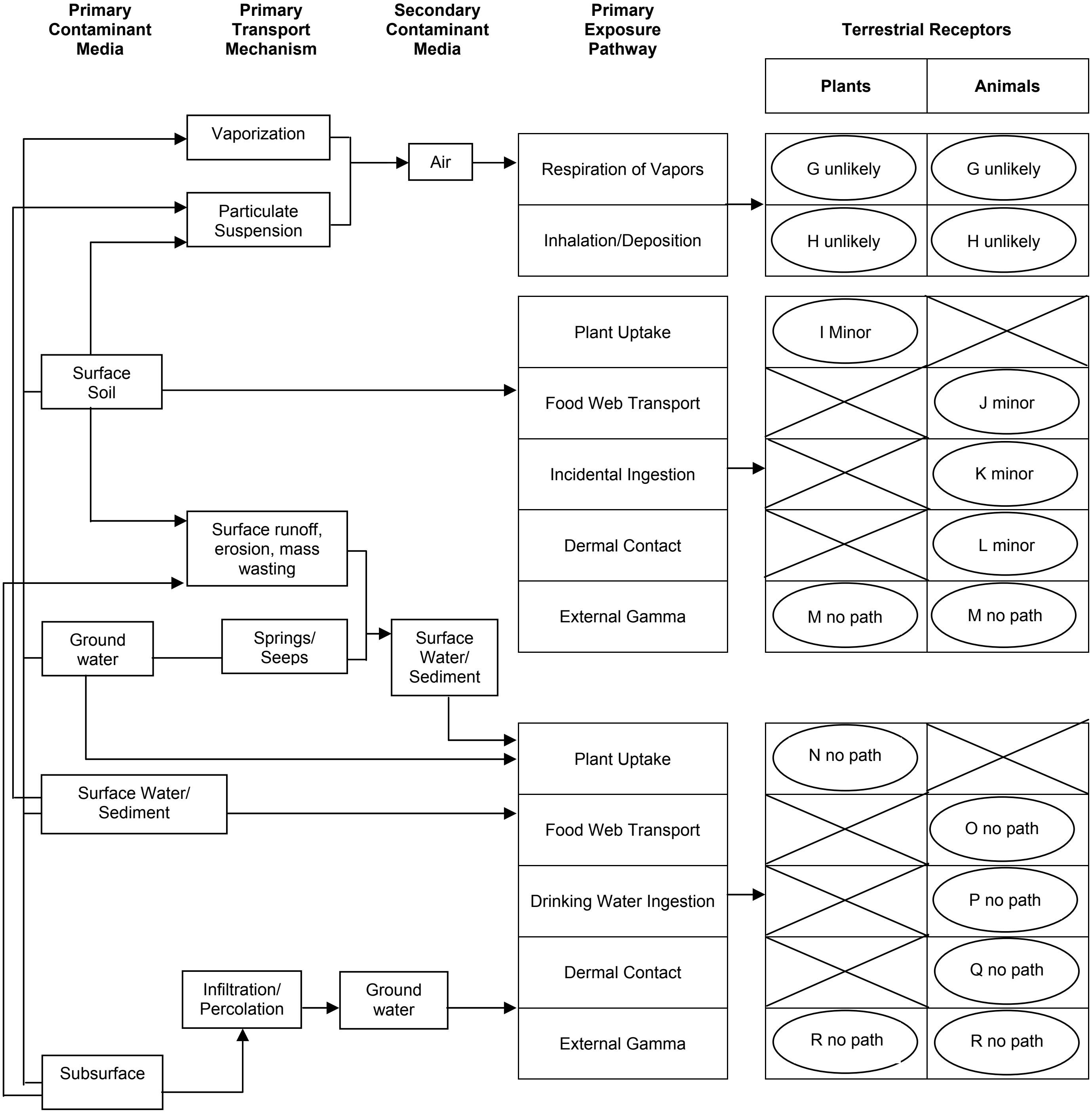
Aquatic Plants: 0

Aquatic Animals: 0

Provide explanation: There are no aquatic environments on-site.

