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Date: JUN 29 2018
Refer To: N3B-18-0134

John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of the Investigation Report for DP Site Aggregate Area Sites at DP East

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of the Investigation Report for DP Site Aggregate Area Sites at DP East. This investigation report evaluates the nature and extent of contamination and potential human health and ecological risks for three solid waste management units (SWMUs) and one area of concern (AOC) in the DP Site Aggregate Area at Los Alamos National Laboratory. The SWMUs and AOC addressed in this report are located in Technical Area 21 (TA-21). This report is being submitted to fulfill Fiscal Year 2018 Milestone 7 in Appendix B of the 2016 Compliance Order on Consent (Consent Order).

Pursuant to Section XXIII.C of the Consent Order, a pre-submission review meeting was held between the U.S. Department of Energy Environmental Management Los Alamos Field Office, Newport News Nuclear BWXT – Los Alamos, LLC (N3B), and the New Mexico Environment Department on June 19, 2018, to discuss the investigation results and recommendations for the four sites.

If you have any questions, please contact Kent Rich at (505) 660-6570 (kent.rich@em-la.doe.gov) or Cheryl Rodriguez at (505) 665-5330 (cheryl.rodriguez@em.doe.gov).

Sincerely,

for
Joseph A. Legare
Program Manager
Environmental Remediation Program

Sincerely,

for
David S. Rhodes, Director
Office of Quality and Regulatory Compliance
Environmental Management
Los Alamos Field Office

JL/EE/KR/CR

Enclosure(s): Two hard copies with electronic files – Investigation Report for DP Site Aggregate Area Sites at DP East (EM2018-0007)

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June 2018
EM2018-0007

Investigation Report for DP Site Aggregate Area Sites at DP East

N3B Los Alamos

EM2018-0007

Investigation Report for DP Site Aggregate Area Sites at DP East

June 2018

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EXECUTIVE SUMMARY

This investigation report evaluates the nature and extent of contamination and potential human health and ecological risks for three solid waste management units (SWMUs) and one area of concern (AOC) in the DP Site Aggregate Area at Los Alamos National Laboratory (LANL or the Laboratory). The SWMUs and AOC addressed in this report are located in Technical Area 21 (TA-21).

The results of the investigation and/or remediation activities conducted at these sites in 2010 and 2011 were previously reported in the "Investigation Report for DP Site Aggregate Area Delayed Sites [Consolidated Unit 21-004(b)-99 and Solid Waste Management Unit 21-011(b)] and DP East Building Footprints at Technical Area 21, Revision 1," submitted by the U.S. Department of Energy (DOE) and Los Alamos National Security, LLC (LANS) to the New Mexico Environment Department (NMED) in March 2012. The 2012 investigation report was disapproved by NMED and the disapproval required DOE and LANS to respond to comments and submit a revised investigation report. The deadline for submitting the revised report was subsequently extended and the requirement was eventually replaced by a Fiscal Year 2018 milestone in Appendix B of the 2016 Compliance Order on Consent (Consent Order) for submittal of an investigation report for DP Sites Aggregate Area at DP East at TA-21.

After the 2012 investigation report had been submitted and disapproved, NMED and DOE entered into a framework agreement for the realignment of environmental priorities at the Laboratory. Under the framework agreement, NMED and DOE agreed to review characterization efforts undertaken to date pursuant to the Consent Order to identify those sites where the nature and extent of contamination have been adequately characterized. Pursuant to the framework agreement, the Laboratory reviewed its data evaluation process with respect to U.S. Environmental Protection Agency (EPA) guidance and the framework agreement principles and concluded that this process could be revised to more efficiently complete site characterization, while providing full protection of human health and the environment. Specifically, the process for evaluating data to define extent of contamination was revised to provide a greater emphasis on risk reduction, consistent with EPA guidance.

The revised process was used to evaluate the 2010–2011 data and previous decision-level investigation data for the three SWMUs and one AOC identified in the 2012 investigation report as requiring additional sampling to define extent. Based on the evaluation of investigation results using the revised process, the extent of contamination has been defined (or a determination has been made that no further sampling for extent is warranted) at two sites, and additional sampling for extent is required at two sites, which also require remediation. Human health and ecological risk assessments were performed for all sites.

Based on the results of data evaluations presented in this investigation report, Newport News Nuclear BWXT – Los Alamos, LLC (N3B) recommends the following:

- Corrective action complete without controls is recommended for two sites for which extent is defined and which pose no potential unacceptable human health risk under the industrial, construction worker, and residential scenarios and no unacceptable ecological risk.

Soil removal is recommended for two sites, one of which poses a potential unacceptable dose under the construction worker and residential scenarios and one of which poses a potential unacceptable risk under the residential scenario. Additional sampling and analysis for extent is also recommended for these two sites.

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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 (LANS). 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 approximately 39 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 has been a participant in a national effort by DOE to clean up sites and facilities formerly involved in weapons research and development. The goal of this effort is to ensure past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the Laboratory has investigated sites potentially contaminated by past Laboratory operations.

This investigation report addresses four of these potentially contaminated sites within Technical Area 21 (TA-21) in the DP Site Aggregate Area at the Laboratory (Figures 1.0-1 and 1.0-2). Three of these sites are designated as solid waste management units (SWMUs), and the fourth site is designated as an area of concern (AOC). These sites are potentially contaminated with both hazardous and radioactive components. Corrective actions at the Laboratory are subject to a Compliance Order on Consent (the Consent Order). The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 435.1, “Radioactive Waste Management,” and DOE Order 458.1, Administrative Change 3, “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.

1.1 General Site Information

The DP Site Aggregate Area is located in TA-21 at the Laboratory (Figure 1.0-1). Table 1.1-1 lists the sites addressed in this report, along with a brief description for each site and the site status. The site status refers to the investigations and/or remediation completed to date. The results of the investigation and/or remediation activities conducted at these sites were previously reported in the “Investigation Report for DP Site Aggregate Area Delayed Sites [Consolidated Unit 21-004(b)-99 and Solid Waste Management Unit 21-011(b)] and DP East Building Footprints at Technical Area 21,” Revision 1, submitted by DOE and LANS to NMED in March 2012 (LANL 2012, 213390). The 2012 investigation report was disapproved by NMED (NMED 2012, 520745) and the disapproval required DOE and LANS to respond to disapproval comments and submit a revised investigation report. The deadline for submitting the revised report was subsequently extended and the requirement was eventually replaced by a Fiscal Year 2018 milestone in Appendix B of the 2016 Consent Order for submittal of an investigation report for DP Sites Aggregate Area at DP East at TA-21. This investigation report, prepared by Newport News Nuclear BWXT – Los Alamos, LLC (N3B), addresses that Consent Order milestone.

1.2 Purpose of Investigation

The sites addressed in this investigation report are potentially contaminated with hazardous chemicals and/or radionuclides. The overall objectives for investigating these sites are to (1) establish the nature and extent of contamination; (2) determine whether current site conditions pose a potential unacceptable risk/dose to human health or the environment; and (3) assess whether any additional sampling and/or corrective actions are required.

1.3 Document Organization

This report is organized in nine sections, including this introduction, with multiple supporting appendixes. Sections 2 through 6 present the site conditions, scope of activities, results of the field activities performed during the investigation conducted in 2010–2011, regulatory criteria, site contamination, and the results of human health and ecological risk-screening assessments for each site. Section 7 presents conclusions, both for the nature and extent of contamination and the risk assessments, for each site. Section 8 discusses recommendations based on the applicable extent sampling data, the remediation excavation and sampling data, and the risk-screening assessments. Section 9 includes a list of references cited and the map data sources used in all figures and plates.

Appendixes include acronyms, a metric conversion table, and definitions of the data qualifiers used in this report (Appendix A); field methods (Appendix B); sample collection logs (SCLs), chain-of-custody (COC) forms, and analytical suites and results (Appendix C); radiological surveys (Appendix D); investigation-derived waste (IDW) management (Appendix E); a description of the analytical program (Appendix F); box plots and statistical comparisons (Appendix G); and risk-screening assessments (Appendix H).

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 was mapped as 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).

Soil formed in a semiarid climate and was derived from chemical, biological, and physical weathering of local bedrock units, fallout pumice deposits, eolian deposits, and sediment weathered from these geological materials (Nyhan et al. 1978, 005702). A large variety of soil has developed on the Pajarito Plateau as the result of interactions between the underlying bedrock, slope, and climate. The mineral components of the soil are in large part derived from the Bandelier Tuff, but dacitic lavas of the Tschicoma Formation, basalts of the Cerros del Rio volcanic field, and sedimentary rocks of the Puye Formation are locally important. Alluvium derived from the Pajarito Plateau and from the east side of the Jemez Mountains contributes to soil in the canyons and also to soil on some mesa tops.

Soil in the vicinity of TA-21 is typical of soils across the Pajarito Plateau and is generally poorly developed, derived from Bandelier Tuff bedrock, and formed in a semiarid climate. Soil on the TA-21 mesa top is mainly shallow, well-drained sandy loams of the Hackroy series. The surface layer of the Hackroy soil is a brown sandy loam, or a loam, about 10 cm thick. The subsoil is a reddish-brown clay, gravelly clay, or clay loam, about 20 cm thick. The depth to bedrock and the effective rooting depth area is 20 cm to 50 cm. Hackroy soil is classified as Alfisols, in part reflecting the clayey subsurface horizons. Intermixed with the Hackroy soil on the mesa tops are small areas of deeper loams of the Nyjack series and patches of bedrock. The Nyjack soil is texturally similar to Hackroy soil and is distinguished by thicknesses of 7.9 in. (50 cm) to 40.2 in. (102 cm) and by the common presence of pumice fragments in the lower soil (Nyhan et al. 1978, 005702). Areas of exposed rock are predominant toward the east end of the mesa and TA-21 development (LANL 2004, 087461; NMED 2005, 089314).

2.1.2 Surface Water

No permanent surface water exists at TA-21. Surface water runoff occurs as a result of usually short, but often intense, seasonal thunderstorms producing large amounts of rain. Snowmelt is also a source of runoff.

2.1.3 Land Use

The current and reasonably foreseeable future land use of TA-21 is industrial. TA-21 will be transferred to Los Alamos County for Commercial/Industrial use in the future.

2.2 Subsurface Conditions

2.2.1 Stratigraphy

TA-21 is centrally located on the Pajarito Plateau, approximately midway between the flanks of the Jemez Mountains on the west and the Rio Grande to the east. The general stratigraphy beneath TA-21 has been defined from investigations conducted in recent years (Figure 2.2-1). Additional information on the geologic setting of the TA-21 area and information on the Pajarito Plateau can be found in the Laboratory’s hydrogeologic synthesis report (Collins et al. 2005, 092028). The following sections describe the geologic units encountered below TA-21.

Santa Fe Group

The Santa Fe Group consists of predominately fluvial, slightly consolidated sedimentary rock that crops out in the lower reaches of Los Alamos Canyon, along White Rock Canyon, and in extensive areas east of the Rio Grande (Galusha and Blick 1971, 021526). In the area of the Pajarito Plateau, the Santa Fe Group consists of the Tesuque Formation and the Chamita Formation. A trough of late Miocene coarse-grained sediment at the top of the Santa Fe Group that postdates the Chamita Formation and these deposits is called the Chaquehui Formation (Purtymun 1995, 045344). The trough is filled with 1500 ft of gravels, cobbles, and boulders derived from highlands to the north and east. Regional cross-sections show that the Chaquehui Formation exists beneath TA-21 (LANL 2004, 087461; NMED 2005, 089314).

Puye Formation

The Puye Formation is a fanglomerate deposit consisting of poorly sorted boulders, cobbles, and coarse sand made up of dacitic to latitic debris eroded from the contemporaneous Tschicoma Formation (Turbeville et al. 1989, 021587; Spell et al. 1990, 021586). The unit is 940 ft thick and may consist of interbedded basalt flows of the Cerros del Rio volcanic field and Tschicoma Formation (LANL 1991, 007529). Also included in the Puye Formation is the Totavi Lentil, a deposit of well-rounded cobbles and boulders of Precambrian quartzites and crystalline rocks (Griggs and Hem 1964, 092516).

The Bandelier Tuff

The Valles Caldera erupted between 1.61 and 1.22 million yr ago creating the Bandelier Tuff. The unit is divided into the Otowi (Qbo) and Tshirege (Qbt) Members, which are separated by the Cerro Toledo interval. The tuff is rhyolitic, with a strong consolidated matrix of crystals. Because the Bandelier Tuff is the most prominent rock type on the Pajarito Plateau, its detailed stratigraphy is of considerable importance and is discussed further below (Broxton and Reneau 1995, 049726).

The nature and extent of the Otowi Member are described by Griggs and Hem (1964, 092516), Smith and Bailey (1966, 021584), Bailey et al. (1969, 021498), and Smith et al. (1970, 009752). The Otowi Member consists of moderately consolidated (indurated), porous, and nonwelded vitric tuff (ignimbrite) that forms gentle colluvium-covered slopes along the base of canyon walls. The Otowi ignimbrites contain light gray to orange pumice supported in a white to tan ash matrix (Broxton and Eller 1995, 058207; Goff 1995, 049682). The ash matrix consists of glass shards, broken pumice and crystal fragments, and fragments of perlite.

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

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 and Eller 1995, 058207; Broxton and Reneau 1995, 049726; Goff 1995, 049682). Although it is intercalated between the two members of the Bandelier Tuff, it is not considered part of that formation (Bailey et al. 1969, 021498). Outcrops of the Cerro Toledo interval generally occur wherever the top of the Otowi Member appears in Los Alamos Canyon and in canyons to the north; the interval outcrops in the TA-21 area. The unit contains primary volcanic deposits normally assigned to the Cerro Toledo rhyolite, as described by Smith et al. (1970, 009752), as well as intercalated and reworked volcaniclastic sediment not normally included in the Cerro Toledo rhyolite. 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 at TA-21 (Heiken et al. 1986, 048638; Stix et al. 1988, 049680; Broxton and Eller 1995, 058207; Goff 1995, 049682). The tuffaceous sediment is the reworked equivalent of Cerro Toledo rhyolite tephra that erupted from the Cerro Toledo and Rabbit Mountain rhyolite domes located in the Sierra de los Valles. At TA-21, oxidation and clay-rich horizons indicate at least two periods of soil development occurred within the Cerro Toledo deposits. Because this soil is rich in clay, it may act as a barrier to the movement of vadose zone groundwater. Some of the epiclastic tuffaceous deposits contain both crystal-poor and crystal-rich varieties of pumice. The ashy matrix of these deposits is commonly rich with crystals and contains subhedral sanadine and quartz. The mixed pumice and the crystal-rich nature of the matrix indicate this reworked tuff was derived from both the Cerro Toledo rhyolite and the underlying Otowi Member. The pumice falls tend to form porous and permeable horizons within the Cerro Toledo interval, and locally they 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 made up of porphyritic dacite derived from the Tschicoma Formation interbedded with the tuffaceous rock, and in some deposits, dacitic materials are volumetrically more important than rhyolitic detritus (Broxton and Eller 1995, 058207; Goff 1995, 049682; Broxton and Reneau 1996, 055429).

Tshirege Member of the Bandelier Tuff

The Tshirege Member is the upper member of the Bandelier Tuff and is the most widely exposed bedrock unit of the Pajarito Plateau (Griggs and Hem 1964, 092516; Smith and Bailey 1966, 021584; Bailey et al. 1969, 021498; Smith et al. 1970, 009752). Emplacement of this unit occurred during eruptions of the Valles Caldera approximately 1.2 million yr ago (Izett and Obradovich 1994, 048817; Spell et al. 1996, 055542). The Tshirege Member is a multiple-flow, ash-and-pumice sheet that forms the prominent cliffs in most of the canyons on the Pajarito Plateau and at TA-21. It is a chemical 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 (called joints) that average between several feet and 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 compaction. Time breaks between the successive emplacement of flow units caused the tuff to cool as several distinct units. For this reason, the Tshirege Member is a chemical cooling unit, consisting 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 and Eller 1995, 058207). These variations in physical properties reflect zonal patterns of different degrees of welding and of glass crystallization, which accompanies welding (Smith 1960, 048820; Smith 1960, 048819). The welding and crystallization variabilities 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.

Extensive descriptions of the Tshirege Member cooling units (Broxton and Eller 1995, 058207), in ascending order, are provided below.

The Tsankawi Pumice Bed forms the base of the Tshirege Member. Where exposed, it is commonly 20 in. 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 subunit of the thick ignimbrite sheet overlying the Tsankawi Pumice Bed. It consists of porous, nonwelded, and poorly sorted ash-flow tuff. The “g” in this designation stands for glass because none of the glass in ash shards and pumices shows crystallization by devitrification or vapor-phase crystallization. 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 in. to 10 in.), pumice-poor surge deposit commonly occurs at the base of this unit.

Subunit Qbt 1v forms alternating cliff-like and sloping outcrops composed of porous, nonwelded, crystallized tuff. The “v” stands for vapor-phase crystallization which, together with in situ crystallization devitrification, has converted much of the glass in shards and pumices into microcrystalline aggregates. The base of this unit is a thin, horizontal zone of preferential weathering that marks the abrupt transition from glassy tuff below (in unit 1g) to the crystallized tuff above. This feature forms a widespread marker horizon (locally termed the vapor-phase notch) throughout the Pajarito Plateau, which is readily visible in canyon walls at TA-21. The lower part of Qbt 1v is orange brown, resistant to weathering, and has distinctive columnar (vertical) joints; hence, the term colonnade tuff is appropriate for its description. A distinctive white band of alternating cliff- and slope-forming tuff overlies the colonnade tuff. The tuffs of Qbt 1v are commonly nonwelded (pumices and shards retain their initial equant shapes) and have 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 tuffs above and below at TA-21. It displays the greatest degree of welding in the Tshirege Member. A series of surge beds commonly marks its base. It is typically nonporous and has low permeability relative to the other units of the Tshirege Member. Vapor-phase crystallization of flattened shards and pumice is extensive in this unit.

Qbt 3 is a nonwelded to partially welded, vapor-phase altered tuff, which forms many of the upper cliffs in the TA-21 area. Its base consists of a purple-gray, unconsolidated, porous, and crystal-rich nonwelded tuff that underlies a broad, gently sloping bench developed on top of Qbt 2. This basal, nonwelded portion forms relatively soft outcrops that weather into low rounded mounds with a white color, which contrast with the cliffs of partially welded tuff in the middle and upper portions of Qbt 3.

2.3 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; the wettest canyons contain continuous streams and contain perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional streamflow and may lack alluvial groundwater. Intermediate perched groundwater has been found at certain locations on the plateau at depths ranging between 100 ft and 400 ft. The regional aquifer is found at depths of about 600 ft to 1200 ft (Collins et al. 2005, 092028).

The hydrogeologic conceptual site model for the Laboratory (LANL 2012, 225493) 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.

2.3.1 Groundwater

In the Los Alamos area, groundwater occurs as (1) water in shallow alluvium in some of the larger canyons, (2) intermediate perched groundwater, 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 annual Interim Facility-Wide Groundwater Monitoring Plan (the Interim Plan) (LANL 2017, 602406) details the implementation of extensive groundwater characterization across the Pajarito Plateau within an area potentially affected by past and present Laboratory operations.

No intermediate or alluvial groundwater was encountered at TA-21.

The regional aquifer of the Los Alamos area is the only aquifer capable of supporting/supplying large-scale municipal water (Purtymun 1984, 006513). The surface of the regional aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Formation beneath the central and western part of the Pajarito Plateau. The depths to groundwater below the mesa tops range between about 1200 ft along the western margin of the plateau and about 600 ft at the eastern margin. The location of wells and the generalized water-level contours on top of the regional aquifer are described in the Interim Plan (LANL 2017,602406). The regional aquifer is typically separated from the alluvial groundwater and intermediate perched zone groundwater by 350 ft to 620 ft of tuff, basalt, and sediment (LANL 1993, 023249).

Groundwater in the regional aquifer flows east-southeast, toward the Rio Grande. The velocity of groundwater flow ranges from about 20 ft/yr 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 documents (Purtymun 1995, 045344; LANL 1997, 055622; LANL 2000, 066802).

The regional aquifer beneath TA-21 is at an elevation of approximately 5900 ft, or approximately 1100 ft below the surface, and is located chiefly within sediment of the Puye and Tesuque Formations (Broxton and Eller 1995, 058207). Thus, for mesa-top sites at TA-21, more than 1100 ft of tuff and volcaniclastic sediment separate the surface from the regional aquifer.

2.3.2 Vadose Zone

The unsaturated zone from the mesa surface to the top of the regional aquifer is referred to as the vadose zone. The source of moisture for the vadose zone is precipitation, but much of it runs off, evaporates, or is absorbed by plants. The subsurface vertical movement of water is influenced by properties and conditions of the materials that make up the vadose zone.

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

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

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

3.0 SCOPE OF ACTIVITIES

This section presents the 2010–2011 field investigation activities conducted in accordance with the approved investigation work plan (LANL 2009, 108166.9; LANL 2010, 110082.4; NMED 2010, 108443; NMED 2010, 110422). The scope of activities for the investigation included site access and premobilization, geodetic surveying, waste line and structure removals, surface and subsurface sampling, laboratory analysis, health and safety monitoring, and waste management. The most current versions of all standard operating procedures (SOPs) were used to implement the approved work plans. Details of the field methods and procedures used to perform field activities are provided in Appendix B. Any deviations from the approved investigation work plan are summarized in section 3.3 and described in Appendix B.

3.1 Site Access and Premobilization Activities

Portions of TA-21 were undergoing remediation during the field investigation, resulting in road and foot traffic by Laboratory personnel. Before personnel were mobilized in the field, the issue of Laboratory worker access (e.g., traffic control plan, notifications) was reviewed as part of the management self-assessment process. 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

The following sections describe the field activities conducted during the 2010–2011 site investigation and the laboratory analyses requested. Field notes and data were recorded on the field SCLs, on the COC forms, and in the field logbook. SCLs and COC forms completed for this investigation are included in Appendix C (on CD).

3.2.1 Geodetic Survey

Geodetic surveys were conducted during the field investigation at site 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 SOP-5028, “Coordinating and Evaluating Geodetic Surveys,” using a Trimble 5700 differential global positioning system. The surveyed coordinates for the sampling locations are presented in Table 3.2-1. The geodetic coordinates are expressed as State Plane Coordinate System 1983, New Mexico Central, U.S.

3.2.2 Field Screening

This section summarizes the field-screening methods and results of the field screening conducted at the sites during the characterization activities.

As the field investigation samples were collected, each was screened for radioactivity. A Laboratory radiological control technician (RCT) conducted radiological screening using an HP 210 pancake probe, a Ludlum 2221 probe, an Eberline 50-cm^2 alpha probe, a Spa 3 type sodium iodine probe, a Ludlum 2929 smear counter, and a low-volume air sampler. Results for alpha and beta/gamma radioactivity were recorded in disintegrations per minute (dpm). Each sample was then placed into a sealed plastic bag for approximately 5 min, at which point the samples were field screened for headspace organic vapors using an 11.7-electronvolt MiniRAE 2000 photoionization detector (PID). Calibration and use of this instrument were performed according to the manufacturer’s specifications and SOP-06.33, “Headspace Vapor Screening with a PID.”

Field-screening results are presented in Table 3.2-2. Organic vapors were detected at less than 5 ppm above ambient air in all but two samples during PID screening of samples. At locations 21-613818 and 21-613819 at SWMU 21-011(b), PID readings were 83.6 ppm and 77.6 ppm, respectively, in the top depths sampled. Trace levels of volatile organic compounds (VOCs) were detected at these locations. No radiological-screening results exceeded twice the daily site background levels. No changes to sampling or other activities occurred because of the field-screening results.

3.2.3 Radiological Survey Results

As prescribed by the approved investigation work plan (LANL 2009, 108166.9; NMED 2010, 108443), radiological surveys were conducted at excavated waste-line trenches and at the outfall at SWMU 21-011(b) and SWMUs 21-004(b) and 21-004(c) on March 16–17 and June 23, 2011. The surveys, conducted by Environmental Restoration Group, Inc., included a static alpha-beta surface survey and global positioning system–based gamma surveys of excavated waste-line trenches and beneath the asphalt pad. Because of the numerous possible radionuclides present at the site (americium-241, cesium-137, plutonium-239, strontium-90, and tritium), the surveys included alpha-beta, low-energy gamma, and high-energy gamma surveys. No areas of contamination were identified (Appendix D), and no highly elevated values with respect to the mean trench readings were detected. Based on these screening results, the prescribed sampling locations were sampled as-is and were not adjusted in the field.

3.2.4 Sample Management

A total of 100 samples were collected (including duplicates and blanks) and analyzed for chemical and radiological analytes in accordance with the approved investigation work plan (LANL 2009, 108166.9; NMED 2010, 108443). All surface and shallow subsurface 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/quality control (QA/QC) samples (field duplicates, field trip blanks, and rinsate blanks) were also collected in accordance with SOP-5059, “Field Quality Control Samples.”

All sample collection activities were coordinated with the Sample Management Office (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 analytical laboratory (SCLs and COC forms included in Appendix C [on CD]).

3.2.4.1 Surface and Shallow Subsurface Soil Investigation

Table 3.2-1 shows the proposed sampling locations as listed in the approved investigation work plan (LANL 2009, 108166.9; NMED 2010, 108443), with the corresponding actual location identifiers as sampled.

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.” The samples were collected in stainless-steel bowls and transferred to sample collection bottles with a stainless-steel spoon. Sample collection details and field methods, as well as deviations from the work plans, are described in Appendix B.

3.2.4.2 Borehole Drilling and Subsurface Sampling

A hand auger or a power-auger truck-attachment was used to collect samples at all required sampling depths and locations; a drill rig with a hollow-stem auger was not used to collect subsurface samples. 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.” Appendix B provides a detailed summary of the field methods.

3.2.5 Borehole Abandonment

No boreholes were drilled using a drill rig during the 2010–2011 investigation.

3.2.6 Excavations

Excavations removed structures, waste lines, debris, and/or asphalt from the areas described below. Table 3.2-3 provides the coordinates for structures that could not be fully excavated because of the depth below the ground surface or nearby active utilities. Section 3.3 summarizes the deviations from the work plans, and Appendix B provides additional details.

SWMUS 21-004(b) and 21-004(c)

The waste line connecting the acid waste sump (structure 21-223) and the aboveground tanks (structure 21-346) was excavated and removed. The waste included approximately 55 ft of vitrified clay pipe and 65 ft of 6-in. galvanized pipe.

The asphalt pad and berm associated with structure 21-346 were excavated. Material removed included approximately 30 yd^3 of asphalt.

All wastes were managed in accordance with the approved waste characterization strategy form (WCSF) (Appendix E).

SWMU 21-011(b)

The mechanical components of the radioactive liquid waste (RLW) sump, structure 21-223, were removed and the aboveground structure was demolished. The underground concrete portion of the sump was partially removed. Appendix B provides additional details of the removal.

The buried 3-in. cast-iron waste line from structure 21-223 to the Material Disposal Area (MDA) T boundary (approximately 700 ft of cast-iron pipe) was excavated and removed. Buried 6-in. cast-iron waste line, 2-in. steel or cast-iron waste line, and 4-in. steel or cast-iron waste line from buildings 21-155 and 21-152 to structure 21-223 (approximately 400 ft of steel and cast-iron waste line) were excavated and removed. Approximately 8 ft of waste line remains just east of the MDA T fence (Figure 3.2-1).

Two manholes (structures 21-221 and 21-222) were partially removed. The concrete that formed the bottom of the manholes was left in place because the concrete was formed to the underlying tuff and was more than 10 ft below ground surface (bgs).

The industrial waste line between manholes 21-221 and 21-222 was not completely removed (Figure 3.2-1). Some of the waste line was left in place and partially grouted because an active fire water line runs parallel to and several feet shallower than the waste line.

All wastes were managed in accordance with the approved WCSF (Appendix E).

3.2.7 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 each sample-collection event and between sampling locations to prevent cross-contamination of samples and sampling equipment. Dry 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 are described in Appendix B.

3.2.8 Sample Analyses

All samples were shipped by the SMO to contract analytical laboratories for the requested analyses. The analyses requested were as specified by the approved work plan (LANL 2009, 108166.9; NMED 2010, 108443). The samples were analyzed for all or a subset of the following: target analyte list (TAL) metals, total cyanide, nitrate, pH, perchlorate, explosive compounds, dioxins/furans, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), VOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technetium-99, and tritium.

Field duplicates of investigation samples were analyzed for the same analytical suites as the corresponding investigation samples, as applicable. 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 F. Analytical results, analytical reports, and SCLs/COCs are included on CD in Appendix C.

3.2.9 Health and Safety

All 2010–2011 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 gross-alpha and -beta radioactivity using portable air-monitoring systems. No health and safety measures affected or limited task completion.

3.2.10 IDW Management

All IDW generated during the investigation was managed in accordance with SOP-5238, “Characterization and Management of Environmental Program Waste.” This procedure incorporates the requirements of applicable U.S. Environmental Protection Agency (EPA) and NMED regulations, DOE orders, and internal implementation requirements, policies, and/or procedures. IDW was also managed in accordance with the approved WCSF. Details of IDW management are presented in Appendix E.

The waste streams associated with the investigation included excavation waste, uncontainerized liquid waste, and contact waste. Each waste stream was containerized and placed in an accumulation area appropriate for the regulatory classification of the waste, in accordance with the approved WCSF (Appendix E).

3.3 Deviations

While field activities were being conducted, some deviations from the approved work plan (LANL 2009, 108166.9; NMED 2010, 108443) were necessary to accommodate site-specific field conditions. The deviations did not adversely affect the completion or results of the investigation. Deviations to sampling locations and analytical suites are summarized below.

SWMU 21-004(b)

- At location 21-614326, PCBs were inadvertently ordered for analysis in the 5- to 6-ft depth interval.

SWMU 21-011(b)

- Because active systems in the vicinity of existing building 21-257 likely intersect the targeted acid waste line, a portion of the acid waste line was left in place. The acid waste line was removed up to the fence line of building 21-257 and MDA T (Figure 3.2-1). The portion of the acid waste line within the fence surrounding building 21-257 was left in place. The remaining line will be removed and proposed locations 30 to 43 (LANL 2009, 108166.9) will be sampled when the building is demolished and decommissioned.
- Sump structure 21-223, which extended at least 15 ft belowgrade, was demolished to below 10 ft belowgrade. The remaining lower portion of this cast-in-place sump had been poured against competent tuff bedrock, so it was left in place. Appendix B, section B-8.0, presents more information. Therefore, proposed sampling location 14 (LANL 2009, 108166.9, Figure 4.1-1) was not sampled. However, as part of the investigation, samples were collected from under the former sump inlet and outlet lines (locations 21-613815, 21-613827, and 21-614319).
- North of former building 21-155, the southwest waste line connecting to manhole structure 21-222 could not be found within approximately 10 ft bgs. Therefore, proposed sampling location 7 (LANL 2009, 108166.9, Figure 4.1-1) was not sampled.
- An approximately 50-ft section of the line on the west side of former building 21-155 was abandoned in place because it was encased in 2 ft of concrete foundation left in place by the demolition and decommissioning (D&D) operations (Figure 3.2-1). Samples could not be collected at proposed sampling locations 4 and 5 (LANL 2009, 108166.9, Figure 4.1-1).
- Samples from locations 21-613828 and 21-613829 were inadvertently not analyzed for isotopic thorium. However, this does not affect the results because a total of 72 samples were analyzed for isotopic thorium at the sites investigated, with all detections at or below background levels. Therefore, it is unlikely that isotopic thorium would be detected above background at these two locations.

All deviations are described in Appendix B, section B-8.0.

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 sample medium in the Consent Order include cleanup standards, risk-based screening levels, and risk-based cleanup goals.

Human health risk-screening evaluations were conducted using NMED guidance (NMED 2017, 602273). Ecological risk-screening assessments were performed using Laboratory guidance (LANL 2017, 602649).

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(s). The current and reasonably foreseeable future land use(s) for a site determines the receptors and exposure scenarios used to select screening and cleanup levels. The land use within and surrounding the DP Site Aggregate Area is currently industrial and is expected to remain industrial for the reasonably foreseeable future. A construction worker scenario is evaluated because underground utilities are present near or within the boundaries of various DP Site Aggregate Area SWMUs and AOCs, and maintenance or repair of these underground utilities is a reasonable possibility in the foreseeable future. The residential scenario is evaluated for comparison purposes and is the decision scenario for sites that do not require future controls.

4.2 Screening Levels

Human health and ecological risk-screening evaluations were conducted for the chemicals of potential concern (COPCs) detected in solid media at sites within the DP Site Aggregate Area. The human health risk-screening assessments (Appendix H) were performed on inorganic and organic COPCs using NMED soil screening levels (SSLs) for the industrial, construction worker, and residential scenarios (NMED 2012, 219971). When an NMED SSL for a COPC was not available, SSLs were obtained from EPA regional tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017) (adjusted to a risk level of 10^{-5} for carcinogens). For this investigation report, the November 2017 online version of the EPA regional tables was used to obtain EPA screening levels. Radionuclides were assessed using the Laboratory screening action levels (SALs) for the same scenarios (LANL 2015, 600929). Surrogate SSLs were used for some COPCs for which no SSLs were available based on structural similarity or breakdown products.

NMED guidance includes total chromium SSLs for the residential, industrial, and construction worker scenarios (NMED 2017, 602273). Because the toxicity of chromium strongly depends on its oxidation state, NMED and EPA also have SSLs for trivalent chromium and hexavalent chromium. For screening purposes, the NMED SSLs for total chromium are used for comparison unless there is a known or suspected source of hexavalent chromium at the SWMU/AOC or site conditions could alter the speciation of chromium in the environment. Total chromium screening levels are appropriate for low-level releases to soil from sources not associated with hexavalent chromium. However, NMED and EPA recommend collecting valence-specific data for chromium if chromium is likely to be an important contaminant at a site and when hexavalent chromium may exist (NMED 2017, 602273), (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).

The Laboratory conducted a chromium background study to determine the prevalence of hexavalent chromium in soil, sediment, and tuff samples where there was no evidence of previous releases of chromium (LANL 2017, 602650). The report concluded that naturally occurring chromium is predominantly in the trivalent form and that the appropriate SSL for comparisons with data for purposes of evaluating extent of contamination at sites with no known chromium releases is the trivalent SSL. The chromium background study was approved by NMED in October 2017 (NMED 2017, 602678).

The SWMUs and AOC included in this investigation report are not known or suspected to be sources of hexavalent chromium. Cooling towers are a potential source of hexavalent chromium and aboveground tanks SWMUs 21-004(b) and 21-004(c) may have received discharges from cooling towers in DP East (see sections 6.2.1 and 6.3.1). The tanks were not installed until 1979, however, and use of hexavalent chromium in cooling towers at the Laboratory was discontinued in the early to mid 1970s (LANL 2006, 091987). Chemicals used in Laboratory cooling towers in the 1980s as corrosion and scale inhibitors and microbiological controls included a number of inorganic and organic chemicals, none of which contained chromium (Radzinski 1992, 040068). As specified in the approved investigation work plan (LANL 2010, 108166.9; LANL 2010, 108443), samples from all sites were analyzed for total chromium, rather than hexavalent chromium. In accordance with the NMED-approved chromium background study (LANL 2017, 602650; NMED 2017, 602678), total chromium results are compared with the trivalent chromium SSLs for the purpose of evaluating extent of contamination. SSLs for total chromium, rather than SSLs for trivalent chromium, are conservatively used for the purpose of evaluating potential human-health risk due to exposure to chromium.

4.3 Ecological Screening Levels

The ecological risk-screening assessments (Appendix H) were conducted using ecological screening levels (ESLs) obtained from the Laboratory's ECORISK Database, Version 4.1 (LANL 2017, 602538). 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, is presented in the ECORISK Database, Version 4.1 (LANL 2017, 602538).

4.4 Cleanup Standards

As specified in the Consent Order, screening levels are used as soil cleanup levels unless they are determined to be impracticable or values do not exist for current and reasonably foreseeable future land use. Screening assessments compare COPC concentrations for each site with industrial, residential, and construction worker SSLs/SALs.

The cleanup goals specified in the Consent Order are a target risk of 1×10^{-5} for carcinogens or a hazard index (HI) of 1 for noncarcinogens. For radionuclides, the target dose is 25 mrem/yr as authorized by DOE Order 458.1. The SSLs/SALs used in the risk-screening assessments in Appendix H are based on these cleanup goals.

5.0 DATA REVIEW METHODOLOGY

The purpose of the data review is to define the nature and extent of contaminants for each site addressed by this investigation report. The nature of a contaminant refers to the specific contaminants that are present, the affected media, and associated concentrations. The nature of contamination is defined through identification of COPCs, which is discussed in section 5.1. The identification of a chemical or radionuclide as a COPC does not mean the constituent(s) is related to the site and is a result of site operations. A COPC is identified because it is present at a site based on the criteria discussed below but may be present because of adjacent and/or upgradient operations, and/or infrastructure typical of industrial and metropolitan development. If such origins are evident, the constituents may be excluded from the data analyses and risk assessments. The extent of contamination refers to the spatial distribution of COPCs, with an emphasis on the distribution of COPCs potentially posing a risk or requiring corrective action. The process for determining the extent of contamination and for concluding no further sampling for extent is warranted is discussed in section 5.2.

5.1 Identification of COPCs

The COPCs are chemicals and radionuclides that may be present as a result of releases from SWMUs or AOCs. Inorganic chemicals and some radionuclides occur naturally and inorganic chemicals and radionuclides detected because of natural background are not considered COPCs. Similarly, some radionuclides may be present as a result of fallout from historical nuclear weapons testing and these radionuclides are also not considered COPCs. The Laboratory has collected data on background concentrations of many inorganic chemicals, naturally occurring radionuclides, and fallout radionuclides. These data have been used to develop media-specific background values (BVs) and fallout values (FVs) (LANL 1998, 059730). For inorganic chemicals and radionuclides for which BVs or FVs exist, identification of COPCs involves background comparisons, which are described in sections 5.1.1 and 5.1.2. If no BVs or FVs are available or if samples are collected where FVs are not appropriate (i.e., greater than 1-ft depth or in rock), COPCs are identified based on detection status (i.e., if the inorganic chemical or radionuclide is detected, it is identified as a COPC unless available information indicates it is not present as a result of a release from the SWMU or AOC).

Organic chemicals may also be present as a result of anthropogenic activities unrelated to the SWMU or AOC or, to a lesser extent, from natural sources. Because no background data for organic chemicals are available, background comparisons cannot be performed in the same manner as for inorganic chemicals or radionuclides. Therefore, organic COPCs are identified on the basis of detection status (i.e., the organic chemical is detected). When assessing the nature of contamination, the history of site operations may be evaluated to determine whether an organic COPC is present because of a release from a SWMU or AOC or is present from non-site-related sources. Organic chemicals that are present from sources other than releases from a SWMU or AOC may be eliminated as COPCs and are not evaluated further.

5.1.1 Inorganic Chemical and Radionuclide Background Comparisons

The COPCs are identified for inorganic chemicals and radionuclides following EP-SOP-10071, “Background Comparisons for Inorganic Chemicals,” and EP-SOP-10073, “Background Comparisons for Radionuclides.” Inorganic COPCs are identified by comparing site data with BVs, statistical comparisons, and other lines of evidence, as applicable (LANL 1998, 059730). The upper end of the background data set may be used for comparison if one or more of the following conditions exist:

- Statistically determined BV is significantly greater than the maximum background concentration.
- Statistical tests cannot be performed because of insufficient data (fewer than eight samples and/or five detections per medium) or a high percentage of nondetections.
- Sufficient numbers of samples have been collected to determine nature and extent but results are predominately nondetections.
- Site history does not indicate the constituent is directly related to site activities or to a dominant waste stream.
- Spatial analyses do not show a pattern or trend indicating contamination.
- The maximum detected concentration is statistically determined to be an outlier. (Note: A sufficient number of samples must be collected to show a point is an outlier and is not indicative of a hot spot.)

Radionuclides are identified as COPCs based on background comparisons, statistical methods if BVs or FVs are available or detection status if BVs or FVs have not been established, and other lines of evidence, as applicable.

Background data are generally available for inorganic chemicals in soil, sediment, and tuff (LANL 1998, 059730). However, some analytes (e.g., nitrate and perchlorate) have no BVs. A BV may be either a calculated value from the background data set (upper tolerance limit [UTL] 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.

For inorganic chemicals, data are evaluated by sample media to facilitate the comparison with media-specific background data. To identify inorganic COPCs, the first step is to compare the sampling result with BVs. If sampling results are above the BV and sufficient data are available (eight or more sampling results and five or more detections), statistical tests are used to compare the site sample data with the background data set for the appropriate media. If statistical tests cannot be performed because of insufficient data or a high percentage of nondetections, the sampling results are compared with the BV and the upper end of the background data set for the appropriate media. If concentrations are above the BV but no results are greater than the upper end of the background data set, lines of evidence are presented to determine whether the inorganic chemical is or is not a COPC. If at least one sampling result is above the BV and the upper end of the background data set, the inorganic chemical is identified as a COPC. The same evaluation is performed using DLs when an inorganic chemical is not detected but has a DL above the BV. If no BV is available, detected inorganic chemicals are identified as COPCs.

Radionuclides are identified as COPCs based on comparisons with BVs for naturally occurring radionuclides or with FVs for fallout radionuclides. Thorium-228, thorium-230, thorium-232, uranium-234, uranium-235/236, and uranium-238 are naturally occurring radionuclides. Americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, and tritium are fallout radionuclides.

Naturally occurring radionuclides detected at activities above their respective BVs are identified as COPCs. These radionuclides have no background data sets. If there is no associated BV or FV and the radionuclide is detected, it is retained as a COPC.

The FVs for the fallout radionuclides apply to the top 0.0 to 1.0 ft of soil and fill, and to sediment regardless of depth. If a fallout radionuclide is detected in a soil or fill sample collected below 1.0 ft or in tuff samples, the radionuclide is identified as a COPC. For soil and fill samples from 1.0 ft bgs or less, if the activity of a fallout radionuclide is greater than the FV, comparisons of the top 0.0 to 1.0 ft sampling data are made with the fallout data set and the radionuclide is eliminated as a COPC if activities are similar to fallout activities based on statistical comparisons or comparisons to the maximum fallout concentration. Sediment results are evaluated in the same manner, although all data are included, not only the data from 0.0 to 1.0 ft bgs.

The FV for tritium in surface soil (LANL 1998, 059730) is in units of pCi/mL. This FV requires using sample percent moisture to convert sample tritium data from pCi/g (as provided by analytical laboratories) to the corresponding values in units of pCi/mL. Because sample percent moisture historically has been determined using a variety of methods, often undocumented, the Laboratory adopted the conservative approach of identifying tritium in soil as a COPC based on detection status.

Sample media encountered during investigations include soil (all soil horizons, designated by the media code ALLH or SOIL), fill material (media code FILL), sediment (media code SED), and Bandelier Tuff (media codes Qbt 1g, Qct, Qbo, Qbt 2, Qbt 3, and Qbt 4). Because no separate BVs are available for fill material, fill samples are evaluated by comparison with soil BVs (LANL 1998, 059730). In this report, the discussions of site contamination in soil include fill samples with soil samples in sample counts and comparisons with background. Fill samples are not discussed separately from soil. The units of the Bandelier Tuff (Qbt 2, Qbt 3, and Qbt 4 and Qbt 1g, Qct, and Qbo) are likewise evaluated together with respect to background (LANL 1998, 059730).

5.1.2 Statistical Methods Overview

A variety of statistical methods may be applied to each of the data sets. The use of any of these methods depends on how appropriate the method is for the available data. The results of the statistical tests are presented in Appendix G.

5.1.2.1 Distributional Comparisons

Comparisons between site-specific data and Laboratory-collected background data are performed using a variety of statistical methods. These methods begin with a simple comparison of site data with an UTL estimated from the background data (UTL or the 95% upper confidence bound on the 95th quantile). The UTLs are used to represent the upper end of the concentration distribution and are referred to as BVs. The UTL comparisons are then 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 elevated above background levels). Nonparametric tests most commonly performed include the Gehan test (modification of the Wilcoxon Rank Sum test) and the quantile test (Gehan 1965, 055611; Gilbert and Simpson 1990, 055612).

The Gehan test is recommended when between 10% and 50% of the data sets are nondetections. It handles data sets with nondetections reported at multiple DLs in a statistically robust manner (Gehan 1965, 055611; Millard and Deverel 1988, 054953). The Gehan test is not recommended if either of the two data sets has more than 50% nondetections. If there are no nondetected concentrations in the data, the Gehan test is equivalent to the Wilcoxon Rank Sum test. The Gehan test is the preferred test because of its applicability to a majority of environmental data sets and its recognition and recommendation in EPA-sponsored workshops and publications.