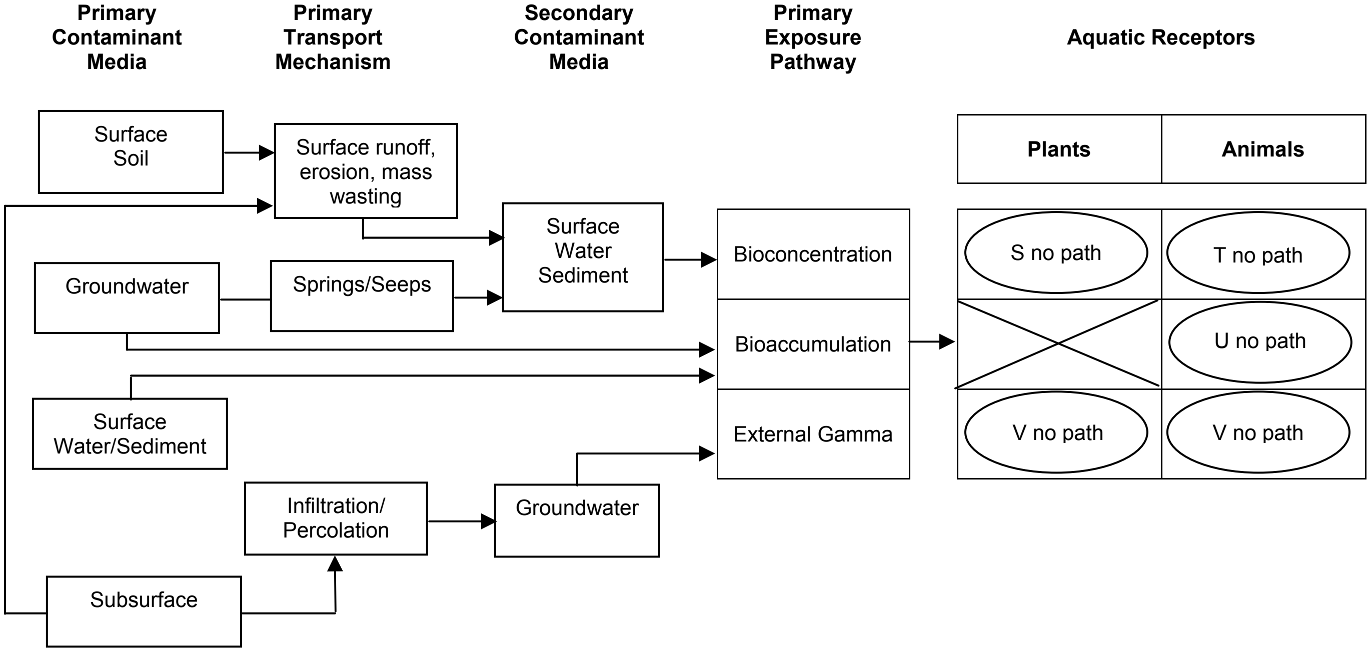
NOTE:
Letters in circles refer to questions on the Scoping Checklist

Ecological Scoping Checklist
Terrestrial Receptors
Ecological Pathways Conceptual Exposure Model



Ecological Scoping Checklist
Aquatic Receptors
Ecological Pathways Conceptual Exposure Model

NOTE:
Letters in circles refer to questions on the Scoping Checklist



Signatures and certifications:

Checklist completed by (provide name, organization and phone number):

Name (printed): Ali Furmall

Name (signature): Ali Furmall

Organization: Los Alamos Technical Associates

Phone number: (505) 662-1830

Date Completed: 08/30/2011

Verification by a member of ER Project Ecological Risk Task Team (provide name, organization and phone number):

Name (printed): Richard J. Mirenda

Name (signature): Richard J. Mirenda

Organization: WES-EDA

Phone number: (505) 665-6953

Part A—Scoping Meeting Documentation

Site ID	**Consolidated Unit 05-005(b)-00 [SWMU 05-005(b) and SWMU 05-006(c)]**
Form of site releases (solid, liquid, vapor). Describe all relevant known or suspected mechanisms of release (spills, dumping, material disposal, outfall, explosive testing, etc.) and describe potential areas of release. Reference locations on a map as appropriate.	SWMU 05-005(b) is an area of potentially contaminated soil associated with a former outfall that was located in TA-05 at the edge of Mortandad Canyon. The outfall served building 05-5 (a shop and darkroom) and was located approximately 80 ft south of the building. The outfall is believed to have operated during the same time period as the building, which operated from 1944 to 1959. Building 05-5 supported TA-05 firing site activities, including shop work and processing photographs of experiments conducted at the firing sites. For a brief period in 1952, the calibration of high-range radiation meters was also conducted in the building. SWMU 05-006(c) is an area of potentially contaminated soil associated with the location of former building 05-5, a shop and darkroom. The shop was 16 ft square and the darkroom was 6 ft wide × 9 ft long. The building was operational from about 1944 to 1959. The structure was originally used to support firing site activities, including processing photographs of experiments conducted at the TA-05 firing sites. In 1952, J Division temporarily used the building to calibrate high-range radiation meters. A 1959 memorandum indicates this structure was contaminated with HE, as does a 1959 list generated by the Laboratory's H-3 Group. Potential soil contamination associated with SWMU 05-006(c) was reported to also include uranium. Building 05-5 was destroyed by intentional burning on March 5, 1960.
List of Primary Impacted Media **(Indicate all that apply.)**	**Surface soil** – X **Surface water/sediment** – Not applicable **Subsurface** – X **Groundwater –** Not applicable **Other, explain** – Not applicable
FIMAD vegetation class based on Arcview vegetation coverage **(Indicate all that apply.)**	**Water –** Not applicable **Bare Ground/Unvegetated** – X **Spruce/fir/aspen/mixed conifer** – Not applicable **Ponderosa pine** – X **Piñon juniper/juniper savannah** – X **Grassland/shrubland** – X **Developed** – X
Is T&E Habitat Present? **If applicable, list species known or suspected to use the site for breeding or foraging.**	Yes. Location information maintained by the FIMAD was intersected with T&E species habitat using GIS databases. The sites are within Mexican spotted owl nesting habitat and within an area where the owl can conservatively be assumed to forage at a high frequency. The sites are also entirely within an area where the peregrine falcon can conservatively be assumed to forage at a relatively high frequency.
Provide list of Neighboring/ Contiguous/ Up-gradient sites, include a brief summary of COPCs and form of releases for relevant sites and reference map as appropriate. **(Use information to evaluate need to aggregate sites for screening.)**	The outfall of SWMU 05-005(b) was associated with former building 05-5 [SWMU 05-006(c)]. SWMUs 05-005(b) and 05-006(c) comprise Consolidated Unit 05-005(b)-00.
Surface Water Erosion Potential	Surface water transport and erosion potential on the mesa top is considered low because of the relatively flat terrain (<10% slope). Runoff terminates in Mortandad Canyon.

Part B—Site Visit Documentation for Consolidated Unit 05-005(b)-00

Site ID	SWMU 05-005(b) and SWMU 05-006(c)
Date of Site Visit	08/30/2011
Site Visit Conducted by	Ali Furmall

Receptor Information:

Estimate cover	**Relative vegetative cover (high, medium, low, none)** = medium **Relative wetland cover (high, medium, low, none)** = none **Relative structures/asphalt, etc. cover (high, medium, low, none)** = low
Field notes on the FIMAD vegetation class to assist in ground-truthing the Arcview information	The SWMU exhibits a low-moderate amount of vegetative cover. The vegetative class is from a transitional zone between the piñon-juniper and ponderosa pine zone. The locations also exhibit a moderate amount of native bunch grasses and shrub species.
Field notes on T&E Habitat, if applicable. Consider the need for a site visit by a T&E subject matter expert to support the use of the site by T&E receptors.	Based on the size and vegetative cover within the Consolidated Unit 05-005(b)-00 habitat, it is unlikely to provide an ideal foraging environment for T&E species.
Are ecological receptors present at the site? **(yes/no/uncertain)** **Describe the general types of receptors present at the site (terrestrial and aquatic), and make notes on the quality of habitat present at the site.**	Yes. The site contains terrestrial biota such as reptiles, small mammals, insects, birds, and plants. The quality of habitat at the site is sustainable for native plant and animal species present in the area.