The quantile test is better suited to assessing shifts in a subset of the data. The quantile test determines whether more of the observations in the top chosen quantile of the combined data set come from the site data set than would be expected by chance, given the relative sizes of the site and background data sets. If the relative proportion of the two populations being tested is different in the top chosen quantile of the data than in the remainder of the data, the distributions may be partially shifted because of a subset of site data. This test is capable of detecting a statistical difference when only a small number of concentrations are elevated (Gilbert and Simpson 1992, 054952). The quantile test is the most useful distribution shift test where samples from a release represent a small fraction of the overall data collected. The quantile test is applied at a prespecified quantile or threshold, usually the 80th percentile. The test cannot be performed if more than 80% (or, in general, more than the chosen percentile) of the combined data are nondetected values. It can be used when the frequency of nondetections is approximately the same as the quantile being tested. For example, in a case with 75% nondetections in the combined background and site data set, application of a quantile test comparing 80th percentiles is appropriate. However, the test cannot be performed if nondetections occur in the top chosen quantile. The threshold percentage can be adjusted to accommodate the detection rate of an analyte or to look for differences further into the distribution tails. The quantile test is more powerful than the Gehan test for detecting differences when only a small percentage of the site concentrations is elevated.

Occasionally, if the differences between two distributions appear to occur far into the tails, the slippage test may 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. This test is based on the maximum concentration in the background data set and the number (“n”) of site concentrations that exceed the maximum concentration in the background set (Gilbert and Simpson 1990, 055612, pp. 5–8). The result (p-value) of the slippage test is the probability that “n” (or more) site samples exceed the maximum background concentration by chance alone. The test accounts for the number of samples in each data set (number of samples from the site and number of samples from background) and determines the probability of “n” (or more) exceedances if the two data sets came from identical distributions. This test is similar to the BV comparison in that it evaluates the largest site measurements but is more useful than the BV comparison because it is based on a statistical hypothesis test, not simply on a statistic calculated from the background distribution.

For all statistical tests, a p-value less than 0.05 was the criterion for accepting the null hypothesis that site sampling results are different from background (Appendix G).

5.1.2.2 Graphical Presentation

Box plots are provided for a visual representation of the data and to help illustrate the presence of outliers or other anomalous data that may affect statistical results and interpretations. The plots allow a visual comparison among data distributions. The differences of interest may include an overall shift in concentration (shift of central location) or, when the centers are nearly equal, a difference between the upper tails of the two distributions (elevated concentrations in a small fraction of one distribution). The plots may be used in conjunction with the statistical tests (distributional comparisons) described above. Unless otherwise noted, the nondetected concentrations are included in the plots at their reported DL.

The box plots produced in Appendix G of this report consist 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, 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 extend to the most extreme point that is not considered an outlier, with a maximum whisker length of 1.5 times the interquartile range, outside of which data may be evaluated for their potential to be outliers. The concentrations are plotted as points overlying 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.

5.2 Extent of Contamination

Spatial concentration trends are initially used to determine whether the extent of contamination is defined. Evaluation of spatial concentration data considers the conceptual site model of the release and subsequent migration. Specifically, the conceptual site model should define where the highest concentrations would be expected if a release had occurred and how these concentrations should vary with distance and depth. If the results are different from the conceptual site model, it could indicate no release has occurred or there are other sources of contamination.

In general, both laterally and vertically decreasing concentrations are used to define extent. If concentrations are increasing or not changing, other factors are considered to determine whether extent is defined or if additional extent sampling is warranted. These factors include

- the magnitude of concentrations and rate of increase compared with SSLs/SALs,
- the magnitude of concentrations of inorganic chemicals or radionuclides compared with the maximum background concentrations for the medium,
- concentrations of organic chemicals compared with estimated quantitation limits (EQLs), and
- results from nearby sampling locations.

The primary focus for defining the extent of contamination is characterizing contamination that potentially poses a potential unacceptable risk and may require additional corrective actions. As such, comparison with SSLs/SALs is used as an additional step following a determination of whether extent is defined by decreasing concentrations with depth and distance and whether concentrations are below EQLs or DLs. The initial SSL/SAL comparison is conducted using the residential SSL/SAL (regardless of whether the current and reasonably foreseeable future land use is residential) because this value is typically the most protective. If the current and reasonably foreseeable future land use is not residential, comparison with the relevant SSL/SAL may also be conducted if the residential SSL/SAL is exceeded or otherwise similar to COPC concentrations. For the SWMUs and AOC at TA-21, the current and reasonably foreseeable future land use is industrial (section 4.1).

The SSL/SAL comparison is not necessary if all COPC concentrations are decreasing with depth and distance. If, however, concentrations increase with depth and distance or do not display any obvious trends, the SSLs/SALs are used to determine whether additional sampling for extent is warranted. If the COPC concentrations are sufficiently below the SSL/SAL (e.g., the residential and/or industrial SSL/SAL is 10 times [an order of magnitude] or more than all concentrations), the COPC does not pose a potential unacceptable risk, and no further sampling for extent is warranted. The validity of the assumption that the COPC does not pose a risk is confirmed using the results of the risk-screening assessment. The calculation of risk also assists in determining whether additional sampling is warranted to define the extent of contamination needing additional corrective actions.

Calcium, magnesium, potassium, and sodium may be COPCs for some sites. These constituents are essential nutrients and their maximum concentrations are compared with NMED’s essential nutrient screening levels (NMED 2017, 602273). If the maximum concentration is less than the screening level(s), no additional sampling for extent is warranted and the inorganic chemical is eliminated from further evaluation in the risk assessment.

6.0 TA-21 BACKGROUND AND FIELD INVESTIGATION RESULTS

6.1 Background of TA-21

6.1.1 Operational History

TA-21 is located on DP Mesa on the northern boundary of the Laboratory and is immediately east-southeast of the Los Alamos townsite (Figure 1.0-1). It extends from the mesa top to the stream channels in two adjacent canyons, DP Canyon to the north and Los Alamos Canyon to the south.

During World War II, the Laboratory was established for research, development, and testing of the first deliverable nuclear weapon. In 1945, the operations for establishing the chemical and metallurgical properties of the nuclear material necessary to achieve and sustain a nuclear fission reaction were transferred to newly built facilities at TA-21. TA-21 includes five MDAs: A, B, T, U, and V (Figure 1.0-1).

DP West operations began in September 1945, primarily to produce metal and alloys of plutonium from nitrate solution feedstock provided by other production facilities. This procedure involved several acid dissolution and chemical precipitation steps to separate the plutonium and other valuable actinides from the feedstock. A major research objective at DP West was the development of new purification techniques that would increase the efficiency of the separation processes (Christensen and Maraman 1969, 004779). Details of the purification techniques are discussed in the operable unit work plan for TA-21 (LANL 1991, 007529). Other operations performed at DP West included nuclear fuel reprocessing. In 1977, transfer of work to the new plutonium facility at TA-55 began and much of the DP West complex was vacated.

DP East operations also began in September 1945. These facilities were used to process polonium and actinium and to produce initiators (a nuclear weapons component). From 1952 through 1973, the facilities supported the Rover nuclear propulsion project. In 1964, building 21-209 was built to house research operations for high-temperature and actinide chemistry. Following the Rover project, the facilities supported fusion research. Building 21-155 housed the Tritium Systems Test Assembly (TSTA) for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels used in fusion reactors. Operations ceased and the DP East facilities were placed in safe shutdown in 2003.

6.1.2 Summary of Releases

The DP Site Aggregate Area consists of SWMUs and AOCs located throughout TA-21. The SWMUs and AOCs addressed by this investigation report include aboveground tanks, an RLW sump and associated waste line, and a former storage area on a concrete loading dock. Surface and subsurface contamination may have resulted from leaks and releases at these sites.

6.1.3 Current Site Usage and Status

All operations at TA-21 have ceased and none of the sites are active sources that continue to release contamination. The majority of the structures at TA-21 have undergone D&D beginning in 2009. Nearly all the buildings have been removed to the foundations, some areas have been remediated, and septic tanks are not receiving any discharges; all sumps and septic tanks are disconnected from their sources, some tanks have been removed, some have been filled and left in place, or some have been emptied and left in place. Roads and large paved parking areas remain and many unpaved areas are landscaped. The MDAs and the main TA-21 area are fenced for controlled access, but some former operational areas are located outside the main fenced areas. Currently, TA-21 is under DOE control and the land use is industrial.

6.2 SWMU 21-004(b), Aboveground Tank

6.2.1 Site Description and Operational History

SWMU 21-004(b) is part of Consolidated Unit 21-004(b)-99, which consists of SWMUs 21-004(b) and 21-004(c) and AOC 21-004(d). SWMU 21-004(b) was an aboveground stainless-steel tank (one of two tanks composing structure 21-346) that was installed in 1979. This tank, along with SWMU 21-004(c), was used as an overflow holding tank for liquid waste from chilled water systems and from Laboratory and radionuclide experimental operations in the TSTA facility (building 21-155). The tank was 9 ft high and 8 ft in diameter with a capacity of 3000 gal. (LANL 1990, 007512). The tank was mounted on steel legs above the surface of an asphalt bermed area. The bermed area had a capacity of approximately 9600 gal. and measured 36 ft long by 18 ft wide. The tanks and asphalt were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded.

6.2.2 Relationship to Other SWMUs and AOCs

SWMU 21-004(b) was located within the same bermed containment area as SWMU 21-004(c). SWMU 21-004(b) was connected to a drainline [AOC 21-004(d)] located to the south. AOC 21-004(d) was approved for no further action by EPA in 2005 (EPA 2005, 088464).

6.2.3 Summary of Previous Investigations

Two boreholes were drilled downslope of SWMUs 21-004(b) and 21-004(c) to a total depth of 5 ft bgs in the fall of 1994 during Resource Conservation and Recovery Act facility investigation (RFI) activities (LANL 1996, 054828, pp. 32–33).

Plutonium-239, tritium, and uranium-234 were detected above BVs/FVs in a 1988 sample collected 2 ft downslope of the outfall discharge area (LANL 1991, 007529, p. 15-97). No inorganic chemicals or radionuclides were detected above background in the 1994 RFI samples collected downslope of the tanks (LANL 1996, 054828, pp. 33–34). These data are considered screening-level data because they were collected over 20 yr ago.

6.2.4 Site Contamination

6.2.4.1 Soil, Rock, and Sediment Sampling

As part of the 2010–2011 investigation, the following activities were conducted at SWMU 21-004(b):

- 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 C) and are presented in Table 3.2-2.
- Three samples were collected from one location (21-614326) within the footprint of the former tank at 0.5–1.5 ft, 2.5–3.5 ft, and 5–6 ft bgs.
- All samples were analyzed for TAL metals, cyanide, nitrate, perchlorate, SVOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technicium-99, and tritium. Two samples were also analyzed for VOCs and one for PCBs.

The sampling location for the 2010–2011 investigation at SWMU 21-004(b) is shown in Figure 6.2-1. Table 6.2-1 presents the samples collected and the analyses requested for SWMU 21-004(b). The geodetic coordinates of the sampling locations are presented in Table 3.2-1.

6.2.4.2 Soil, Rock, and Sediment Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient-air levels during PID screening of the samples during the 2010–2011 investigation. No radiological field-screening results exceeded twice the daily site background levels. Field-screening results for the samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the results of field screening.

6.2.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data at SWMU 21-004(b) consist of the results from three samples (one soil and two tuff) collected from one location.

Inorganic Chemicals

Three samples (one soil and two tuff) were analyzed for TAL metals, nitrate, perchlorate, and total cyanide. Table 6.2-2 presents the results of the inorganic chemicals above BVs and the detected inorganic chemicals that have no BVs. Figure 6.2-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the Qbt 2,3,4 BV (0.5 mg/kg) in two samples with a maximum concentration of 0.751 mg/kg and was not detected above the soil BV (0.83 mg/kg) but had a DL (0.978 mg/kg) above BV in one sample. Antimony is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had a DL (0.489 mg/kg) above BV in one sample. The DL was only 0.089 mg/kg above the BV and was below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg) and the three highest background DLs (2 mg/kg, 2 mg/kg, and 2 mg/kg). Cadmium was detected below BVs in the other two samples. Cadmium is not a COPC.

Calcium was detected above the soil BV (6120 mg/kg) in one sample at a concentration of 16,200 mg/kg. Calcium is retained as a COPC.

Chromium was detected above the Qbt 2,3,4 BV (7.14 mg/kg) in two samples with a maximum concentration of 51.8 mg/kg. Chromium is retained as a COPC.

Copper was not detected above the Qbt 2,3,4 BV (4.66 mg/kg) but had DLs (10.5 mg/kg and 13 mg/kg) above BV in two samples. Copper is retained as a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in two samples with a maximum concentration of 13 mg/kg. Nickel is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (1 mg/kg and 1.01 mg/kg) above BV in two samples. Selenium is retained as a COPC.

Organic Chemicals

Three samples (one soil and two tuff) were analyzed for SVOCs, two tuff samples were analyzed for VOCs, and one tuff sample was analyzed for PCBs. Table 6.2-3 presents the detected organic chemicals. Figure 6.2-3 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at SWMU 21-004(b) include Aroclor-1254, Aroclor-1260, and diethylphthalate. The detected organic chemicals are retained as COPCs.

Radionuclides

Three samples (one soil and two tuff) were analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technetium-99, and tritium. Table 6.2-4 presents the radionuclides detected or detected above BVs/FVs. Figure 6.2-4 shows the spatial distribution of radionuclides detected or detected above BVs/FVs.

Cesium-137 was detected below 1 ft bgs in one soil sample at an activity of 0.0376 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-239/240 was detected below 1 ft bgs in one soil sample at an activity of 0.0625 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected in three samples with a maximum activity of 0.127 pCi/g. Tritium is retained as a COPC.

6.2.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 21-004(b) are discussed below. Samples at SWMU 21-004(b) were collected from one location within the footprint of the former aboveground tank and also within the footprint of the former bermed containment area to characterize vertical extent of potential releases. Releases from the tank would have been contained by the berm, so lateral extent was not evaluated for this site.

Inorganic Chemicals

Inorganic COPCs at SWMU 21-004(b) include antimony, calcium, chromium, copper, nickel, and selenium.

Antimony was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 0.751 mg/kg and was not detected above the soil BV but had a DL (0.978 mg/kg) above BV in one sample. Concentrations increased with depth. The residential SSL was approximately 42 times the maximum concentration and 32 times the DL. Further sampling for vertical extent of antimony is not warranted.

Calcium was detected above the soil BV in one sample at a concentration of 16,200 mg/kg. Concentrations decreased with depth. Vertical extent of calcium is defined.

Chromium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 51.8 mg/kg. Concentrations increased with depth. The vertical increase (8.7 mg/kg) in concentration is not significant, and the other chemicals and radionuclides detected at this location did not exhibit any significant trends of increasing concentrations/activities. As described in section 4.2, SWMU 21-004(b) is not a potential source of hexavalent chromium and use of the SSL for trivalent chromium to determine whether additional sampling is warranted is appropriate. The residential SSL for trivalent chromium (117,000 mg/kg) was approximately 2260 times the maximum concentration. Further sampling for vertical extent of chromium is not warranted.

Copper was not detected above the Qbt 2,3,4 BV but had DLs (10.5 mg/kg and 13 mg/kg) above BV in two samples. The residential SSL was approximately 240 times the maximum DL. Further sampling for vertical extent of copper is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 13 mg/kg. Concentrations did not change substantially with depth (0.1 mg/kg). The residential SSL was approximately 120 times the maximum concentration. Further sampling for vertical extent of nickel is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (1 mg/kg and 1.01 mg/kg) above BV in two samples. The residential SSL was approximately 387 times the maximum DL. Further sampling for vertical extent of selenium is not warranted.

Organic Chemicals

Organic COPCs at SWMU 21-004(b) include Aroclor-1254, Aroclor-1260, and diethylphthalate.

Aroclor-1254 and Aroclor-1260 were each detected in one sample at concentrations of 0.0459 mg/kg and 0.0208 mg/kg, respectively. Only the deepest sample at location 21-614326 was analyzed for PCBs. The residential SSLs for Aroclor-1254 and Aroclor-1260 were approximately 25 times and 122 times the detected concentrations, respectively. Further sampling for vertical extent of Aroclor-1254 and Aroclor-1260 is not warranted.

Diethylphthalate was detected in three samples with a maximum concentration of 0.145 mg/kg. Concentrations did change substantially with depth (0.009 mg/kg) and all results were below the EQL. The residential SSL was approximately 340,000 times the maximum concentration. Further sampling for vertical extent of diethylphthalate is not warranted.

Radionuclides

Radionuclide COPCs at SWMU 21-004(b) include cesium-137, plutonium-239/240, and tritium.

Cesium-137 was detected below 1 ft bgs in one soil sample at an activity of 0.0376 pCi/g. Activities decreased with depth. The vertical extent of cesium-137 is defined.

Plutonium-239/240 was detected below 1 ft bgs in one soil sample at an activity of 0.0625 pCi/g. Activities decreased with depth. The vertical extent of plutonium-239/240 is defined.

Tritium was detected in three samples with a maximum activity of 0.127 pCi/g. Activities increased with depth. The residential SAL was approximately 13,400 times the maximum activity. Further sampling for vertical extent of tritium is not warranted.

Summary of Nature and Extent

The vertical extent of inorganic, organic, and radionuclide COPCs is defined or no further sampling for vertical extent is warranted at SWMU 21-004(b). Lateral extent was not evaluated at SWMU 21-004(b).

6.2.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The industrial HI is 0.002, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.02 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.4, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.03 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 6×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.08, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Based on the risk-screening assessment results, no potential unacceptable risks and doses exist for the industrial, construction worker, and residential scenarios at SWMU 21-004(b).

6.2.6 Summary of Ecological Risk Screening

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for threatened and endangered [T&E] species), LOAEL analyses, and the relationship of detected concentrations and screening levels to background concentrations, no potential ecological risks exist for SWMU 21-004(b).

6.3 SWMU 21-004(c), Aboveground Tank

6.3.1 Site Description and Operational History

SWMU 21-004(c) is part of Consolidated Unit 21-004(b)-99, which consists of SWMUs 21-004(b) and 21-004(c) and AOC 21-004(d). SWMU 21-004(c) was an aboveground stainless-steel tank (one of two tanks composing structure 21-346) that was installed in 1979. This tank, along with SWMU 21-004(b), was used as an overflow holding tank for liquid waste from chilled water systems and from Laboratory and radionuclide experimental operations in the TSTA facility (building 21-155). The tank was 9 ft high and 8 ft in diameter with a capacity of 3000 gal. (LANL 1990, 007512). The tank was mounted on steel legs above the surface of an asphalt bermed area. The bermed area had a capacity of approximately 9600 gal. and measured 36 ft long by 18 ft wide. The tanks and asphalt were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded.

6.3.2 Relationship to Other SWMUs and AOCs

SWMU 21-004(c) was located within the same bermed containment area as SWMU 21-004(b). SWMU 21-004(c) was connected to a drainline [AOC 21-004(d)] located to the south. AOC 21-004(d) was approved for no further action by EPA in 2005 (EPA 2005, 088464).

6.3.3 Summary of Previous Investigations

Two boreholes were drilled downslope of SWMUs 21-004(b) and 21-004(c) to a total depth of 5 ft bgs in the fall of 1994 during RFI activities (LANL 1996, 054828, pp. 32–33).

Plutonium-239, tritium, and uranium-234 were detected above BVs/FVs in a 1988 sample collected 2 ft downslope of the outfall discharge area (LANL 1991, 007529, p. 15-97). No inorganic chemicals or radionuclides were detected above background in the 1994 RFI samples collected downslope of the tanks (LANL 1996, 054828, pp. 33–34). These data are considered screening-level data because they were collected over 20 yr ago.

6.3.4 Site Contamination

6.3.4.1 Soil, Rock, and Sediment Sampling

As part of the 2010–2011 investigation, the following activities were conducted at SWMU 21-004(c):

- 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 C) and are presented in Table 3.2-2.
- Three samples were collected from one location (21-614329) within the footprint of the former tank at 0.5–1.5 ft, 2.5–3.5 ft, and 5–6 ft bgs.

- All samples were analyzed for TAL metals, cyanide, nitrate, perchlorate, dioxins/furans, explosive compounds, SVOCs, PCBs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technicium-99, and tritium. Two samples were also analyzed for VOCs.

The sampling location for the 2010–2011 investigation at SWMU 21-004(c) is shown in Figure 6.2-1. Table 6.3-1 presents the samples collected and the analyses requested for SWMU 21-004(c). The geodetic coordinates of the sampling locations are presented in Table 3.2-1.

6.3.4.2 Soil, Rock, and Sediment Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient-air levels during PID screening of the samples during the 2010–2011 investigation. No radiological field-screening results exceeded twice the daily site background levels. Field-screening results for the samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the results of field screening.

6.3.4.3 Soil, Rock, and Sediment Sampling Analytical Results

Decision-level data at SWMU 21-004(c) consist of the results from three samples (one soil and two tuff) collected from one location.

Inorganic Chemicals

Three samples (one soil and two tuff) were analyzed for TAL metals, nitrate, perchlorate, and total cyanide. Table 6.3-2 presents the results of the inorganic chemicals above BVs and the detected inorganic chemicals that have no BVs. Figure 6.2-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was not detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.971 mg/kg and 1 mg/kg) above BV in one soil sample and one tuff sample. Antimony is retained as a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had a DL (0.501 mg/kg) above BV in one sample. The DL was only 0.101 mg/kg above the BV and was below the three highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg) and the three highest background DLs (2 mg/kg, 2 mg/kg, and 2 mg/kg). Cadmium was detected below BVs in the other two samples. Cadmium is not a COPC.

Chromium was detected above the Qbt 2,3,4 BV (7.14 mg/kg) in two samples with a maximum concentration of 40.8 mg/kg. Chromium is retained as a COPC.

Copper was not detected above the Qbt 2,3,4 BV (4.66 mg/kg) but had DLs (5.57 mg/kg and 7.19 mg/kg) above BV in two samples. Copper is retained as a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in two samples with a maximum concentration of 7.84 mg/kg. Nickel is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (0.96 mg/kg and 0.979 mg/kg) above BV in two samples. Selenium is retained as a COPC.

Silver was detected above the soil and Qbt 2,3,4 BVs (1 mg/kg and 1 mg/kg) in one soil and one tuff sample with a maximum concentration of 1.17 mg/kg. Silver is retained as a COPC.

Organic Chemicals

Three samples (one soil and two tuff) were analyzed for dioxins/furans, explosive compounds, SVOCs, and PCBs and two tuff samples were also analyzed for VOCs. Table 6.3-3 presents the detected organic chemicals. Figure 6.2-3 shows the spatial distribution of detected organic chemicals.

Dioxins and Furans

Dioxins and furans are frequently detected as a result of environmental sampling but generally are not associated with industrial activities conducted at the Laboratory or released from SWMUs or AOCs being investigated at the Laboratory. Because of the limited history of many of the sites in the DP Site Aggregate Area, a full analytical suite including chlorinated dibenzo-p-dioxins (dioxins) and chlorinated dibenzo-p-furans (furans) was required by NMED (NMED 2005, 092099). The Laboratory proposed analysis of dioxins and furans from a limited subset of samples from locations believed to have the highest potential for contamination (LANL 2005, 087836). These samples were to be submitted for quick turn-around analysis, and the results from these analyses were to be used by NMED and the Laboratory to determine whether additional samples should be analyzed for dioxins and furans. This proposed approach was approved by NMED (NMED 2005, 089314) and implemented by the Laboratory. Based on this approach, additional sampling for dioxins and furans was not required at SWMU 21-004(c).

Dioxins and furans are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as industrial sources and burning of municipal trash and other waste materials. Industrial sources of dioxins and furans are primarily associated with impurities in the production of chlorinated chemical products (e.g., pentachlorophenol, chlorinated herbicides) and the wastes associated with production of those materials. Another industrial source is the pulp and paper industry and processes that bleach wood pulp (EPA 2006, 600913). None of these common industrial-process-related source activities have occurred at the Laboratory. Other anthropogenic sources of dioxins and furans include the combustion of materials containing chlorine, such as the incineration of municipal trash containing chlorinated plastics, and other waste materials (EPA 2006, 600913).

Site Activities

SWMU 21-004(c) is a former aboveground tank and was identified as a SWMU because of possible soil contamination resulting from releases of wastewater stored in the tank. The wastewater generally consisted of diluted laboratory wastes and liquids from chilled water systems originating from operations at DP East (LANL 1992, 007529, p. 14-31). These operations did not include combustion of waste materials or other activities that would generate dioxins or furans.

The dioxin and furan congeners detected at SWMU 21-004(c) were generally detected only in the shallow sample, were detected at low concentrations (0.000000957 mg/kg to 0.00000613 mg/kg), and consisted of hepta- and octa-chlorinated congeners. These results likely reflect natural and/or anthropogenic background rather than a site-related release. The dioxin and furan congeners detected in samples used to characterize this site [1,2,3,4,6,7,8-heptachlorodibenzodioxin and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin] are not related to historic Laboratory site operations and are not COPCs.

Organic COPCs

Other organic chemicals detected at SWMU 21-004(c) include acetone, Aroclor-1254, diethylphthalate, and 4-isopropyltoluene. The detected organic chemicals listed are retained as COPCs.

Radionuclides

Three samples (one soil and two tuff) were analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technetium-99, and tritium. Table 6.3-4 presents the radionuclides detected or detected above BVs/FVs. Figure 6.2-4 shows the spatial distribution of radionuclides detected or detected above BVs/FVs.

Plutonium-239/240 was detected below 1 ft bgs in one soil sample at an activity of 0.054 pCi/g. Plutonium-239/240 is retained as a COPC.

Tritium was detected in three samples with a maximum activity of 0.0265 pCi/g. Tritium is retained as a COPC.

6.3.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 21-004(c) are discussed below. Samples at SWMU 21-004(c) were collected from one location within the footprint of the former aboveground tank and also within the footprint of the former bermed containment area to characterize vertical extent of potential releases. Releases from the tank would have been contained by the berm, so lateral extent was not evaluated for this site.

Inorganic Chemicals

Inorganic COPCs at SWMU 21-004(c) include antimony, chromium, copper, nickel, selenium, and silver.

Antimony was not detected above the soil and Qbt 2,3,4 BVs but had DLs (0.971 mg/kg and 1 mg/kg) above BV in one soil sample and one tuff sample. Antimony was not detected above BVs and did not have a DL above BV in the deepest sample at location 21-614329. The vertical extent of antimony is defined.

Chromium was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 40.8 mg/kg. Concentrations did not change substantially with depth (3.4 mg/kg), and the other chemicals and radionuclides detected at this location did not exhibit any significant trends of increasing concentrations/activities. As described in section 4.2, SWMU 21-004(c) is not a potential source of hexavalent chromium and use of the SSL for trivalent chromium to determine whether additional sampling is warranted is appropriate. The residential SSL for trivalent chromium (117,000 mg/kg) was approximately 2870 times the maximum concentration. Further sampling for vertical extent of chromium is not warranted.

Copper was not detected above the Qbt 2,3,4 BV but had DLs (5.57 mg/kg and 7.19 mg/kg) above BV in two samples. The residential SSL was approximately 435 times the maximum concentration. Further sampling for vertical extent of copper is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 7.84 mg/kg. Concentrations did not change substantially with depth (0.34 mg/kg). The residential SSL was approximately 199 times the maximum concentration. Further sampling for vertical extent of nickel is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (0.96 mg/kg and 0.979 mg/kg) above BV in two samples. The residential SSL was approximately 399 times the maximum DL. Further sampling for vertical extent of selenium is not warranted.

Silver was detected above the soil and Qbt 2,3,4 BVs in one soil and one tuff sample with a maximum concentration of 1.17 mg/kg. Concentrations decreased with depth. The vertical extent of silver is defined.

Organic Chemicals

Organic COPCs at SWMU 21-004(c) include acetone, Aroclor-1254, diethylphthalate, and 4-isopropyltoluene.

Acetone was detected in two samples with a maximum concentration of 0.0118 mg/kg. Concentrations increased with depth. The residential SSL was approximately 5,620,000 times the maximum concentration. Further sampling for vertical extent of acetone is not warranted.

Aroclor-1254 was detected in one sample at a concentration of 0.0015 mg/kg. Concentrations increased with depth but the detected concentration was below the EQL. The residential SSL was approximately 760 times the detected concentration. Further sampling for vertical extent of Aroclor-1254 is not warranted.

Diethylphthalate was detected in one sample at a concentration of 0.103 mg/kg. Concentrations increased with depth but the detected concentration was below the EQL. The residential SSL was approximately 479,000 times the detected concentration. Further sampling for vertical extent of diethylphthalate is not warranted.

Isopropyltoluene[4-] was detected in one sample at a concentration of 0.00117 mg/kg. Concentrations decreased with depth. The vertical extent of 4-isopropyltoluene is defined.

Radionuclides

Radionuclide COPCs at SWMU 21-004(c) include plutonium-239/240 and tritium.

Plutonium-239/240 was detected below 1 ft bgs in one soil sample at an activity of 0.054 pCi/g. Activities decreased with depth. The vertical extent of plutonium-239/240 is defined.

Tritium was detected in three samples with a maximum activity of 0.0265 pCi/g. Activities increased with depth. The residential SAL was approximately 64,200 times the maximum activity. Further sampling for vertical extent of tritium is not warranted.

Summary of Nature and Extent

The vertical extent of inorganic, organic, and radionuclide COPCs is defined or no further sampling for vertical extent is warranted at SWMU 21-004(c). Lateral extent was not evaluated at SWMU 21-004(c).

6.3.5 Summary of Human Health Risk Screening

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The industrial HI is 0.003, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.001 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 9×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.3, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.007 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.03, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.02 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Based on the risk-screening assessment results, no potential unacceptable risks and doses exist for the industrial, construction worker, and residential scenarios at SWMU 21-004(c).

6.3.6 Summary of Ecological Risk Screening

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, the relationship of detected concentrations and screening levels to background concentrations, and chemicals of potential ecological concern (COPECs) without ESLs, no potential ecological risks exist for SWMU 21-004(c).

6.4 SWMU 21-011(b), Sump and Acid Waste Lines

6.4.1 Site Description and Operational History

SWMU 21-011(b) consists of an RLW sump (structure 21-223) and associated waste lines (Figure 6.4-1). Constructed in 1965, the subsurface concrete sump housed a mechanical pump and was located inside a small metal containment building (no structure number assigned) that was located approximately 760 ft east of the TA-21 waste treatment plant (building 21-257) and 70 ft northwest of the TSTA (building 21-155). In 1965, a 4-in. waste line was installed to transport acid waste from building 21-155 to the sump. From the sump, a 3-in. waste line transported acid waste to the old waste treatment plant/laboratory (building 21-035) (LASL 1968, 089722; Francis 1997, 076126). The sump also connected to a 6-in. vitrified clay overflow pipe, which discharged to DP Canyon, eventually running into the same area as the discharge from the SWMU 21-024(h) septic system (LASL 1968, 089722). The SWMU 21-024(h) outfall was addressed in the DP Site Aggregate Area Phase I and II investigations (LANL 2004, 087461; NMED 2005, 089314; LANL 2008, 104989).

In 1967–1968, the old waste treatment plant/laboratory (building 21-035) was removed and the sump outlet line was extended to the new waste treatment plant (building 21-257) (LASL 1968, 089723; LASL 1975, 089724). In 1979, the sump overflow pipe was connected to the aboveground stainless-steel tanks ([structure 21-346, SWMUs 21-004(b) and 21-004(c)] LASL 1979, 089721). In the mid- to late-1980s, two new 4-in. acid waste steel or iron lines (LANL 1988, 087575) were connected from building 21-155 to a manhole (structure 21-222) to be pumped by the sump pump (LASL 1977, 089726). This line continued to another manhole (structure 21-221) (Figure 6.4-1).

The sump and a portion of the line outside of the MDA T boundary were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded. The two manholes along the industrial waste lines associated with former buildings 21-155 and 21-152 (former structures 21-221 and 21-222) were partially removed. The concrete that formed the bottom of the manholes was left in place because the concrete was formed to the underlying tuff and was more than 10 ft bgs.

6.4.2 Relationship to Other SWMUs and AOCs

The SWMU 21-011(b) industrial waste line runs along the north side of MDA A and eventually extends within the boundary of MDA T. SWMU 21-022(f), a removed sump (structure 21-173), and an industrial waste line, connected to the east end of SWMU 21-011(b) (Figure 6.4-1). The sump (21-173) was removed and investigated during the DP Site Aggregate Area investigation, and the results were reported in the Phase II investigation report (LANL 2010, 110772.33).

6.4.3 Summary of Previous Investigations

This SWMU has not been investigated previously and no historical data are available.

6.4.4 Site Contamination

6.4.4.1 Soil, Rock, and Sediment Sampling

As part of the 2010–2011 investigation, the following activities were conducted at SWMU 21-011(b):

- 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 C) and are presented in Table 3.2-2.
- Fifty-two samples were collected from twenty-six locations along the waste line and at the location of the former sump. At each location, samples were collected at two depth intervals (4.0–5.0 ft to 10.0–11.0 ft bgs and 6.0–7.0 ft to 12.0–13.0 ft bgs).
- All samples were analyzed for TAL metals, cyanide, nitrate, perchlorate, SVOCs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, technicium-99, and tritium. Forty-eight samples were analyzed for isotopic thorium and six samples were analyzed for dioxins/furans, explosive compounds, and PCBs.

The sampling locations for the 2010–2011 investigation at SWMU 21-011(b) are shown in Figure 6.4-1. Table 6.4-1 presents the samples collected and the analyses requested for SWMU 21-011(b). The geodetic coordinates of the sampling locations are presented in Table 3.2-1.

6.4.4.2 Soil, Rock, and Sediment Field-Screening Results

Organic vapors were detected at less than 5 ppm above ambient air in all but two samples during PID screening of samples. At locations 21-613818 and 21-613819 at SWMU 21-011(b), PID readings were 83.6 ppm and 77.6 ppm in the top depths sampled. No radiological field-screening results exceeded twice the daily site background levels. Field-screening results for the samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the results of field screening.

6.4.4.3 Soil, Rock, and Sediment Analytical Results

Decision-level data at SWMU 21-011(b) consist of the results from 52 samples (24 soil and 28 tuff) collected from 26 locations.

Inorganic Chemicals

Fifty-two samples (24 soil and 28 tuff) were analyzed for TAL metals, nitrate, perchlorate, and total cyanide. Table 6.4-2 presents the results of the inorganic chemicals above BVs and the detected inorganic chemicals that have no BVs. Plate 1 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Aluminum was detected above the Qbt 2,3,4 BV (7340 mg/kg) in two samples with a maximum concentration of 8470 mg/kg. The Gehan and quantile tests indicated site concentrations of aluminum in tuff are not statistically different from background (Figure G-1 and Table G-1). Aluminum is not a COPC.

Antimony was not detected above the soil or Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) but had DLs (0.679 mg/kg to 1.25 mg/kg) in 21 soil samples and 27 tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in 10 samples with a maximum concentration of 101 mg/kg). The Gehan and quantile tests indicated site concentrations of barium in tuff are statistically different from background (Figure G-2 and Table G-1). Barium is retained as a COPC.

Beryllium was detected above the soil and Qbt 2,3,4 BVs (1.83 mg/kg and 1.21 mg/kg) in one soil and one tuff sample with a maximum concentration of 1.9 mg/kg. The Gehan and quantile tests indicated site concentrations of beryllium in soil and tuff are not statistically different from background (Figure G-3 and Table G-2, and Figure G-4 and Table G-1, respectively). Beryllium is not a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.471 mg/kg to 0.598 mg/kg) above BV in 22 samples. The maximum DL was only 0.198 mg/kg above the BV and was below the 3 highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg) and the 3 highest background DLs (2 mg/kg, 2 mg/kg, and 2 mg/kg). Cadmium was not detected or was detected below BV in the other 30 samples (detected below BV in 2 samples). Cadmium is not a COPC.

Calcium was detected above the soil and Qbt 2,3,4 BVs (6120 mg/kg and 2200 mg/kg) in three soil samples and seven tuff samples with a maximum concentration of 10,600 mg/kg and was not detected above the Qbt 2,3,4 BV but had a DL (2400 mg/kg) above BV in one sample. The Gehan and quantile tests indicated site concentrations of calcium in soil and tuff are statistically different from background (Figure G-5 and Table G-2 and Figure G-6 and Table G-1, respectively). Calcium is retained as a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in 1 soil sample and 10 tuff samples with a maximum concentration of 30.1 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in soil are not statistically different from background (Figure G-7 and Table G-2). The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-8 and Table G-1). Chromium is retained as a COPC.

Cobalt was detected above the soil BV (8.64 mg/kg) in one sample at a concentration of 9.18 mg/kg. The Gehan and quantile tests indicated site concentrations of cobalt in soil are not statistically different from background (Figure G-9 and Table G-2). Cobalt is not a COPC.

Copper was detected above the soil and Qbt 2,3,4 BVs (14.7 mg/kg and 4.66 mg/kg) in two soil samples and six tuff samples with a maximum concentration of 23.2 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in soil are not statistically different from background (Figure G-10 and Table G-2). The Gehan and quantile tests indicated site concentrations of copper in tuff are statistically different from background (Figure G-11 and Table G-1). Copper is retained as a COPC.

Cyanide was detected above the soil BV (0.5 mg/kg) in one sample at a concentration of 2.04 mg/kg. Cyanide is retained as a COPC.

Lead was detected above the Qbt 2,3,4 BV (11.2 mg/kg) in four samples with a maximum concentration of 16.3 mg/kg. The Gehan and quantile tests indicated site concentrations of lead in tuff are not statistically different from background (Figure G-12 and Table G-1). Lead is not a COPC.

Magnesium was detected above the Qbt 2,3,4 BV (1690 mg/kg) in one sample at a concentration of 1770 mg/kg. The Gehan test indicated site concentrations of magnesium in tuff are statistically different from background (Table G-1). However, the quantile and slippage tests indicated site concentrations of magnesium in tuff are not statistically different from background (Figure G-13 and Table G-1). Magnesium is not a COPC.

Manganese was detected above the soil BV (671 mg/kg) in one sample at a concentration of 741 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in soil are not statistically different from background (Figure G-14 and Table G-2). Manganese is not a COPC.

Mercury was detected above the soil and Qbt 2,3,4 BVs (0.1 mg/kg and 0.1 mg/kg) in six soil samples and one tuff sample with a maximum concentration of 0.258 mg/kg. Mercury is retained as a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in four samples with a maximum concentration of 7.82 mg/kg. The quantile and slippage tests indicated site concentrations of nickel in tuff are statistically different from background (Figure G-15 and Table G-1). Nickel is retained as a COPC.

Nitrate was detected in 22 soil samples and 22 tuff samples with a maximum concentration of 10.3 mg/kg. Nitrate is retained as a COPC.

Perchlorate was detected in seven soil samples and two tuff samples with a maximum concentration of 0.00286 mg/kg. Perchlorate is retained as a COPC.

Selenium was not detected above the Qbt 2,3,4 BV (0.3 mg/kg) but had DLs (0.952 mg/kg to 1.14 mg/kg) above BV in 28 samples. Selenium is retained as a COPC.

Silver was not detected above the soil BV (1 mg/kg) but had a DL (2.35 mg/kg) above BV in 1 sample. The DL was only 1.35 mg/kg above BV and silver was not detected or detected above BV in 49 other samples (detected below BV in 17 samples). Silver is not a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in two samples with a maximum concentration of 195 mg/kg. The Gehan and quantile tests indicated site concentrations of zinc in soil are not statistically different from background (Figure G-16 and Table G-2). Zinc is not a COPC.

Organic Chemicals

Fifty-two samples (twenty-four soil and twenty-eight tuff) were analyzed for SVOCs and VOCs. Six of the fifty-two samples were analyzed for explosive compounds, dioxins/furans, and PCBs. Table 6.4-3 presents the detected organic chemicals. Plate 2 shows the spatial distribution of detected organic chemicals.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a class of SVOCs frequently detected as a result of environmental sampling but generally were not released from the SWMUs or AOCs being investigated. PAHs unrelated to site activities are thus often detected in samples analyzed for the presence of site-related SVOCs.

PAHs are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as combustion of fossil fuels, oil drips off motor vehicles, vehicle tires, coal tar pitch, and weathering or eroding of asphalt pavement (Kose et al. 2008, 219977; Teaf 2008, 219976). PAHs from these sources generally occur as complex mixtures, not as single compounds. Individual PAH compounds can be manufactured for research purposes, and some PAHs (e.g., anthracene, fluorene, naphthalene, and pyrene) are used in dye production, the manufacture of synthetic fibers, and in plastics and pesticides.

The principal sources of PAHs in soil along parking lots, roads, and highways are vehicular exhaust and emissions, the wearing of tires, and asphalt. PAH-containing materials, such as asphalt and rubber particles, do not easily dissolve in water, preventing migration, except as suspended particles in storm water. PAH concentrations in excess of soil cleanup levels may result from common anthropogenic sources, such as runoff from asphalt parking lots.

Dioxins and Furans

Dioxins and furans are frequently detected as a result of environmental sampling but generally are not associated with industrial activities conducted at the Laboratory or released from SWMUs or AOCs being investigated at the Laboratory. Because of the limited history of many of the sites in the DP Site Aggregate Area, a full analytical suite including dioxins and furans was required by NMED (NMED 2005, 092099). The Laboratory proposed analysis of dioxins and furans from a limited subset of samples from locations believed to have the highest potential for contamination (LANL 2005, 087836). These samples were to be submitted for quick turn-around analysis, and the results from these analyses were to be used by NMED and the Laboratory to determine whether additional samples should be analyzed for dioxins and furans. This proposed approach was approved by NMED (NMED 2005, 089314) and implemented by the Laboratory. Based on this approach, additional sampling for dioxins and furans was not required at SWMU 21-011(b).

Dioxins and furans are known to be widely distributed in the environment from a number of sources, both natural, such as forest fires, and anthropogenic, such as industrial sources and burning of municipal trash and other waste materials. Industrial sources of dioxins and furans are primarily associated with impurities in the production of chlorinated chemical products (e.g., pentachlorophenol, chlorinated herbicides) and the wastes associated with production of those materials. Another industrial source is the pulp and paper industry and processes that bleach wood pulp (EPA 2006, 600913). None of these common industrial-process-related source activities have occurred at the Laboratory. Other anthropogenic sources of dioxins and furans include the combustion of materials containing chlorine, such as the incineration of municipal trash containing chlorinated plastics, and other waste materials (EPA 2006, 600913).

Site Activities

SWMU 21-011(b) is a RLW sump and associated drainlines and was identified as a SWMU because of possible soil contamination resulting from releases of RLW.

The SWMU 21-011(b) drainline is located adjacent to and beneath an asphalt road and samples were collected by augering through or adjacent to the roadway. Although all samples at this site were collected from depth, the concentrations were low and PAHs were detected in only 24 of 50 samples. The maximum concentration was 0.592 mg/kg, and 144 of the 168 detected PAH results were less than 0.1 mg/kg. The sample locations and the frequency and magnitude of detection suggest the detections of PAHs may have resulted from cross-contamination from augering through asphalt and/or surface contamination. Additionally, because PAHs were not used in the structure associated with the sump, the PAHs detected in samples used to characterize this site [acenaphthene; 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; phenanthrene; and pyrene] are associated with weathered asphalt, are not related to historic Laboratory site operations, and are not COPCs.

The operations at DP East that generated the RLW managed by SWMU 21-011(b) did not include combustion of waste materials or other activities that would generate dioxins or furans. The dioxin and furan congeners detected at SWMU 21-011(b) were detected at low concentrations (0.000000585 mg/kg to 0.000132 mg/kg) and consisted of hexa-, hepta-, and octa-chlorinated congeners. These results likely reflect natural and/or anthropogenic background rather than a site-related release. The dioxin and furan congeners detected in samples used to characterize this site [1,2,3,4,6,7,8-heptachlorodibenzodioxin; 1,2,3,4,6,7,8-heptachlorodibenzofuran; 1,2,3,6,7,8-hexachlorodibenzodioxin; and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin] are not related to historic Laboratory site operations and are not COPCs.

Organic COPCs

Other organic chemicals detected at SWMU 21-011(b) include acetone, Aroclor-1254, bis(2-ethylhexyl)phthalate, diethylphthalate, 2-hexanone, 4-isopropyltoluene, and methylene chloride. The detected organic chemicals listed are retained as COPCs.

Radionuclides

A total of 52 samples (24 soil and 28 tuff) were analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic uranium, strontium-90, technetium-99 and tritium. A total of 48 samples (21 soil and 27 tuff) were analyzed for isotopic thorium. Table 6.4-4 presents the radionuclides detected or detected above BVs/FVs. Plate 3 shows the spatial distribution of radionuclides detected or detected above BVs/FVs.

Americium-241 was detected in seven soil samples collected below 1 ft bgs and seven tuff samples with a maximum activity of 40.6 pCi/g. Americium-241 is retained as a COPC.

Cesium-137 was detected in two soil samples collected below 1 ft bgs with a maximum activity of 0.209 pCi/g. Cesium-137 is retained as a COPC.

Plutonium-238 was detected in two tuff samples with a maximum activity of 0.0299 pCi/g. Plutonium-238 is retained as a COPC.

Plutonium-239/240 was detected in 16 soil samples collected below 1 ft bgs and 16 tuff samples with a maximum activity of 1620 pCi/g. Plutonium-239/240 is retained as a COPC.