Contaminant Transport Information:

Surface water transport **Field notes on the erosion potential, including a discussion of the terminal point of surface water transport (if applicable).**	Surface water transport and erosion potential on the mesa top is considered low because of the relatively flat terrain (<10% slope). Runoff terminates in Mortandad Canyon.
Are there any off-site transport pathways (surface water, air, or groundwater)? **(yes/no/uncertain)** **Provide explanation**	Yes. Storm events may produce runoff downgradient. No air or groundwater transport pathways exist. Groundwater is greater than 1200 ft bgs.
Interim action needed to limit off-site transport? **(yes/no/uncertain)** **Provide explanation/ recommendation to project lead for IA SMDP.**	No. The contaminants for these areas are at low levels and the erosion potential for the area is low.

Ecological Effects Information:

Physical Disturbance **(Provide list of major types of disturbances, including erosion and construction activities, review historical aerial photos where appropriate.)**	The site does have a low amount of physical disturbance. The disturbance is mainly the result of erosion, the installation of a dirt road, installation of stormwater BMPs, and a former structure.
Are there obvious ecological effects? **(yes/no/uncertain)** **Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).**	No.
Interim action needed to limit apparent ecological effects? **(yes/no/uncertain)** **Provide explanation and recommendations to mitigate apparent exposure pathways to project lead for IA SMDP.**	No.

No Exposure/Transport Pathways:

If there are no complete exposure pathways to ecological receptors onsite and no transport pathways to offsite receptors, the remainder of the checklist should not be completed. Stop here and provide additional explanation/justification for proposing an ecological No Further Action recommendation (if needed). At a minimum, the potential for future transport should include likelihood that future construction activities could make contamination more available for exposure or transport.

Not applicable.

Adequacy of Site Characterization:

Do existing or proposed data provide information on the nature, rate and extent of contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if the maximum value was captured by existing sample data.)**	Yes. The nature and extent of potential contamination have been defined for Consolidated Unit 05-005(b)-00.
Do existing or proposed data for the site address potential transport pathways of site contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if other sites should aggregated to characterize potential ecological risk.)**	Yes. The extent of contamination has been defined.

Part C—Ecological Pathways Conceptual Exposure Model

Question A:

Could soil contaminants reach receptors via vapors?

- **Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant >10^{-5} atm-me/mol and molecular weight <200 g/mol).**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Volatile organic compounds were not frequently detected, most were in the subsurface, and were at low concentrations.

Question B:

Could the soil contaminants reach receptors through fugitive dust carried in air?

- **Soil contamination would have to be on the actual surface of the soil to become available for dust.**
- **In the case of dust exposures to burrowing animals, the contamination would have to occur in the depth interval where these burrows occur.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: Potential for dust entrainment on the mesa top is negligible because of vegetation.

Question C:

Can contaminated soil be transported to aquatic ecological communities (use SOP 2.01 run-off score and terminal point of surface water runoff to help answer this question)?

- **If the SOP 2.01 run-off score* for each SWMU included in the site is equal to zero, this suggests that erosion at the site is not a transport pathway. (* Note that the runoff score is not the entire erosion potential score, rather it is a subtotal of this score with a maximum value of 46 points).**
- **If erosion is a transport pathway, evaluate the terminal point to see if aquatic receptors could be affected by contamination from this site.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: No active aquatic ecological communities exist on or within close proximity to the sites and there is limited runoff from the sites.

Question D:

Is contaminated groundwater potentially available to biological receptors through seeps or springs or shallow groundwater?

- **Known or suspected presence of contaminants in groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**

- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: No seeps or springs are present on the mesa top, and no perched water has been found. The depth to groundwater is greater than 1200 ft bgs.

<u>**Question E:**</u>

Is infiltration/percolation from contaminated subsurface material a viable transport and exposure pathway?

- **Suspected ability of contaminants to migrate to groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**
- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: Contaminants are unlikely to migrate to the regional aquifer given the depth to groundwater. The lack of a significant hydraulic driver (e.g., no pond water on the surface) facilitating infiltration also mitigates the potential for contaminants reaching groundwater.

<u>**Question F:**</u>

Might erosion or mass wasting events be a potential release mechanism for contaminants from subsurface materials or perched aquifers to the surface?

- **This question is only applicable to release sites located on or near the mesa edge.**
- **Consider the erodability of surficial material and the geologic processes of canyon/mesa edges.**

Answer (likely/unlikely/uncertain): Unlikely.

Provide explanation: Surface contamination is minimal across the site. No perched aquifers exist near these sites. Stormwater BMPs have been installed near the mesa edge.

<u>**Question G:**</u>

Could airborne contaminants interact with receptors through respiration of vapors?

- **Contaminants must be present as volatiles in the air.**
- **Consider the importance of inhalation of vapors for burrowing animals.**
- **Foliar uptake of organic vapors is typically not a significant exposure pathway.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 1

Terrestrial Animals: 1

Provide explanation: Volatile organic compounds were detected infrequently and at low concentrations.

Question H:

Could airborne contaminants interact with plants through deposition of particulates or with animals through inhalation of fugitive dust?

- **Contaminants must be present as particulates in the air or as dust for this exposure pathway to be complete.**
- **Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that would be exposed to dust disturbed by their foraging or burrowing activities or by wind movement.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 1

Terrestrial Animals: 1

Provide explanation: Vegetation/ground cover minimizes particulates and dust.

Question I:

Could contaminants interact with plants through root uptake or rain splash from surficial soils?

- **Contaminants in bulk soil may partition into soil solution, making them available to roots.**
- **Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash).**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 2

Provide explanation: Low concentrations of COPCs were detected in surficial soil.

Question J:

Could contaminants interact with receptors through food web transport from surficial soils?

- **The chemicals may bioaccumulate in animals.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Some bioaccumulating contaminants were present but at low enough concentrations that the transport pathway through the food webs to receptors is minimal.

Question K:

Could contaminants interact with receptors via incidental ingestion of surficial soils?

- **Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: COPCs in surface and subsurface are at low levels.

Question L:

Could contaminants interact with receptors through dermal contact with surficial soils?

- **Significant exposure via dermal contact would generally be limited to organic contaminants that are lipophilic and can cross epidermal barriers.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Lipophilic chemicals were detected at low concentrations at this site.

Question M:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 0

Provide explanation: No gamma-emitting radionuclides were detected.

Question N:

Could contaminants interact with plants through direct uptake from water and sediment or sediment rain splash?

- **Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters.**
- **Terrestrial plants may be exposed to particulates deposited on leaf and stem surfaces by rain striking contaminated sediments (i.e., rain splash) in an area that is only periodically inundated with water.**
- **Contaminants in sediment may partition into soil solution, making them available to roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Provide explanation: There are no aquatic environments on-site.

Question O:

Could contaminants interact with receptors through food web transport from water and sediment?

- **The chemicals may bioconcentrate in food items.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question P:

Could contaminants interact with receptors via ingestion of water and suspended sediments?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial receptors may incidentally ingest sediments.**
- **Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question Q:

Could contaminants interact with receptors through dermal contact with water and sediment?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods.**
- **Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question R:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question S:

Could contaminants bioconcentrate in free floating aquatic, attached aquatic plants, or emergent vegetation?

- **Aquatic plants are in direct contact with water.**
- **Contaminants in sediment may partition into pore water, making them available to submerged roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Plants/Emergent Vegetation: 0

Provide explanation: There are no aquatic environments on-site.

Question T:

Could contaminants bioconcentrate in sedimentary or water column organisms?

- **Aquatic receptors may actively or incidentally ingest sediment while foraging.**
- **Aquatic receptors may be directly exposed to contaminated sediments or may be exposed to contaminants through osmotic exchange, respiration, or ventilation of sediment pore waters.**
- **Aquatic receptors may be exposed through osmotic exchange, respiration, or ventilation of surface waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question U:

Could contaminants bioaccumulate in sedimentary or water column organisms?