Thorium-228 was detected above the soil BV (2.28 pCi/g) in one sample with an activity of 2.3 pCi/g. This activity was only 0.02 pCi/g above the BV and thorium-228 was detected below BV in 45 other samples. Thorium-228 is not a COPC.

Tritium was detected in 24 soil samples and 27 tuff samples with a maximum activity of 1560 pCi/g. Tritium is retained as a COPC.

Uranium-235/236 was detected above the Qbt 2,3,4 BV (0.09 pCi/g) in two tuff samples with a maximum activity of 0.0949 pCi/g. The maximum activity was only 0.0049 pCi/g above the BV, and uranium-235/236 was not detected or was detected below BV in 48 other samples (detected below BV in 21 samples). Uranium-235/236 is not a COPC.

6.4.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at SWMU 21-011(b) are discussed below. Lateral extent beyond the waste line footprint is not applicable because contamination from the waste line would have traveled vertically and not laterally (gravity flow). Therefore, the lateral extent is defined for SWMU 21-011(b), and the discussion below addresses only the vertical extent.

Inorganic Chemicals

Inorganic COPCs at SWMU 21-011(b) include antimony, barium, calcium, chromium, copper, cyanide, mercury, nickel, nitrate, perchlorate, and selenium.

Antimony was not detected above the soil or Qbt 2,3,4 BVs but had DLs (0.679 mg/kg to 1.25 mg/kg) in 21 soil samples and 27 tuff samples. The residential SSL was approximately 25 times the maximum DL. Further sampling for vertical extent of antimony is not warranted.

Barium was detected above the Qbt 2,3,4 BV in 10 samples with a maximum concentration of 101 mg/kg). Concentrations decreased with depth at all locations (the concentrations in the shallower samples at locations 21-613816 and 21-613826 were 140 mg/kg and 109 mg/kg, respectively, and below the soil BV [Appendix C, Pivot Tables]). The vertical extent of barium is defined.

Calcium was detected above the soil and Qbt 2,3,4 BVs in three soil samples and seven tuff samples with a maximum concentration of 10,600 mg/kg and was not detected above the Qbt 2,3,4 BV but had a DL (2400 mg/kg) above BV in 1 sample. Concentrations increased with depth at location 21-613825, did not change substantially with depth (40 mg/kg) at location 21-613821, and decreased with depth at locations 21-613816, 21-613819, 21-613827, 21-613834, and 21-613839 (the concentration in the shallower sample at location 21-613816 was 5670 mg/kg and below the soil BV [Appendix C, Pivot Tables]). The residential essential nutrient SSL was approximately 1230 times the maximum concentration. Further sampling for vertical extent of calcium is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in 1 soil sample and 10 tuff samples with a maximum concentration of 30.1 mg/kg. Concentrations increased with depth at locations 21-613819, 21-613820, and 21-613847; did not change substantially with depth (1.6 mg/kg and 2.4 mg/kg) at locations 21-613816 and 21-613837; and decreased with depth at locations 21-613813, 21-613836, and 21-613848 (the concentrations in the shallower samples at locations 21-613813 and 21-613816 were 14.3 mg/kg and 11.3 mg/kg, respectively, and below the soil BV [Appendix C, Pivot Tables]). In addition, the maximum vertical increase was only 9.5 mg/kg (location 21-613847) and concentrations decreased with depth at the location of the maximum concentration (location 21-613836). As described in section 4.2, SWMU 21-011(b) is not a potential source of hexavalent chromium and use of the SSL for trivalent chromium to determine whether additional sampling is warranted is appropriate. The residential SSL for trivalent chromium (117,000 mg/kg) was approximately 3890 times the maximum concentration. Further sampling for vertical extent of chromium is not warranted.

Copper was detected above the soil and Qbt 2,3,4 BVs in two soil samples and six tuff samples with a maximum concentration of 23.2 mg/kg. Concentrations did not change substantially with depth (0.57 mg/kg and 0.11 mg/kg) at locations 21-613821 and 21-613836 and decreased with depth at locations 21-613816, 21-613826, 21-613834, and 21-613847 (the concentrations in the shallower samples at locations 21-613816 and 21-613826 were 10.2 mg/kg and 7.08 mg/kg, respectively, and below the soil BV [Appendix C, Pivot Tables]). The residential SSL was approximately 135 times the maximum concentration. Further sampling for vertical extent of copper is not warranted.

Cyanide was detected above the soil BV in one sample at a concentration of 2.04 mg/kg. Concentrations decreased with depth. The vertical extent of cyanide is defined.

Mercury was detected above the soil and Qbt 2,3,4 BVs in six soil samples and one tuff sample with a maximum concentration of 0.258 mg/kg. Concentrations increased with depth at locations 21-613827 and 21-613849 and decreased with depth at locations 21-613819, 21-613824, 21-613826, 21-613834, and 21-614319. The residential SSL was approximately 91 times the maximum concentration. Further sampling for vertical extent of mercury is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in four samples with a maximum concentration of 7.82 mg/kg. Concentrations did not change substantially with depth (0.87 mg/kg and 0.68 mg/kg) at locations 21-613821 and 21-613826 and decreased with depth at location 21-613816 (the concentrations in the shallower samples at locations 21-613816 and 21-613826 were 15.2 mg/kg and 8.5 mg/kg, respectively, and below the soil BV [Appendix C, Pivot Tables]). The residential SSL was approximately 199 times the maximum concentration. Further sampling for vertical extent of nickel is not warranted.

Nitrate was detected in 22 soil samples and 22 tuff samples with a maximum concentration of 10.3 mg/kg. Concentrations increased with depth at location 21-613821; decreased with depth at locations 21-613815, 21-613819, 21-613823, 21-613826, 21-613827, and 21-613829; and did not change substantially with depth (0.01 mg/kg to 0.49 mg/kg) at all other locations. The residential SSL was approximately 12,100 times the maximum concentration. Further sampling for vertical extent of nitrate is not warranted.

Perchlorate was detected in seven soil samples and two tuff samples with a maximum concentration of 0.00286 mg/kg. Concentrations increased with depth at location 21-613826, did not change substantially with depth (0.000214 mg/kg and 0.000009 mg/kg) at locations 21-613827 and 21-614319, and decreased with depth at locations 21-613815, 21-613819, and 21-613834. All but one of the detected values were below EQLs. The residential SSL was approximately 19,200 times the maximum concentration. Further sampling for vertical extent of perchlorate is not warranted.

Selenium was not detected above the Qbt 2,3,4 BV but had DLs (0.952 mg/kg to 1.14 mg/kg) above BV in 28 samples. Concentrations did not change substantially with depth (0.029 mg/kg) at location 21-613813. The residential SSL was approximately 400 times the maximum concentration and 343 times the maximum DL. Further sampling for vertical extent of selenium is not warranted

Organic Chemicals

Organic COPCs at SWMU 21-011(b) include acetone, Aroclor-1254, bis(2-ethylhexyl)phthalate, diethylphthalate, 2-hexanone, 4-isopropyltoluene, and methylene chloride.

Acetone was detected in seven samples with a maximum concentration of 0.0037 mg/kg. Concentrations increased with depth at locations 21-613818 and 21-613819, did not change substantially with depth (0.00025 mg/kg) at location 21-613836, and decreased with depth at locations 21-613837 and 21-613848. All detected concentrations were below EQLs. The residential SSL was approximately 19,700,000 times the maximum concentration. Further sampling for vertical extent of acetone is not warranted.

Aroclor-1254 was detected in two samples with a maximum concentration of 0.0106 mg/kg. Concentrations increased with depth at location 21-613849 but the result from the deeper sample was below the EQL. The residential SSL was approximately 108 times the maximum concentration. Further sampling for vertical extent of Aroclor-1254 is not warranted.

Bis(2-ethylhexyl)phthalate was detected in two samples with a maximum concentration of 2.34 mg/kg. Concentrations decreased with depth at both locations. The vertical extent of bis(2-ethylhexyl)phthalate is defined.

Diethylphthalate was detected in one sample at a concentration of 3.06 mg/kg. Concentrations increased with depth. The residential SSL was approximately 16,100 times the detected concentration. Further sampling for vertical extent of diethylphthalate is not warranted.

Hexanone[2-] was detected in one sample at a concentration of 0.0939 mg/kg. Concentrations increased with depth. The residential SSL was approximately 2130 times the detected concentration. Further sampling for vertical extent of 2-hexanone is not warranted.

Isopropyltoluene[4-] was detected in one sample at a concentration of 0.000943 mg/kg. Concentrations decreased with depth. The vertical extent of 4-isopropyltoluene] is defined.

Methylene chloride was detected in one sample at a concentration of 0.00249 mg/kg. Concentrations decreased with depth. The vertical extent of methylene chloride is defined.

Radionuclides

Radionuclide COPCs at SWMU 21-011(b) include americium-241, cesium-137, plutonium-238, plutonium-239/240, and tritium.

Americium-241 was detected in seven soil samples collected below 1 ft bgs and seven tuff samples with a maximum activity of 40.6 pCi/g. Activities increased with depth at locations 21-613813 and 21-613838 and decreased with depth at locations 21-613818, 21-613819, 21-613821, 21-613822, 21-613823, 21-613824, 21-613825, 21-613826, 21-613829, and 21-613847. Activities decreased with depth at the location of the maximum activity (location 21-613847). The residential SAL was approximately 686 times the maximum activity where activities increased with depth (0.121 pCi/g at location 21-613813). Further sampling for vertical extent of americium-241 is not warranted.

Cesium-137 was detected in two soil samples collected below 1 ft bgs with a maximum activity of 0.209 pCi/g. Activities decreased with depth at both locations. The vertical extent of cesium-137 is defined.

Plutonium-238 was detected in two tuff samples with a maximum activity of 0.0299 pCi/g. Activities decreased with depth at both locations. The vertical extent of plutonium-238 is defined.

Plutonium-239/240 was detected in 16 soil samples collected below 1 ft bgs and 16 tuff samples with a maximum activity of 1620 pCi/g. Activities increased with depth at locations 21-613814, 21-613828, 21-613838, and 21-614319 and decreased with depth at all other locations. The residential SAL was approximately 140 times the maximum activity where activities increased with depth (0.566 pCi/g at location 21-614319). Although activities decreased with depth at the location of the maximum detected activity (location 21-613847), the activity in the deeper sample at this location (596 pCi/g) was approximately 7.5 times the residential SAL and approximately half the industrial SAL. Further sampling for vertical extent of plutonium-239/240 at location 21-613847 is warranted.

Tritium was detected in 24 soil samples and 27 tuff samples with a maximum activity of 1560 pCi/g. Activities increased with depth at locations 21-613822 and 21-613827; decreased with depth at locations 21-613813, 21-613815, 21-613816, 21-613818, 21-613819, 21-613823, 21-613824, 21-613825, 21-613826, 21-613829, 21-613847, and 21-614319; and did not change substantially with depth (0.0027 pCi/g to 0.61 pCi/g) at all other locations. Activities decreased with depth at the location of the maximum detected activity (location 21-613826). The residential SAL was approximately 3300 times the maximum activity where activities increased with depth (0.512 pCi/g at location 21-613827). Further sampling for vertical extent of tritium is not warranted.

Summary of Nature and Extent

The vertical extent of inorganic, organic, and radionuclide COPCs is defined or no further sampling for vertical extent is warranted at SWMU 21-011(b) except for vertical extent of plutonium-239/240 at location 21-613847. Lateral extent was not evaluated at SWMU 21-011(b).

6.4.5 Summary of Human Health Risk Screening

Industrial Scenario

The samples at SWMU 21-011(b) were collected from depths greater than 0.0 to 1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.1, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 30 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.08, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 70 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Based on the risk-screening assessment results, no potential unacceptable risks and doses exist for the industrial scenario and no potential unacceptable risks exist for the construction worker and residential scenarios at SWMU 21-011(b). There are potential unacceptable doses for the construction worker and residential scenario at SWMU 21-011(b).

6.4.6 Summary of Ecological Risk Screening

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, the relationship of detected concentrations and screening levels to background concentrations, and COPECs without ESLs, no potential ecological risks exist for SWMU 21-011(b).

6.5 AOC 21-028(d), Container Storage Area

6.5.1 Site Description and Operational History

AOC 21-028(d) consisted of a former container storage area located on a concrete loading dock at the northwest corner of former building 21-209 (Figure 6.5-1) (LANL 1991, 007529). The dock dimensions were approximately 8.5 ft wide by 60 ft long by 3.25 ft deep. The dock and the foundations were removed in 2010 along with building 21-209 during D&D activities (LANL 2011, 206183). The AOC has been covered with approximately 1 ft of clean backfill/gravel.

Storage of containers on the loading dock likely began in 1965 when building 21-209 was constructed (LANL 1991, 007529, p. 14-39). The dock was used to store 55-gal. drums of lithium-deuterium waste; 30- and 55-gal. drums of fissionable waste (waste containing natural uranium, natural thorium, uranium-235, uranium-238, thorium-228, thorium-230, and thorium-232); and gas cylinders of tritium-contaminated hydrogen and argon gas (LANL 1991, 007529, p. 14-39). Containers of product stored in the same area included cylinders of deuterium, argon, nitrogen, helium, and compressed hydrogen; 55-gal. drums of oil; acetone; Convoil 20 (a multipurpose vacuum pump fluid); ethanol; ethyl alcohol; and various solvents stored in a chemical safety cabinet (LANL 1991, 007529, p. 14-39).

6.5.2 Relationship to Other SWMUs and AOCs

AOC 21-028(d) was connected to the northwest corner of building 21-209 (Figure 6.5-1).

6.5.3 Summary of Previous Investigations

RFI activities conducted in 1994 included a radiological surface survey of the area adjacent to the west side of the loading dock and soil sampling (0- to 0.5-ft-depth interval) from four locations in this same area. These samples were sent to an off-site laboratory for analyses of inorganic and organic chemicals and radionuclides (LANL 1996, 054828, pp. 37–47). The site was recommended for no further action in the RFI report (LANL 1996, 054828, p. 51). The data indicated that inorganic chemicals and radionuclides were detected above BVs/FVs (LANL 1998, 059730) and that organic chemicals were detected. The vertical extent was not defined since only one depth was sampled. Additionally, these samples were not collected in the area of the highest radiological activity as indicated by radiological survey results (LANL 1996, 054828, pp. 39–42).

QA/QC information is not available for the four samples collected and analyzed. Therefore, the RFI data are considered screening-level data.

6.5.4 Site Contamination

6.5.4.1 Soil, Rock, and Sediment Sampling

As part of the 2010–2011 investigation, the following activities were conducted at AOC 21-028(d):

- 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 C) and are presented in Table 3.2-2.
- Eighteen samples were collected from six locations within the footprint of the former storage area. At each location, samples were collected at three depth intervals (1.0–2.0 ft, 5.0–6.0 ft bgs, and 10.0–11.0 ft bgs).
- All samples were analyzed for TAL metals, cyanide, nitrate, perchlorate, SVOCs, VOCs, PCBs, americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technicium-99, and tritium.

The sampling locations for the 2010–2011 investigation at AOC 21-028(d) are shown in Figure 6.5-1. Table 6.5-1 presents the samples collected and the analyses requested for AOC 21-028(d). The geodetic coordinates of the sampling locations are presented in Table 3.2-1.

6.5.4.2 Soil, Rock, and Sediment Field-Screening Results

No organic vapors were detected at more than 5 ppm above ambient-air levels during PID screening of the samples during the 2010–2011 investigation. No radiological field-screening results exceeded twice the daily site background levels. Field-screening results for the samples are presented in Table 3.2-2. No changes to sampling or other activities occurred because of the results of field screening.

6.5.4.3 Soil, Rock, and Sediment Analytical Results

Decision-level data at AOC 21-028(d) consist of results from 4 soil and 14 tuff samples collected from 6 locations in 2010 and 2011.

Inorganic Chemicals

Eighteen samples (four soil and fourteen tuff) were analyzed for TAL metals, nitrate, perchlorate, and total cyanide. Table 6.5-2 presents the results of the inorganic chemicals above BVs and the detected inorganic chemicals that have no BVs. Figure 6.5-2 shows the spatial distribution of inorganic chemicals detected or detected above BVs.

Antimony was detected above the soil and Qbt 2,3,4 BVs (0.83 mg/kg and 0.5 mg/kg) in 2 soil samples and 2 tuff samples with a maximum concentration of 1.6 mg/kg and was not detected above the soil and tuff BVs but had DLs (0.714 mg/kg to 1.53 mg/kg) above BV in 2 soil samples and 11 tuff samples. Antimony is retained as a COPC.

Barium was detected above the Qbt 2,3,4 BV (46 mg/kg) in five samples with a maximum concentration of 61.6 mg/kg. The Gehan and quantile tests indicated site concentrations of barium in tuff are not statistically different from background (Figure G-17 and Table G-3). Barium is not a COPC.

Cadmium was not detected above the soil BV (0.4 mg/kg) but had DLs (0.468 mg/kg to 0.51 mg/kg) above BV in 3 samples. The maximum DL was only 0.11 mg/kg above the BV and was below the 3 highest soil background concentrations (0.6 mg/kg, 1.4 mg/kg, and 2.6 mg/kg) and the 3 highest background DLs (2 mg/kg, 2 mg/kg, and 2 mg/kg). Cadmium was not detected or was detected below BVs in the other 15 samples (detected below BV in 2 samples). Cadmium is not a COPC.

Calcium was detected above the soil and Qbt 2,3,4 BVs (6120 mg/kg and 2200 mg/kg) in two soil samples and three tuff samples with a maximum concentration of 21,900 mg/kg. The Gehan and quantile tests indicated site concentrations of calcium in tuff are not statistically different from background (Figure G-18 and Table G-3). The maximum concentration of calcium in soil (21,900 mg/kg) is greater than the maximum soil background concentration (14,000 mg/kg). Calcium is retained as a COPC.

Chromium was detected above the soil and Qbt 2,3,4 BVs (19.3 mg/kg and 7.14 mg/kg) in 2 soil samples and 11 tuff samples with a maximum concentration of 37.8 mg/kg. The Gehan and quantile tests indicated site concentrations of chromium in tuff are statistically different from background (Figure G-19 and Table G-3). Chromium is retained as a COPC.

Cobalt was detected above the Qbt 2,3,4 BV (3.14 mg/kg) in 1 sample at a concentration of 3.17 mg/kg. This result was only 0.03 mg/kg above BV and cobalt was detected below BV in 19 other samples. The Gehan and quantile tests indicated site concentrations of cobalt in tuff are not statistically different from background (Figure G-20 and Table G-3). Cobalt is not a COPC.

Copper was detected above the soil and Qbt 2,3,4 BVs (14.7 mg/kg and 4.66 mg/kg) in one soil sample and five tuff samples with a maximum concentration of 14.8 mg/kg. The Gehan and quantile tests indicated site concentrations of copper in tuff are statistically different from background (Figure G-21 and Table G-3). Copper is retained as a COPC.

Lead was detected above the Qbt 2,3,4 BV (11.2 mg/kg) in one sample at a concentration of 17.9 mg/kg. The Gehan test indicated site concentrations of lead in tuff are statistically different from background (Table G-3). However, the quantile and slippage tests indicated site concentrations of lead in tuff are not statistically different from background (Figure G-22 and Table G-3). Lead is not a COPC.

Manganese was detected above the Qbt 2,3,4 BV (482 mg/kg) in one sample at a concentration of 931 mg/kg. The Gehan and quantile tests indicated site concentrations of manganese in tuff are not statistically different from background (Figure G-23 and Table G-3). Manganese is not a COPC.

Mercury was detected above the Qbt 2,3,4 BV (0.1 mg/kg) in 1 sample at a concentration of 0.118 mg/kg. This result was only 0.018 mg/kg above the BV and mercury was not detected or was detected below BV in 17 other samples (detected below BV in 12 samples). Mercury is not a COPC.

Nickel was detected above the Qbt 2,3,4 BV (6.58 mg/kg) in two samples with a maximum concentration of 13.3 mg/kg. The quantile and slippage tests indicated site concentrations of nickel in tuff are statistically different from background (Figure G-24 and Table G-3). Nickel is retained as a COPC.

Nitrate was detected in 3 soil samples and 12 tuff samples with a maximum concentration of 8.4 mg/kg. Nitrate is naturally occurring, and the concentrations likely reflect naturally occurring levels. In addition, the AOC is a former storage area and was not used to store nitrate and is not a source of nitrate. Nitrate is not a COPC.

Perchlorate was detected in two soil samples and two tuff samples with a maximum concentration of 0.0831 mg/kg. Perchlorate is retained as a COPC.

Selenium was detected above the Qbt 2,3,4 BV (0.3 mg/kg) in 2 tuff samples with a maximum concentration of 0.679 mg/kg and was not detected above the tuff BV but had DLs (1.03 mg/kg to 1.1 mg/kg) above BV in 12 samples. Selenium is retained as a COPC.

Silver was not detected above the Qbt 2,3,4 BV (1 mg/kg) but had DLs (1.29 mg/kg to 2.58 mg/kg) in 2 samples. The maximum DL was only 1.58 mg/kg above BV and silver was not detected or was detected below BV in 18 other samples (detected below BV in 10 samples). Silver is not a COPC.

Vanadium was detected above the Qbt 2,3,4 BV (17 mg/kg) in one sample at a concentration of 17.1 mg/kg. The Gehan and quantile tests indicated site concentrations of vanadium in tuff are not statistically different from background (Figure G-25 and Table G-3). Vanadium is not a COPC.

Zinc was detected above the soil BV (48.8 mg/kg) in one sample at a concentration of 120 mg/kg. Zinc is retained as a COPC.

Organic Chemicals

Eighteen samples (four soil and fourteen tuff) were analyzed for SVOCs, VOCs, and PCBs. Table 6.5-3 presents the detected organic chemicals. Figure 6.5-3 shows the spatial distribution of detected organic chemicals.

Organic chemicals detected at AOC 21-028(d) include acenaphthene; acetone; anthracene; Aroclor-1242; Aroclor-1254; 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; dibenzofuran; dibutylphthalate; ethylbenzene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; methylene chloride; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; toluene; 1,2,4-trimethylbenzene; 1,2-xylene, and 1,3-xylene+1,4-xylene. The detected organic chemicals are retained as COPCs.

Radionuclides

Eighteen samples (four soil and fourteen tuff) were analyzed for americium-241, gamma-emitting radionuclides, isotopic plutonium, isotopic thorium, isotopic uranium, strontium-90, technetium-99, and tritium. Table 6.5-4 presents the radionuclides detected or detected above BVs/FVs. Figure 6.5-4 shows the spatial distribution of radionuclides detected or detected above BVs/FVs.

Tritium was detected in 4 soil samples and 11 tuff samples with a maximum activity of 61.7 pCi/g. Tritium is retained as a COPC.

6.5.4.4 Nature and Extent of Contamination

The nature and extent of inorganic, organic, and radionuclide COPCs at AOC 21-028(d) are discussed below.

Inorganic Chemicals

Inorganic COPCs at AOC 21-028(d) include antimony, calcium, chromium, copper, nickel, perchlorate, selenium, and zinc.

Antimony was detected above the soil and Qbt 2,3,4 BVs in 2 soil samples and 2 tuff samples with a maximum concentration of 1.6 mg/kg and was not detected above the soil and tuff BVs but had DLs (0.714 mg/kg to 1.53 mg/kg) above BV in 2 soil samples and 11 tuff samples. Concentrations decreased with depth at locations 21-614373, 21-614374, and 21-614378. Concentrations did not change substantially laterally (0.39 mg/kg). The residential SSL was approximately 20 times the maximum concentration and 20 times the maximum DL. Further sampling for extent of antimony is not warranted.

Calcium was detected above the soil and Qbt 2,3,4 BVs in two soil samples and three tuff samples with a maximum concentration of 21,900 mg/kg. Concentrations decreased with depth at all locations and increased laterally at location 21-614376, where the maximum concentration was detected. The residential essential nutrient SSL was approximately 594 times the maximum concentration. The vertical extent of calcium is defined and further sampling for lateral extent is not warranted.

Chromium was detected above the soil and Qbt 2,3,4 BVs in 2 soil samples and 11 tuff samples with a maximum concentration of 37.8 mg/kg. Concentrations increased with depth at locations 21-614374 and 21-614377, did not change substantially with depth (1.85 mg/kg) at location 21-614373, and decreased with depth at locations 21-614375, 21-614376, and 21-614378 (the concentration in the shallower sample at location 21-614373 was 7 mg/kg and below the soil BV [Appendix C, Pivot Tables]). Concentrations decreased with depth at the location of the maximum concentration (location 21-614378). Concentrations decreased laterally. As described in section 4.2, AOC 21-028(d) is not a potential source of hexavalent chromium and use of the SSL for trivalent chromium to determine whether additional sampling is warranted is appropriate. The residential SSL for trivalent chromium (117,000 mg/kg) was approximately 3100 times the maximum concentration. The lateral extent of chromium is defined and further sampling for vertical extent is not warranted.

Copper was detected above the soil and Qbt 2,3,4 BVs in one soil sample and five tuff samples with a maximum concentration of 14.8 mg/kg. Concentrations increased with depth at location 21-614375 and decreased with depth at locations 21-614376, 21-614377, and 21-614378. Concentrations increased laterally at location 21-614376. The residential SSL was approximately 211 times the maximum concentration. Further sampling for extent of copper is not warranted.

Nickel was detected above the Qbt 2,3,4 BV in two samples with a maximum concentration of 13.3 mg/kg. Concentrations decreased with depth at both locations and increased laterally at location 21-614376. The residential SSL was approximately 117 times the maximum concentration. The vertical extent of nickel is defined and further sampling for lateral extent is not warranted.

Perchlorate was detected in two soil samples and two tuff samples with a maximum concentration of 0.0831 mg/kg. Concentrations decreased with depth and decreased laterally. The lateral and vertical extent of perchlorate are defined.

Selenium was detected above the Qbt 2,3,4 BV in 2 tuff samples with a maximum concentration of 0.679 mg/kg and was not detected above the tuff BV but had DLs (1.03 mg/kg to 1.1 mg/kg) above BV in 12 samples. Concentrations increased with depth at location 21-614374 and decreased with depth at location 21-614375 and decreased laterally. The residential SSL was approximately 576 times the maximum concentration and 355 times the maximum DL. The lateral extent of selenium is defined and further sampling for vertical extent is not warranted.

Zinc was detected above the soil BV in one sample at a concentration of 120 mg/kg. Concentrations decreased with depth but increased laterally at location 21-614376. The residential SSL was approximately 196 times the detected concentration. The vertical extent of zinc is defined and further sampling for lateral extent is not warranted.

Organic Chemicals

Organic COPCs at AOC 21-028(d) include acenaphthene; acetone; anthracene; Aroclor-1242; Aroclor-1254; 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; dibenzofuran; diethylphthalate; ethylbenzene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; methylene chloride; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; toluene; 1,2,4-trimethylbenzene; 1,2-xylene, and 1,3-xylene+1,4-xylene.

Acenaphthene, benzo(k)fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, and naphthalene were each detected in 11 samples with maximum concentrations of 13 mg/kg, 8.21 mg/kg, 15.4 mg/kg, 9.29 mg/kg, and 32.5 mg/kg, respectively. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The residential SSLs for acenaphthene, fluorene, and naphthalene were approximately 268, 151, and 37 times the maximum concentrations, respectively. The residential and industrial SSLs for benzo(k)fluoranthene were approximately 1.9 and 39 times the maximum concentration, respectively. The maximum concentration for indeno(1,2,3-cd)pyrene was approximately 6.1 times the residential SSL. The industrial SSL for indeno(1,2,3-cd)pyrene was approximately 3.5 times the maximum concentration. Vertical extent of acenaphthene, benzo(k)fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, and naphthalene is defined. Further sampling for lateral extent of acenaphthene, benzo(k)fluoranthene, fluorene, and naphthalene is not warranted, but additional sampling for lateral extent of indeno(1,2,3-cd)pyrene at location 21-614376 is warranted.

Acetone was detected in three samples with a maximum concentration of 0.00625 mg/kg. Concentrations increased with depth at location 21-614374, decreased with depth at locations 21-614375 and 21-614376, and decreased laterally. All detected concentrations were below the EQL. The residential SSL was approximately 10,600,000 times the maximum concentration. The lateral extent of acetone is defined and further sampling for vertical extent is not warranted.

Anthracene was detected in 13 samples with a maximum concentration of 24 mg/kg. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The residential SSL was approximately 725 times the maximum concentration. Vertical extent of anthracene is defined and further sampling for lateral extent is not warranted.

Aroclor-1242 was detected in two samples with a maximum concentration of 0.17 mg/kg. Concentrations decreased with depth at both locations and increased laterally at location 21-614376. The residential and industrial SSLs were approximately 14 times and 64 times the maximum concentration, respectively. The vertical extent of Aroclor-1242 is defined and further sampling for lateral extent is not warranted.

Aroclor-1254 was detected in seven samples with a maximum concentration of 0.177 mg/kg. Concentrations increased with depth at location 21-614374 and decreased with depth at locations 21-614375, 21-614376, 21-614377, and 21-614378. The detected concentration at location 21-614374 was below the EQL. Concentrations increased laterally at location 21-614376. The residential and industrial SSLs were approximately 9.7 and 94 times the maximum concentration, respectively. Further sampling for extent of Aroclor-1254 is not warranted.

Aroclor-1260 was detected in two samples with a maximum concentration of 0.0265 mg/kg. Concentrations decreased with depth at both locations and decreased laterally. The lateral and vertical extent of Aroclor-1260 are defined.

Benzo(a)anthracene was detected in 14 samples with a maximum concentration of 22.8 mg/kg. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The maximum concentration for benzo(a)anthracene was approximately 15 times the residential SSL. The industrial SSL for benzo(a)anthracene was approximately 1.4 times the maximum concentration. The vertical extent of benzo(a)anthracene is defined. Further sampling for lateral extent of benzo(a)anthracene at location 21-614376 is warranted.

Benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, and chrysene were each detected in 12 samples with maximum concentrations of 19.1 mg/kg, 21.8 mg/kg, 9.09 mg/kg, and 24.3 mg/kg, respectively. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The residential SSL for benzo(g,h,i)perylene was approximately 191 times the maximum concentration. The residential and industrial SSLs for chrysene were approximately 6.3 times and 133 times the maximum concentration, respectively. The maximum concentrations of benzo(a)pyrene and benzo(b)fluoranthene were 17 times and 14 times the residential SSLs, respectively. The industrial SSLs for benzo(a)pyrene and benzo(b)fluoranthene were approximately 1.2 times and 1.5 times the maximum concentration, respectively. Vertical extent of benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, and chrysene is defined. Further sampling for lateral extent of benzo(g,h,i)perylene and chrysene is not warranted. Further sampling for lateral extent of benzo(a)pyrene and benzo(b)fluoranthene at location 21-614376 is warranted.

Bis(2-ethylhexyl)phthalate was detected in one sample at a concentration of 0.222 mg/kg. Concentrations decreased with depth and decreased laterally. The detected concentration was below the EQL. The lateral and vertical extent of bis(2-ethylhexyl)phthalate are defined.

Dibenz(a,h)anthracene was detected in seven samples with a maximum concentration of 3.21 mg/kg. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The maximum concentration was approximately 21 times the residential SSL. The industrial SSL was approximately equal to the maximum concentration. Vertical extent of dibenz(a,h)anthracene is defined. Further sampling for lateral extent of dibenz(a,h)anthracene at location 21-614376 is warranted.

Dibenzofuran was detected in five samples with a maximum concentration of 9.9 mg/kg. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The residential and industrial SSLs were approximately 7.4 times and 101 times the maximum concentration, respectively. Vertical extent of dibenzofuran is defined and further sampling for lateral extent is not warranted.

Diethylphthalate was detected in one sample at a concentration of 0.284 mg/kg. Concentrations decreased with depth and decreased laterally. The detected concentration was below the EQL. The lateral and vertical extent of diethylphthalate are defined.

Ethylbenzene and 1,2-xylene were each detected in one sample at concentrations of 0.000607 mg/kg and 0.000486 mg/kg, respectively. Concentrations decreased with depth and increased laterally at location 21-614376. Both detected concentrations were below EQLs. The residential SSLs were approximately 123,000 and 1,640,000 times the maximum concentrations, respectively. Vertical extent of ethylbenzene and 1,2-xylene is defined and further sampling for lateral extent is not warranted.

Fluoranthene, phenanthrene, and pyrene were each detected in 17 samples with maximum concentrations of 69.2 mg/kg, 83.6 mg/kg, and 61.9 mg/kg, respectively. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The residential SSLs were approximately 34 times, 21 times, and 28 times the maximum concentrations, respectively. Vertical extent of fluoranthene, phenanthrene, and pyrene is defined and further sampling for lateral extent is not warranted.

Methylene chloride was detected in two samples with a maximum concentration of 0.00252 mg/kg. Concentrations decreased with depth at both locations and did not change substantially laterally (0.0001 mg/kg). Both detected concentrations were below EQLs. The residential SSL was approximately 3570 times the maximum concentration. Vertical extent of methylene chloride is defined and further sampling for lateral extent is not warranted.

Methylnaphthalene[2-] was detected in 10 samples with a maximum concentration of 7.06 mg/kg. Concentrations decreased with depth at all locations and increased laterally at location 21-614376. The residential SSL was approximately 33 times the maximum concentration. Vertical extent of 2-methylnaphthalene is defined and further sampling for lateral extent is not warranted.

Toluene and 1,3-xylene+1,4-xylene were each detected in two samples with maximum concentrations of 0.000883 mg/kg and 0.00115 mg/kg, respectively. Concentrations decreased with depth at both locations and increased laterally at location 21-614376. All detected concentrations were below EQLs. Vertical extent of toluene and 1,3-xylene+1,4-xylene is defined and further sampling for lateral extent is not warranted.

Trimethylbenzene[1,2,4-] was detected in two samples with a maximum concentration of 0.00162 mg/kg Concentrations decreased with depth at both locations and increased laterally at location 21-614376. The residential SSL was approximately 35,800 times the maximum concentration. The vertical extent of trimethylbenzene[1,2,4-] is defined and further sampling for lateral extent is not warranted.

Radionuclides

Radionuclide COPCs at AOC 21-028(d) include tritium.

Tritium was detected in 4 soil samples and 11 tuff samples with a maximum activity of 61.7 pCi/g. Activities decreased with depth at all locations and increased laterally at location 21-614376. The residential SAL was approximately 28 times the maximum activity. Vertical extent of tritium is defined and further sampling for lateral extent is not warranted.

Summary of Nature and Extent

The lateral and vertical extent of inorganic, organic, and radionuclide COPCs are defined or no further sampling is warranted at AOC 21-028(d) except for lateral extent of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene at location 21-614376.

6.5.5 Summary of Human Health Risk Screening

Industrial Scenario

The samples at AOC 21-028(d) were collected from depths greater than 0.0 to 1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.4, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.0005 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Residential Scenario

The total excess cancer risk for the residential scenario is 5×10^{-4}, which is greater than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.3, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

Based on the risk-screening assessment results, no potential unacceptable risks and doses exist for the industrial and construction worker scenarios and no potential unacceptable noncancer risks or doses exist for the residential scenario at AOC 21-028(d). There are potential unacceptable cancer risks for the residential scenario at AOC 21-028(d).

6.5.6 Summary of Ecological Risk Screening

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, the relationship of detected concentrations and screening levels to background concentrations, and COPECs without ESLs, no potential ecological risks exist for AOC 21-028(d).

7.0 CONCLUSIONS

7.1 Nature and Extent of Contamination

The nature and extent of contamination have been defined and/or no further sampling for extent is warranted for the following DP Site Aggregate Area sites at DP East:

- SWMU 21-004(b), Aboveground Tank
- SWMU 21-004(c), Aboveground Tank

The nature and extent of contamination have not been defined and further sampling is warranted for two DP Site Aggregate Area sites at DP East. Additional sampling is needed to define the extent of contamination for one or more organic chemicals or radionuclides at the following sites:

- SWMU 21-011(b)— vertical extent of plutonium-239/240 at location 21-613847
- AOC 21-028(d)— lateral extent of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene at location 21-614376

7.2 Summary of Risk-Screening Assessments

7.2.1 Human Health Risk Screening Assessments

For the industrial scenario, the total excess cancer risks were less than the 1×10^{-5} target risk level, the HIs were less than the target level of 1, and the doses were less than the target dose of 25 mrem/yr at all sites evaluated. SWMU 21-011(b) and AOC 21-028(d) were not evaluated for the industrial scenario because no samples were collected in the 0.0- to 1.0-ft depth interval.

For the construction worker scenario, the total excess cancer risks were less than the 1×10^{-5} target risk level and the HIs were less than the target level of 1 at all sites. The total doses were less than the target level of 25 mrem/yr at three of four sites. The construction worker total dose was greater than the target dose limit at SWMU 21-011(b) from plutonium-239/240.

For the residential scenario, the HIs were less than the target level of 1 at all sites. The total excess cancer risks were less than the 1×10^{-5} target risk level at three of four sites. The residential total excess cancer risk was above the 1×10^{-5} target risk level at AOC 21-028(d) from PAHs. The total doses were less than the target level of 25 mrem/yr at three of four sites. The residential total dose was greater than the target dose limit at SWMU 21-011(b) from plutonium-239/240.

7.2.2 Ecological Risk Screening Assessments

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, the relationship of detected concentrations and screening levels to background concentrations, and COPECs without ESLs, no potential ecological risks exist for any of the sites.

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 upon 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 scenarios (industrial and construction worker) result in corrective action complete with controls; that is, some type of institutional controls must be in place to ensure land use remains consistent with site cleanup levels or that exposure controls are implemented during construction activities. The current and reasonably foreseeable future land use for sites in the DP Site Aggregate Area at DP East is industrial.

8.1 Recommendations for Corrective Actions Complete

Two sites (1) do not pose a potential unacceptable risk or dose under the industrial, construction worker, and residential scenarios; (2) have no potential ecological risks for any receptor; and (3) have the nature and extent of contamination defined and/or no further sampling for extent is warranted. At these sites, N3B recommends corrective action complete without controls (Table 8.1-1). The sites are

- SWMU 21-004(b), Aboveground Tank
- SWMU 21-004(c), Aboveground Tank.

8.2 Additional Field Characterization and Remediation Activities

The nature and extent of contamination have not been defined for two sites investigated in the DP Site Aggregate Area at DP East (Table 8.1-1). Additional sampling is needed to define the extent of contamination for one or more organic chemicals and/or radionuclides at the following sites:

- SWMU 21-011(b), Sump and Acid Waste Lines
- AOC 21-028(d), Container Storage Area

SWMU 21-011(b) poses a potential unacceptable dose under the construction worker and residential scenarios due to plutonium-239/240. AOC 21-028(d) poses a potential unacceptable risk under the residential scenario due to PAHs. Removal of contaminated soil to reduce risk is recommended at these two sites. Post-removal confirmation sampling to define extent of contamination is also recommended.

A letter work plan will be developed based on the conclusions and recommendations presented in this investigation report. The letter work plan will specify sampling locations, numbers of samples, and analytical suites required to define the extent of contamination for the above sites and areas requiring soil removal to meet risk targets. The results will be presented in an investigation report or accelerated corrective action report upon completion of the cleanups, extent sampling, and remaining sampling at SWMU 21-011(b).

9.0 REFERENCES AND MAP DATA SOURCES

9.1 References

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9.2 Map Data Sources

Locations: ER Project Locations; Los Alamos National Laboratory, ESH&Q Waste and Environmental Services Division, 2010-2E; 1:2,500 Scale Data; 04 October 2010.

Removed Piping: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Piping: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former dry well: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former floor trench: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former generator: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former pit: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former Floor drain: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former holding pit: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former 5 ft wide round pit: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Former storage area: Digitized from LANL/LASL engineering drawings as published, unknown publication date.

Security fence: Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Paved roads: Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Unpaved roads: Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Communication line: Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 29 November 2010.

Electric line: Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Gas line: Primary Gas Distribution Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Sewer line: Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Steam line: Steam Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Water line: Water Utility Distribution System Maintained by the County of Los Alamos; County of Los Alamos, Information Services; as published 04 March 2009.

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

Structures: Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Former structures: Former Structures of the Los Alamos Site; Los Alamos National Laboratory, ESH&Q Waste and Environmental Services Division, EP2010-1B; 1:2,500 Scale Data; 09 August 2010.

Road centerline: Road Centerlines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 15 December 2005; as published 29 November 2010.

Technical area: Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 13 August 2010.

Wells: Well Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2003-0390; 03 June 2003.

MDA: Waste Storage Features; Los Alamos National Laboratory, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.

PRS: Potential Release Sites; Los Alamos National Laboratory, ESH&Q Waste & Environmental Services Division, Environmental Data and Analysis Group, EP2010-1C; 1:2,500 Scale Data; 02 December 2010.

LANL area: LANL Areas Used and Occupied ; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; 19 September 2007; as published 13 August 2010.