- **Lipophilic organic contaminants and some metals may concentrate in an organism's tissues**
- **Ingestion of contaminated food items may result in contaminant bioaccumulation through the food web.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic environments on-site.

Question V:

Could contaminants interact with aquatic plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **The water column acts to absorb radiation, thus external irradiation is typically more important for sediment dwelling organisms.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

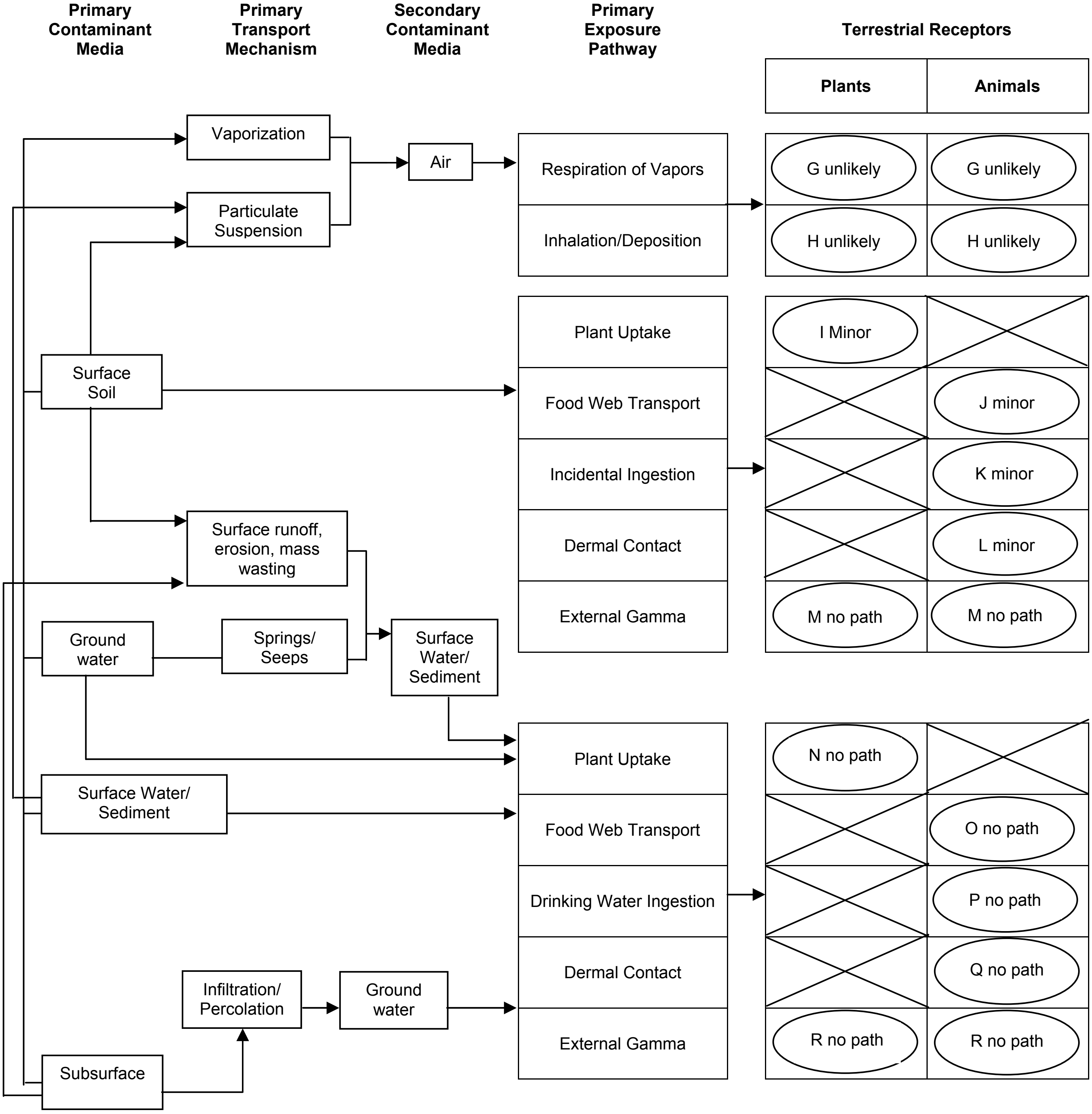
Aquatic Plants: 0

Aquatic Animals: 0

Provide explanation: There are no aquatic environments on-site.