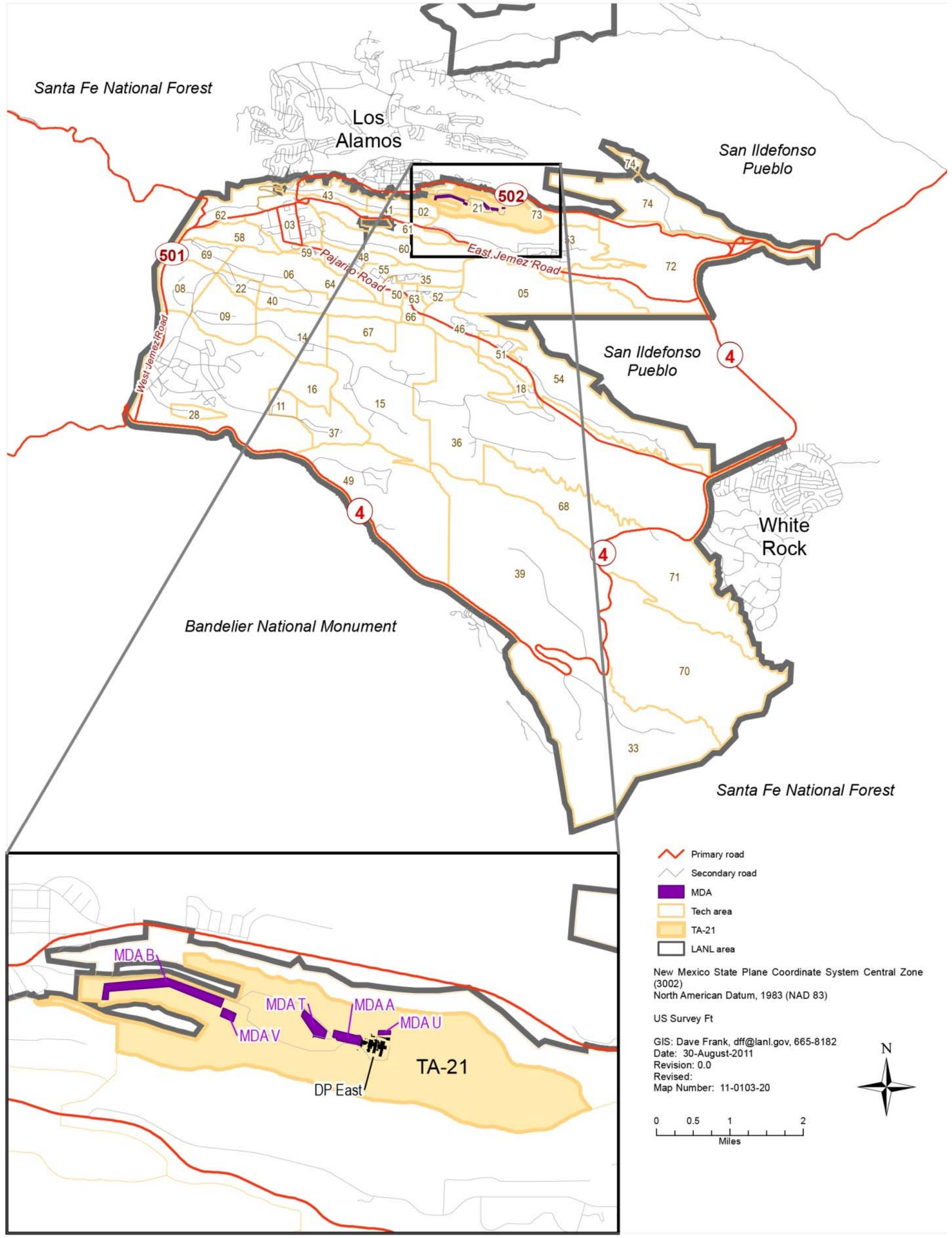


Figure 1.0-1 Location of TA-21 with respect to surrounding landholdings

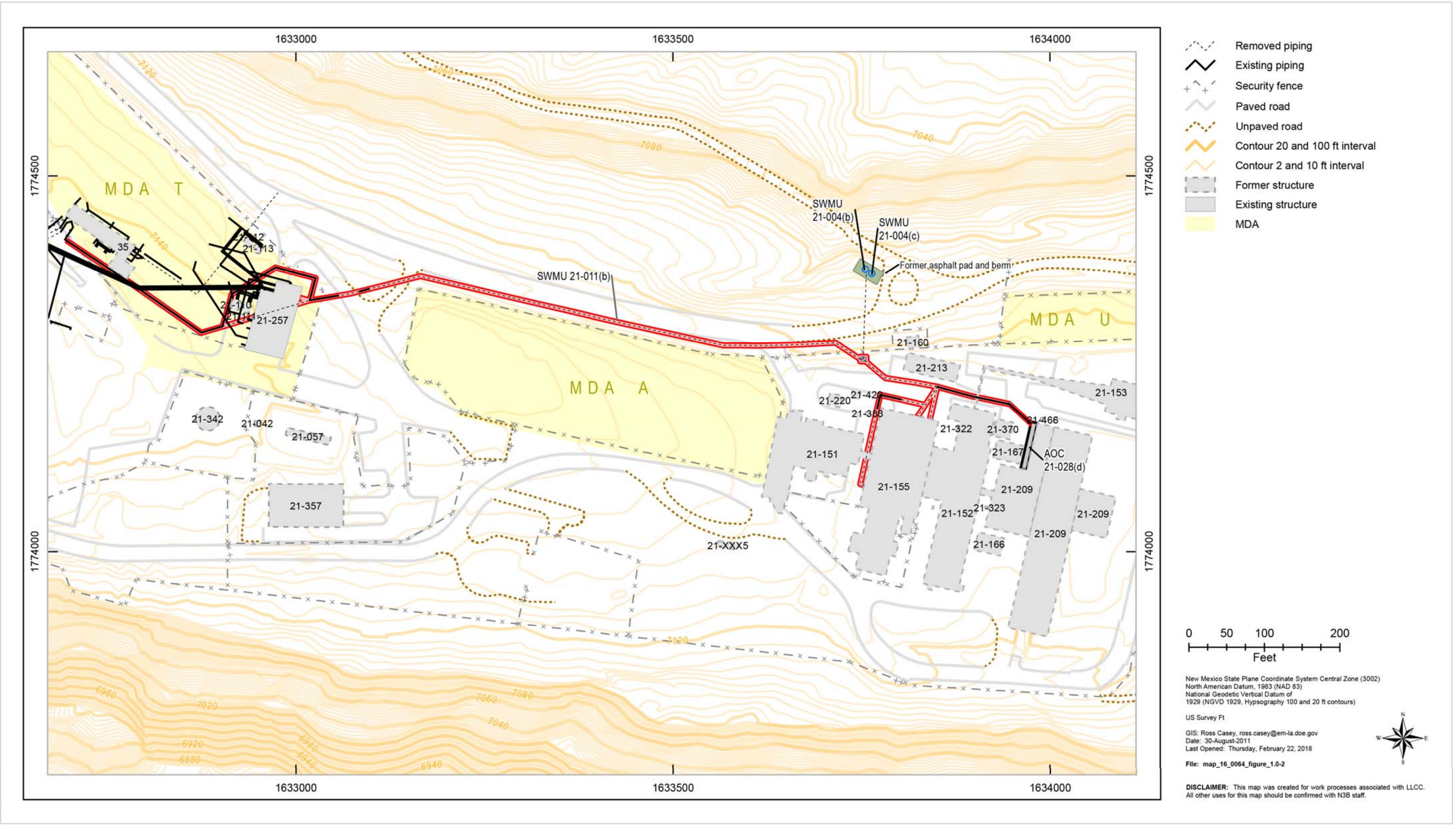
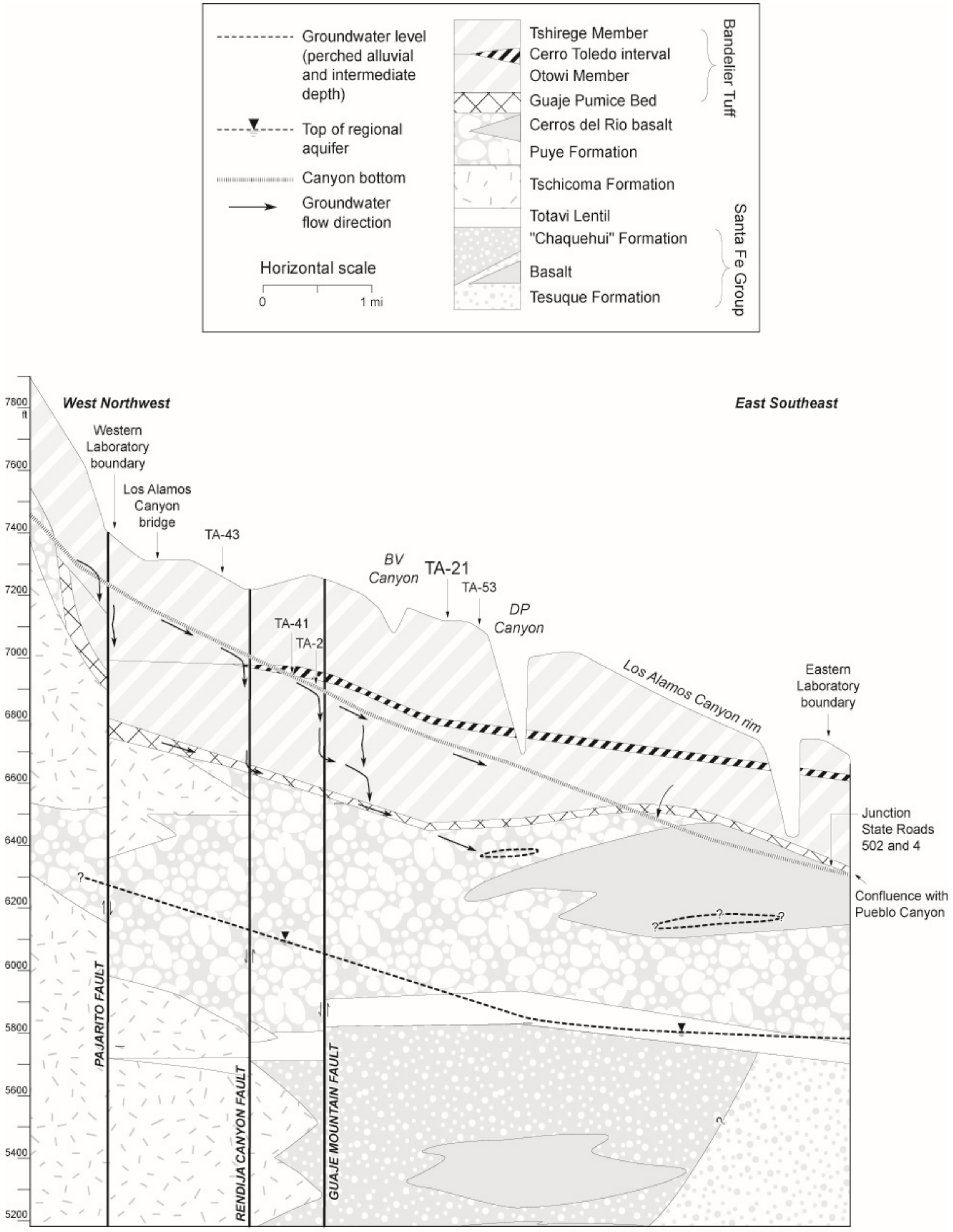
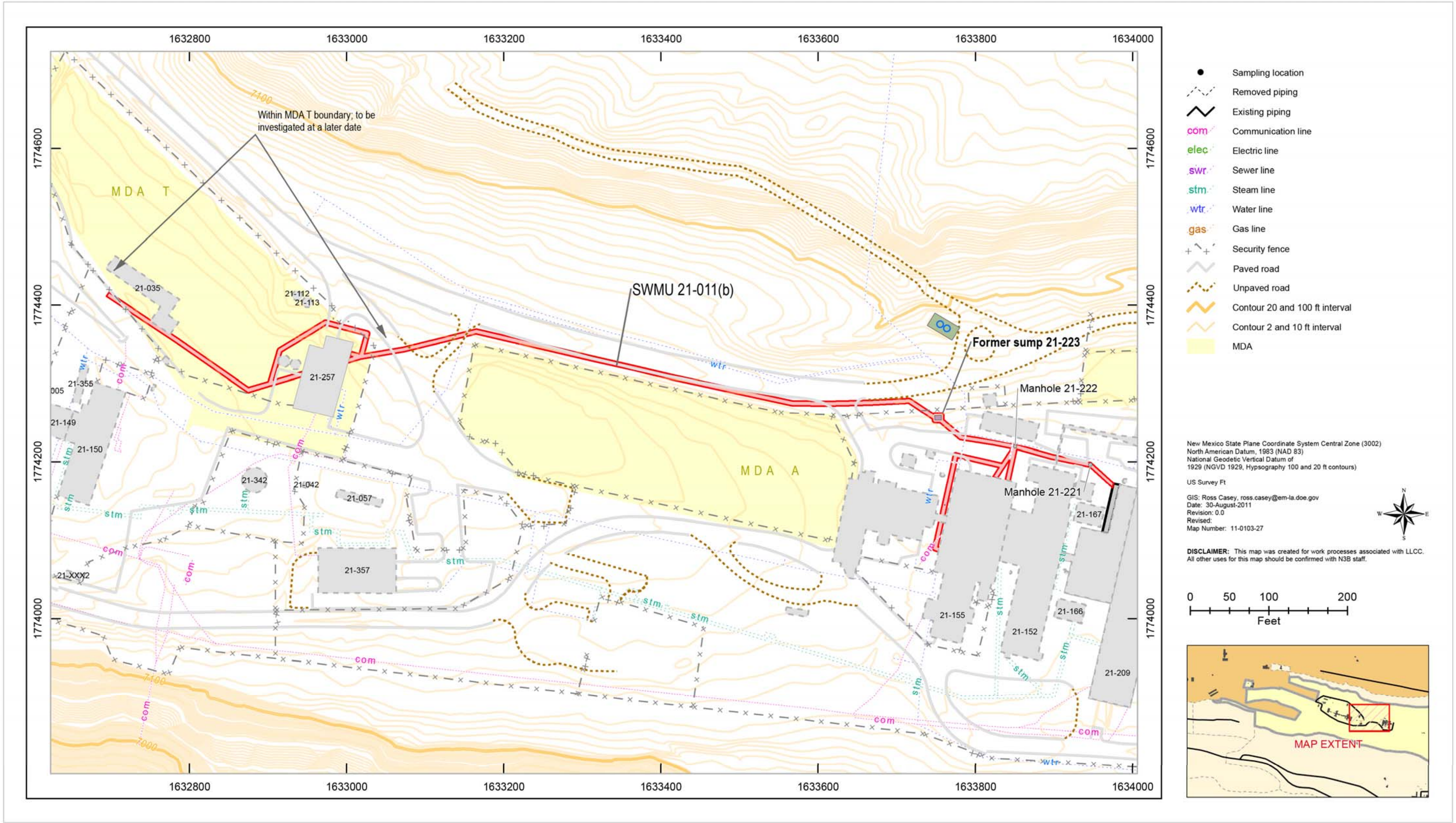


Figure 1.0-2 DP Site Aggregate Area sites addressed in this report



A. Kron 12/2/96; modified for F3.3-1/DP IWP/080303/rlm

Figure 2.2-1 General stratigraphy beneath TA-21



New Mexico State Plane Coordinate System Central Zone (3002)
North American Datum, 1983 (NAD 83)
National Geodetic Vertical Datum of
1929 (NGVD 1929, Hypsography 100 and 20 ft contours)

US Survey Ft

GIS: Ross Casey, ross.casey@em-la.doe.gov
Date: 30-August-2011
Revision: 0.0
Revised:
Map Number: 11-0103-27

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Figure 3.2-1 SWMU 21-011(b) acid waste lines and sump site map

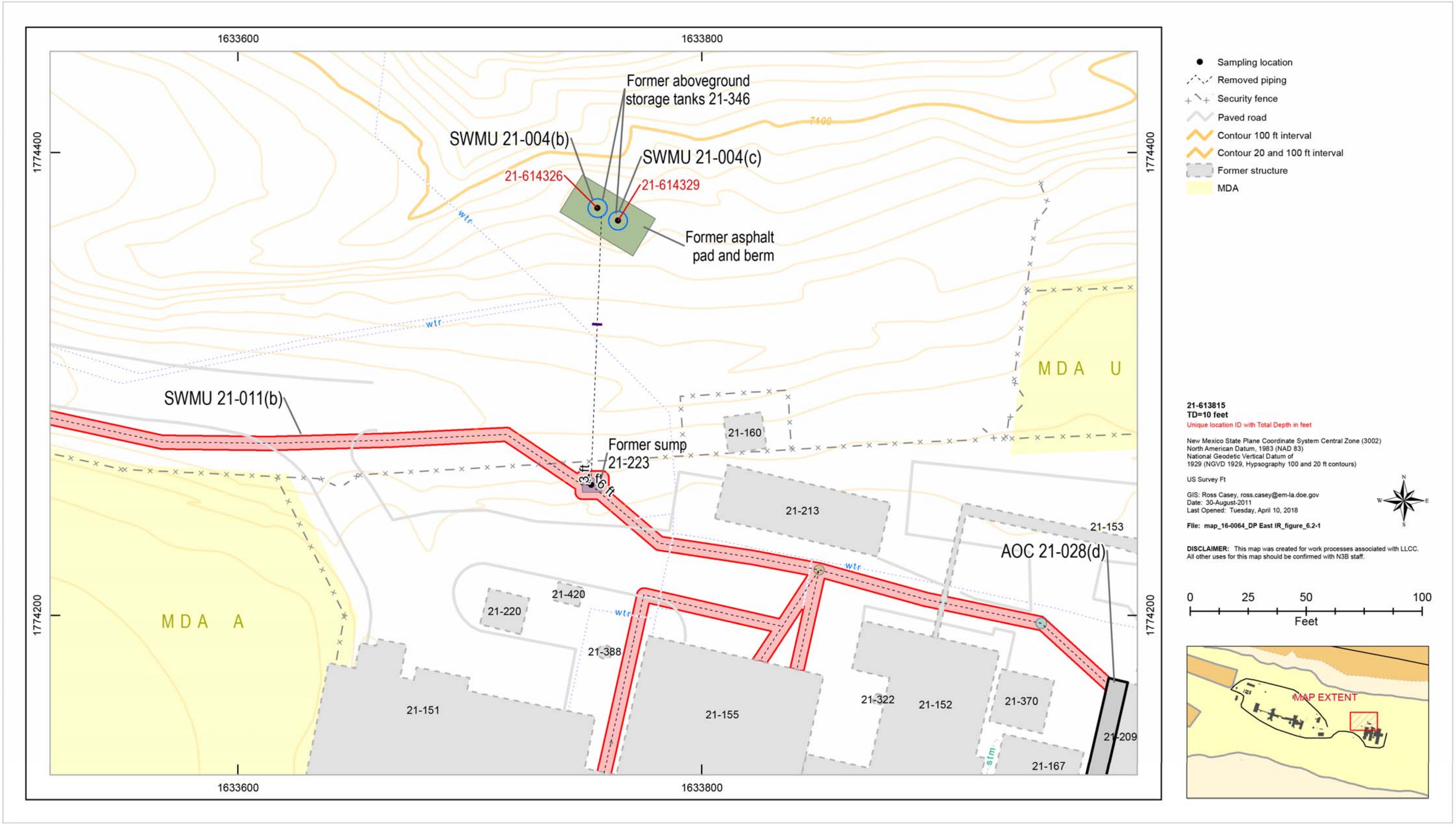


Figure 6.2-1 Site map and sampling locations for SWMUs 21-004(b) and 21-004(c)

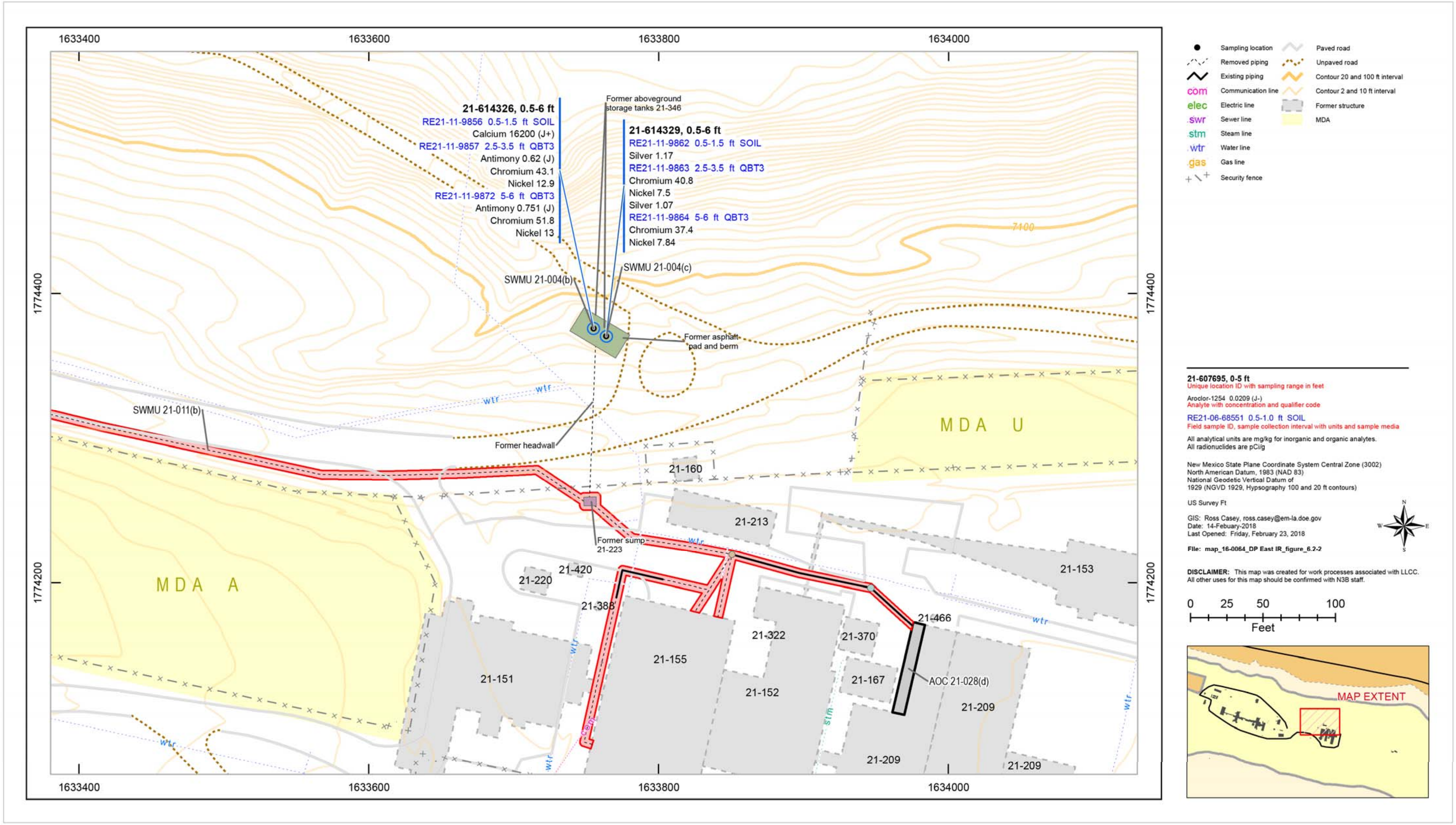


Figure 6.2-2 Inorganic chemicals detected or detected above BVs at SWMUs 21-004(b) and 21-004(c)

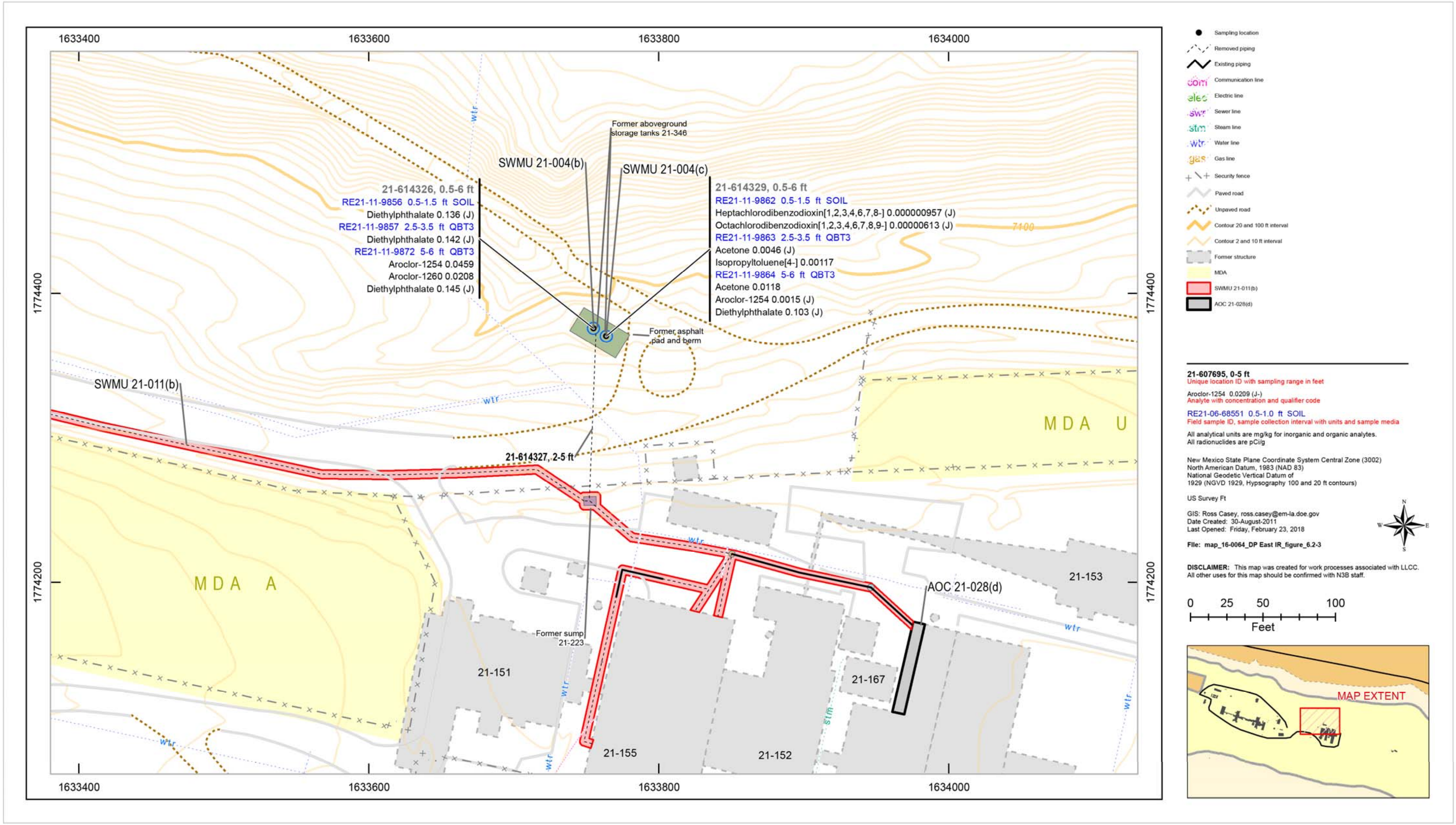


Figure 6.2-3 Organic chemicals detected at SWMUs 21-004(b) and 21-004(c)

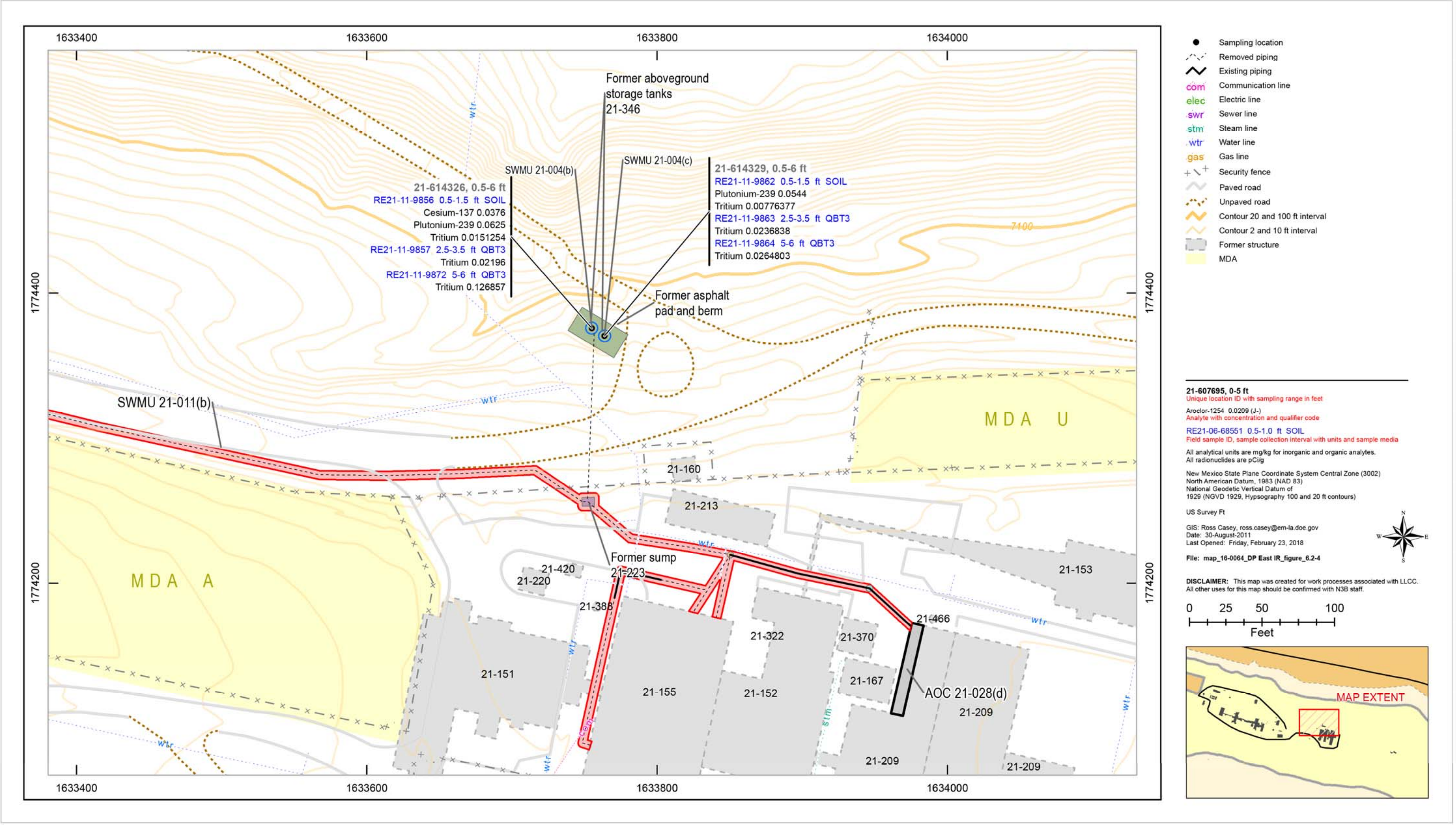


Figure 6.2-4 Radionuclides detected or detected above BVs/FVs at SWMUs 21-004(b) and 21-004(c)

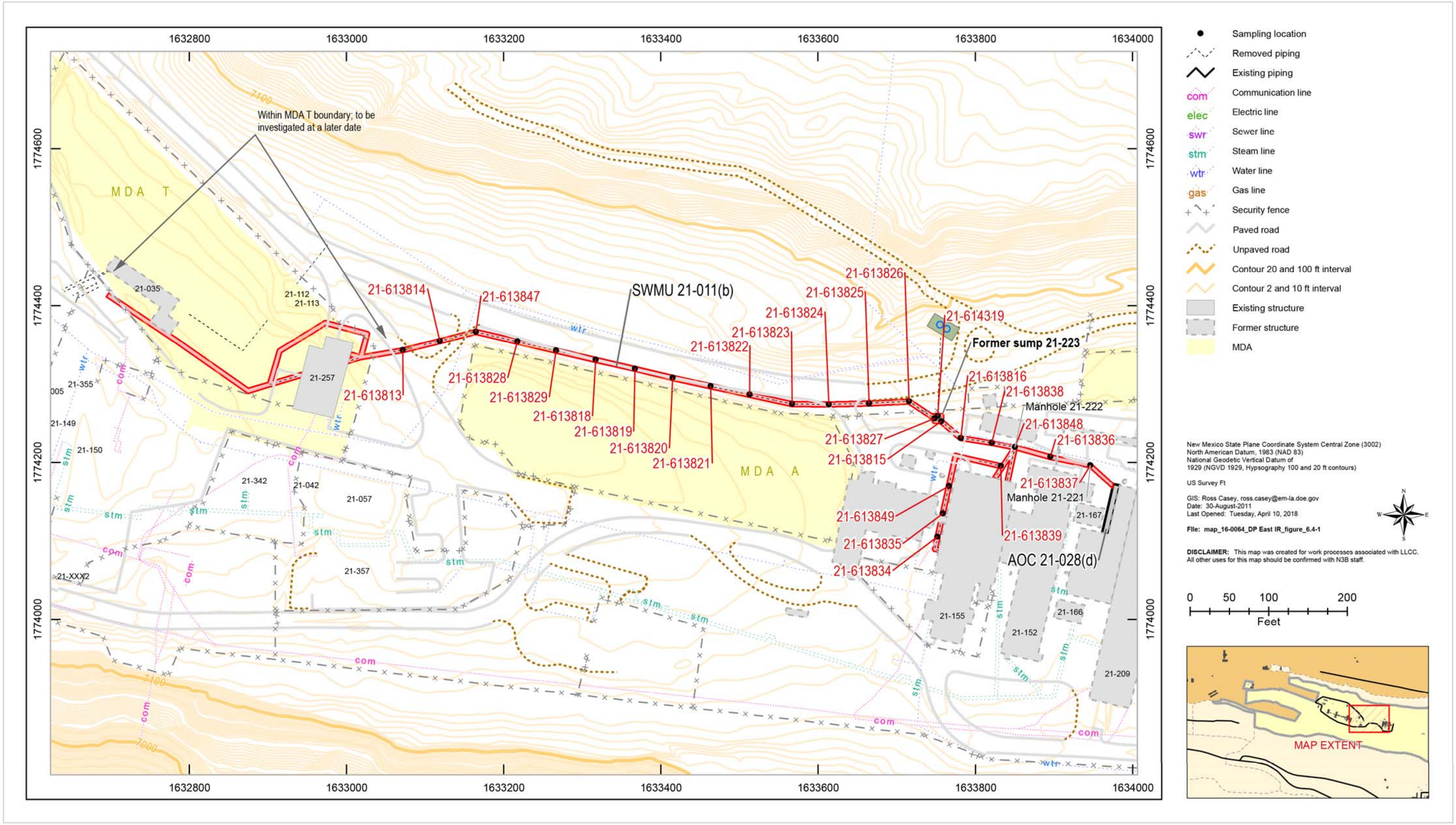
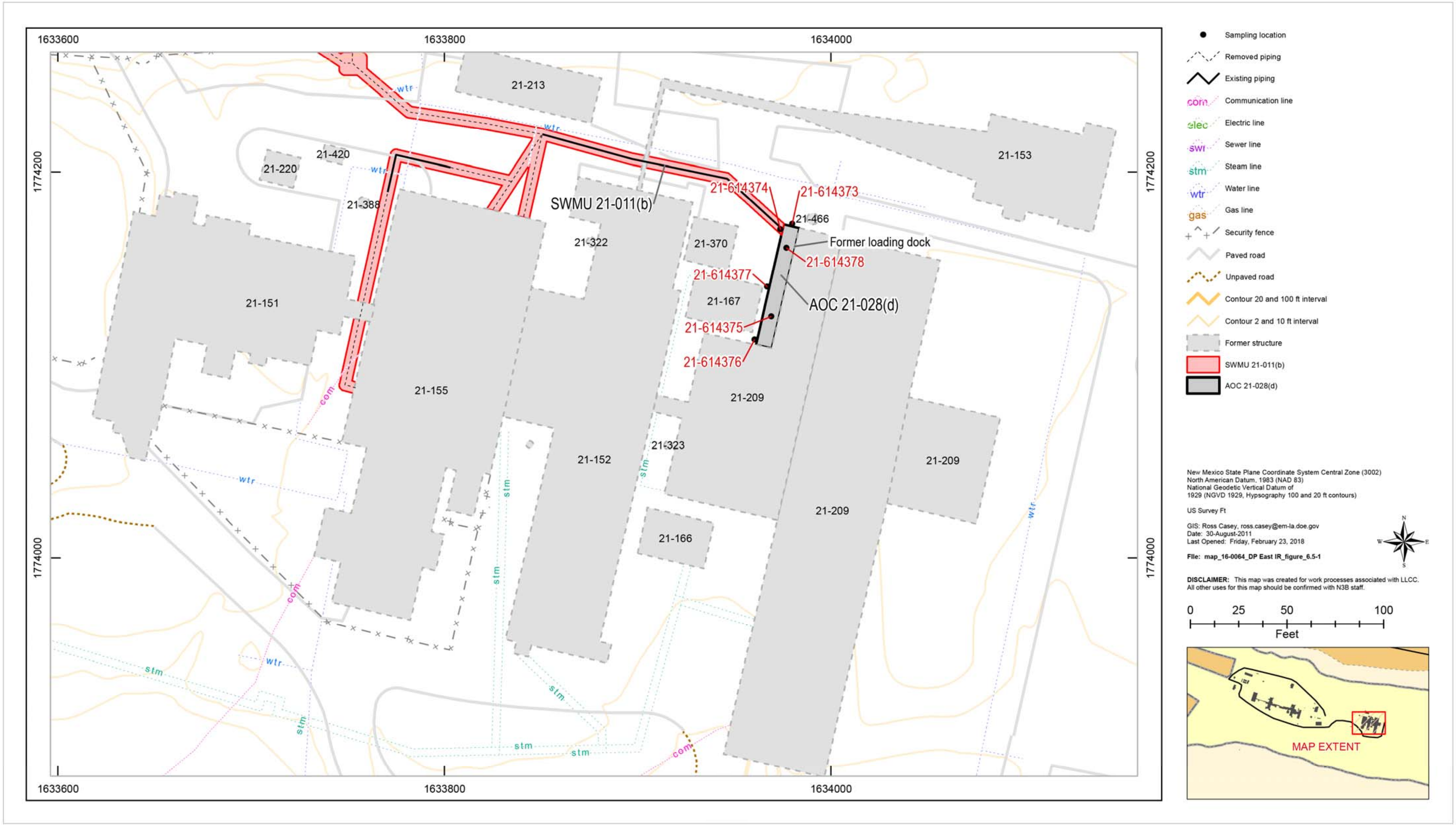


Figure 6.4-1 Site map and sampling locations at SWMU 21-011(b)



New Mexico State Plane Coordinate System Central Zone (3002)
North American Datum, 1983 (NAD 83)
National Geodetic Vertical Datum of
1929 (NGVD 1929, Hypsography 100 and 20 ft contours)

US Survey Ft

GIS: Ross Casey, ross.casey@em-la.doe.gov
Date: 30-August-2011
Last Opened: Friday, February 23, 2018

File: map_16-0064_DP East IR_figure_6.5-1

DISCLAIMER: This map was created for work processes associated with LLCC. All other uses for this map should be confirmed with N3B staff.

Figure 6.5-1 Site map and sampling locations at AOC 21-028(d)

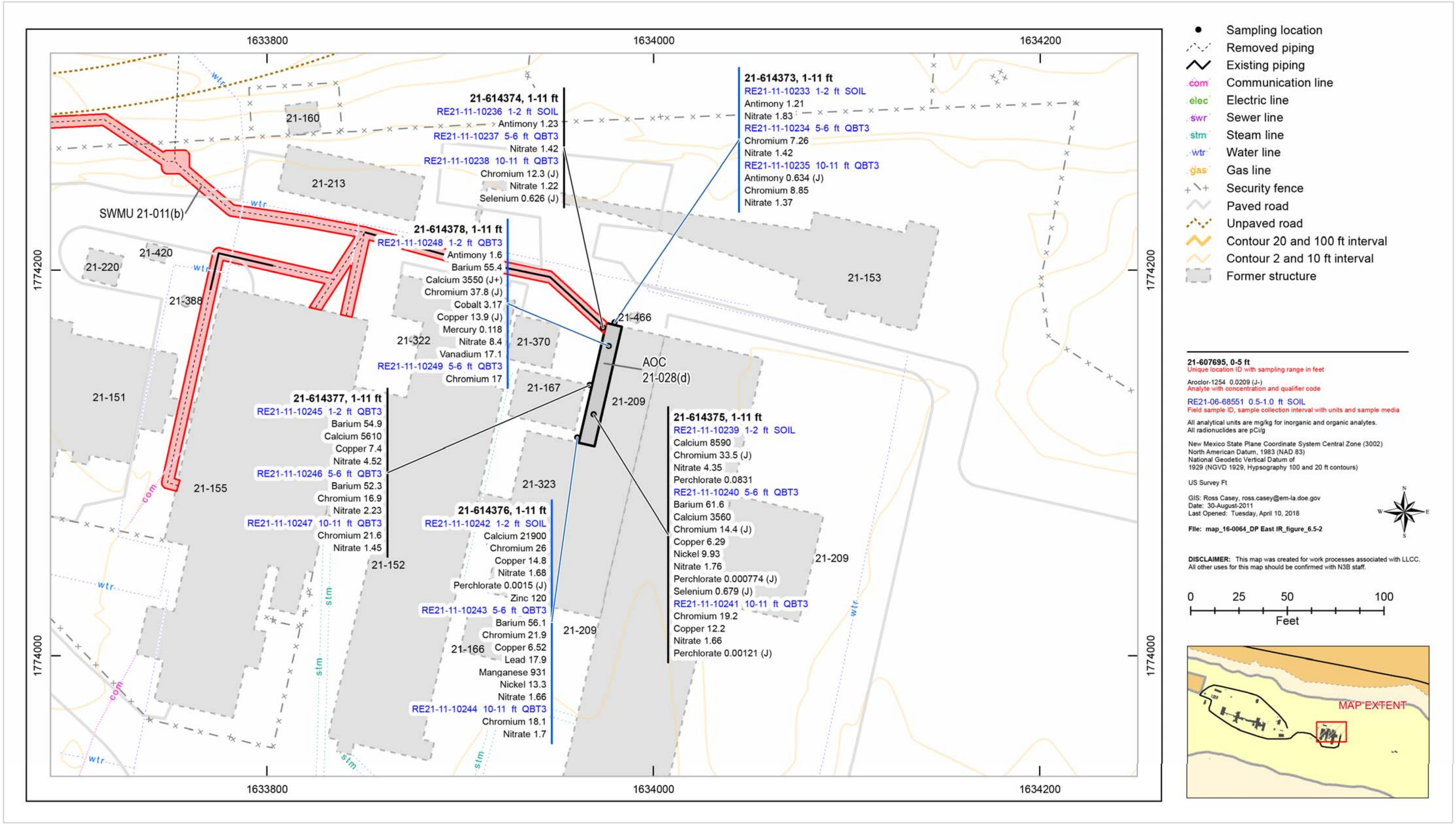


Figure 6.5-2 Inorganic chemicals detected or detected above BVs at AOC 21-028(d)

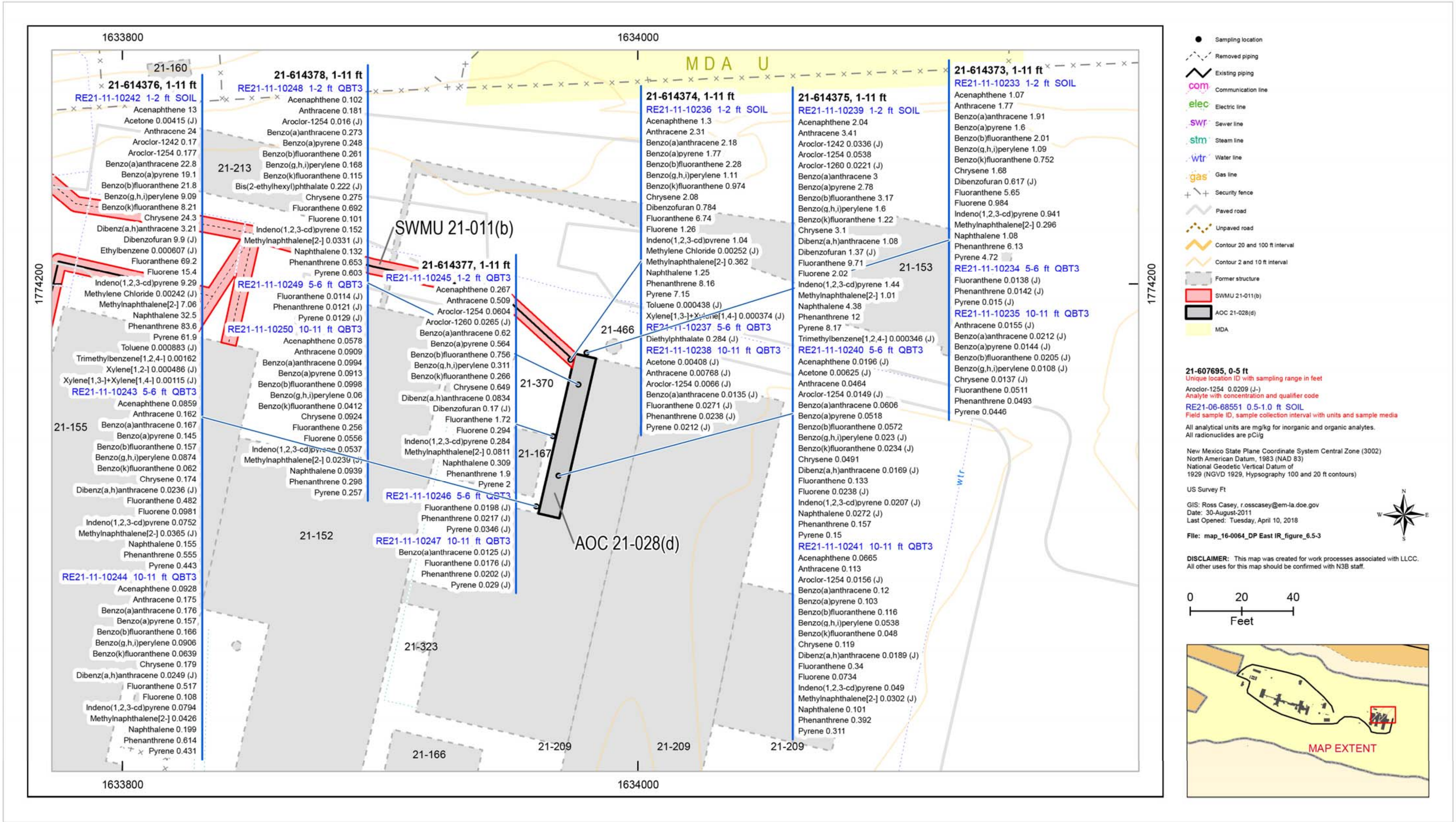


Figure 6.5-3 Organic chemicals detected at AOC 21-028(d)

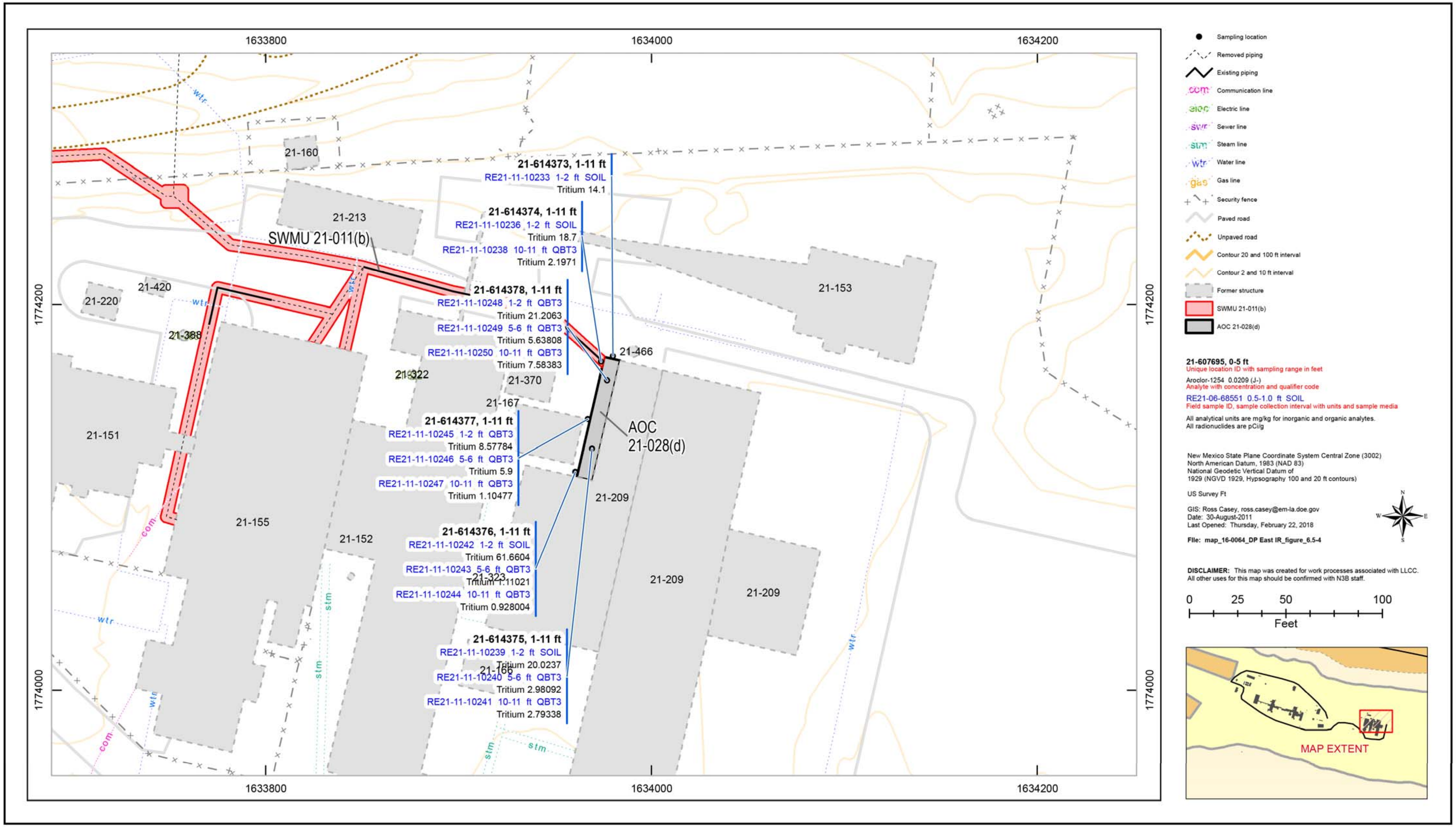


Figure 6.5-4 Radionuclides detected or detected above BVs/FVs at AOC 21-028(d)

Table 1.1-1
DP Site Aggregate Area Sites at DP East under Investigation

SWMU/AOC	Brief Description	2010–2011 Investigation	Current Status
SWMU 21-004(b)	Aboveground tank	Tank removed and sampled beneath as directed in the delayed sites work plan (LANL 2009, 108166.9) (section 6.2).	Sampled in the 2010–2011 investigation
SWMU 21-004(c)	Aboveground tank	Tank removed and sampled beneath as directed in the delayed sites work plan (LANL 2009, 108166.9) (section 6.3).	Sampled in the 2010–2011 investigation
SWMU 21-011(b)	Sump and acid waste lines	A portion of the radioactive liquid waste lines outside of Material Disposal Area T removed; upper portion of sump removed; sampled beneath as directed in the delayed sites work plan (LANL 2009, 108166.9) (section 6.4).	Sampled in the 2010–2011 investigation
AOC 21-028(d)	Container storage area	Sampled as directed in the DP East building footprints work plan (LANL 2010, 110082.4) (section 6.5).	Sampled in the 2010–2011 investigation

Table 3.2-1
Surveyed Coordinates and Corresponding Work Plan Locations for Locations Sampled

Site	Location ID	Easting (ft)	Northing (ft)	Work Plan Location ID	Work Plan
21-004(b)	21-614326	1633755.17	1774375.94	9*	DP delayed sites (LANL 2009, 108166.9)
21-004(c)	21-614329	1633764.00	1774370.52	10*	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613813	1633071.87	1774343.50	29	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613814	1633118.78	1774354.99	28	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613815	1633756.77	1774252.59	13	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613816	1633781.74	1774231.20	12	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613818	1633317.45	1774331.12	24	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613819	1633367.16	1774319.83	23	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613820	1633415.22	1774308.15	22	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613821	1633463.54	1774297.57	21	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613822	1633513.14	1774287.20	20	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613823	1633567.29	1774274.98	19	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613824	1633613.77	1774274.40	18	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613825	1633665.31	1774275.75	17	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613826	1633715.96	1774278.26	16	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613827	1633748.51	1774256.39	15	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613828	1633217.71	1774354.43	26	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613829	1633266.81	1774343.14	25	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613834	1633752.16	1774105.46	1	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613835	1633758.77	1774135.19	2	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613836	1633895.63	1774207.48	9	DP delayed sites (LANL 2009, 108166.9)

Table 3.2-1 (continued)

Site	Location ID	Easting (ft)	Northing (ft)	Work Plan Location ID	Work Plan
21-011(b)	21-613837	1633946.48	1774196.57	10	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613838	1633821.13	1774225.24	11	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613839	1633832.64	1774195.77	6	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613847	1633165.00	1774366.74	27	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613848	1633850.68	1774219.67	8	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-613849	1633766.75	1774170.03	3	DP delayed sites (LANL 2009, 108166.9)
21-011(b)	21-614319	1633752.43	1774259.37	1*	DP delayed sites (LANL 2009, 108166.9)
21-028(d)	21-614373	1633980.06	1774173.10	BH-1	DP East building footprints (LANL 2010, 110082.4)
21-028(d)	21-614374	1633973.91	1774170.33	BH-2	DP East building footprints (LANL 2010, 110082.4)
21-028(d)	21-614375	1633969.20	1774125.21	BH-6	DP East building footprints (LANL 2010, 110082.4)
21-028(d)	21-614376	1633960.64	1774113.26	BH-4	DP East building footprints (LANL 2010, 110082.4)
21-028(d)	21-614377	1633967.15	1774140.53	BH-3	DP East building footprints (LANL 2010, 110082.4)
21-028(d)	21-614378	1633977.04	1774160.68	BH-5	DP East building footprints (LANL 2010, 110082.4)

* Location included in work plan locations for Consolidated Unit 21-004(b)-99.

Table 3.2-2
Field-Screening Results for Samples Collected

Sample ID	Location ID	PID Reading (ppm)	Alpha Reading* (dpm)	Beta/Gamma Reading* (dpm)	Depth (ft)
SWMU 21-004(b)					
RE21-11-9856	21-614326	0	15	280	0.5–1.5
RE21-11-9857	21-614326	0	31	560	2.5–3.5
RE21-11-9872	21-614326	0	15	560	5–6
SWMU 21-004(c)					
RE21-11-9862	21-614329	0	15	420	0.5–1.5
RE21-11-9863	21-614329	0	15	420	2.5–3.5
RE21-11-9864	21-614329	0	46	280	5–6
SWMU 21-011(b)					
RE21-11-3822	21-613813	0	0	305	4–5
RE21-11-3823	21-613813	0	56	305	6–7
RE21-11-3824	21-613814	0	0	305	6–7
RE21-11-3825	21-613814	0	0	0	8–9
RE21-11-3826	21-613815	0	31	466	7–8
RE21-11-3827	21-613815	0	31	466	9–10
RE21-11-3828	21-613816	0	46	420	7–8
RE21-11-3829	21-613816	0	62	700	9–10
RE21-11-3832	21-613818	83.6	31	212	6–7
RE21-11-3833	21-613818	0	6	288	8–9
RE21-11-3834	21-613819	77.6	19	742	5–6
RE21-11-3835	21-613819	0	15	511	7–8
RE21-11-3836	21-613820	0	25	650	4–5
RE21-11-3837	21-613820	0	27	612	6–7
RE21-11-3838	21-613821	0	28	1219	4–5
RE21-11-3839	21-613821	0	14	914	6–7
RE21-11-3840	21-613822	0	42	1219	4–5
RE21-11-3841	21-613822	0	14	610	6–7
RE21-11-3842	21-613823	0	14	610	4–5
RE21-11-3843	21-613823	0	28	610	6–7
RE21-11-3844	21-613824	0	28	305	4–5
RE21-11-3845	21-613824	0	0	1219	6–7
RE21-11-3846	21-613825	0	28	914	4–5
RE21-11-3847	21-613825	0	28	610	6–7
RE21-11-3848	21-613826	0	0	914	4–5
RE21-11-3849	21-613826	0	28	610	6–7
RE21-11-3850	21-613827	0	0	305	4–5
RE21-11-3851	21-613827	0	0	305	6–7
RE21-11-3852	21-613828	0	14	610	5–6

Table 3.2-2 (continued)

Sample ID	Location ID	PID Reading (ppm)	Alpha Reading* (dpm)	Beta/Gamma Reading* (dpm)	Depth (ft)
RE21-11-3853	21-613828	0	0	610	7–8
RE21-11-3854	21-613829	0	42	610	5–6
RE21-11-3855	21-613829	0	141	305	7–8
RE21-11-3864	21-613834	0	31	466	1–2
RE21-11-3865	21-613834	0	15	699	3–4
RE21-11-3866	21-613835	0	46	699	2–3
RE21-11-3867	21-613835	0	46	466	3–4
RE21-11-3868	21-613836	0	34	1120	10–11
RE21-11-3869	21-613836	0	34	990	12–13
RE21-11-3870	21-613837	0	28	1090	10–11
RE21-11-3871	21-613837	0	28	960	12–13
RE21-11-3872	21-613838	0	77	840	7–8
RE21-11-3873	21-613838	0	77	700	9–10
RE21-11-3874	21-613839	0	46	560	5–6
RE21-11-3875	21-613839	0	46	560	7–8
RE21-11-3890	21-613847	0	226	305	6–7
RE21-11-3891	21-613847	0	183	305	8–9
RE21-11-3892	21-613848	0	57	900	10–11
RE21-11-3893	21-613848	0	57	1010	12–13
RE21-11-3894	21-613849	0	34	710	2–3
RE21-11-3895	21-613849	0	17	700	4–5
RE21-11-9842	21-614319	0	31	466	7–8
RE21-11-9843	21-614319	0	31	466	9–10
AOC 21-028(d)					
RE21-11-10233	21-614373	0	62	466	1–2
RE21-11-10234	21-614373	0	62	466	5–6
RE21-11-10235	21-614373	0	0	466	10–11
RE21-11-10236	21-614374	0	31	699	1–2
RE21-11-10237	21-614374	0	15	699	5–6
RE21-11-10238	21-614374	0	0	466	10–11
RE21-11-10239	21-614375	0	15	699	1–2
RE21-11-10240	21-614375	0	46	466	5–6
RE21-11-10241	21-614375	0	15	699	10–11
RE21-11-10242	21-614376	0	0	699	1–2
RE21-11-10243	21-614376	0	0	699	5–6
RE21-11-10244	21-614376	0	0	466	10–11
RE21-11-10245	21-614377	0	93	699	1–2
RE21-11-10246	21-614377	0	31	699	5–6
RE21-11-10247	21-614377	0	15	466	10–11

Table 3.2-2 (continued)

Sample ID	Location ID	PID Reading (ppm)	Alpha Reading* (dpm)	Beta/Gamma Reading* (dpm)	Depth (ft)
RE21-11-10248	21-614378	0	62	560	1–2
RE21-11-10249	21-614378	0	46	1120	5–6
RE21-11-10250	21-614378	0	31	700	10–11

*Results reported represent site background levels.

Table 3.2-3
Coordinates of Piping and Structures Left in Place

Building/SWMU or Consolidated Unit	Existing Piping/ Structure Description	West Endpoint		East Endpoint	
		X Coordinate (ft)	Y Coordinate (ft)	X Coordinate (ft)	Y Coordinate (ft)
SWMU 21-011(b)	Sump 21-223 floor	1633752.76	1774256.17	n/a*	n/a
SWMU 21-011(b)	Line northwest of building 21-155	1633770.83	1774189.69	1633803.33	1774202.42
SWMU 21-011(b)	Corner of line northwest of building 21-155	1633775.10	1774208.88	n/a	n/a
SWMU 21-011(b)	Approximate 8-ft section of line east of MDA T	1633083.87	1774346.44	1633098.17	1774349.94
SWMU 21-011(b)	Manhole 21-222 floor and line north of building 21-152	1633850.68	1774219.67	n/a	n/a
SWMU 21-011(b)	Manhole 21-221 floor and line north of building 21-152	n/a	n/a	1633946.48	1774196.57
SWMU 21-011(b)	Diagonal line between manhole 21-221 and building 21-209	n/a	n/a	1633975.16	1774170.24

*n/a = Not applicable.

Table 6.2-1
Samples Collected and Analyses Requested at SWMU 21-004(b)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Gamma-Emitting Radionuclides	Tritium	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	Technetium-99	VOCs	Cyanide (Total)
RE21-11-9856	21-614326	0.5–1.5	SOIL	11-2820[a]	11-2818	11-2820	11-2820	11-2820	11-2820	11-2820	11-2818	—[b]	11-2818	11-2820	11-2817	11-2820	—	11-2818
RE21-11-9857	21-614326	2.5–3.5	QBT3	11-2820	11-2818	11-2820	11-2820	11-2820	11-2820	11-2820	11-2818	—	11-2818	11-2820	11-2817	11-2820	11-2817	11-2818
RE21-11-9872	21-614326	5–6	QBT3	11-2820	11-2818	11-2820	11-2820	11-2820	11-2820	11-2820	11-2818	11-2817	11-2818	11-2820	11-2817	11-2820	11-2817	11-2818

[a] Analytical request number.

[b]— = Analysis not requested.

Table 6.2-2
Inorganic Chemicals Detected or Detected above BVs at SWMU 21-004(b)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Cadmium	Calcium	Chromium	Copper	Nickel	Selenium
Qbt 2,3,4 BV[a]				**0.5**	**1.63**	**2200**	**7.14**	**4.66**	**6.58**	**0.3**
Soil BV[a]				**0.83**	**0.4**	**6120**	**19.3**	**14.7**	**15.4**	**1.52**
Construction Worker SSL[b]				**142**	**72.1**	**11,100,000**	**134**[c]	**14,200**	**753**	**1750**
Industrial SSL[b]				**519**	**1110**	**40,600,000**	**505**[c]	**51,900**	**25,700**	**6490**
Residential SSL[b]				**31.3**	**70.5**	**13,000,000**	**96.6**[c]	**3130**	**1560**	**391**
RE21-11-9856	21-614326	0.5–1.5	SOIL	0.978 (U)	0.489 (U)	16,200 (J+)	—[d]	—	—	—
RE21-11-9857	21-614326	2.5–3.5	QBT3	0.62 (J)	—	—	43.1	10.5 (U)	12.9	1 (U)
RE21-11-9872	21-614326	5–6	QBT3	0.751 (J)	—	—	51.8	13 (U)	13	1.01 (U)

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

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

[b] SSLs are from NMED (2017, 602273). If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

[c] SSLs are for total chromium.

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

Table 6.2-3
Organic Chemicals Detected at SWMU 21-004(b)

Sample ID	Location ID	Depth (ft)	Media	Aroclor-1254	Aroclor-1260	Diethylphthalate
Construction Worker SSL[a]				**4.91**	**85.3**	**215,000**
Industrial SSL[a]				**11**	**11.1**	**733,000**
Residential SSL[a]				**1.14**	**2.43**	**49,300**
RE21-11-9856	21-614326	0.5–1.5	SOIL	NA[b]	NA	0.136 (J)
RE21-11-9857	21-614326	2.5–3.5	QBT3	NA	NA	0.142 (J)
RE21-11-9872	21-614326	5–6	QBT3	0.0459	0.0208	0.145 (J)

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

[a] SSLs are from NMED (2017, 602273). If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

[b] NA = Not analyzed.

Table 6.2-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 21-004(b)

Sample ID	Location ID	Depth (ft)	Media	Cesium-137	Plutonium-239/240	Tritium
Qbt 2, 3, 4 BV/FV[a]				**na**[b]	**na**	**na**
Soil BV/FV[a]				**1.65**	**0.054**	**na**
Construction Worker SAL[c]				**37**	**200**	**1,600,000**
Industrial SAL[c]				**41**	**1200**	**2,400,000**
Residential SAL[c]				**12**	**79**	**1700**
RE21-11-9856	21-614326	0.5–1.5	SOIL	0.0376	0.0625	0.0151
RE21-11-9857	21-614326	2.5–3.5	QBT3	—[d]	—	0.022
RE21-11-9872	21-614326	5–6	QBT3	—	—	0.127

Note: Results are in pCi/g.

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

[b] na = Not available.

[c] SALs are from LANL (2015, 600929).

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

Table 6.3-1
Samples Collected and Analyses Requested at SWMU 21-004(c)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	Technetium-99	VOCs	Cyanide (Total)
RE21-11-9862	21-614329	0.5–1.5	SOIL	11-2805[a]	11-2804	11-2803	11-2805	11-2805	11-2802	11-2805	11-2805	11-2805	11-2804	11-2802	11-2804	11-2805	11-2802	11-2805	—[b]	11-2804
RE21-11-9863	21-614329	2.5–3.5	QBT3	11-2805	11-2804	11-2803	11-2805	11-2805	11-2802	11-2805	11-2805	11-2805	11-2804	11-2802	11-2804	11-2805	11-2802	11-2805	11-2802	11-2804
RE21-11-9864	21-614329	5-6	QBT3	11-2820	11-2818	11-2819	11-2820	11-2820	11-2817	11-2820	11-2820	11-2820	11-2818	11-2817	11-2818	11-2820	11-2817	11-2820	11-2817	11-2818

[a] Analytical request number.

[b] — = Analysis not requested.

Table 6.3-2
Inorganic Chemicals Detected or Detected above BVs at SWMU 21-004(c)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Cadmium	Chromium	Copper	Nickel	Selenium	Silver
Qbt 2, 3, 4 BV[a]				**0.5**	**1.63**	**7.14**	**4.66**	**6.58**	**0.3**	**1**
Soil BV[a]				**0.83**	**0.4**	**19.3**	**14.7**	**15.4**	**1.52**	**1**
Construction Worker SSL[b]				**142**	**72.1**	**134[c]**	**14,200**	**753**	**1750**	**1770**
Industrial SSL[b]				**519**	**1110**	**505[c]**	**51,900**	**25,700**	**6490**	**6490**
Residential SSL[b]				**31.3**	**70.5**	**96.6[c]**	**3130**	**1560**	**391**	**391**
RE21-11-9862	21-614329	0.5–1.5	SOIL	1 (U)	0.501 (U)	—[d]	—	—	—	1.17
RE21-11-9863	21-614329	2.5–3.5	QBT3	0.971 (U)	—	40.8	7.19 (U)	7.5	0.96 (U)	1.07
RE21-11-9864	21-614329	5–6	QBT3	—	—	37.4	5.57 (U)	7.84	0.979 (U)	—

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

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

[b] SSLs are from NMED (2017, 602273). If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

[c] SSLs are for total chromium.

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

Table 6.3-3
Organic Chemicals Detected at SWMU 21-004(c)

Sample ID	Location ID	Depth (ft)	Media	Acetone	Aroclor-1254	Diethylphthalate	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	Heptachlorodibenzodioxins (Total)	Hexachlorodibenzodioxins (Total)	Isopropyltoluene[4-]	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofurans (Total)	Tetrachlorodibenzofurans (Total)
Construction Worker SSL[a]				**241,000**	**4.91**	**215,000**	**na[b]**	**na**	**na**	**2710[c]**	**na**	**na**	**na**
Industrial SSL[a]				**959,000**	**11**	**733,000**	**na**	**na**	**na**	**14,100[c]**	**na**	**na**	**na**
Residential SSL[a]				**66,300**	**1.14**	**49,300**	**na**	**na**	**na**	**2350[c]**	**na**	**na**	**na**
RE21-11-9862	21-614329	0.5–1.5	SOIL	NA[d]	—[e]	—	0.000000957 (J)	0.00000192 (J)	0.000000799 (J)	NA	0.00000613 (J)	0.000000533 (J)	0.000000436 (J)
RE21-11-9863	21-614329	2.5–3.5	QBT3	0.0046 (J)	—	—	—	—	—	0.00117	—	—	0.000000366 (J)
RE21-11-9864	21-614329	5–6	QBT3	0.0118	0.0015 (J)	0.103 (J)	—	—	—	—	—	—	—

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

[a] SSLs are from NMED (2017, 602273). If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

[b] na = Not available.

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

[d] NA = Not analyzed.

[e] — = Not detected.

Table 6.3-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 21-004(c)

Sample ID	Location ID	Depth (ft)	Media	Plutonium-239/240	Tritium
Qbt 2, 3, 4 BV/FV[a]				**na[b]**	**na**
Soil BV/FV[a]				**0.054**	**na**
Construction Worker SAL[c]				**200**	**1,600,000**
Industrial SAL[c]				**1200**	**2,400,000**
Residential SAL[c]				**79**	**1700**
RE21-11-9862	21-614329	0.5–1.5	SOIL	0.054	0.00776
RE21-11-9863	21-614329	2.5–3.5	QBT3	—	0.0237
RE21-11-9864	21-614329	5–6	QBT3	—	0.0265

Note: Results are in pCi/g.

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

[b] na = Not available.

[c] SALs are from LANL (2015, 600929).

Table 6.4-1
Samples Collected and Analyses Requested at SWMU 21-011(b)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	Technetium-99	VOCs	Cyanide (Total)
RE21-11-3822	21-613813	4–5	SOIL	11-1819[a]	11-1818	—[b]	11-1819	11-1819	—	11-1819	11-1819	11-1819	11-1818	—	11-1818	11-1819	11-1816	11-1819	11-1816	11-1818
RE21-11-3823	21-613813	6–7	QBT3	11-1819	11-1818	—	11-1819	11-1819	—	11-1819	11-1819	11-1819	11-1818	—	11-1818	11-1819	11-1816	11-1819	11-1816	11-1818
RE21-11-3824	21-613814	6–7	SOIL	11-1819	11-1818	—	11-1819	11-1819	—	11-1819	11-1819	11-1819	11-1818	—	11-1818	11-1819	11-1816	11-1819	11-1816	11-1818
RE21-11-3825	21-613814	8–9	SOIL	11-1819	11-1818	—	11-1819	11-1819	—	11-1819	11-1819	11-1819	11-1818	—	11-1818	11-1819	11-1816	11-1819	11-1816	11-1818
RE21-11-3826	21-613815	7–8	SOIL	11-2270	11-2270	—	11-2270	11-2270	—	11-2270	11-2270	11-2270	11-2270	—	11-2270	11-2270	11-2270	11-2270	11-2270	11-2270
RE21-11-3827	21-613815	9–10	QBT3	11-2270	11-2270	—	11-2270	11-2270	—	11-2270	11-2270	11-2270	11-2270	—	11-2270	11-2270	11-2270	11-2270	11-2270	11-2270
RE21-11-3828	21-613816	7–8	SOIL	11-2535	11-2534	—	11-2535	11-2535	—	11-2535	11-2535	11-2535	11-2534	—	11-2534	11-2535	11-2533	11-2535	11-2533	11-2534
RE21-11-3829	21-613816	9–10	QBT3	11-2535	11-2534	—	11-2535	11-2535	—	11-2535	11-2535	11-2535	11-2534	—	11-2534	11-2535	11-2533	11-2535	11-2533	11-2534
RE21-11-3832	21-613818	6–7	QBT3	11-1701	11-1700	—	11-1701	11-1701	—	11-1701	11-1701	11-1701	11-1700	—	11-1700	11-1701	11-1699	11-1701	11-1699	11-1700
RE21-11-3833	21-613818	8–9	QBT3	11-1701	11-1700	—	11-1701	11-1701	—	11-1701	11-1701	11-1701	11-1700	—	11-1700	11-1701	11-1699	11-1701	11-1699	11-1700
RE21-11-3834	21-613819	5–6	QBT3	11-1701	11-1700	—	11-1701	11-1701	—	11-1701	11-1701	11-1701	11-1700	—	11-1700	11-1701	11-1699	11-1701	11-1699	11-1700
RE21-11-3835	21-613819	7–8	QBT3	11-1701	11-1700	—	11-1701	11-1701	—	11-1701	11-1701	11-1701	11-1700	—	11-1700	11-1701	11-1699	11-1701	11-1699	11-1700
RE21-11-3836	21-613820	4–5	QBT3	11-1701	11-1700	—	11-1701	11-1701	—	11-1701	11-1701	11-1701	11-1700	—	11-1700	11-1701	11-1699	11-1701	11-1699	11-1700
RE21-11-3837	21-613820	6–7	QBT3	11-1701	11-2410	—	11-1701	11-1701	—	11-1701	11-1701	11-1701	11-2410	—	11-2410	11-1701	11-1699	11-1701	11-1699	11-2410
RE21-11-3838	21-613821	4–5	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3839	21-613821	6–7	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3840	21-613822	4–5	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3841	21-613822	6–7	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3842	21-613823	4–5	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3843	21-613823	6–7	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3844	21-613824	4–5	SOIL	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3845	21-613824	6–7	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3846	21-613825	4–5	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3847	21-613825	6–7	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3848	21-613826	4–5	SOIL	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3849	21-613826	6–7	QBT3	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3850	21-613827	4–5	SOIL	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3851	21-613827	6–7	SOIL	11-1741	11-1739	—	11-1741	11-1741	—	11-1741	11-1741	11-1741	11-1739	—	11-1739	11-1741	11-1740	11-1741	11-1740	11-1739
RE21-11-3852	21-613828	5–6	SOIL	11-1915	11-1914	—	11-1915	11-1915	—	11-1915	—	11-1915	11-1914	—	11-1914	11-1915	11-1913	11-1915	11-1913	11-1914
RE21-11-3853	21-613828	7–8	SOIL	11-1915	11-1914	—	11-1915	11-1915	—	11-1915	—	11-1915	11-1914	—	11-1914	11-1915	11-1913	11-1915	11-1913	11-1914
RE21-11-3854	21-613829	5–6	SOIL	11-1915	11-1914	—	11-1915	11-1915	—	11-1915	—	11-1915	11-1914	—	11-1914	11-1915	11-1913	11-1915	11-1913	11-1914
RE21-11-3855	21-613829	7–8	QBT3	11-1915	11-1914	—	11-1915	11-1915	—	11-1915	—	11-1915	11-1914	—	11-1914	11-1915	11-1913	11-1915	11-1913	11-1914

Table 6.4-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Dioxins/Furans	Gamma-Emitting Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	Technetium-99	VOCs	Cyanide (Total)
RE21-11-3864	21-613834	1–2	SOIL	11-2445	11-2444	—	11-2445	11-2445	—	11-2445	11-2445	11-2445	11-2444	—	11-2444	11-2445	11-2443	11-2445	11-2443	11-2444
RE21-11-3865	21-613834	3–4	QBT3	11-2445	11-2444	—	11-2445	11-2445	—	11-2445	11-2445	11-2445	11-2444	—	11-2444	11-2445	11-2443	11-2445	11-2443	11-2444
RE21-11-3866	21-613835	2–3	QBT3	11-2445	11-2444	—	11-2445	11-2445	—	11-2445	11-2445	11-2445	11-2444	—	11-2444	11-2445	11-2443	11-2445	11-2443	11-2444
RE21-11-3867	21-613835	3–4	SOIL	11-2445	11-2444	—	11-2445	11-2445	—	11-2445	11-2445	11-2445	11-2444	—	11-2444	11-2445	11-2443	11-2445	11-2443	11-2444
RE21-11-3868	21-613836	10–11	QBT3	11-2463	11-2462	—	11-2463	11-2463	—	11-2463	11-2463	11-2463	11-2462	—	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3869	21-613836	12–13	QBT3	11-2463	11-2462	—	11-2463	11-2463	—	11-2463	11-2463	11-2463	11-2462	—	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3870	21-613837	10–11	QBT3	11-2463	11-2462	—	11-2463	11-2463	—	11-2463	11-2463	11-2463	11-2462	—	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3871	21-613837	12–13	QBT3	11-2463	11-2462	—	11-2463	11-2463	—	11-2463	11-2463	11-2463	11-2462	—	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3872	21-613838	7–8	SOIL	11-2535	11-2534	—	11-2535	11-2535	—	11-2535	11-2535	11-2535	11-2534	—	11-2534	11-2535	11-2533	11-2535	11-2533	11-2534
RE21-11-3873	21-613838	9–10	SOIL	11-2535	11-2534	—	11-2535	11-2535	—	11-2535	11-2535	11-2535	11-2534	—	11-2534	11-2535	11-2533	11-2535	11-2533	11-2534
RE21-11-3874	21-613839	5–6	SOIL	11-2556	11-2555	—	11-2556	11-2556	—	11-2556	11-2556	11-2556	11-2555	—	11-2555	11-2556	11-2554	11-2556	11-2554	11-2555
RE21-11-3875	21-613839	7–8	SOIL	11-2556	11-2555	—	11-2556	11-2556	—	11-2556	11-2556	11-2556	11-2555	—	11-2555	11-2556	11-2554	11-2556	11-2554	11-2555
RE21-11-3890	21-613847	6–7	SOIL	11-1819	11-1818	11-1817	11-1819	11-1819	11-1816	11-1819	11-1819	11-1819	11-1818	11-1816	11-1818	11-1819	11-1816	11-1819	11-1816	11-1818
RE21-11-3891	21-613847	8–9	SOIL	11-1819	11-1818	11-1817	11-1819	11-1819	11-1816	11-1819	11-1819	11-1819	11-1818	11-1816	11-1818	11-1819	11-1816	11-1819	11-1816	11-1818
RE21-11-3892	21-613848	10–11	QBT3	11-2463	11-2462	11-2460	11-2463	11-2463	11-2461	11-2463	11-2463	11-2463	11-2462	11-2461	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3893	21-613848	12–13	QBT3	11-2463	11-2462	11-2460	11-2463	11-2463	11-2461	11-2463	11-2463	11-2463	11-2462	11-2461	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3894	21-613849	2–3	SOIL	11-2463	11-2462	11-2460	11-2463	11-2463	11-2461	11-2463	11-2463	11-2463	11-2462	11-2461	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-3895	21-613849	4–5	SOIL	11-2463	11-2462	11-2460	11-2463	11-2463	11-2461	11-2463	11-2463	11-2463	11-2462	11-2461	11-2462	11-2463	11-2461	11-2463	11-2461	11-2462
RE21-11-9842	21-614319	7–8	SOIL	11-2269	11-2269	—	11-2269	11-2269	—	11-2269	11-2269	11-2269	11-2269	—	11-2269	11-2269	11-2269	11-2269	11-2269	11-2269
RE21-11-9843	21-614319	9–10	SOIL	11-2269	11-2269	—	11-2269	11-2269	—	11-2269	11-2269	11-2269	11-2269	—	11-2269	11-2269	11-2269	11-2269	11-2269	11-2269

[a] Analytical request number.

[b] — = Analysis not requested.

Table 6.4-2
Inorganic Chemicals Detected or Detected above BVs at SWMU 21-011(b)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Cyanide (Total)
Qbt 2, 3, 4 BV[a]				**7340**	**0.5**	**46**	**1.21**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**	**0.5**
Soil BV[a]				**29200**	**0.83**	**295**	**1.83**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**	**0.5**
Construction Worker SSL[b]				**41,400**	**142**	**4390**	**148**	**72.1**	**11,100,000**	**134[c]**	**36.7**	**14,200**	**12**
Industrial SSL[b]				**1,290,000**	**519**	**255,000**	**2580**	**1110**	**40,600,000**	**505[c]**	**388**	**51,900**	**62.8**
Residential SSL[b]				**78,000**	**31.3**	**15,600**	**156**	**70.5**	**13,000,000**	**96.6[c]**	**23.4**	**3130**	**11.1**
RE21-11-3822	21-613813	4–5	SOIL	—[d]	0.966 (U)	—	—	0.483 (U)	—	—	—	—	—
RE21-11-3823	21-613813	6–7	QBT3	—	0.947 (U)	—	—	—	2400 (U)	10.9	—	—	—
RE21-11-3824	21-613814	6–7	SOIL	—	0.988 (U)	—	—	0.494 (U)	—	—	—	—	—
RE21-11-3825	21-613814	8–9	SOIL	—	1.1 (U)	—	—	0.551 (U)	—	—	—	—	—
RE21-11-3826	21-613815	7–8	SOIL	—	1.05 (U)	—	—	0.524 (U)	—	—	—	—	—
RE21-11-3827	21-613815	9–10	QBT3	—	0.989 (U)	—	—	—	—	—	—	—	—
RE21-11-3828	21-613816	7–8	SOIL	—	1.18 (U)	—	1.9	0.588 (U)	—	—	—	—	2.04
RE21-11-3829	21-613816	9–10	QBT3	—	1.16 (U)	65.9 (J-)	—	—	2900	12.9	—	5.65	—
RE21-11-3832	21-613818	6–7	QBT3	—	0.679 (U)	48.8 (J+)	—	—	—	—	—	—	—
RE21-11-3833	21-613818	8–9	QBT3	—	0.955 (U)	—	—	—	—	—	—	—	—
RE21-11-3834	21-613819	5–6	QBT3	—	0.94 (U)	81.5 (J+)	—	—	2460 (J+)	—	—	—	—
RE21-11-3835	21-613819	7–8	QBT3	—	1.01 (U)	—	—	—	—	10.2	—	—	—
RE21-11-3836	21-613820	4–5	QBT3	—	0.909 (U)	48.4 (J+)	—	—	—	—	—	—	—
RE21-11-3837	21-613820	6–7	QBT3	—	1.03 (U)	—	—	—	—	8.79	—	—	—
RE21-11-3838	21-613821	4–5	QBT3	8470	0.524 (U)	101	—	—	2220	—	—	5.59	—
RE21-11-3839	21-613821	6–7	QBT3	—	1.13 (U)	75.7	—	—	2480	—	—	5.02	—
RE21-11-3840	21-613822	4–5	QBT3	—	1.06 (U)	—	—	—	—	—	—	—	—
RE21-11-3841	21-613822	6–7	QBT3	—	1.05 (U)	—	—	—	—	—	—	—	—
RE21-11-3842	21-613823	4–5	QBT3	—	1.09 (U)	68	—	—	—	—	—	—	—
RE21-11-3843	21-613823	6–7	QBT3	—	0.996 (U)	—	—	—	—	—	—	—	—
RE21-11-3844	21-613824	4–5	SOIL	—	—	—	—	0.533 (U)	—	—	—	—	—
RE21-11-3845	21-613824	6–7	QBT3	—	0.998 (U)	—	—	—	—	—	—	—	—
RE21-11-3846	21-613825	4–5	QBT3	—	—	74.2	—	—	2250	—	—	—	—
RE21-11-3847	21-613825	6–7	QBT3	—	1.02 (U)	56.3	—	—	3120	—	—	—	—
RE21-11-3848	21-613826	4–5	SOIL	—	1.03 (U)	—	—	—	—	—	—	—	—
RE21-11-3849	21-613826	6–7	QBT3	8410	1.06 (U)	56.6	1.23	—	—	—	—	4.85	—
RE21-11-3850	21-613827	4–5	SOIL	—	—	—	—	—	10,600	—	—	—	—

Table 6.4-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Cyanide (Total)
Qbt 2, 3, 4 BV[a]				**7340**	**0.5**	**46**	**1.21**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**	**0.5**
Soil BV[a]				**29200**	**0.83**	**295**	**1.83**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**	**0.5**
Construction Worker SSL[b]				**41,400**	**142**	**4390**	**148**	**72.1**	**11,100,000**	**134[c]**	**36.7**	**14,200**	**12**
Industrial SSL[b]				**1,290,000**	**519**	**255,000**	**2580**	**1110**	**40,600,000**	**505[c]**	**388**	**51,900**	**62.8**
Residential SSL[b]				**78,000**	**31.3**	**15,600**	**156**	**70.5**	**13,000,000**	**96.6[c]**	**23.4**	**3130**	**11.1**
RE21-11-3851	21-613827	6–7	SOIL	—	1.05 (U)	—	—	0.524 (U)	—	—	—	—	—
RE21-11-3852	21-613828	5–6	SOIL	—	—	—	—	0.513 (U)	—	—	—	—	—
RE21-11-3853	21-613828	7–8	SOIL	—	1.13 (U)	—	—	0.564 (U)	—	—	—	—	—
RE21-11-3854	21-613829	5–6	SOIL	—	1.06 (U)	—	—	0.529 (U)	—	—	—	—	—
RE21-11-3855	21-613829	7–8	QBT3	—	1.01 (U)	—	—	—	—	—	—	—	—
RE21-11-3864	21-613834	1–2	SOIL	—	0.994 (UJ)	—	—	0.497 (U)	8610	—	—	23.2	—
RE21-11-3865	21-613834	3–4	QBT3	—	1.11 (UJ)	—	—	—	—	—	—	—	—
RE21-11-3866	21-613835	2–3	QBT3	—	0.984 (UJ)	—	—	—	—	—	—	—	—
RE21-11-3867	21-613835	3–4	SOIL	—	1.13 (UJ)	—	—	0.566 (U)	—	—	—	—	—
RE21-11-3868	21-613836	10–11	QBT3	—	1 (U)	—	—	—	—	30.1	—	4.91	—
RE21-11-3869	21-613836	12–13	QBT3	—	1.07 (U)	—	—	—	—	20	—	5.02	—
RE21-11-3870	21-613837	10–11	QBT3	—	1.05 (U)	—	—	—	—	19.7	—	—	—
RE21-11-3871	21-613837	12–13	QBT3	—	1.04 (U)	—	—	—	—	17.3	—	—	—
RE21-11-3872	21-613838	7–8	SOIL	—	1.1 (U)	—	—	0.552 (U)	—	—	—	—	—
RE21-11-3873	21-613838	9–10	SOIL	—	1.11 (U)	—	—	0.555 (U)	—	—	9.18 (J)	—	—
RE21-11-3874	21-613839	5–6	SOIL	—	1.25 (U)	—	—	0.507 (U)	8340 (J)	—	—	—	—
RE21-11-3875	21-613839	7–8	SOIL	—	0.878 (U)	—	—	0.555 (U)	—	—	—	—	—
RE21-11-3890	21-613847	6–7	SOIL	—	0.941 (U)	—	—	0.471 (U)	—	—	—	16.3	—
RE21-11-3891	21-613847	8–9	SOIL	—	1.11 (U)	—	—	0.554 (U)	—	20.2	—	—	—
RE21-11-3892	21-613848	10–11	QBT3	—	1.07 (U)	—	—	—	—	17.3	—	—	—
RE21-11-3893	21-613848	12–13	QBT3	—	1.07 (U)	—	—	—	—	7.75	—	—	—
RE21-11-3894	21-613849	2–3	SOIL	—	1.12 (U)	—	—	0.558 (U)	—	—	—	—	—
RE21-11-3895	21-613849	4–5	SOIL	—	1.2 (U)	—	—	0.598 (U)	—	—	—	—	—
RE21-11-9842	21-614319	7–8	SOIL	—	0.955 (U)	—	—	0.478 (U)	—	—	—	—	—
RE21-11-9843	21-614319	9–10	SOIL	—	1.04 (U)	—	—	0.519 (U)	—	—	—	—	—

Table 6.4-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Lead	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium	Silver	Zinc
Qbt 2, 3, 4 BV[a]				**11.2**	**1690**	**482**	**0.1**	**6.58**	**na[e]**	**na**	**0.3**	**1**	**63.5**
Soil BV[a]				**22.3**	**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**	**1**	**48.8**
Construction Worker SSL[b]				**800**	**1,550,000**	**464**	**77.1**	**753**	**566,000**	**248**	**1750**	**1770**	**106,000**
Industrial SSL[b]				**800**	**5,680,000**	**160,000**	**389**	**25,700**	**2,080,000**	**908**	**6490**	**6490**	**389,000**
Residential SSL[b]				**400**	**20,900,000**	**10,500**	**23.5**	**1560**	**125,000**	**54.8**	**391**	**391**	**23,500**
RE21-11-3822	21-613813	4–5	SOIL	—	—	—	—	—	4.92	—	—	—	—
RE21-11-3823	21-613813	6–7	QBT3	—	—	—	—	—	10.2	—	0.978 (U)	—	—
RE21-11-3824	21-613814	6–7	SOIL	—	—	—	—	—	1.74	—	—	—	—
RE21-11-3825	21-613814	8–9	SOIL	—	—	—	—	—	2.01	—	—	—	—
RE21-11-3826	21-613815	7–8	SOIL	—	—	—	—	—	1.32	0.000689 (J)	—	—	—
RE21-11-3827	21-613815	9–10	QBT3	—	—	—	—	—	—	—	1.01 (UJ)	—	—
RE21-11-3828	21-613816	7–8	SOIL	—	—	—	—	—	2.09	—	—	—	—
RE21-11-3829	21-613816	9–10	QBT3	12.7	—	—	—	7.51	2.03	—	1.13 (UJ)	—	—
RE21-11-3832	21-613818	6–7	QBT3	—	—	—	—	—	1.2	—	1.06 (UJ)	—	—
RE21-11-3833	21-613818	8–9	QBT3	—	—	—	—	—	1.18	—	1.04 (UJ)	—	—
RE21-11-3834	21-613819	5–6	QBT3	—	—	—	0.145	—	1.25	0.000757 (J)	0.957 (UJ)	—	—
RE21-11-3835	21-613819	7–8	QBT3	—	—	—	—	—	—	—	0.952 (UJ)	—	—
RE21-11-3836	21-613820	4–5	QBT3	—	—	—	—	—	1.53	—	1.02 (UJ)	—	—
RE21-11-3837	21-613820	6–7	QBT3	—	—	—	—	—	1.18	—	1.03 (UJ)	—	—
RE21-11-3838	21-613821	4–5	QBT3	—	1770 (J+)	—	—	6.77	—	—	1.1 (UJ)	—	—
RE21-11-3839	21-613821	6–7	QBT3	—	—	—	—	7.64	1.23	—	1.12 (UJ)	—	—
RE21-11-3840	21-613822	4–5	QBT3	—	—	—	—	—	1.21	—	1.03 (UJ)	—	—
RE21-11-3841	21-613822	6–7	QBT3	—	—	—	—	—	1.12	—	1.04 (UJ)	—	—
RE21-11-3842	21-613823	4–5	QBT3	—	—	—	—	—	1.36	—	1.07 (UJ)	—	—
RE21-11-3843	21-613823	6–7	QBT3	—	—	—	—	—	—	—	1.03 (UJ)	—	—
RE21-11-3844	21-613824	4–5	SOIL	—	—	—	0.158	—	1.19	—	-	—	—
RE21-11-3845	21-613824	6–7	QBT3	—	—	—	—	—	1.14	—	1.03 (UJ)	—	—
RE21-11-3846	21-613825	4–5	QBT3	16.3	—	—	—	—	1.15	—	1.01 (UJ)	—	—
RE21-11-3847	21-613825	6–7	QBT3	11.3	—	—	—	—	1.08	—	0.985 (UJ)	—	—
RE21-11-3848	21-613826	4–5	SOIL	—	—	—	0.138	—	1.41	0.00122 (J)	—	—	—
RE21-11-3849	21-613826	6–7	QBT3	—	—	—	—	7.82	—	0.00286	1.07 (UJ)	—	—
RE21-11-3850	21-613827	4–5	SOIL	—	—	—	—	—	10.3	0.000786 (J)	—	—	195
RE21-11-3851	21-613827	6–7	SOIL	—	—	—	0.258	—	1.59	0.001 (J)	—	—	—
RE21-11-3852	21-613828	5–6	SOIL	—	—	—	—	—	1.23	—	—	—	—
RE21-11-3853	21-613828	7–8	SOIL	—	—	—	—	—	1.35	—	—	—	—
RE21-11-3854	21-613829	5–6	SOIL	—	—	—	—	—	1.39	—	—	—	—
RE21-11-3855	21-613829	7–8	QBT3	13.2	—	—	—	—	—	—	1.02 (UJ)	—	—
RE21-11-3864	21-613834	1–2	SOIL	—	—	—	0.181	—	1.16	0.00113 (J)	—	—	—

Table 6.4-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Lead	Magnesium	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium	Silver	Zinc
Qbt 2, 3, 4 BV[a]				**11.2**	**1690**	**482**	**0.1**	**6.58**	**na[e]**	**na**	**0.3**	**1**	**63.5**
Soil BV[a]				**22.3**	**4610**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**	**1**	**48.8**
Construction Worker SSL[b]				**800**	**1,550,000**	**464**	**77.1**	**753**	**566,000**	**248**	**1750**	**1770**	**106,000**
Industrial SSL[b]				**800**	**5,680,000**	**160,000**	**389**	**25,700**	**2,080,000**	**908**	**6490**	**6490**	**389,000**
Residential SSL[b]				**400**	**20,900,000**	**10,500**	**23.5**	**1560**	**125,000**	**54.8**	**391**	**391**	**23,500**
RE21-11-3865	21-613834	3–4	QBT3	—	—	—	—	—	1.51	—	1.14 (U)	—	—
RE21-11-3866	21-613835	2–3	QBT3	—	—	—	—	—	1.56	—	1.08 (U)	—	—
RE21-11-3867	21-613835	3–4	SOIL	—	—	—	—	—	1.68	—	—	—	—
RE21-11-3868	21-613836	10–11	QBT3	—	—	—	—	—	1.56	—	1.07 (U)	—	—
RE21-11-3869	21-613836	12–13	QBT3	—	—	—	—	—	1.64	—	1.07 (U)	—	—
RE21-11-3870	21-613837	10–11	QBT3	—	—	—	—	—	1.61	—	1.01 (U)	—	—
RE21-11-3871	21-613837	12–13	QBT3	—	—	—	—	—	1.66	—	1.07 (U)	—	—
RE21-11-3872	21-613838	7–8	SOIL	—	—	—	—	—	2.57	—	—	—	—
RE21-11-3873	21-613838	9–10	SOIL	—	—	741 (J)	—	—	2.52	—	—	—	—
RE21-11-3874	21-613839	5–6	SOIL	—	—	—	—	—	—	—	—	—	—
RE21-11-3875	21-613839	7–8	SOIL	—	—	—	—	—	—	—	—	—	—
RE21-11-3890	21-613847	6–7	SOIL	—	—	—	—	—	2.8	—	—	2.35 (U)	—
RE21-11-3891	21-613847	8–9	SOIL	—	—	—	—	—	2.31	—	—	—	—
RE21-11-3892	21-613848	10–11	QBT3	—	—	—	—	—	1.37	—	1.02 (U)	—	—
RE21-11-3893	21-613848	12–13	QBT3	—	—	—	—	—	1.38	—	1.1 (U)	—	—
RE21-11-3894	21-613849	2–3	SOIL	—	—	—	—	—	1.99	—	—	—	—
RE21-11-3895	21-613849	4–5	SOIL	—	—	—	0.116	—	1.88	—	—	—	—
RE21-11-9842	21-614319	7–8	SOIL	—	—	—	0.118	—	1.38	0.000709 (J)	—	—	—
RE21-11-9843	21-614319	9–10	SOIL	—	—	—	—	—	1.6	0.0007 (J)	—	—	49.3

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

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

[b] SSLs are from NMED (2017, 602273). If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

[c] SSLs are for total chromium.