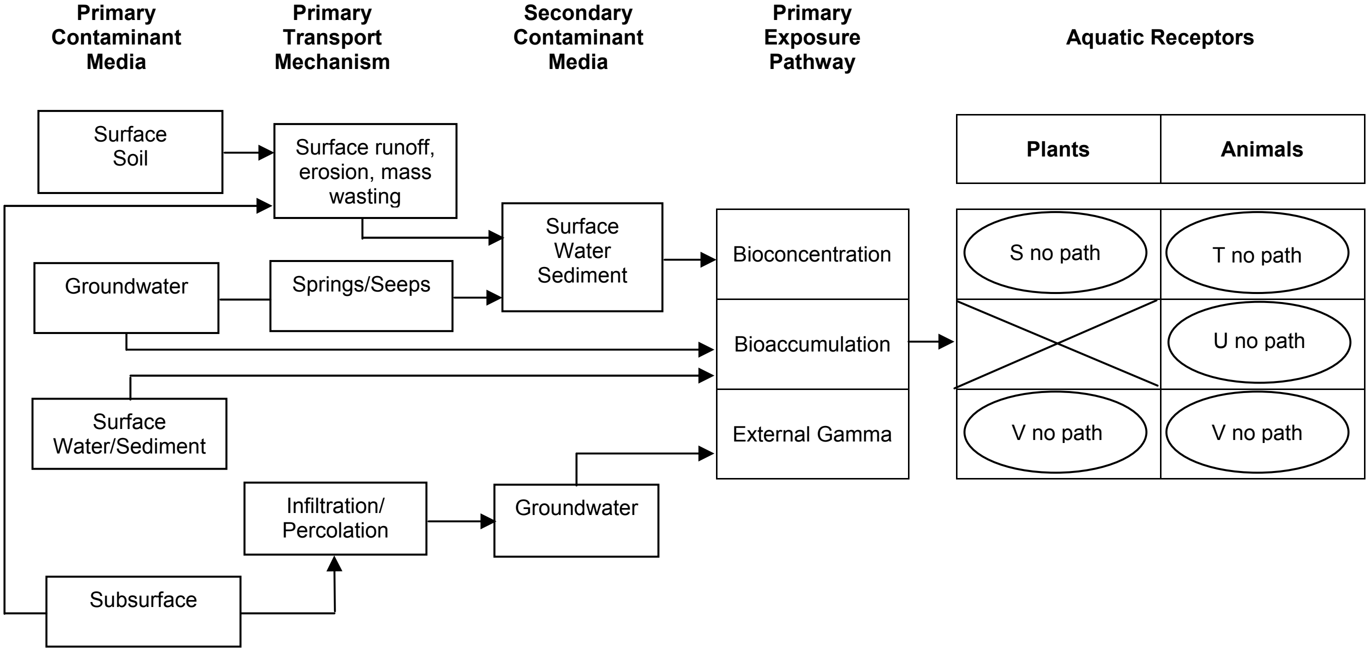
Ecological Scoping Checklist
Terrestrial Receptors
Ecological Pathways Conceptual Exposure Model

NOTE:
Letters in circles refer to questions on the Scoping Checklist



NOTE:
Letters in circles refer to questions on the Scoping Checklist

Ecological Scoping Checklist
Aquatic Receptors
Ecological Pathways Conceptual Exposure Model



Signatures and certifications:

Checklist completed by (provide name, organization and phone number):

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Name (signature): Ali Furmall

Organization: Los Alamos Technical Associates

Phone number: (505) 662-1830

Date Completed: 08/30/2011

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