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

[e] na = Not available.

Table 6.4-3
Organic Chemicals Detected at SWMU 21-011(b)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1254	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Bis(2-ethylhexyl)phthalate	Chrysene
Construction Worker SSL[a]				**15,100**	**241,000**	**75,300**	**4.91**	**240**	**106**	**240**	**7530**[b]	**2310**	**5380**	**23,100**
Industrial SSL[a]				**50,500**	**959,000**	**253,000**	**11**	**32.3**	**23.6**	**32.3**	**25,300**[b]	**323**	**1830**	**3230**
Residential SSL[a]				**3480**	**66,300**	**17,400**	**1.14**	**1.53**	**1.12**	**1.53**	**1740**[b]	**15.3**	**380**	**153**
RE21-11-3822	21-613813	4–5	SOIL	—[c]	—	—	NA[d]	—	—	—	—	—	—	—
RE21-11-3823	21-613813	6–7	QBT3	—	—	0.0168 (J)	NA	0.03 (J)	0.0214 (J)	0.0239 (J)	0.0111 (J)	0.0118 (J)	—	0.0268 (J)
RE21-11-3824	21-613814	6–7	SOIL	—	—	—	NA	—	—	—	—	—	—	—
RE21-11-3825	21-613814	8–9	SOIL	—	—	—	NA	—	—	—	—	—	—	—
RE21-11-3826	21-613815	7–8	SOIL	0.0152 (J)	—	0.0758 (J)	NA	0.226 (J)	0.144 (J)	0.252 (J)	—	0.0818 (J)	0.114 (J)	0.238 (J)
RE21-11-3827	21-613815	9–10	QBT3	—	—	—	NA	0.0336 (J)	0.016 (J)	0.0302 (J)	—	0.0146 (J)	—	0.0255 (J)
RE21-11-3832	21-613818	6–7	QBT3	—	—	—	NA	0.0142 (J)	0.0294 (J)	0.0145 (J)	—	—	—	0.011 (J)
RE21-11-3833	21-613818	8–9	QBT3	—	0.00337 (J)	—	NA	—	—	—	—	—	—	—
RE21-11-3834	21-613819	5–6	QBT3	—	—	—	NA	0.0207 (J)	0.033 (J)	0.026 (J)	—	—	—	0.0186 (J)
RE21-11-3835	21-613819	7–8	QBT3	—	0.00176 (J)	—	NA	—	—	—	—	—	—	—
RE21-11-3836	21-613820	4–5	QBT3	—	—	—	NA	—	—	—	—	—	—	—
RE21-11-3842	21-613823	4–5	QBT3	—	—	—	NA	0.0173 (J)	0.0158 (J)	0.0223 (J)	—	—	—	0.0158 (J)
RE21-11-3844	21-613824	4–5	SOIL	—	—	0.00727 (J)	NA	0.076	0.088	0.113	0.0396	0.0494	—	0.0902
RE21-11-3846	21-613825	4–5	QBT3	—	—	—	NA	—	—	—	—	—	—	—
RE21-11-3847	21-613825	6–7	QBT3	—	—	—	NA	—	—	—	—	—	—	—
RE21-11-3848	21-613826	4–5	SOIL	—	—	0.0102 (J)	NA	0.0632	0.0695	0.126	0.0462	—	2.34	0.0603
RE21-11-3850	21-613827	4–5	SOIL	—	—	0.0096 (J)	NA	0.0224 (J)	0.0185 (J)	0.0252 (J)	—	0.0124 (J)	—	0.0206 (J)
RE21-11-3864	21-613834	1–2	SOIL	0.0157 (J)	—	0.0462	NA	0.179	0.206	0.257	0.126	0.078	—	0.198
RE21-11-3866	21-613835	2–3	QBT3	—	—	—	NA	0.0276 (J)	0.0269 (J)	0.0375	—	—	—	0.0213 (J)
RE21-11-3867	21-613835	3–4	SOIL	—	—	—	NA	0.0122 (J)	—	—	—	—	—	—
RE21-11-3868	21-613836	10–11	QBT3	—	0.00241 (J)	—	NA	—	—	—	—	—	—	—
RE21-11-3869	21-613836	12–13	QBT3	—	0.00216 (J)	—	NA	—	—	—	—	—	—	—
RE21-11-3870	21-613837	10–11	QBT3	—	0.00219 (J)	—	NA	—	—	—	—	—	—	—
RE21-11-3871	21-613837	12–13	QBT3	—	—	—	NA	0.0199 (J)	—	—	—	—	—	0.017 (J)
RE21-11-3872	21-613838	7–8	SOIL	—	—	—	NA	0.0211 (J)	0.0163 (J)	0.0236 (J)	—	—	—	0.0155 (J)

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1254	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Bis(2-ethylhexyl)phthalate	Chrysene
Construction Worker SSL[a]				**15,100**	**241,000**	**75,300**	**4.91**	**240**	**106**	**240**	**7530[b]**	**2310**	**5380**	**23,100**
Industrial SSL[a]				**50,500**	**959,000**	**253,000**	**11**	**32.3**	**23.6**	**32.3**	**25,300[b]**	**323**	**1830**	**3230**
Residential SSL[a]				**3480**	**66,300**	**17,400**	**1.14**	**1.53**	**1.12**	**1.53**	**1740[b]**	**15.3**	**380**	**153**
RE21-11-3873	21-613838	9–10	SOIL	—	—	—	NA	—	—	—	—	—	—	—
RE21-11-3874	21-613839	5–6	SOIL	—	—	0.00747 (J)	NA	0.0381	0.0349 (J)	0.0484	—	0.0203 (J)	—	0.0359
RE21-11-3890	21-613847	6–7	SOIL	—	—	0.0101 (J)	—	0.0476	0.0408	0.0545	0.0281 (J)	0.027 (J)	—	0.0382
RE21-11-3891	21-613847	8–9	SOIL	—	—	0.0195 (J)	—	0.0901	0.0764	0.105	0.0382	0.05	—	0.0611
RE21-11-3892	21-613848	10–11	QBT3	—	0.00328 (J)	—	—	—	—	—	—	—	—	—
RE21-11-3893	21-613848	12–13	QBT3	—	0.00247 (J)	—	—	—	—	—	—	—	—	—
RE21-11-3894	21-613849	2–3	SOIL	—	—	—	0.0045	0.0146 (J)	—	0.0158 (J)	—	—	—	—
RE21-11-3895	21-613849	4–5	SOIL	—	—	—	0.0106 (J)	0.0364 (J)	0.036 (J)	0.0525	0.0154 (J)	0.0186 (J)	—	0.0303 (J)
RE21-11-9843	21-614319	9–10	SOIL	—	—	—	NA	0.0157 (J)	0.0161 (J)	0.0154 (J)	—	—	—	0.0136 (J)

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Dibenz(a,h)anthracene	Diethylphthalate	Fluoranthene	Fluorene	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)
Construction Worker SSL[a]				**24**	**215,000**	**10,000**	**10,000**	**na[e]**	**na**	**na**	**na**	**na**	**na**
Industrial SSL[a]				**3.23**	**733,000**	**33,700**	**33,700**	**na**	**na**	**na**	**na**	**na**	**na**
Residential SSL[a]				**0.153**	**49,300**	**2320**	**2320**	**na**	**na**	**na**	**na**	**na**	**na**
RE21-11-3822	21-613813	4–5	SOIL	—	—	0.0207 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3823	21-613813	6–7	QBT3	—	3.06	0.0592	—	NA	NA	NA	NA	NA	NA
RE21-11-3824	21-613814	6–7	SOIL	—	—	—	—	NA	NA	NA	NA	NA	NA
RE21-11-3825	21-613814	8–9	SOIL	—	—	0.0123 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3826	21-613815	7–8	SOIL	0.0418 (J)	—	0.513 (J)	0.0188 (J)	NA	NA	NA	NA	NA	NA
RE21-11-3827	21-613815	9–10	QBT3	—	—	0.0557 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3832	21-613818	6–7	QBT3	—	—	0.0188 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3833	21-613818	8–9	QBT3	—	—	—	—	NA	NA	NA	NA	NA	NA
RE21-11-3834	21-613819	5–6	QBT3	—	—	0.0421	—	NA	NA	NA	NA	NA	NA
RE21-11-3835	21-613819	7–8	QBT3	—	—	—	—	NA	NA	NA	NA	NA	NA
RE21-11-3836	21-613820	4–5	QBT3	—	—	0.0163 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3842	21-613823	4–5	QBT3	—	—	0.0285 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3844	21-613824	4–5	SOIL	—	—	0.118	—	NA	NA	NA	NA	NA	NA
RE21-11-3846	21-613825	4–5	QBT3	—	—	0.013 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3847	21-613825	6–7	QBT3	—	—	-	—	NA	NA	NA	NA	NA	NA
RE21-11-3848	21-613826	4–5	SOIL	—	—	0.114	—	NA	NA	NA	NA	NA	NA
RE21-11-3850	21-613827	4–5	SOIL	—	—	0.0469	—	NA	NA	NA	NA	NA	NA
RE21-11-3864	21-613834	1–2	SOIL	—	—	0.335	—	NA	NA	NA	NA	NA	NA
RE21-11-3866	21-613835	2–3	QBT3	—	—	0.0405	—	NA	NA	NA	NA	NA	NA
RE21-11-3867	21-613835	3–4	SOIL	—	—	0.0134 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3868	21-613836	10–11	QBT3	—	—	—	—	NA	NA	NA	NA	NA	NA
RE21-11-3869	21-613836	12–13	QBT3	—	—	—	—	NA	NA	NA	NA	NA	NA
RE21-11-3870	21-613837	10–11	QBT3	—	—	—	—	NA	NA	NA	NA	NA	NA
RE21-11-3871	21-613837	12–13	QBT3	—	—	0.0243 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3872	21-613838	7–8	SOIL	—	—	0.0211 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3873	21-613838	9–10	SOIL	—	—	0.0164 (J)	—	NA	NA	NA	NA	NA	NA
RE21-11-3874	21-613839	5–6	SOIL	—	—	0.0622	—	NA	NA	NA	NA	NA	NA

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Dibenz(a,h)anthracene	Diethylphthalate	Fluoranthene	Fluorene	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)
Construction Worker SSL[a]				**24**	**215,000**	**10,000**	**10,000**	**na**[e]	**na**	**na**	**na**	**na**	**na**
Industrial SSL[a]				**3.23**	**733,000**	**33,700**	**33,700**	**na**	**na**	**na**	**na**	**na**	**na**
Residential SSL[a]				**0.153**	**49,300**	**2320**	**2320**	**na**	**na**	**na**	**na**	**na**	**na**
RE21-11-3890	21-613847	6–7	SOIL	—	—	0.0765	—	—	—	—	—	—	—
RE21-11-3891	21-613847	8–9	SOIL	—	—	0.13	—	—	—	—	—	—	—
RE21-11-3892	21-613848	10–11	QBT3	—	—	—	—	—	—	—	—	—	—
RE21-11-3893	21-613848	12–13	QBT3	—	—	—	—	—	—	—	—	—	—
RE21-11-3894	21-613849	2–3	SOIL	—	—	0.0182 (J)	—	0.00000465 (J)	0.00000883	0.000000627 (J)	0.00000188 (J)	—	0.000000521 (J)
RE21-11-3895	21-613849	4–5	SOIL	—	—	0.0428	—	0.0000133	0.0000254	0.00000203 (J)	0.00000597	0.000000585 (J)	0.00000272 (J)
RE21-11-9843	21-614319	9–10	SOIL	—	—	0.0147 (J)	—	NA	NA	NA	NA	NA	NA

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachlorodibenzofurans (Total)	Hexanone[2-]	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]	Methylene Chloride	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofurans (Total)	Phenanthrene	Pyrene	Tetrachlorodibenzofurans (Total)
Construction Worker SSL[a]				**na**	**1760**[f,]	**240**	**2710**[g]	**1200**	**na**	**na**	**7530**	**7530**	**na**
Industrial SSL[a]				**na**	**1300**[h]	**32.3**	**14,100**[g]	**5110**	**na**	**na**	**25,300**	**25,300**	**na**
Residential SSL[a]				**na**	**200**[h]	**1.53**	**2350**[g]	**409**	**na**	**na**	**1740**	**1740**	**na**
RE21-11-3822	21-613813	4–5	SOIL	NA	—	—	—	—	NA	NA	—	0.0265 (J)	NA
RE21-11-3823	21-613813	6–7	QBT3	NA	—	—	—	—	NA	NA	0.0617	0.0656	NA
RE21-11-3824	21-613814	6–7	SOIL	NA	—	—	0.000943 (J)	—	NA	NA	—	—	NA
RE21-11-3825	21-613814	8–9	SOIL	NA	—	—	—	—	NA	NA	—	0.0147 (J)	NA
RE21-11-3826	21-613815	7–8	SOIL	NA	—	—	—	—	NA	NA	0.164 (J)	0.438 (J)	NA
RE21-11-3827	21-613815	9–10	QBT3	NA	—	—	—	—	NA	NA	0.0126 (J)	0.0492 (J)	NA
RE21-11-3832	21-613818	6–7	QBT3	NA	—	—	—	—	NA	NA	—	0.0117 (J)	NA
RE21-11-3833	21-613818	8–9	QBT3	NA	—	—	—	—	NA	NA	—	—	NA
RE21-11-3834	21-613819	5–6	QBT3	NA	—	—	—	—	NA	NA	0.0196 (J)	0.0298 (J)	NA
RE21-11-3835	21-613819	7–8	QBT3	NA	—	—	—	—	NA	NA	—	—	NA
RE21-11-3836	21-613820	4–5	QBT3	NA	—	—	—	—	NA	NA	—	—	NA
RE21-11-3842	21-613823	4–5	QBT3	NA	—	—	—	—	NA	NA	0.0142 (J)	0.0243 (J)	NA
RE21-11-3844	21-613824	4–5	SOIL	NA	—	0.0356 (J)	—	—	NA	NA	0.0371	0.128	NA
RE21-11-3846	21-613825	4–5	QBT3	NA	—	—	—	—	NA	NA	—	0.0161 (J)	NA
RE21-11-3847	21-613825	6–7	QBT3	NA	0.0939	—	—	—	NA	NA	—	—	NA
RE21-11-3848	21-613826	4–5	SOIL	NA	—	0.0325 (J)	—	—	NA	NA	0.0685	0.144	NA
RE21-11-3850	21-613827	4–5	SOIL	NA	—	—	—	—	NA	NA	0.0441	0.0487	NA
RE21-11-3864	21-613834	1–2	SOIL	NA	—	0.0973	—	—	NA	NA	0.218	0.592	NA
RE21-11-3866	21-613835	2–3	QBT3	NA	—	—	—	—	NA	NA	0.0243 (J)	0.074	NA
RE21-11-3867	21-613835	3–4	SOIL	NA	—	—	—	—	NA	NA	—	0.0191 (J)	NA
RE21-11-3868	21-613836	10–11	QBT3	NA	—	—	—	—	NA	NA	—	—	NA
RE21-11-3869	21-613836	12–13	QBT3	NA	—	—	—	—	NA	NA	—	—	NA
RE21-11-3870	21-613837	10–11	QBT3	NA	—	—	—	—	NA	NA	—	—	NA
RE21-11-3871	21-613837	12–13	QBT3	NA	—	—	—	—	NA	NA	0.0228 (J)	0.0608	NA
RE21-11-3872	21-613838	7–8	SOIL	NA	—	—	—	—	NA	NA	—	0.0399	NA
RE21-11-3873	21-613838	9–10	SOIL	NA	—	—	—	—	NA	NA	—	0.0186 (J)	NA

Table 6.4-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Hexachlorodibenzofurans (Total)	Hexanone[2-]	Indeno(1,2,3-cd)pyrene	Isopropyltoluene[4-]	Methylene Chloride	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	Pentachlorodibenzofurans (Total)	Phenanthrene	Pyrene	Tetrachlorodibenzofurans (Total)
Construction Worker SSL[a]				**na**	**1760**[f,]	**240**	**2710**[g]	**1200**	**na**	**na**	**7530**	**7530**	**na**
Industrial SSL[a]				**na**	**1300**[h]	**32.3**	**14,100**[g]	**5110**	**na**	**na**	**25,300**	**25,300**	**na**
Residential SSL[a]				**na**	**200**[h]	**1.53**	**2350**[g]	**409**	**na**	**na**	**1740**	**1740**	**na**
RE21-11-3874	21-613839	5–6	SOIL	NA	—	0.0132 (J)	—	0.00249 (J)	NA	NA	0.0327 (J)	0.0633	NA
RE21-11-3890	21-613847	6–7	SOIL	—	—	0.0216 (J)	—	—	0.00000192 (J)	—	0.048	0.0916	—
RE21-11-3891	21-613847	8–9	SOIL	—	—	0.0306 (J)	—	—	0.00000694 (J)	—	0.0898	0.151	—
RE21-11-3892	21-613848	10–11	QBT3	—	—	—	—	—	0.0000017 (J)	—	—	—	—
RE21-11-3893	21-613848	12–13	QBT3	—	—	—	—	—	0.00000118 (J)	—	—	—	—
RE21-11-3894	21-613849	2–3	SOIL	0.00000156 (J)	—	—	—	—	0.0000397	—	—	0.0221 (J)	—
RE21-11-3895	21-613849	4–5	SOIL	0.0000048	—	0.0129 (J)	—	—	0.000132	0.000000732 (J)	0.0259 (J)	0.0691	0.000000826 (J)
RE21-11-9843	21-614319	9–10	SOIL	NA	—	—	—	—	NA	NA	—	0.0185 (J)	NA

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

[a] SSLs are from NMED (2017, 602273), unless otherwise noted. If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

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

[c] — = Not detected.

[d] NA = Not analyzed.

[e] na = Not available.

[f] Construction worker SSL calculated using toxicity value from EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017) and equation and parameters from NMED (2017, 602273).

[g] Isopropylbenzene SSL used as surrogate based on structural similarity.

[h] EPA regional screening level (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).

Table 6.4-4
Radionuclides Detected or Detected above BVs/FVs at SWMU 21-011(b)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-137	Plutonium-238	Plutonium-239/240	Thorium-228	Tritium	Uranium-235/236
Qbt 2, 3, 4 BV/FV[a]				**na**[b]	**na**	**na**	**na**	**2.52**	**na**	**0.09**
Soil BV/FV[a]				**0.013**	**1.65**	**0.023**	**0.054**	**2.28**	**na**	**0.2**
Construction Worker SAL[c]				**230**	**37**	**230**	**200**	**15**	**1,600,000**	**130**
Industrial SAL[c]				**1000**	**41**	**1300**	**1200**	**17**	**2,400,000**	**160**
Residential SAL[c]				**83**	**12**	**84**	**79**	**4.6**	**1700**	**42**
RE21-11-3822	21-613813	4–5	SOIL	0.033	—[d]	—	0.305	—	0.399	—
RE21-11-3823	21-613813	6–7	QBT3	0.121	—	—	0.172	—	0.158	—
RE21-11-3824	21-613814	6–7	SOIL	—	—	—	—	—	0.0622	—
RE21-11-3825	21-613814	8–9	SOIL	—	—	—	0.139	2.3 (J-)	0.0649	—
RE21-11-3826	21-613815	7–8	SOIL	—	—	—	0.052	—	37.5	—
RE21-11-3827	21-613815	9–10	QBT3	—	—	—	—	—	2.54	—
RE21-11-3828	21-613816	7–8	SOIL	—	—	—	—	—	0.684	—
RE21-11-3829	21-613816	9–10	QBT3	—	—	—	—	—	0.415	—
RE21-11-3832	21-613818	6–7	QBT3	0.0223	—	—	0.616	—	0.0291	—
RE21-11-3833	21-613818	8–9	QBT3	—	—	—	—	—	0.018	—
RE21-11-3834	21-613819	5–6	QBT3	0.0371	—	—	0.404	—	2.96	—
RE21-11-3835	21-613819	7–8	QBT3	—	—	—	—	—	0.0594	—
RE21-11-3836	21-613820	4–5	QBT3	—	—	—	0.282	—	0.0219	—
RE21-11-3837	21-613820	6–7	QBT3	—	—	—	0.0338	—	0.0271	—
RE21-11-3838	21-613821	4–5	QBT3	0.0335	—	—	0.46	—	0.16	—
RE21-11-3839	21-613821	6–7	QBT3	—	—	—	0.0283	—	0.145	—
RE21-11-3840	21-613822	4–5	QBT3	0.0237	—	—	0.609	—	0.0486	—
RE21-11-3841	21-613822	6–7	QBT3	—	—	—	0.0389	—	0.131	—
RE21-11-3842	21-613823	4–5	QBT3	0.0342	—	0.0142	0.977	—	247	—
RE21-11-3843	21-613823	6–7	QBT3	—	—	—	0.114	—	43.2	—
RE21-11-3844	21-613824	4–5	SOIL	0.0287	0.115	—	0.451	—	0.144	—
RE21-11-3845	21-613824	6–7	QBT3	—	—	—	0.0995	—	0.0688	—
RE21-11-3846	21-613825	4–5	QBT3	0.0697	—	0.0299	5.81	—	3.66	—
RE21-11-3847	21-613825	6–7	QBT3	—	—	—	0.0629	—	0.438	—
RE21-11-3848	21-613826	4–5	SOIL	0.0496	0.209	—	0.498	—	1560	—
RE21-11-3849	21-613826	6–7	QBT3	—	—	—	0.0352	—	9.94	0.0949
RE21-11-3850	21-613827	4–5	SOIL	—	—	—	0.0645	—	0.193	—
RE21-11-3851	21-613827	6–7	SOIL	—	—	—	0.0489	—	0.512	—
RE21-11-3852	21-613828	5–6	SOIL	—	—	—	—	NA[e]	0.035	—
RE21-11-3853	21-613828	7–8	SOIL	—	—	—	0.0366	NA	0.0382	—
RE21-11-3854	21-613829	5–6	SOIL	0.0266	—	—	0.219	NA	0.0322	—

Table 6.4-4 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-137	Plutonium-238	Plutonium-239/240	Thorium-228	Tritium	Uranium-235/236
Qbt 2, 3, 4 BV/FV[a]				**na[b]**	**na**	**na**	**na**	**2.52**	**na**	**0.09**
Soil BV/FV[a]				**0.013**	**1.65**	**0.023**	**0.054**	**2.28**	**na**	**0.2**
Construction Worker SAL[c]				**230**	**37**	**230**	**200**	**15**	**1,600,000**	**130**
Industrial SAL[c]				**1000**	**41**	**1300**	**1200**	**17**	**2,400,000**	**160**
Residential SAL[c]				**83**	**12**	**84**	**79**	**4.6**	**1700**	**42**
RE21-11-3855	21-613829	7–8	QBT3	—	—	—	0.0883	NA	—	0.0903 (J+)
RE21-11-3864	21-613834	1–2	SOIL	—	—	—	0.115	—	0.588	—
RE21-11-3865	21-613834	3–4	QBT3	—	—	—	—	—	0.643	—
RE21-11-3866	21-613835	2–3	QBT3	—	—	—	—	—	0.89	—
RE21-11-3867	21-613835	3–4	SOIL	—	—	—	—	—	0.853	—
RE21-11-3868	21-613836	10–11	QBT3	—	—	—	—	—	0.936	—
RE21-11-3869	21-613836	12–13	QBT3	—	—	—	—	—	0.93	—
RE21-11-3870	21-613837	10–11	QBT3	—	—	—	—	—	0.877	—
RE21-11-3871	21-613837	12–13	QBT3	—	—	—	—	—	0.853	—
RE21-11-3872	21-613838	7–8	SOIL	—	—	—	—	—	1.18	—
RE21-11-3873	21-613838	9–10	SOIL	0.0243	—	—	0.0447	—	1.52	—
RE21-11-3874	21-613839	5–6	SOIL	—	—	—	0.0619	—	1.29	—
RE21-11-3875	21-613839	7–8	SOIL	—	—	—	—	—	1.9	—
RE21-11-3890	21-613847	6–7	SOIL	40.6 (J-)	—	—	1620	—	18.4	—
RE21-11-3891	21-613847	8–9	SOIL	12.4	—	—	596	—	4.88	—
RE21-11-3892	21-613848	10–11	QBT3	—	—	—	—	—	0.68	—
RE21-11-3893	21-613848	12–13	QBT3	—	—	—	—	—	1.01	—
RE21-11-3894	21-613849	2–3	SOIL	—	—	—	—	—	0.75	—
RE21-11-3895	21-613849	4–5	SOIL	—	—	—	—	—	1.05	—
RE21-11-9842	21-614319	7–8	SOIL	—	—	—	0.121	—	7.63	—
RE21-11-9843	21-614319	9–10	SOIL	—	—	—	0.566	—	3.63	—

Note: Results are in pCi/g.

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

[b] na = Not available.

[c] SALs are from LANL (2015, 600929).

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

[e] NA = Not analyzed.

Table 6.5-1
Samples Collected and Analyses Requested at AOC 21-028(d)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Nitrate	Gamma-Emitting Radionuclides	Tritium	Isotopic Plutonium	Isotopic-Thorium	Isotopic-Uranium	TAL Metals	PCBs	Perchlorate	Strontium-90	SVOCs	Technetium-99	VOCs	Cyanide (Total)
RE21-11-10233	21-614373	1–2	SOIL	11-2405*	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2406	11-2405	11-2405	11-2406	11-2405	11-2406	11-2405
RE21-11-10234	21-614373	5–6	QBT3	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2406	11-2405	11-2405	11-2406	11-2405	11-2406	11-2405
RE21-11-10235	21-614373	10–11	QBT3	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2406	11-2405	11-2405	11-2406	11-2405	11-2406	11-2405
RE21-11-10236	21-614374	1–2	SOIL	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2406	11-2405	11-2405	11-2406	11-2405	11-2406	11-2405
RE21-11-10237	21-614374	5–6	QBT3	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2405	11-2406	11-2405	11-2405	11-2406	11-2405	11-2406	11-2405
RE21-11-10238	21-614374	10–11	QBT3	11-2420	11-2419	11-2420	11-2420	11-2420	11-2420	11-2420	11-2419	11-2418	11-2419	11-2420	11-2418	11-2420	11-2418	11-2419
RE21-11-10239	21-614375	1–2	SOIL	11-2420	11-2419	11-2420	11-2420	11-2420	11-2420	11-2420	11-2419	11-2418	11-2419	11-2420	11-2418	11-2420	11-2418	11-2419
RE21-11-10240	21-614375	5–6	QBT3	11-2420	11-2419	11-2420	11-2420	11-2420	11-2420	11-2420	11-2419	11-2418	11-2419	11-2420	11-2418	11-2420	11-2418	11-2419
RE21-11-10241	21-614375	10–11	QBT3	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10242	21-614376	1–2	SOIL	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10243	21-614376	5–6	QBT3	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10244	21-614376	10–11	QBT3	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10245	21-614377	1–2	QBT3	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10246	21-614377	5–6	QBT3	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10247	21-614377	10–11	QBT3	11-2451	11-2450	11-2451	11-2451	11-2451	11-2451	11-2451	11-2450	11-2449	11-2450	11-2451	11-2449	11-2451	11-2449	11-2450
RE21-11-10248	21-614378	1–2	QBT3	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485	11-2485
RE21-11-10249	21-614378	5–6	QBT3	11-2496	11-2496	11-2496	11-2496	11-2496	11-2496	11-2496	11-2496	11-2497	11-2496	11-2496	11-2497	11-2496	11-2497	11-2496
RE21-11-10250	21-614378	10–11	QBT3	11-2496	11-2496	11-2496	11-2496	11-2496	11-2496	11-2496	11-2496	11-2497	11-2496	11-2496	11-2497	11-2496	11-2497	11-2496

* Analytical request number.

Table 6.5-2
Inorganic Chemicals Detected or Detected above BVs at AOC 21-028(d)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Barium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Nitrate	Perchlorate	Selenium	Silver	Vanadium	Zinc
Qbt 2, 3, 4 BV[a]				**0.5**	**46**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**	**11.2**	**482**	**0.1**	**6.58**	**na[b]**	**na**	**0.3**	**1**	**17**	**63.5**
Soil BV[a]				**0.83**	**295**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**	**22.3**	**671**	**0.1**	**15.4**	**na**	**na**	**1.52**	**1**	**39.6**	**48.8**
Construction Worker SSL[c]				**142**	**4390**	**72.1**	**11,100,000**	**134[d]**	**36.7**	**14,200**	**800**	**464**	**77.1**	**753**	**566,000**	**248**	**1750**	**1770**	**614**	**106,000**
Industrial SSL[c]				**519**	**255,000**	**1110**	**40,600,000**	**505[d]**	**388**	**51,900**	**800**	**160,000**	**389**	**25,700**	**2,080,000**	**908**	**6490**	**6490**	**6530**	**389,000**
Residential SSL[c]				**31.3**	**15,600**	**70.5**	**13,000,000**	**96.6[d]**	**23.4**	**3130**	**400**	**10,500**	**23.5**	**1560**	**125,000**	**54.8**	**391**	**391**	**394**	**23,500**
RE21-11-10233	21-614373	1–2	SOIL	1.21	—[e]	—	—	—	—	—	—	—	—	—	1.83	—	—	—	—	—
RE21-11-10234	21-614373	5–6	QBT3	1.04 (U)	—	—	—	7.26	—	—	—	—	—	—	1.42	—	1.1 (U)	—	—	—
RE21-11-10235	21-614373	10–11	QBT3	0.634 (J)	—	—	—	8.85	—	—	—	—	—	—	1.37	—	1.05 (U)	2.58 (U)	—	—
RE21-11-10236	21-614374	1–2	SOIL	1.23	—	0.468 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE21-11-10237	21-614374	5–6	QBT3	1.05 (U)	—	—	—	—	—	—	—	—	—	—	1.42	—	1.05 (U)	—	—	—
RE21-11-10238	21-614374	10–11	QBT3	0.714 (U)	—	—	—	12.3 (J)	—	—	—	—	—	—	1.22	—	0.626 (J)	—	—	—
RE21-11-10239	21-614375	1–2	SOIL	1.53 (U)	—	0.48 (U)	8590	33.5 (J)	—	—	—	—	—	—	4.35	0.0831	—	—	—	—
RE21-11-10240	21-614375	5–6	QBT3	1.25 (U)	61.6	—	3560	14.4 (J)	—	6.29	—	—	—	9.93	1.76	0.000774 (J)	0.679 (J)	—	—	—
RE21-11-10241	21-614375	10–11	QBT3	1.05 (UJ)	—	—	—	19.2	—	12.2	—	—	—	—	1.66	0.00121 (J)	1.03 (U)	—	—	—
RE21-11-10242	21-614376	1–2	SOIL	1.02 (UJ)	—	0.51 (U)	21,900	26	—	14.8	—	—	—	—	1.68	0.0015 (J)	—	—	—	120
RE21-11-10243	21-614376	5–6	QBT3	1.08 (UJ)	56.1	—	—	21.9	—	6.52	17.9	931	—	13.3	1.66	—	1.03 (U)	—	—	—
RE21-11-10244	21-614376	10–11	QBT3	1.04 (UJ)	—	—	—	18.1	—	—	—	—	—	—	1.7	—	1.05 (U)	—	—	—
RE21-11-10245	21-614377	1–2	QBT3	1.1 (UJ)	54.9	—	5610	—	—	7.4	—	—	—	—	4.52	—	1.04 (U)	—	—	—
RE21-11-10246	21-614377	5–6	QBT3	1.13 (UJ)	52.3	—	—	16.9	—	—	—	—	—	—	2.23	—	1.08 (U)	—	—	—
RE21-11-10247	21-614377	10–11	QBT3	1.11 (UJ)	—	—	—	21.6	—	—	—	—	—	—	1.45	—	1.05 (U)	—	—	—
RE21-11-10248	21-614378	1–2	QBT3	1.6	55.4	—	3550 (J+)	37.8 (J)	3.17	13.9 (J)	—	—	0.118	—	8.4	—	0.986 (UJ)	1.29 (U)	17.1	—
RE21-11-10249	21-614378	5–6	QBT3	—	—	—	—	17	—	—	—	—	—	—	—	—	1.1 (U)	—	—	—
RE21-11-10250	21-614378	10–11	QBT3	1.06 (U)	—	—	—	—	—	—	—	—	—	—	—	—	1.1 (U)	—	—	—

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

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

[b] na = Not available.

[c] SSLs are from NMED (2017, 602273). If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

[d] SSLs are for total chromium.

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

Table 6.5-3
Organic Chemicals Detected at AOC 21-028(d)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Aroclor-1242	Aroclor-1254	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	Dibenzofuran
Construction Worker SSL[a]				**15,100**	**241,000**	**75,300**	**85.3**	**4.91**	**85.3**	**240**	**106**	**240**	**7530[b]**	**2310**	**5380**	**23,100**	**24**	**354[c]**
Industrial SSL[a]				**50,500**	**959,000**	**253,000**	**10.9**	**11**	**11.1**	**32.3**	**23.6**	**32.3**	**25,300[b]**	**323**	**1830**	**3230**	**3.23**	**1000[d]**
Residential SSL[a]				**3480**	**66,300**	**17,400**	**2.43**	**1.14**	**2.43**	**1.53**	**1.12**	**1.53**	**1740[b]**	**15.3**	**380**	**153**	**0.153**	**73[d]**
RE21-11-10233	21-614373	1–2	SOIL	1.07	—[e]	1.77	—	—	—	1.91	1.6	2.01	1.09	0.752	—	1.68	—	0.617 (J)
RE21-11-10234	21-614373	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE21-11-10235	21-614373	10–11	QBT3	—	—	0.0155 (J)	—	—	—	0.0212 (J)	0.0144 (J)	0.0205 (J)	0.0108 (J)	—	—	0.0137 (J)	—	—
RE21-11-10236	21-614374	1–2	SOIL	1.3	—	2.31	—	—	—	2.18	1.77	2.28	1.11	0.974	—	2.08	—	0.784
RE21-11-10237	21-614374	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE21-11-10238	21-614374	10–11	QBT3	—	0.00408 (J)	0.00768 (J)	—	0.0066 (J)	—	0.0135 (J)	—	—	—	—	—	—	—	—
RE21-11-10239	21-614375	1–2	SOIL	2.04	—	3.41	0.0336 (J)	0.0538	0.0221 (J)	3	2.78	3.17	1.6	1.22	—	3.1	1.08	1.37 (J)
RE21-11-10240	21-614375	5–6	QBT3	0.0196 (J)	0.00625 (J)	0.0464	—	0.0149 (J)	—	0.0606	0.0518	0.0572	0.023 (J)	0.0234 (J)	—	0.0491	0.0169 (J)	—
RE21-11-10241	21-614375	10–11	QBT3	0.0665	—	0.113	—	0.0156 (J)	—	0.12	0.103	0.116	0.0538	0.048	—	0.119	0.0189 (J)	—
RE21-11-10242	21-614376	1–2	SOIL	13	0.00415 (J)	24	0.17	0.177	—	22.8	19.1	21.8	9.09	8.21	—	24.3	3.21	9.9 (J)
RE21-11-10243	21-614376	5–6	QBT3	0.0859	—	0.162	—	—	—	0.167	0.145	0.157	0.0874	0.062	—	0.174	0.0236 (J)	—
RE21-11-10244	21-614376	10–11	QBT3	0.0928	—	0.175	—	—	—	0.176	0.157	0.166	0.0906	0.0639	—	0.179	0.0249 (J)	—
RE21-11-10245	21-614377	1–2	QBT3	0.267	—	0.509	—	0.0604	0.0265 (J)	0.62	0.564	0.756	0.311	0.266	—	0.649	0.0834	0.17 (J)
RE21-11-10246	21-614377	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE21-11-10247	21-614377	10–11	QBT3	—	—	—	—	—	—	0.0125 (J)	—	—	—	—	—	—	—	—
RE21-11-10248	21-614378	1–2	QBT3	0.102	—	0.181	—	0.016 (J)	—	0.273	0.248	0.261	0.168	0.115	0.222 (J)	0.275	—	—
RE21-11-10249	21-614378	5–6	QBT3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RE21-11-10250	21-614378	10–11	QBT3	0.0578	—	0.0909	—	—	—	0.0994	0.0913	0.0998	0.06	0.0412	—	0.0924	—	—

Table 6.5-3 (continued)

Sample ID	Location ID	Depth (ft)	Media	Diethylphthalate	Ethylbenzene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Methylene Chloride	Methylnaphthalene[2-]	Naphthalene	Phenanthrene	Pyrene	Toluene	Trimethylbenzene[1,2,4-]	Xylene[1,2-]	Xylene[1,3-]+Xylene[1,4-]
Construction Worker SSL[a]				**215,000**	**1760**	**10,000**	**10,000**	**240**	**1200**	**1000**	**5020**	**7530**	**7530**	**14,000**	**245**[c]	**729**	**791**[f]
Industrial SSL[a]				**733,000**	**365**	**33,700**	**33,700**	**32.3**	**5110**	**3370**	**16,800**	**25,300**	**25,300**	**61,100**	**240**[d]	**3910**	**4240**[f]
Residential SSL[a]				**49,300**	**74.5**	**2320**	**2320**	**1.53**	**409**	**232**	**1160**	**1740**	**1740**	**5220**	**58**[d]	**798**	**863**[f]
RE21-11-10233	21-614373	1–2	SOIL	—	—	5.65	0.984	0.941	—	0.296	1.08	6.13	4.72	—	—	—	—
RE21-11-10234	21-614373	5–6	QBT3	—	—	0.0138 (J)	—	—	—	—	—	0.0142 (J)	0.015 (J)	—	—	—	—
RE21-11-10235	21-614373	10–11	QBT3	—	—	0.0511	—	—	—	—	—	0.0493	0.0446	—	—	—	—
RE21-11-10236	21-614374	1–2	SOIL	—	—	6.74	1.26	1.04	0.00252 (J)	0.362	1.25	8.16	7.15	0.000438 (J)	—	—	0.000374 (J)
RE21-11-10237	21-614374	5–6	QBT3	0.284 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
RE21-11-10238	21-614374	10–11	QBT3	—	—	0.0271 (J)	—	—	—	—	—	0.0238 (J)	0.0212 (J)	—	—	—	—
RE21-11-10239	21-614375	1–2	SOIL	—	—	9.71	2.02	1.44	—	1.01	4.38	12	8.17	—	0.000346 (J)	—	—
RE21-11-10240	21-614375	5–6	QBT3	—	—	0.133	0.0238 (J)	0.0207 (J)	—	—	0.0272 (J)	0.157	0.15	—	—	—	—
RE21-11-10241	21-614375	10–11	QBT3	—	—	0.34	0.0734	0.049	—	0.0302 (J)	0.101	0.392	0.311	—	—	—	—
RE21-11-10242	21-614376	1–2	SOIL	—	0.000607 (J)	69.2	15.4	9.29	0.00242 (J)	7.06	32.5	83.6	61.9	0.000883 (J)	0.00162	0.000486 (J)	0.00115 (J)
RE21-11-10243	21-614376	5–6	QBT3	—	—	0.482	0.0981	0.0752	—	0.0365 (J)	0.155	0.555	0.443	—	—	—	—
RE21-11-10244	21-614376	10–11	QBT3	—	—	0.517	0.108	0.0794	—	0.0426	0.199	0.614	0.431	—	—	—	—
RE21-11-10245	21-614377	1–2	QBT3	—	—	1.72	0.294	0.284	—	0.0811	0.309	1.9	2	—	—	—	—
RE21-11-10246	21-614377	5–6	QBT3	—	—	0.0198 (J)	—	—	—	—	—	0.0217 (J)	0.0346 (J)	—	—	—	—
RE21-11-10247	21-614377	10–11	QBT3	—	—	0.0176 (J)	—	—	—	—	—	0.0202 (J)	0.029 (J)	—	—	—	—
RE21-11-10248	21-614378	1–2	QBT3	—	—	0.692	0.101	0.152	—	0.0331 (J)	0.132	0.653	0.603	—	—	—	—
RE21-11-10249	21-614378	5–6	QBT3	—	—	0.0114 (J)	—	—	—	—	—	0.0121 (J)	0.0129 (J)	—	—	—	—
RE21-11-10250	21-614378	10–11	QBT3	—	—	0.256	0.0556	0.0537	—	0.0239 (J)	0.0939	0.298	0.257	—	—	—	—

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

[a] SSLs are from NMED (2017, 602273) unless otherwise noted. If chemical has both carcinogenic and noncarcinogenic SSLs, the lower of the two is presented.

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

[c] Construction worker SSL calculated using toxicity value from EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017) and equation and parameters from NMED (2017, 602273).

[d] EPA regional screening level (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)

[e] — = Not detected.

[f] Xylenes SSL used as surrogate based on structural similarity.

Table 6.5-4
Radionuclides Detected or Detected above BVs/FVs at AOC 21-028(d)

Sample ID	Location ID	Depth (ft)	Media	Tritium
Qbt 2, 3, 4 BV/FV[a]				**na**[b]
Soil BV/FV[a]				**na**
Construction Worker SAL[c]				**1,600,000**
Industrial SAL[c]				**2,400,000**
Residential SAL[c]				**1700**
RE21-11-10233	21-614373	1–2	SOIL	14.1
RE21-11-10236	21-614374	1–2	SOIL	18.7
RE21-11-10238	21-614374	10–11	QBT3	2.2
RE21-11-10239	21-614375	1–2	SOIL	20
RE21-11-10240	21-614375	5–6	QBT3	2.98
RE21-11-10241	21-614375	10–11	QBT3	2.79
RE21-11-10242	21-614376	1–2	SOIL	61.7
RE21-11-10243	21-614376	5–6	QBT3	1.11
RE21-11-10244	21-614376	10–11	QBT3	0.928
RE21-11-10245	21-614377	1–2	QBT3	8.58
RE21-11-10246	21-614377	5–6	QBT3	5.9
RE21-11-10247	21-614377	10–11	QBT3	1.1
RE21-11-10248	21-614378	1–2	QBT3	21.2
RE21-11-10249	21-614378	5–6	QBT3	5.64
RE21-11-10250	21-614378	10–11	QBT3	7.58

Note: Results are in pCi/g.

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

[b] na = Not available.

[c] SALs are from LANL (2015, 600929).

Table 8.1-1
Summary of Investigation Results and Recommendations

SWMU/AOC	Site Description	Extent Defined?	Potential Unacceptable Risk/Dose?	Recommendations
SWMU 21-004(b)	Aboveground tank	Yes	No	Corrective actions complete without controls
SWMU 21-004(c)	Aboveground tank	Yes	No	Corrective actions complete without controls
SWMU 21-011(b)	Sump and Acid waste lines	No	Yes	Additional sampling to define extent and remove contaminated soil
AOC 21-028(d)	Container storage area	No	Yes	Additional sampling to define extent and remove contaminated soil

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

%R	percent recovery
ALARA	as low as reasonably achievable
AOC	area of concern
AUF	area use factor
BCA	bias-corrected and accelerated
bgs	below ground surface
BV	background value
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
CSM	conceptual site model
D&D	demolition and decommissioning
DAF	dilution attenuation factor
DGPS	differential global positioning system
DL	detection limit
dpm	disintegrations per minute
DOE	Department of Energy (U.S.)
EM	Office of Environmental Management (DOE)
EP	Environmental Program
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
EQL	estimated quantitation limit
ESL	ecological screening level
FV	fallout value
GC	gas chromatography
GC/MS	gas chromatography mass spectrometry
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
Interim Plan	Interim Facility-Wide Groundwater Monitoring Plan
IS	internal standard
KM	Kaplan-Meier
LAL	lower acceptance limit
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security, LLC
LCS	laboratory control sample
LLW	low-level waste
LOAEL	lowest observed adverse effect levels
MDA	material disposal area
MDC	minimum detectable concentration
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N3B	Newport News Nuclear BWXT – Los Alamos, LLC
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NOAEL	no observed adverse effect level
PAH	polycyclic aromatic hydrocarbon
PAUF	population area use factor
PCB	polychlorinated biphenyl
PID	photoionization detector
QA	quality assurance
QC	quality control
RCT	radiological control technician
RfD	reference dose
RFI	Resource Conservation and Recovery Act facility investigation
RL	reporting limit
RLW	radioactive liquid waste
RPD	relative percent difference
RRF	relative response factor

SAL	screening action level
SCL	sample collection log
SD	standard deviation
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
TPU	total propagated uncertainty
TRV	toxicity reference value
TSTA	Tritium Systems Test Assembly
UAL	upper acceptance limit
UCL	upper confidence limit
UTL	upper tolerance limit
VOC	volatile organic compound
WCSF	waste characterization strategy form

A-2.0 METRIC CONVERSION TABLE

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

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 used during the 2010–2011 investigation of the DP Site Aggregate Area sites at DP East within Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or Laboratory). Table B-1.0-1 presents a summary of the methods used, and the following sections provide more detailed descriptions of the methods as well as deviations that occurred during execution of the work plan. 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 eprr.lanl.gov.

B-2.0 EXPLORATORY DRILLING CHARACTERIZATION

No exploratory drilling characterization was conducted during the 2010–2011 investigation.

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 as necessary 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 3.2.2 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) and chain-of-custody (COC) forms, provided on DVD in Appendix C. 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 (targeting alpha and beta/gamma emitters) before they were submitted to the SMO. A Laboratory radiological control technician (RCT) conducted radiological screening using an HP 210 pancake probe, a Ludlum 2221 probe, an Eberline 50 cm^2 alpha probe, Spa 3 type sodium iodine probe, a Ludlum 2929 smear counter, and a low-volume air-sampler. Screening measurements were recorded on the SCLs and COC forms and are provided in Appendix C on DVD. The screening results are presented in Table 3.2-2 of the investigation report.

B-3.3 Radiological Survey

Alpha/beta, low-energy gamma, and high-energy gamma radiological surveys were conducted at Solid Waste Management Units (SWMUs) 21-004(b), 21-004(c), and 21-011(b) and Area of Concern (AOC) 21-028(d), and to identify areas of elevated radiological activities, after drainline removal. The surveys did not identify any areas of radiation significantly different from background. The results of the surveys did not change any predetermined sampling locations. Details of the radiological surveys and the results are presented in Appendix D.

B-4.0 FIELD INSTRUMENT CALIBRATION

All instruments were calibrated before use. All calibrations were performed according to the manufacturers' specifications and requirements.

B-5.0 SURFACE AND SUBSURFACE SAMPLING

This section summarizes the methods used to collect surface and subsurface samples, including soil and tuff samples, according to the approved investigation work plan (LANL 2009, 108166.9; LANL 2010, 110082.4; NMED 2010, 108443; NMED 2010, 110422).

B-5.1 Surface Sampling Methods

Surface samples were collected 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 prescribed sampling increments. 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 being transported to the SMO. Samples were managed according to approved subcontractor procedures technically equivalent to SOP-5057, "Handling, Packaging, and Transporting Field Samples," and SOP-5058, "Sample Control and Field Documentation."

Sample collection tools were decontaminated immediately before each sample was collected in accordance with a subcontractor procedure technically equivalent to SOP-5061, "Field Decontamination of Equipment" (see section B-5.6).

B-5.2 Borehole Logging

The required sampling depths at all locations were reached by hand augers or a power auger attachment. A drill rig was not used to collect subsurface samples. Descriptions of the sample media and notable sample features, similar to a borehole log, are provided on the SCLs in Appendix C.

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." The use of the power auger allowed the hand auger to reach the maximum sampling depth 13 ft below ground surface (bgs). The power auger was used to drill down to within 0.5 ft of the sample collection depth. Subsequently, a hand auger was used to collect the sample material at the designated sample depth in a manner equivalent to SOP-06.10. Samples retrieved from the subsurface were field screened for radioactivity and visually inspected.

Samples for volatile organic compound (VOC) analysis were immediately transferred from the auger bucket to the sample container to minimize the loss of subsurface 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.

After VOC samples were collected, the remaining material was placed in a stainless-steel bowl and crushed, if necessary, with a decontaminated rock hammer and stainless-steel spoon to allow the material to fit into the sample containers. The sample collection tools were decontaminated immediately before each sample was collected in accordance with an approved subcontractor procedure technically equivalent to SOP-5061, “Field Decontamination of Equipment” (see section B-5.6).

B-5.4 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 the 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 target analyte list metals and were collected from sampling equipment at a frequency of at least 1 rinsate sample for every 10 solid samples.

Field trip blanks were also collected at a frequency of one per day when samples were being collected for VOC analysis. 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-5.5 Sample Documentation and Handling

Field personnel completed an SCL and COC 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 COC forms and accepted custody of the samples. The SCLs and COC forms are provided in Appendix C (on DVD).

B-5.6 Decontamination of Sampling Equipment

The hand-auger 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. 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. Field rinsate blank samples were collected in accordance with an approved procedure technically equivalent to SOP-5059, “Field Quality Control Samples.”

B-5.7 Site Demobilization and Restoration

Drilling equipment was not used during the 2010–2011 investigation. All temporary fencing and staging areas were dismantled and returned to preinvestigation conditions. At SWMU 21-011(b), the excavation was backfilled to match surrounding site grade. The excavated areas were then seeded with native seed using hydromulch.

B-6.0 GEODETIC SURVEYING

Geodetic surveys of all sampling locations were performed using a Trimble RTK 5700 differential global-positioning system (DGPS) 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 DGPS 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-7.0 IDW STORAGE AND DISPOSAL

All investigation-derived waste (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 New Mexico Environment Department (NMED) regulations, U.S. Department of Energy orders, and Laboratory implementation requirements. IDW was also managed in accordance with the approved waste characterization strategy form. Details of IDW management are presented in Appendix E.

B-8.0 DEVIATIONS FROM THE WORK PLAN

Deviations from the approved investigation work plan (LANL 2009, 108166.9; NMED 2010, 108443) are summarized below.

SWMU 21-004(b)

- At location 21-614326, polychlorinated biphenyls (PCBs) were inadvertently requested for analysis in the 5- to 6-ft depth interval.

SWMU 21-011(b)

- Because active systems in the vicinity of building 21-257 likely intersect the targeted acid waste line, a portion of the SWMU 21-011(b) acid waste line was left in place. The acid waste line was removed up to the fence line of building 21-257. The portion of the acid waste line inside the fence surrounding building 21-257 was left in place. The remaining line will be removed and the proposed sampling locations (30 to 43) will be sampled when the building is demolished and decommissioned.

- A section of the acid waste line near building 21-257 was found under a cast-in-place concrete block poured to protect the acid waste line from the overlying active water line that crossed approximately 12 in. above the acid waste line. At the direction of the Laboratory's subcontractor technical representative and in concurrence with the Laboratory's site engineer, an approximately 8-ft section of the acid waste line beneath the concrete block was left in place and isolated with foam sealant. This did not prevent planned sample collection at the site.
- Sump structure 21-223, which extended at least 15 ft belowgrade, was demolished to below 10 ft belowgrade. The remaining lower portion of this cast-in-place sump was poured against competent tuff bedrock. Because of the sump's location on a relatively steep sloping area, the presence of active fire water lines on parts of two sides of the excavation, and a nearby power pole, the Laboratory's site engineer determined that complete removal of the sump was impracticable; at the direction of the Laboratory's subcontractor technical representative, it was left in place. The remaining portion of the sump was filled with bentonite and soil before the excavation was filled to grade with clean soil. This prevented sampling at planned location 14. However, samples were collected from under the former sump inlet and outlet lines (locations 21-613815, 21-613827, and 21-614319).
- The waste line extending from manhole 21-221 to 21-222 was left in place and partially grouted because of an active fire water line running parallel to, and several feet shallower than, the waste line. The Laboratory's site engineer determined that attempts to excavate the waste line could damage the fire water line and authorized the in-place grouting of the waste line. In attempting to insert plastic tubing to grout the acid waste line between manhole structure 21-221 and manhole structure 21-222, the waste line was found to be blocked. Plastic tubing was inserted into structure 21-221 and fed approximately 90 ft toward manhole structure 21-222. Approximately 150 gal. of grout was pumped into the industrial waste line, and the line was abandoned. This did not prevent planned sample collection at the site.
- A section of waste line connecting manhole 21-221 to former building 21-209 was encountered during the investigation. This portion of the line was left in place and grouted because it was deeper than 10 ft bgs. This did not prevent planned sample collection at the site.
- An approximately 50-ft section of the line on the west side of former building 21-155 was abandoned in place because it was encased in 2 ft of concrete foundation left in place by the demolition and decommissioning operations. Samples could not be collected at proposed sampling locations 4 and 5 (LANL 2009, 108166.9, Figure 4.1-1).
- Samples from locations 21-613828 and 21-613829 were inadvertently not analyzed for isotopic thorium. However, this does not affect the results because a total of 48 samples for SWMU 21-011(b) were analyzed for isotopic thorium, with all detections at or below background levels. Therefore, it is unlikely that isotopic thorium would be detected above background at these two locations.

B-9.0 REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

LANL (Los Alamos National Laboratory), December 2008. "Delta Prime Site Aggregate Area Phase II Work Plan, Revision 1," Los Alamos National Laboratory document LA-UR-08-7794, Los Alamos, New Mexico. (LANL 2008, 104989)

LANL (Los Alamos National Laboratory), December 2009. "Investigation Work Plan for Delta Prime Site Aggregate Area Delayed Sites, Revision 1," Los Alamos National Laboratory document LA-UR-09-8180, Los Alamos, New Mexico. (LANL 2009, 108166.9)

LANL (Los Alamos National Laboratory), July 2010. "Delta Prime East Building Footprints Letter Work Plan, Revision 1," Los Alamos National Laboratory document LA-UR-10-4812, Los Alamos, New Mexico. (LANL 2010, 110082.4)

NMED (New Mexico Environment Department), January 11, 2010. "Approval, Investigation Work Plan for Delta Prime Site Aggregate Area Delayed Sites at Technical Area 21," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 108443)

NMED (New Mexico Environment Department), July 26, 2010. "Approval, Delta Prime East Building Footprints Letter Work Plan for Delta Prime Site Aggregate Area, Technical Area 21," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 110422)

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., 0.5–1.5 ft or 1.0–2.0 ft) soil 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 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 advancing the hole 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 other required sample containers were filled.
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, COC forms, 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. COC forms were completed and signed to verify that the samples were not left unattended.
Field Quality Control 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.
Field Decontamination of 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.

Table B-1.0-1 (continued)

Method	Summary
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 5700 DGPS. The survey data conformed to Laboratory Information Architecture project standards IA-CB02, “GIS 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 waste characterization strategy form that documents site history, field activities, and characterization approach for each waste stream managed. During the investigation, 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 deterioration of containers. A waste storage area was established before waste was generated. Waste storage areas located in controlled areas of the Laboratory were monitored as needed to prevent inadvertent addition or management of wastes by unauthorized personnel. 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 E.

Table B-1.0-2
SOPs Used for Investigation Activities Conducted at DP Site Aggregate Area Sites at DP East

SOP-5018, Integrated Fieldwork Planning and Authorization
SOP-5028, Coordinating and Evaluating Geodetic Surveys
SOP-5034, Monitor Well and RFI Borehole Abandonment
SOP-5238, Characterization and Management of Environmental Program Waste
SOP-5055, General Instructions for Field Investigations
SOP-5056, Sample Containers and Preservation
SOP-5057, Handling, Packaging, and Transporting Field Samples
SOP-5058, 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-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-06.33, Headspace Vapor Screening with a Photo Ionization Detector

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

Appendix C

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

Appendix D

Radiological Surveys

Los Alamos Technical Associates, Inc.

999 Central Ave., Suite 300 / Los Alamos, NM 87544 / Telephone (505) 662-9080 / FAX (505) 662-1757

April 5, 2011

Mr. Mark Thacker
Los Alamos National Security
Los Alamos National Laboratory
P. O. Box 1663, MS C349
Los Alamos, NM 87545
Transmitted via email: mthacker@lanl.gov

SUBJECT: 78450-002-11, Radiological Survey Report for 21-011(b)

Dear Mr. Thacker:

Los Alamos Technical Associates (LATA) is pleased to submit the subject report. ERG conducted the onsite effort March 16-17, 2011.

If you have any questions, please contact me at 662-1816 or Joe Sena, our Field Operations Manager at 662-1837.

Sincerely,

Felicia M. Aguilar

Felicia M. Aguilar
Project Manager

Cy: F. Stafford, via email
M. Thacker, via email
B. Wedgeworth, via email
J. Byers, via email
J. Sena, via email
J. Lockhart, via email

Radiological Survey of SWMU 21-011(B) Pipe Trench at the Los Alamos National Laboratory

Prepared for:

Los Alamos Technical Associates, Inc.

Los Alamos Technical Associates, Inc.
999 Central Ave.
Los Alamos, NM 87544

Prepared by:

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113

March, 2011

Radiological Survey of SWMU 21-011(b) Pipe Trench

1.0 Introduction

Los Alamos Technical Associates (LATA) retained Environmental Restoration Group, Inc. (ERG) to conduct a static alpha-beta surface survey and GPS-based gamma radiological survey of an excavated waste line pipe trench at Los Alamos National Laboratory (LANL) Technical Area 21 (TA-21) Solid Waste Management Unit (SWMU) 21-011(b). The trench excavation was approximately 720 feet in length and surveys were performed over a two day period, March 16, 2011 and March 17, 2011.

SWMU 21-011(b) is a former acid waste sump. From the sump, a 3-inch line transported waste to a treatment plant. Possible radiological constituents released from the pipe into the surrounding soil include Pu-239, Am-241, Sr-90, Cs-137, and H-3. Because of this an alpha/beta survey, low-energy gamma, and a high-energy gamma survey were performed.

2.0 Method

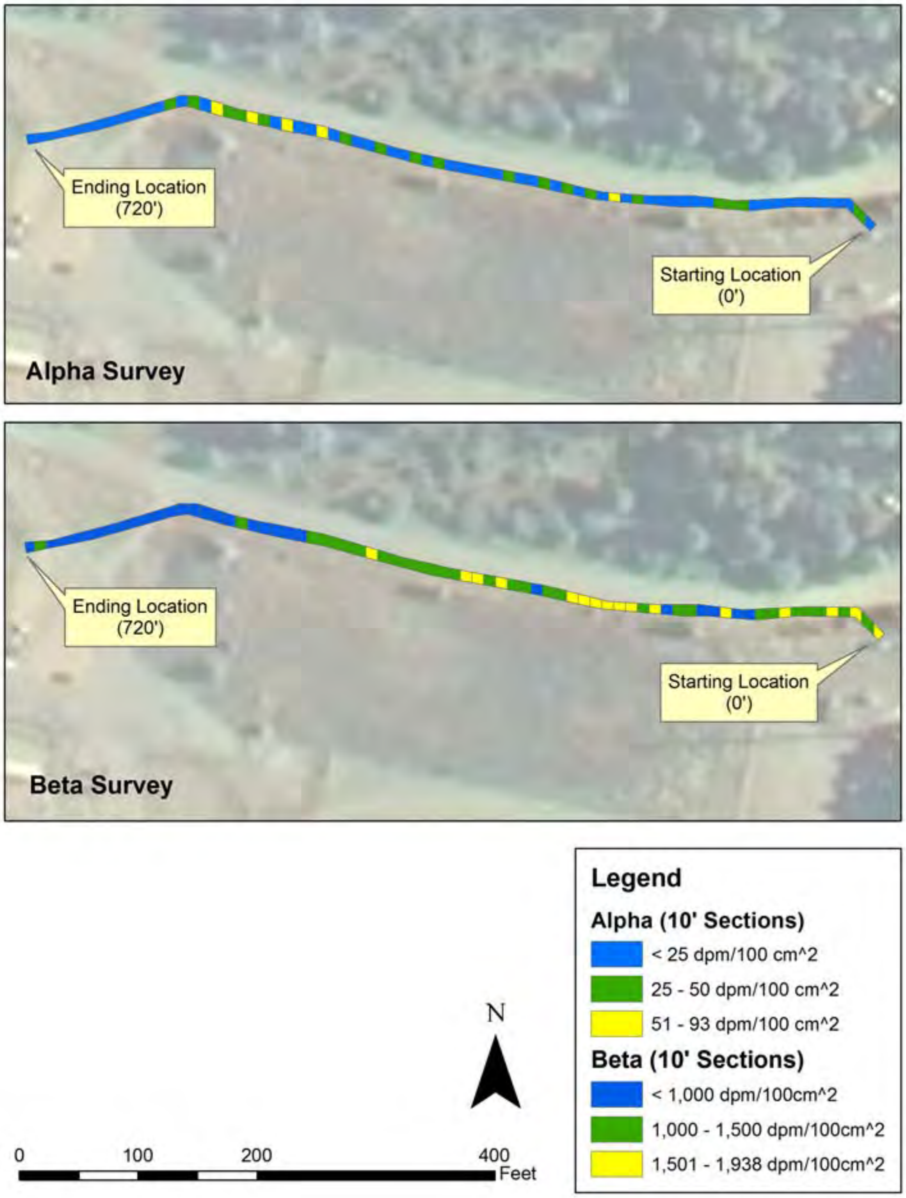
For the alpha/beta survey a static one-minute alpha/beta scaler measurement was made on the floor of the trench, at ten-foot intervals for the entire trench length. Measurements were performed using matched Ludlum Model 43-93 alpha/beta Phoswhich detectors coupled to Ludlum Model 2360 dual-channel scalers. Approximately 10-percent of the trench was inaccessible to personnel due to the trench depth. For this area one of the instrument sets was recalibrated using a longer 12-foot long cable. The detector was then mounted onto a pole allowing the surveyor to safely stand outside of the trench and survey the trench bottom.

The gamma surveys were performed using a Ludlum Model 2221 ratemeter/scaler with appropriate detector, coupled to a Trimble Pro XRS mapping grade GPS. The Ludlum Model 2221 and GPS unit were both carried in a backpack with the Model 2221 operated in ratemeter mode, allowing for each gamma count rate and associated coordinates to be recorded every one second. For the low-energy photon survey, an Alpha Spectra 5-inch diameter FIDLER detector was used, and maintained approximately 6-inches above the trench floor. For the high-energy gamma survey, a Ludlum Model 44-10 2-inch by 2-inch sodium iodide (NaI) detector was used, and maintained approximately 18-inches above the trench floor. The scanning speed for both surveys was approximately 1.0 ft/sec. Approximately 10% of the trench was inaccessible by field personnel due to the trench depth. For this area the gamma detectors were suspended from a pole down the trench allowing for the survey to be conducted in the same manner and height above trench bottom as the accessible areas of the trench. At the end of the survey, the data were downloaded into a laptop computer and processed using a combination of Trimble Pathfinder Office and ESRI ArcGIS computer applications.

3.0 Results

Data for the alpha/beta survey were converted to disintegrations per minute per 100 cm^2 ($dpm/100cm^2$) using the average individual detector efficiencies and average reference background readings for each detector. These data are presented below in Figure 3.1. The figure represents the alpha and beta levels in 10-foot long increments for the length of the trench, with varying colors depicting the total activity rage for the survey. No readings exceeded 100 $dpm/100\ cm^2$ for alpha, or 2,000 $dpm/100\ cm^2$ for beta. The alpha/beta survey data log sheets are located in Appendix A.

Figure 3.1 Alpha/Beta Survey of 21-011B Pipe Trench



The alpha/beta detector survey data statistics are shown below in Table 3.1.

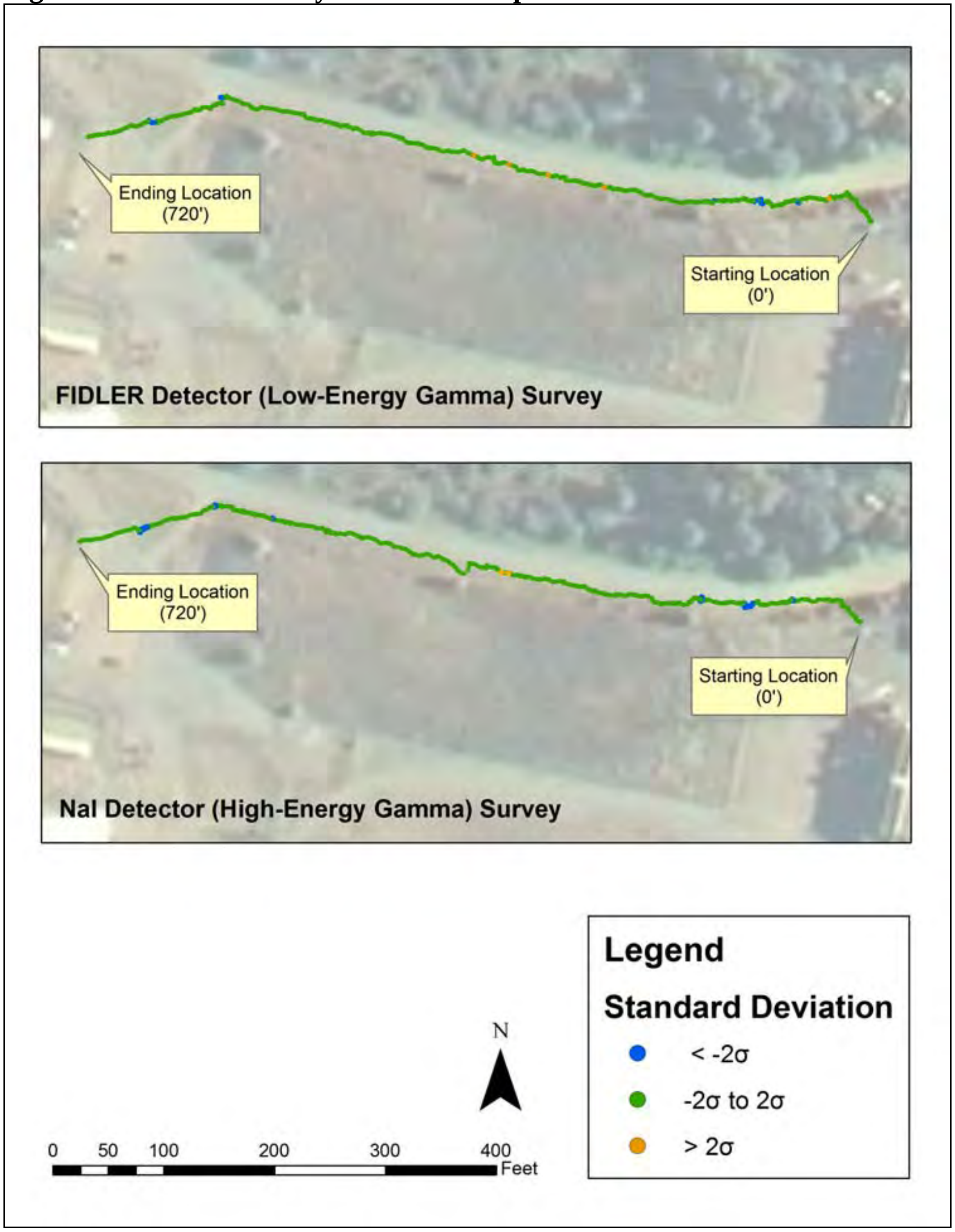
Table 3.1 Alpha/Beta Detector Survey Results

Channel	Readings	Mean (dpm/100cm^2)	Standard Deviation (dpm/100cm^2)	Maximum Reading (dpm/100cm^2)	Minimum Reading (dpm/100cm^2)
Alpha	73	17.9	19.6	93.4	0
Beta	73	1,130	447	1,938	304

3.2 Gamma Surveys

Data for the FIDLER detector (low-energy) and NaI detector (high-energy) gamma surveys are presented below in Figure 3.2. The data within each figure are presented with varying colors depicting the gamma count-rate range for each survey.

Figure 3.3 Gamma Surveys of 21-011B Pipe Trench



Due to the geometry of the trench (floor plus two close sidewalls), readings taken inside the trench would be non-representative of any reference reading taken outside the trench. Because of this, the determination of elevated readings is based on the expected statistical spread of the data.

Gamma radiation detection from a single source is a random process that will result in a Poisson probability distribution of count rates, with the larger percentage of the count rates clustered around the mean and only a small percentage within the tails of the distribution above and below the mean. Highly elevated readings from sources other than background are typically identifiable by a distribution that is heavily weighted on the right side or that contains a sample that falls outside the typical spread from background radiation. Distribution of the low-energy FIDLER detector and high-energy NaI detector data are presented below in Figures 3.3 and 3.4, respectively. Both figures show the data fit the expected Poisson distributions with no right side tail outliers. The data also indicate approximately two distributions, most likely due to a difference in soil and/or rock composition (rhyolitic tuff versus loamy soil) throughout the trench, and/or a change of detector geometry throughout the trench. The distributions for both surveys are similar.

Figure 3.2 Low-energy FIDLER Detector Data Distribution

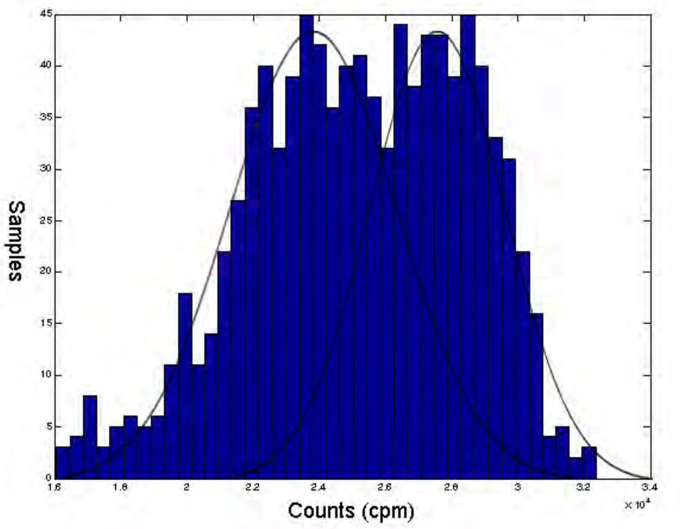
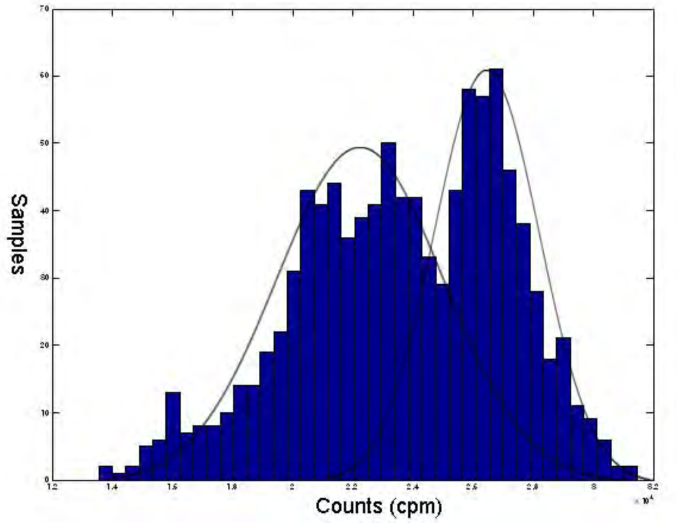


Figure 3.3 High-energy Gamma NaI Detector Data Distribution



The survey data statistics for the FIDLER detector and NaI detector are shown below in Table 3.2. The distribution of data indicates no highly-elevated values with respect to the mean trench readings for either detector data set.

Table 3.2 Gamma Detector Survey Results

Detector	Readings	Mean (cpm)	Standard Deviation	Maximum Reading (cpm)	Minimum Reading (cpm)
FIDLER (low-energy)	971	25,219	3,252	32,371	16,051
NaI 44-10 (high-energy)	1,002	23,713	3,454	31,471	13,553

4.0 Quality Control

All radiological instrumentation was calibrated within six months prior to use using NIST traceable sources and pulser. Field instruments were function checked before and after use each day. Function check forms and calibration sheets are included in Appendix B.

Appendix A

Alpha/Beta Static Measurements Forms

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011B	Date/Time: 3/16/11	Technician: Tyler Alecksen	
Ratemeter: Ludlum 2360	Serial No.: 215292	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR199836	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 700
Alpha Efficiency: 0.207	Beta Efficiency: 0.143	Probe Window Area (cm²): 100	Battery: ok

Comments: ______________________________

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm²)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
0'	1	7	638	52	4178	1.8	220.2	8.7	1539.9	N/A	N/A
20'		4	695			0	277.2	0	1938.5		
40'		6	653			0.8	235.2	3.9	1644.8		
60'		6	585			0.8	167.2	3.9	1169.2		
80'		4	659			0	241.2	0	1687		
100'		5	574			0	156.2	0	1092.3		
130'		11	673			5.8	255.2	28	1785		
150'		5	508			0	90.2	0	631		
170'		4	620			0	202.2	0	1414		
190'	↓	9	692	↓	↓	3.8	274.2	18.4	1918	↓	↓

Form Completed By: ______________________ Date: 3/18/11

Reviewed By: ______________________ Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011B	Date/Time: 3/16/11	Technician: Tyler Aleeksen
Ratemeter: Ludlum 2360	Serial No.: 215292	Cal. Due Date: 3/14/12
Detector: Ludlum 43-93	Serial No.: PR199836	Cal. Due Date: 3/14/12
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30 | HV: 700
Alpha Efficiency: 0.207	Beta Efficiency: 0.143	Probe Window Area (cm²): 100 | Battery: ok

Comments:

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm²)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
210'	1	10	667	52	4178	4.8	249.2	23.2	1743	N/A	N/A
230'		5	646			0	228.2	0	1596		
250'		4	655			0	237.2	0	1659		
270'		5	631			0	213.2	0	1491		
290'		7	560			1.8	142.2	8.7	994.4		
310'		11	629			5.8	211.2	28	1477		
330'		4	632			0	214.2	0	1498		
350'		2	646			0	228.2	0	1596		
370'		15	616			9.8	198.2	47.3	1386		
390'	↓	11	576	↓	↓	5.8	158.2	28	1106.3	↓	↓

Form Completed By: Date: 3/18/11

Reviewed By: Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011B	Date/Time: 3/16/11	Technician: Tyler Aleksen	
Ratemeter: Ludlum 2360	Serial No.: 215292	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR199836	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 700
Alpha Efficiency: 0.207	Beta Efficiency: 0.143	Probe Window Area (cm^2): 100	Battery: ok

Comments:

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm^2)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
410'	1	7	621	52	4178	1.8	203.2	8.7	1421	N/A	N/A
430'	↓	3	656	↓	↓	0	238.2	0	1666	↓	↓
450'		14	619			8.8	201.2	42.5	1407		
470'		17	578			11.8	160.2	57	1120.3		
490'		9	493			3.8	75.2	18.4	526		
510'		5	538			0	120.2	0	840.6		
530'		16	520			10.8	102.2	52.2	715		
550'		12	536			6.8	118.2	32.9	826.6		
570'		7	551			1.8	133.2	8.7	931.5		
590'		7	520			1.8	102.2	8.7	715		

Form Completed By: Date: 3/18/11

Reviewed By: Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011 B	Date/Time: 3/16/11	Technician: Matt Simonds	
Ratemeter: Ludlum 2360	Serial No.: 145462	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR299679	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 700
Alpha Efficiency: 0.198	Beta Efficiency: 0.145	Probe Window Area (cm^2): 100	Battery: ok

Comments: ____________________

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm^2)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
10'	1	8	637	25	4482	5.5	188.8	27.8	1302	N/A	N/A
30'		7	606			4.5	157.8	22.7	1088		
50'		6	658			3.5	209.8	17.7	1447		
70'		3	662			0.5	213.8	2.5	1475		
90'		7	638			4.5	189.8	22.7	1309		
110'		10	534			7.5	85.8	37.9	591.7		
120'		8	586			5.5	137.8	27.8	950.3		
140'		7	575			4.5	126.8	22.7	874.5		
160'		5	660			2.5	211.8	12.6	1461		
180'	↓	5	592	↓	↓	2.5	143.8	12.6	992	↓	↓

Form Completed By: ____________________ Date: 3/18/11

Reviewed By: ____________________ Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21 - 011 B	Date/Time: 3/16/11	Technician: Matt Simonds	
Ratemeter: Ludlum 2360	Serial No.: 145462	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR299679	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 700
Alpha Efficiency: 0.198	Beta Efficiency: 0.145	Probe Window Area (cm^2): 100	Battery: ok

Comments:

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm^2)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
200'	1	10	611	25	4482	7.5	162.8	37.9	1122.8	N/A	N/A
220'	↓	13	716	↓	↓	10.5	267.8	53	1847	↓	↓
240'		12	719			9.5	270.8	48	1867.6		
260'		9	675			6.5	226.8	32.8	1564		
280'		8	615			5.5	166.8	27.8	1150.3		
300'		4	623			1.5	174.8	7.6	1205.5		
320'		1	699			0	250.8	0	1729.7		
340'		4	700			1.5	251.8	7.6	1736.6		
360'		5	614			2.5	165.8	12.6	1143.4		
380'		5	624			2.5	175.8	12.6	1212.4		

Form Completed By: Date: 3/18/11

Reviewed By: Kenneth Bohn Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011 B	Date/Time: 3/16/11	Technician: Matt Simonds	
Ratemeter: Ludlum 2360	Serial No.: 145462	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR299679	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 700
Alpha Efficiency: 0.198	Beta Efficiency: 0.145	Probe Window Area (cm^2): 100	Battery: ok

Comments:

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm^2)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
400'	1	3	658	25	4482	0.5	209.8	2.5	1447	N/A	N/A
420'	↓	8	617	↓	↓	5.5	168.8	27.8	1164.1	↓	↓
440'	↓	6	609	↓	↓	3.5	160.8	17.7	1109	↓	↓
460'	↓	3	625	↓	↓	0.5	176.8	2.5	1219.3	↓	↓
480'	↓	7	595	↓	↓	4.5	146.8	22.7	1012.4	↓	↓
500'	↓	17	556	↓	↓	14.5	107.8	73.2	743.4	↓	↓
520'	↓	10	522	↓	↓	7.5	73.8	37.9	509	↓	↓
540'	↓	10	613	↓	↓	7.5	164.8	37.9	1336.6	↓	↓
560'	↓	21	530	↓	↓	18.5	81.8	93.4	564.1	↓	↓
580'	↓	11	516	↓	↓	8.5	67.8	42.9	467.6	↓	↓

Form Completed By: Date: 3/18/11

Reviewed By: Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011 B	Date/Time: 3/16/11	Technician: Matt Simonds	
Ratemeter: Ludlum 2360	Serial No.: 145462	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR299679	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 700
Alpha Efficiency: 0.198	Beta Efficiency: 0.145	Probe Window Area (cm²): 100	Battery: ok

Comments: ____________________

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm²)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
600'	1	11	535	25	4482	8.5	86.8	42.9	598.6	N/A	N/A

Form Completed By: ____________________ Date: 3/18/11

Reviewed By: Kenneth R Bohn Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011B	Date/Time: 3/17/11	Technician: Tyler Alecksen	
Ratemeter: Ludlum 2360	Serial No.: 145462	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR299679	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 800
Alpha Efficiency: 0.192	Beta Efficiency: 0.143	Probe Window Area (cm^2): 100	Battery: ok

Comments:

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm^2)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
610'	1	2	580	39	5045	0	75.5	0	528	N/A	N/A
620'	↓	6	553	↓	↓	2.1	48.5	10.9	339.2	↓	↓
630'		3	551			0	46.5	0	325.2		
640'		4	610			0.1	105.5	0.5	737.8		
650'		5	560			1.1	55.5	5.7	388		
660'		3	548			0	43.5	0	304.2		
670'		5	556			1.1	51.5	5.7	360		
680'		3	596			0	91.5	0	639.9		
690'		2	616			0	111.5	0	779.7		
700'		2	630			0	125.5	0	877.6		

Form Completed By: Date: 3/18/11

Reviewed By: Date: 3/22/11

ERG Form 2.16A

ERG

Total Contamination Survey Form - Dual Channel

Facility/Site: 21-011B	Date/Time: 3/17/11	Technician: Tyler Alecksen	
Ratemeter: Ludlum 2360	Serial No.: 145462	Cal. Due Date: 3/14/12	
Detector: Ludlum 43-93	Serial No.: PR299679	Cal. Due Date: 3/14/12	
Alpha Threshold (mV): 120	Beta Threshold (mV): 4	Beta Window (mV): 30	HV: 800
Alpha Efficiency: 0.192	Beta Efficiency: 0.143	Probe Window Area (cm^2): 100	Battery: ok

Comments:

Item Surveyed	Count Time (minutes)	Gross Counts		Background Counts (10 min)		Net Counts		Contamination Level (dpm/100 cm^2)		Meets Release Criteria? (yes/no)	Swipe Necessary? (yes/no)
		Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta		
710'	1	6	655	39	5045	2.1	150.5	11	1052.5	N/A	N/A
720'	↓	1	586	↓	↓	0	81.5	0	570	↓	↓

Form Completed By: Date: 3/18/11

Reviewed By: Date: 3/22/11

ERG Form 2.16A

Appendix B

Calibration and Daily Function Check Forms

ERG

Function Check Form
Single Channel Detector

Ratemeter: LUDLUM 2221
Serial No. 262328
Cal. Due Date: 3/14/12

Detector: ALPHA SPECTRA FIDLER
Serial No. 010807 F
Cal. Due Date: 3/16/12

Source: Am-241
Activity: 1 μCi
Serial No. SMOKE DETECTOR ERG-1

Comments: 14-FOOT CABLE USED.

Date	Time	Battery	High Voltage	Threshold	Gross Counts	Background	Net Counts	Efficiency	Initial
3/17/11	08:40	5.4	1150	101	191015	10844	180171	—	cf
3/17/11	1640	5.3	1147	101	192192	11432	180760	—	TA

Reviewed By:

Date: 3/22/11

ERG Form 1.30A

#2

ERG

Function Check Form
Dual Channel Detector

Ratemeter: LUDLUM 2360 Serial No. 145462 Cal. Due Date: 3/14/12

Detector: LUDLUM 4393 Serial No. PR299679 Cal. Due Date: 3/14/12

Alpha Threshold: 120 mV Beta Threshold: 4 mV Beta Window: 30 mV

Alpha Source: TH-230 Activity: 21,300 DPM (3/28/05) Serial No. 5447-05

Beta Source: Tc-99 Activity: 21,700 DPM (6/27/02) Serial No. 4004-02

Comments: CABLE LENGTH ON 3/16/11 WAS 39".

CABLE CHANGED TO 12' ON 3/17/11.

| * 10-MINUTE COUNTS * → | %

	Date	Time	High Voltage	Battery	Alpha		Beta		Background		Efficiency		Initial
					Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	
LATA office	3/16/11	08:50	700	✓	42534	5942	311	35151	3	2351	20.0	15%	CF
ERG office	3/16/11	18:00	700	✓	41609	6213	50	32678	37	2356	19.5	14.0	CF
ERG office	3/17/11	0955	800	✓	38564	8526	364	31982	28	2462	18.6	13.6	TA
	3/17/11	1630	800	✓	42255	7983	173	35047	15	2414	19.8	15.0	TA
											α	β	
							★	3/16	AVG EFFICIENCY:		19.8	14.5	
							★	3/17	"		19.2	14.3	

Reviewed By: Date: 3/22/11

ERG Form 1.30B

#1

ERG

Function Check Form
Dual Channel Detector

Ratemeter: LUDLUM 2360 Serial No. 215292 Cal. Due Date: 3/14/12

Detector: LUDLUM 43-93 Serial No. PR199836 Cal. Due Date: 3/14/12

Alpha Threshold: 120 mV Beta Threshold: 4 mV Beta Window: 30 mV

Alpha Source: TH-230 Activity: 21,300 DPM (3/28/05) Serial No. 5447-05

Beta Source: TC-99 Activity: 21,700 DPM (6/27/02) Serial No. 4004-02

Comments: Cable changed to 12' on 3/17/11

Cable was 39" on 3/16/11.

| * 10 MINUTE COUNTS * ——> | %

	Date	Time	High Voltage	Battery	Alpha		Beta		Background		Efficiency		Initial
					Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	
office	3/16/11	09:10	700	✓	44063	6127	359	34335	22	2343	20.7	14.7	cf
office	3/16/11	18:00	700	✓	44099	6416	54	32608	54	2385	20.7	13.9	cf
	~~3/17/11~~	~~0900~~	~~800~~	~~✓~~	~~44895~~	~~11824~~	~~779~~	~~37382~~	~~1128~~	~~4626~~	BAD	MYLAR	
						IN	MOVING	INSTRUMENT	TO		LONGER	CABLE	
						MY	LAR	WAS	DAMAGED.				
							*	3/16 AVG	EFFICIENCY:		20.7	14.3	

Reviewed By: Kent Baker Date: 3/22/11

ERG Form 1.30B

ERG

Function Check Form
Single Channel Detector

Ratemeter: LUDLUM 2221 Serial No. 262328 Cal. Due Date: 3-14-12

Detector: LUDLUM 44-10 Serial No. PR150786 Cal. Due Date: 3-16-12

Source: Cs-137 Activity: 4μCi (4/12/96) Serial No. 544-96

Comments: 14-FOOT CABLE USED.

Date	Time	Battery	High Voltage	Threshold	Gross Counts	Background	Net Counts	Efficiency	Initial
3/17/11	0830	5.4	1151	101	49220	10291	38929	–	TA
3/17/11	1630	5.3	1150	101	51322	10952	40370	–	TA

Reviewed By: Date: 3/22/11

ERG Form 1.30A

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	215292
Detector:	Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR199836

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☑ Contact ☐ 6 inches ☐ Other:

Source Geometry: ☐ Side ☑ Below ☐ Other:

Alpha Threshold: 120 mV Beta Threshold: 4

Beta Window: 30 mV

Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 12'

Temperature: 74 °F Relative Humidity 20 %

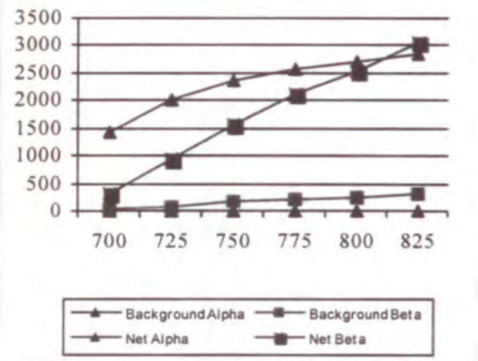
Barometric Pressure: 24.83 inches Hg

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	
				α	β
x 1000	400 Kcpm	400	400	398658	398788
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39834	39836
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	3982	3982
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	398	398
x 1	100 cpm	100	100		

High Voltage	Alpha Source		Beta Source		Background	
	α	β	α	β	α	β
700	1421	340	30	365	0	43
725	2023	367	17	1011	0	74
750	2354	456	24	1727	3	156
775	2556	561	12	2333	2	213
800	2707	680	34	2788	4	256
825	2830	968	21	3383	2	323

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =800

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

Fluke multimeter serial number ☑ 8749012

☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03

☑ Beta Source: Tc-99 @ 7,700 dpm (1/13/10) sn: 4099-03

☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☐ Other Source:

Calibrated By:

Calibration Date: 3-15-11

Calibration Due: 3-15-12

Reviewed By:

Date: 3/17/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	145462
Detector:	Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR299679

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☑ Contact ☐ 6 inches ☐ Other:

Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 12'

Source Geometry: ☐ Side ☑ Below ☐ Other:

Temperature: 72 °F Relative Humidity 20 %

Alpha Threshold: 120 mV Beta Threshold: 4

Barometric Pressure: 24.68 inches Hg

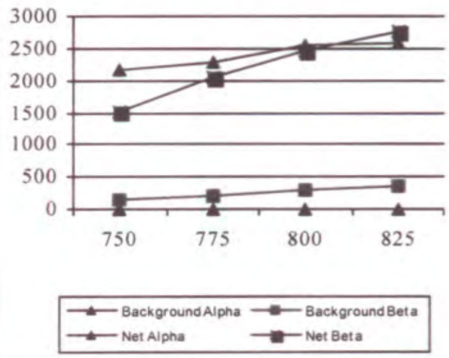
Beta Window: 30 mV

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count α	Integrated 1-Min. Count β
x 1000	400 Kcpm	400	400	399699	399748
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39983	39996
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	4000	3989
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	399	399
x 1	100 cpm	100	100		

High Voltage	Alpha Source α	Alpha Source β	Beta Source α	Beta Source β	Background α	Background β
750	2164	385	31	1650	0	141
775	2276	454	39	2237	1	196
800	2556	603	22	2771	1	293
825	2602	708	25	3121	3	345

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =800

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

Fluke multimeter serial number ☑ 8749012

☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03

☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☑ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03

☐ Other Source:

Calibrated By:

Calibration Date: 5-17-11

Calibration Due: 5-17-12

Reviewed By:

Date: 3/17/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

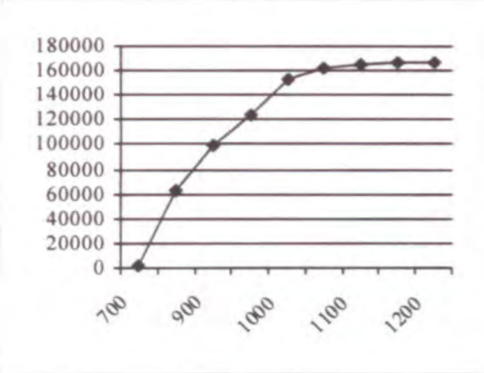
Meter:	Manufacturer:	Ludlum	Model Number:	2221	Serial Number:	262328
Detector:	Manufacturer:	Alpha Spectra	Model Number:	FIDLER	Serial Number:	010807F

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☐ Contact ☐ 6 inches ☑ Other: 3/4" Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 14'
Source Geometry: ☐ Side ☑ Below ☐ Other: Temperature: 74 °F Relative Humidity 20 %
Threshold: 10 mV Window: Barometric Pressure: 24.72 inches Hg
Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398663	400
x 1000	100	100	100		100
x 100	40	400	400	39854	400
x 100	10	100	100		100
x 10	4	400	400	3985	400
x 10	1	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	1362	
800	63121	
900	99855	
950	123647	
1000	152143	
1050	162435	
1100	164685	
1150	165879	5832
1200	165734	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 0.5-min. Recommended HV =1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932
Fluke multimeter serial number: ☐ 8749012
☐ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03
☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03
☐ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03
☑ Other Source: Am-241 @ 1uCi

Calibrated By: Calibration Date: 3-17-11 Calibration Due: 3-17-12

Reviewed By: Review Date: 3/17/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221	Serial Number:	262328
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR150786

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☐ Contact ☑ 6 inches ☐ Other: Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 14'

Source Geometry: ☑ Side ☐ Below ☐ Other: Temperature: 74 °F Relative Humidity 20 %

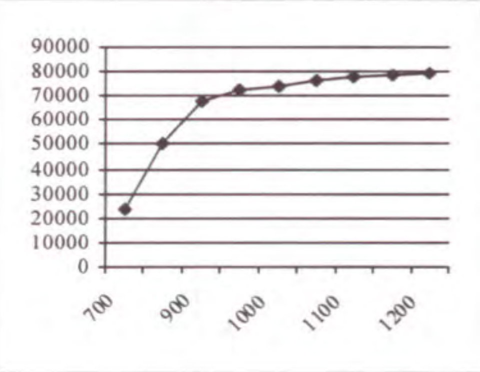
Threshold: 10 mV Window: Barometric Pressure: 24.72 inches Hg

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398663	400
x 1000	100	100	100		100
x 100	40	400	400	39854	400
x 100	10	100	100		100
x 10	4	400	400	3985	400
x 10	1	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	23405	
800	50120	
900	67861	
950	72174	
1000	73869	
1050	76528	
1100	78121	
1150	78357	11394
1200	79121	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932 Fluke multimeter serial number: ☐ 8749012

☐ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03 ☑ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03 ☐ Other Source: Am-241 @ 1uCi

Calibrated By: Calibration Date: 3-17-11 Calibration Due: 3-17-12

Reviewed By: Review Date: 3/17/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

EBERLINE
SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 3905
P.O.# 0423

Description of Standard:

Model No. DNS-12 Serial No. 4004-02 Isotope Tc-99

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 2148/90.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

13,600 ± 407

The total disintegration rate (dpm) assuming 25 % backscatter of beta particles from the surface of the disc, was:

21,700 ± 651 (0.00978 μCi)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST
Reviewed by:

Calibration Technician: Art Reust
Q.A. Representative: Karen Schoenfeller

Calibration Date: 6-27-2002
Reviewed Date: 6-27-02

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

EBERLINE
SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-11 Serial No. 5447-05 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 4001-02 .

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

10,800 ± 431

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

21,300 ± 850 (0.00958 µCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Art Reust Q.A. Representative:

Calibration Date: 3-28-2005 Reviewed Date: 032805

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	215279
Detector:	Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR299677

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check

HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☑ Contact ☐ 6 inches ☐ Other:

Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 60"

Source Geometry: ☐ Side ☑ Below ☐ Other:

Temperature: 72 °F Relative Humidity 20 %

Alpha Threshold: 120 mV Beta Threshold: 4

Barometric Pressure: 24.72 inches Hg

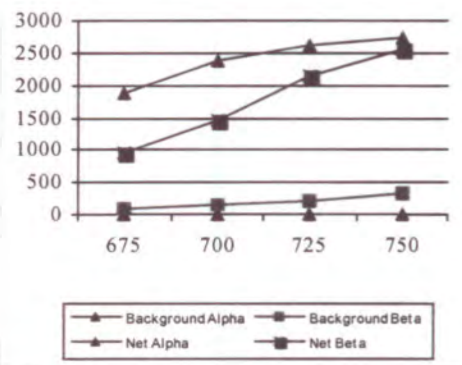
Beta Window: 30 mV

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count α	Integrated 1-Min. Count β
x 1000	400 Kcpm	400	400	398278	398344
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39862	39872
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	3988	3988
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	399	399
x 1	100 cpm	100	100		

High Voltage	Alpha Source α	Alpha Source β	Beta Source α	Beta Source β	Background α	Background β
675	1885	312	4	1025	1	85
700	2375	413	4	1618	3	158
725	2621	483	6	2348	5	222
750	2745	636	5	2878	2	337

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =725

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

Fluke multimeter serial number ☑ 8749012

☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03

☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☑ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03

☐ Other Source:

Calibrated By:

Calibration Date: 3-14-11

Calibration Due: 3-14-12

Reviewed By:

Date: 3/15/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

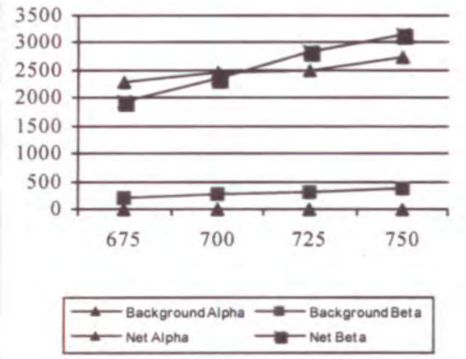
Meter:	Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	145462
Detector:	Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR299679

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☑ Contact ☐ 6 inches ☐ Other: Cable Length: ☑ 39-inch ☐ 72-inch ☐ Other:
Source Geometry: ☐ Side ☑ Below ☐ Other: Temperature: 72 °F Relative Humidity 20 %
Alpha Threshold: 120 mV Beta Threshold: 4 Barometric Pressure: 24.68 inches Hg
Beta Window: 30 mV Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count α	Integrated 1-Min. Count β
x 1000	400 Kcpm	400	400	399699	399748
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39983	39996
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	4000	3989
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	399	399
x 1	100 cpm	100	100		

High Voltage	Alpha Source α	Alpha Source β	Beta Source α	Beta Source β	Background α	Background β
675	2286	399	43	2146	2	191
700	2466	488	43	2650	0	284
725	2512	574	59	3175	0	329
750	2748	790	45	3552	2	394

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =700

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932
Fluke multimeter serial number ☑ 8749012
☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03
☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03
☑ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03
☐ Other Source:

Calibrated By:
Calibration Date: 3-14-11
Calibration Due: 3-14-12

Reviewed By:
Date: 3/15/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	275739
Detector:	Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR298426

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☑ Contact ☐ 6 inches ☐ Other: Cable Length: ☑ 39-inch ☐ 72-inch ☐ Other:

Source Geometry: ☐ Side ☑ Below ☐ Other: Temperature: 72 °F Relative Humidity 20 %

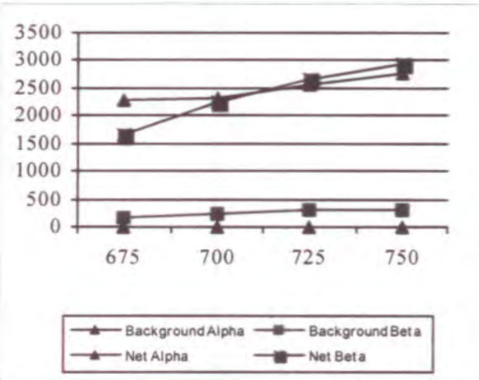
Alpha Threshold: 120 mV Beta Threshold: 4 Barometric Pressure: 24.72 inches Hg

Beta Window: 30 mV Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count α	Integrated 1-Min. Count β
x 1000	400 Kcpm	400	400	399011	399006
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39875	39902
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	3990	3991
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	399	399
x 1	100 cpm	100	100		

High Voltage	Alpha Source α	Alpha Source β	Beta Source α	Beta Source β	Background α	Background β
675	2302	336	75	1864	2	186
700	2320	383	56	2478	2	236
725	2580	485	72	2963	2	298
750	2762	606	55	3284	1	329

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =725

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932 Fluke multimeter serial number ☑ 8749012

☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03 ☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☑ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03 ☐ Other Source:

Calibrated By: Calibration Date: 3-14-11 Calibration Due: 3-14-12

Reviewed By: Date: 3/15/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

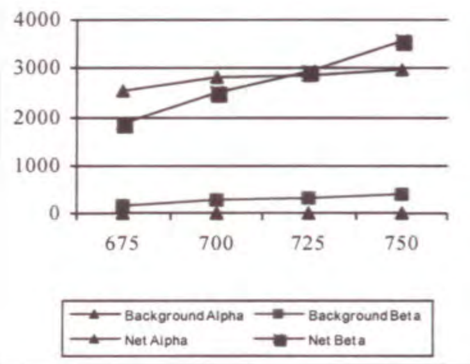
Meter:	Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	215292
Detector:	Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR199836

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☑ Contact ☐ 6 inches ☐ Other: Cable Length: ☑ 39-inch ☐ 72-inch ☐ Other:
Source Geometry: ☐ Side ☑ Below ☐ Other: Temperature: 74 °F Relative Humidity 20 %
Alpha Threshold: 120 mV Beta Threshold: 4 Barometric Pressure: 24.83 inches Hg
Beta Window: 30 mV Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count α	Integrated 1-Min. Count β
x 1000	400 Kcpm	400	400	398658	398788
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39834	39836
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	3982	3982
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	398	398
x 1	100 cpm	100	100		

High Voltage	Alpha Source α	Alpha Source β	Beta Source α	Beta Source β	Background α	Background β
675	2536	432	5	2045	3	171
700	2811	553	1	2767	3	264
725	2861	723	4	3250	1	321
750	2982	930	6	3946	2	377

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =700

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932 Fluke multimeter serial number ☑ 8749012
☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03 ☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03
☑ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03 ☐ Other Source:

Calibrated By: Calibration Date: 3-10-11 Calibration Due: 3-10-12

Reviewed By: Date: 3/15/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221	Serial Number:	262328
Detector:	Manufacturer:	Alpha Spectra	Model Number:	FIDLER	Serial Number:	010807F

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☐ Contact ☐ 6 inches ☑ Other: 3/4" Cable Length: ☐ 39-inch ☑ 72-inch ☐ Other:

Source Geometry: ☐ Side ☑ Below ☐ Other: Temperature: 74 °F Relative Humidity 20 %

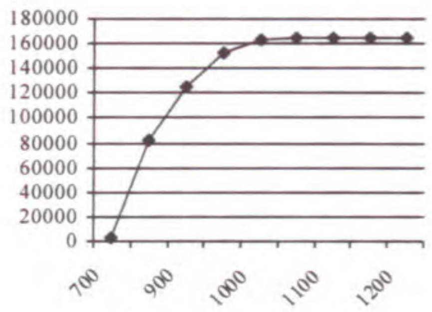
Threshold: 10 mV Window: Barometric Pressure: 24.72 inches Hg

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398663	400
x 1000	100	100	100		100
x 100	40	400	400	39854	400
x 100	10	100	100		100
x 10	4	400	400	3985	400
x 10	1	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	3394	
800	82951	
900	125821	
950	153058	
1000	162911	
1050	164452	
1100	164142	5547
1150	164542	
1200	164589	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 0.5-min. Recommended HV =1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

Fluke multimeter serial number: ☐ 8749012

☐ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03

☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03

☑ Other Source: Am-241 @ 1uCi

Calibrated By: Calibration Date: 3-14-11 Calibration Due: 3-14-12

Reviewed By: Review Date: 3/14/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

Los Alamos Technical Associates, Inc.

999 Central Ave., Suite 300 / Los Alamos, NM 87544 / Telephone (505) 662-9080 / FAX (505) 662-1757

July 13, 2011

Mr. Mark Thacker
Los Alamos National Security
Los Alamos National Laboratory
P. O. Box 1663, MS C349
Los Alamos, NM 87545
Transmitted via email: mthacker@lanl.gov

SUBJECT: 78450-002-11, Radiological Survey Report for the remainder of 21-011(b) and 21-004(b)-99

Dear Mr. Thacker:

Los Alamos Technical Associates (LATA) is pleased to submit the subject report. ERG conducted the onsite effort June 23, 2011.

If you have any questions, please contact me at 662-1816 or Joe Sena, our Field Operations Manager at 662-1837.

Sincerely,

Felicia M. Aguilar

Felicia M. Aguilar
Project Manager

Cy: F. Stafford, via email
M. Thacker, via email
B. Wedgeworth, via email
J. Byers, via email
J. Sena, via email
J. Lockhart, via email

Radiological Survey of SWMU 21-011(B) Waste Line Trenches and 21-004(b)-99 at the Los Alamos National Laboratory

Prepared for:

Los Alamos Technical Associates, Inc.
999 Central Ave.
Los Alamos, NM 87544

Prepared by:

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113

July, 2011

Radiological Survey of SWMU 21-011(b)-99 Pipe Trench

1.0 Introduction

Los Alamos Technical Associates (LATA) retained Environmental Restoration Group, Inc. (ERG) to conduct a static alpha-beta surface survey and GPS-based gamma surveys of excavated waste line pipe trenches at Los Alamos National Laboratory (LANL) Technical Area 21 (TA-21) Solid Waste Management Units (SWMU) 21-011(b) and 21-004(b)-99. Surveys were performed on three excavated acid waste line trenches at 21-011(b) known as Sections 155, 209, and 155/209 and were approximately 200, 33, and 55 linear feet in length, respectively. At 21-004(b)-99 a survey was performed over an area of approximately 135 ft^2. All surveys were performed on June 23, 2011.

Possible radiological constituents at these areas include Pu-239, Am-241, Sr-90, Cs-137, and H-3. Because of this an alpha/beta survey, low-energy gamma survey, and high-energy gamma survey were performed.

2.0 Method

For the alpha/beta survey a static 1-minute alpha/beta scaler measurement was made on the floor of each of the trenches at 10-foot intervals for the length of the entire trench. For 21-004(b)-99, several static measurements were taken at each of several predetermined grid node locations. In addition, several static locations were taken outside the excavated area, primarily where water runoff was most likely to occur. Measurements were performed using matched Ludlum Model 43-93 alpha/beta Phoswhich detectors coupled to Ludlum Model 2360 dual-channel scalers. For areas of the trenches that were inaccessible by personnel, the detector was mounted onto a pole, allowing the surveyor to safely stand outside of the trench and survey the trench bottom.

The gamma surveys were performed using a Ludlum Model 2221 ratemeter/scaler with appropriate gamma detector, coupled to a Trimble Pro XRS mapping grade GPS. The Ludlum Model 2221 and GPS unit were both carried in a backpack with the Ludlum Model 2221 operated in ratemeter mode, allowing for each gamma count rate and associated coordinates to be recorded every one second. For the low-energy gamma survey, an Alpha Spectra 5-inch diameter FIDLER detector was used, and located approximately 6 inches above the trench floor. For the high-energy gamma survey, a Ludlum Model 44-10 2-inch by 2-inch sodium iodide (NaI) detector was used, and located approximately 18 inches above the trench floor. The scanning speed for both gamma surveys was approximately 1.0 ft/sec. For inaccessible areas the gamma detectors were suspended from a pole down the trench allowing for the survey to be conducted in the same manner and height above trench bottom as the accessible areas of the trench. In addition to ratemeter scan data, one-minute static scaler counts were taken at each location in 21-004(b)-99. The counts were performed using both a high-energy and low-energy gamma detector and detector height was maintained similar to that of the mobile detector surveys. At the end of the survey, the data were downloaded into a laptop computer and processed using a combination of Trimble Pathfinder Office and ESRI ArcGIS computer applications.

3.0 Results

Data for the alpha/beta survey were converted to disintegrations per minute per 100 cm^2 ($dpm/100cm^2$) using the average detector efficiencies and average reference background readings for each detector. The measurements are summarized in Tables 3.1, 3.2, 3.3, and 3.4. No alpha/beta readings exceeded 30 dpm/100 cm^2 for alpha, or 2,100 dpm/100 cm^2 for beta. No static gamma readings exceeded 26,000 cpm for low energy or 20,000 cpm for high energy.

Table 3.1 – 21-011(B)-209 Alpha and Beta Static Measurements

Location ID	Alpha (CPM)	Beta (CPM)	Alpha (dpm/100cm^2)	Beta (dpm/100cm^2)
0	2	502	0.00	814.39
1	4	542	0.00	1102.16
2	1	543	0.00	1109.35
3	6	468	0.97	569.78
4	2	457	0.00	490.65
5	5	487	0.00	706.47

Table 3.2 – 21-011(B)-155/209 Alpha and Beta Static Measurements

Location ID	Alpha (CPM)	Beta (CPM)	Alpha (dpm/100cm^2)	Beta (dpm/100cm^2)
0	4	521	0.00	951.08
1	9	652	15.50	1893.53
2	9	524	15.50	972.66
3	9	502	15.50	814.39
0	4	521	0.00	951.08
1	9	652	15.50	1893.53

Table 3.3 – 21-011(B)-155 Alpha and Beta Static Measurements

Location ID	Alpha (CPM)	Beta (CPM)	Alpha (dpm/100cm^2)	Beta (dpm/100cm^2)
0	7	420	5.81	224.46
1	11	348	25.18	0.00
2	8	405	10.65	116.55
3	10	518	20.34	929.50
4	10	418	20.34	210.07
5	4	673	0.00	2044.60
6	5	367	0.00	0.00
7	7	620	5.81	1663.31
8	5	464	0.00	541.01
9	5	449	0.00	433.09
10	9	496	15.50	771.22
11	5	437	0.00	346.76
12	5	427	0.00	274.82
13	4	435	0.00	332.37
14	2	434	0.00	325.18
15	7	474	5.81	612.95
16	8	458	10.65	497.84
17	8	461	10.65	519.42
18	5	469	0.00	576.98
19	3	408	0.00	138.13

Table 3.4 – 21-004(B)-99 Alpha, Beta, and Gamma Static Measurements

Location ID	Alpha (CPM)	Beta (CPM)	Gamma Low Energy (CPM)	Gamma High Energy (CPM)	Alpha (dpm/100cm^2)	Beta (dpm/100cm^2)
0	4	532	25403	19745	0.00	1030.22
1	8	475	22156	18560	10.65	620.14
2	8	527	22618	18143	10.65	994.24
3	8	379	22017	18381	10.65	0.00
4	9	602	21955	18244	15.50	1533.81
5	11	447	18882	17697	25.18	418.71
6	5	403	19572	18797	0.00	102.16
7	8	417	18965	18634	10.65	202.88
8	13	449	18816	19722	34.87	433.09
9	8	404	16923	16145	10.65	109.35
10	8	383	16819	15501	10.65	0.00
11	8	397	16642	15555	10.65	58.99
12	3	402	18853	17971	0.00	94.96
13	11	430	21358	18511	25.18	296.40
14	8	586	22280	19033	10.65	1418.71
15	8	462	21688	19640	10.65	526.62
16	1	560	18863	16841	0.00	1231.65
17	7	426	18683	17025	5.81	267.63
18	5	384	18951	16780	0.00	0.00
19	5	485	19512	18935	0.00	692.09
20	13	380	20429	17770	34.87	0.00
22	5	345	19334	17110	0.00	0.00
22	5	345	19334	17110	0.00	0.00
23	3	357	15736	15737	0.00	0.00

The alpha/beta detector survey data statistics are shown below in Table 3.5.

Table 3.5 Alpha/Beta Detector Survey Results

Area	Channel	Readings	Mean (dpm/100cm^2)	Standard Deviation (dpm/100cm^2)	Maximum Reading (dpm/100cm^2)	Minimum Reading (dpm/100cm^2)
155	Alpha	20	6.5	8	25.2	0
	Beta		528	504	2045	0
209	Alpha	5	11.6	6.7	15.5	0
	Beta		1158	429	1894	814
155/209	Alpha	6	0.2	0.4	1	0
	Beta		799	240	1109	491
99	Alpha	24	9.9	10.5	35	0
	Beta		418	478	1534	0

These data are also presented below in Figures 3.1 and 3.2. The figures represent the approximate location of each measurement for each area.

Figure 3.1 Alpha/Beta Survey of 21-011(b) Areas 155, 209, and 155/209 Waste Line Trenches

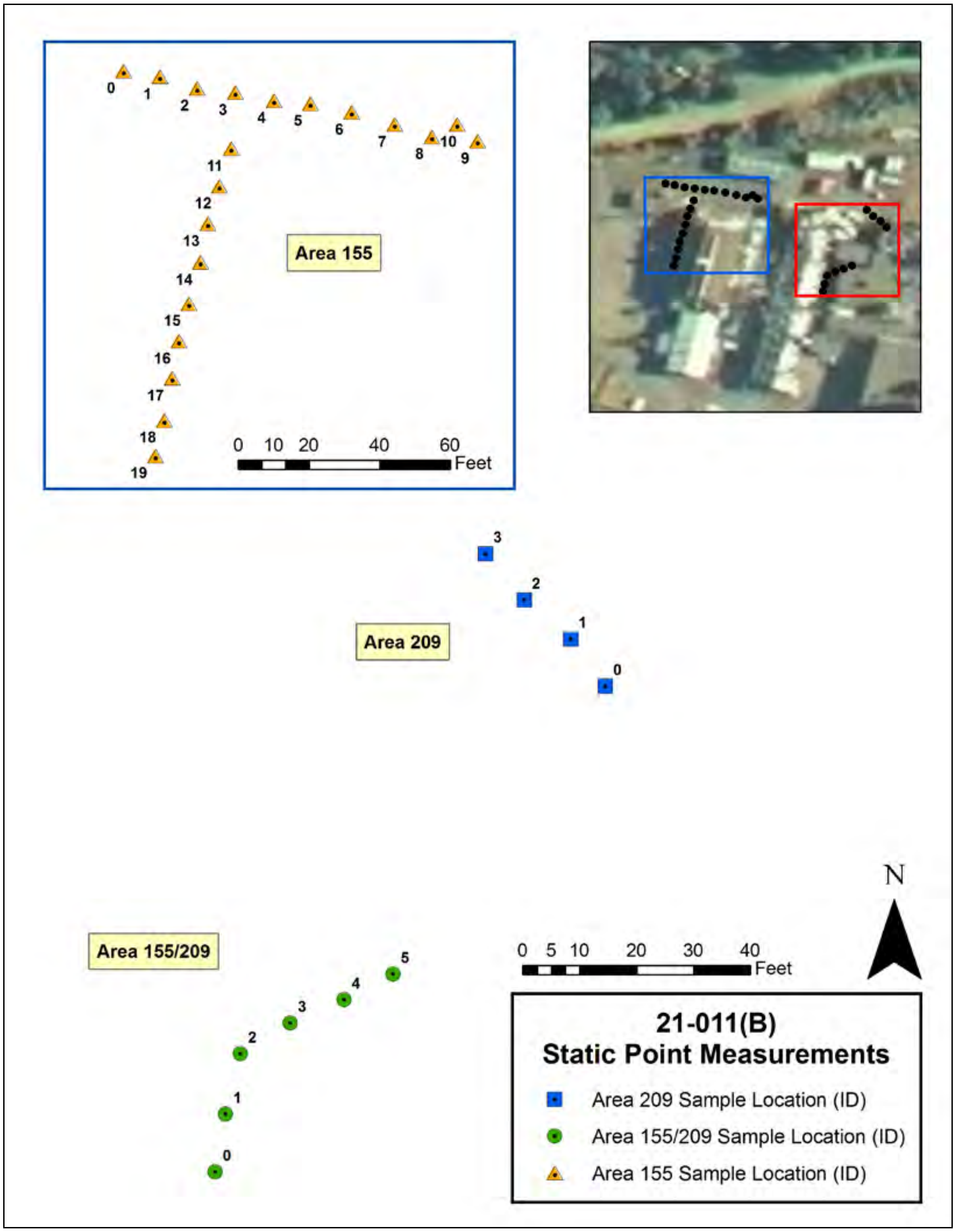
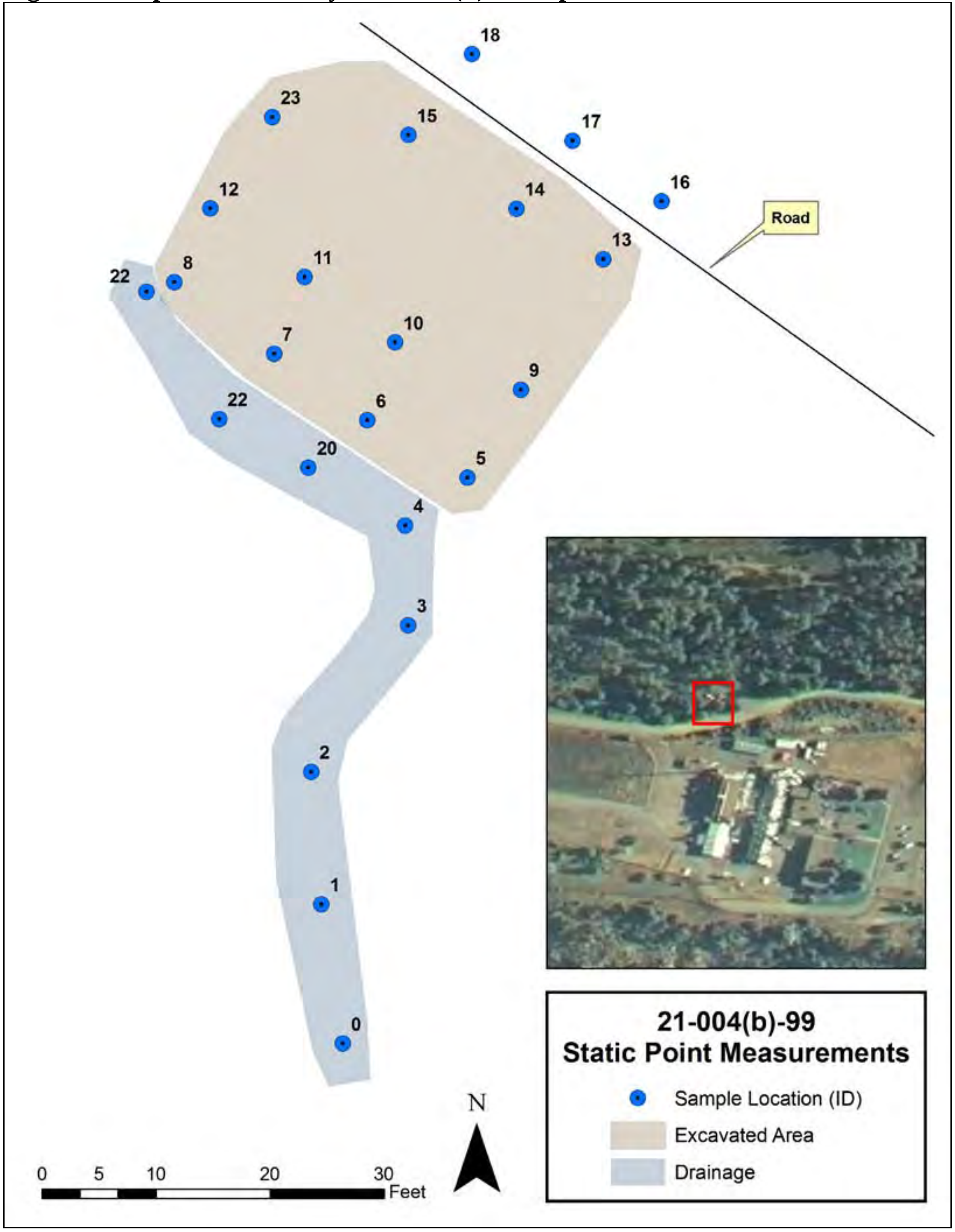


Figure 3.2 Alpha/Beta Survey of 21-004(b)- 99 Pipe Trench



3.2 Gamma Surveys

Data for the FIDLER detector (low-energy) and NaI detector (high-energy) gamma scan surveys are presented below in Figure 3.3 and Figure 3.4. The data within each figure are presented with varying colors depicting the gamma count-rate range for each survey.

Figure 3.3 High-Energy Gamma Survey of 21-011(b) an 21-004(b) -99

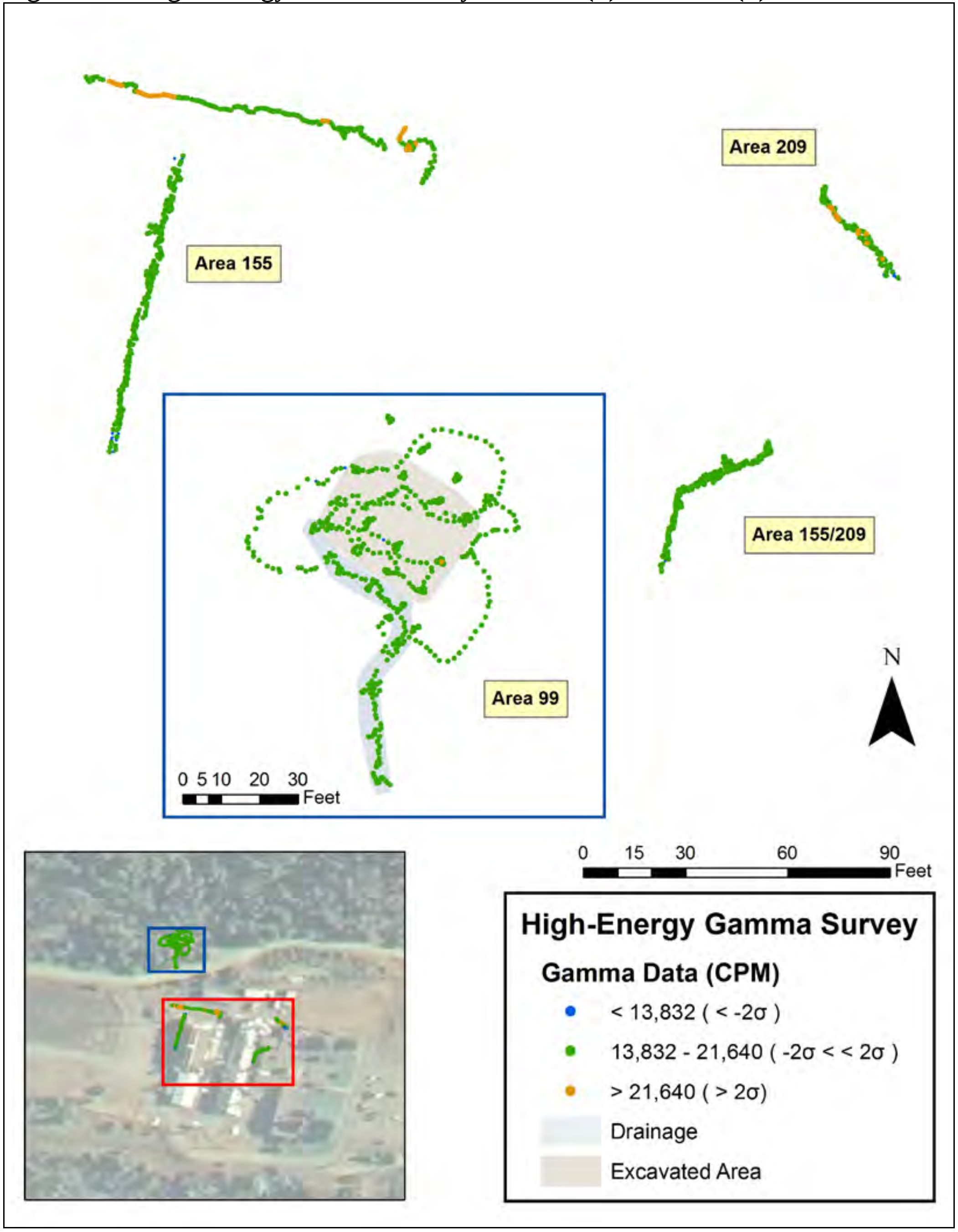
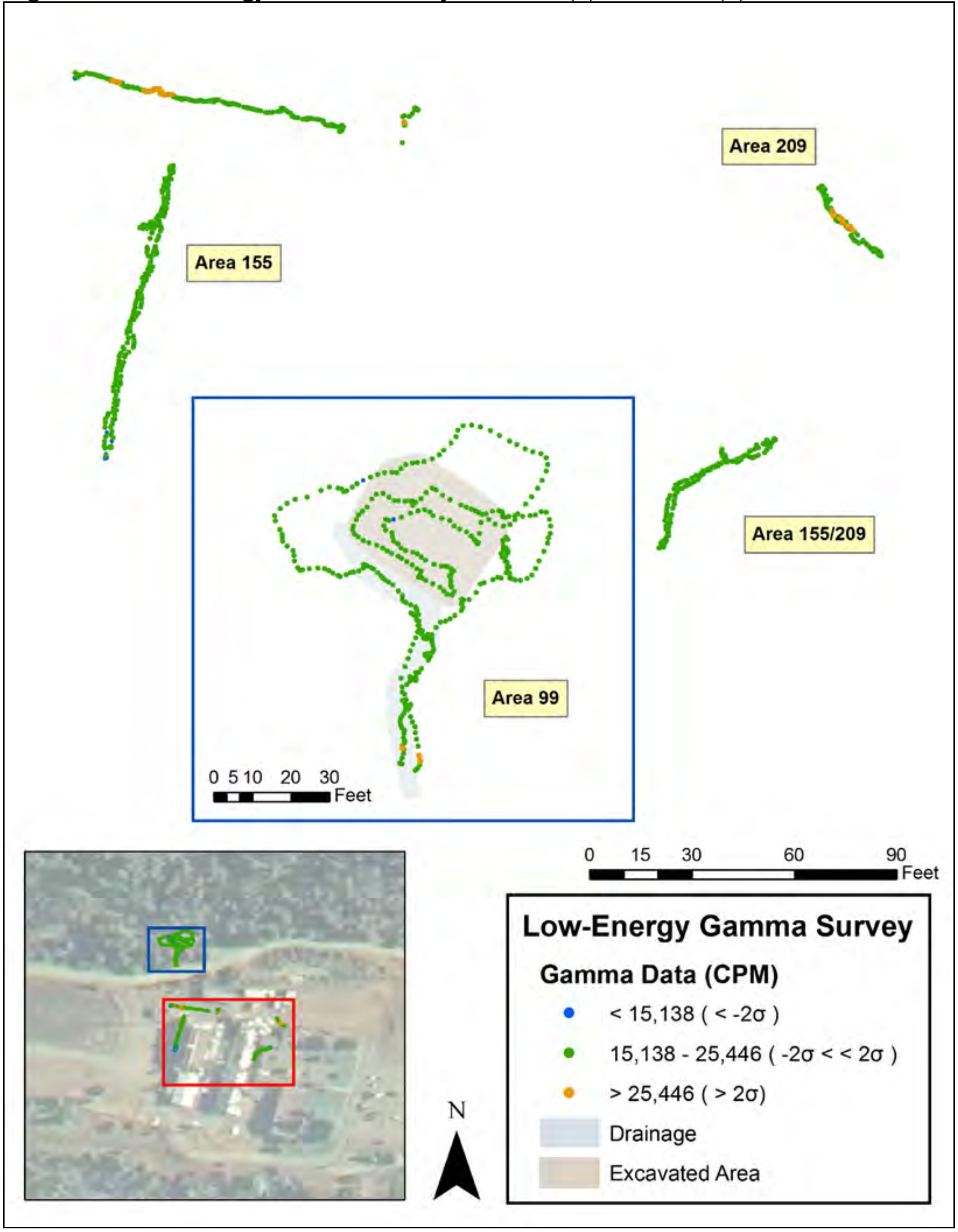


Figure 3.4 Low-Energy Gamma Survey of 21-011(b) an 21-004(b) -99



Due to the geometry of a trench (floor plus two sidewalls), readings taken inside the trench would be non-representative of any reference reading taken outside the trench. Because of this, the determination of elevated readings is based on the expected statistical spread of the data.

Gamma radiation detection from a single source is a random process that will result in a Poisson probability distribution of count rates, with the larger percentage of the count rates clustered around the mean and only a small percentage within the tails of the distribution above and below the mean. Highly elevated readings from sources other than background are typically identifiable by a distribution that is heavily weighted on the right side or that contains a sample that falls outside the typical spread from background radiation. Distribution of the low-energy FIDLER detector and high-energy NaI detector data for all locations are presented below in Figures 3.4 and 3.5, respectively. Both figures show the data fit the expected Poisson distributions with no right side tail outliers. The distributions for both surveys are similar.

Figure 3.5 Low-energy FIDLER Detector Data Distribution

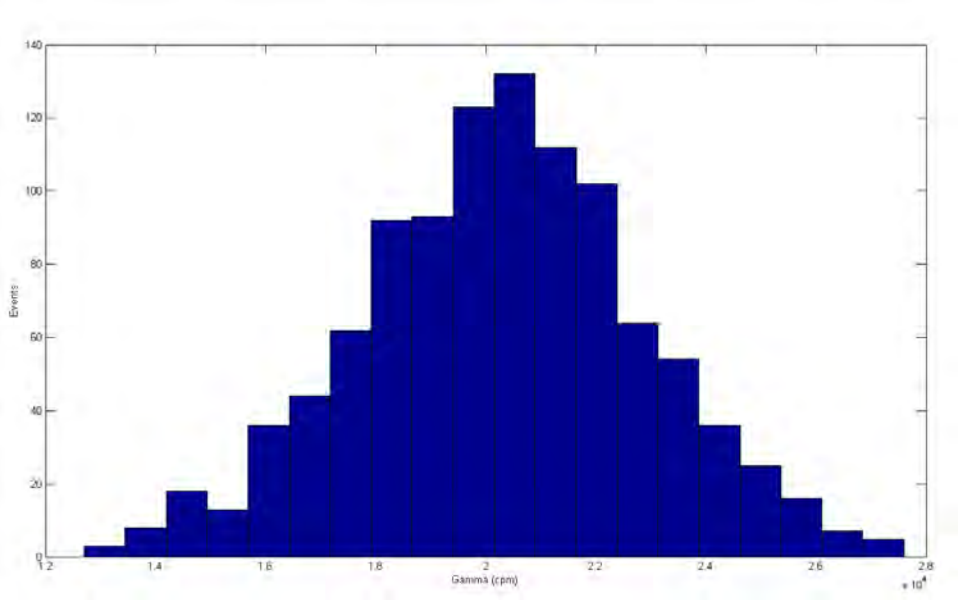
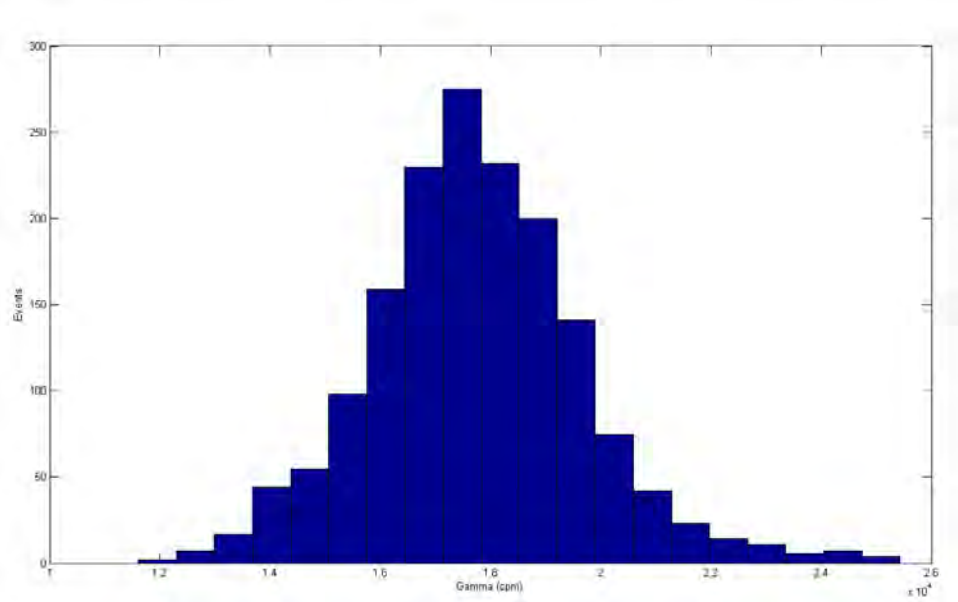


Figure 3.6 High-energy Gamma NaI Detector Data Distribution



The static high-energy and low-energy gamma statistics are shown in Table 3.6. The locations where measurements were made are the same as shown in Figure 3.2 above.

Table 3.6 Static High/Low Energy Gamma Detector Survey Results

Gamma Energy	Readings	Mean (cpm)	Standard Deviation (cpm)	Maximum Reading (cpm)	Minimum Reading (cpm)
FIDLER (low-energy)	24	19,825	2,212	25,403	15,736
NaI 44-10 (high-energy)	24	17,816	1,258	19,745	15,501

The scan survey data statistics for the FIDLER detector and NaI detector are shown below in Table 3.7. The distribution of data indicates no highly-elevated values with respect to the mean trench readings for either detector data set.

Table 3.7 Gamma Detector Survey Results

Detector	Readings	Mean (cpm)	Standard Deviation (cpm)	Maximum Reading (cpm)	Minimum Reading (cpm)
FIDLER (low-energy)	1,045	20,291	2,577	27,597	12,707
NaI 44-10 (high-energy)	1,642	17,736	1,952	25,428	11,608

4.0 Quality Control

All radiological instrumentation was calibrated within six months prior to use using NIST traceable sources and pulser. Field instruments were function checked before and after use each day. Function check forms and calibration sheets are included in Appendix A.

Appendix A

Calibration and Daily Function Check Forms

ERG

Function Check Form
Single Channel Detector

Ratemeter: LUDLUM 2221 Serial No. 268647 Cal. Due Date: 6/22/12

Detector: LUDLUM 44-10 Serial No. PR150786 Cal. Due Date: 6/22/12

Source: Cs-137 Activity: 5.37 μCi 1/13/10 Serial No. 4097-03

Comments: OPERATED w/ 10-FOOT C-CABLE. EQUIPMENT FUNCTION CHECKED & CAL'D @ ERG ALBUQUERQUE OFFICE. SOURCE DIST. ~ 5" SIDE.

Date	Time	Battery	High Voltage	Threshold	Gross Counts	Background	Net Counts	Efficiency	Initial
6/23/11	06:40	4.9	1150	102	68896	10362	58534	-	cf
6/23/11	16:30	4.9	1149	101	69656	9874	59782	-	CF
					*	12673			
					ON SITE LANL 21-004(b)-99				
					PRE-OPERATIONAL BACKGROUND				
					@ 18" ABOVE GROUND.				

Reviewed By: Date: 6/29/11

ERG Form 1.30A

ERG

Function Check Form
Dual Channel Detector

Ratemeter: LUDLUM 2360 Serial No. 177184 Cal. Due Date: 6/22/12

Detector: LUDLUM 43-93 Serial No. PR199827 Cal. Due Date: 6/22/12

Alpha Threshold: 120 mV Beta Threshold: 4 mV Beta Window: 30 mV

Alpha Source: TH-230 Activity: 13,000 DPM Serial No. 4098-03

Beta Source: Tc-99 Activity: 17,700 DPM Serial No. 4099-03

Comments: OPERATED w/ 10-FOOT C-CABLE. CAL/FUNCTION CHECK @ ERG ALBUQUERQUE office. SOURCE DIST. ~ CONTACT.

Date	Time	High Voltage	Battery	Alpha		Beta		Background		Efficiency		Initial
				Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	
6/23/11	07:00	✓	✓	2780	625	4	2641	7	209	0.213	0.137	CF
6/23/11	17:10	✓	✓	2613	611	8	2690	8	204	0.200	0.141	CF

* α: 29 β: 1944 5 min count
on site LANL 21-004(B)-99
Pre-operational background
at surface.

Reviewed By: Date: 6/29/11

ERG Form 1.30B

ERG

Function Check Form
Single Channel Detector

Ratemeter: LUDLUM 2221 5" Serial No. 262328 Cal. Due Date: 6/22/12

Detector: ALPHASPECTRA FIDLER Serial No. 010807C Cal. Due Date: 6/22/12

Source: Am-241 Activity: 1 μCi Serial No. ERG- SD1

Comments: OPERATED w/ 10-FOOT C-CABLE. FUNCTION CHECK & CAL @ ERG ALBUQUERQUE OFFICE. SOURCE DIST. ~ 2" BELOW FACE.

Date	Time	Battery	High Voltage	Threshold	Gross Counts	Background	Net Counts	Efficiency	Initial
6/23/11	06:45	6.0	1101	101	206539	11353	195186	–	
6/23/11	16:45	5.9	1099	99	205628	10952	194676	–	
					*	14374			
					ON SITE	LANL	21-004(b)-99		
					PRE-OPERATIONAL		BACKGROUND		
					@ ~ 6"	ABOVE	GROUND.		

Reviewed By: Date: 6/29/11

ERG Form 1.30A

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

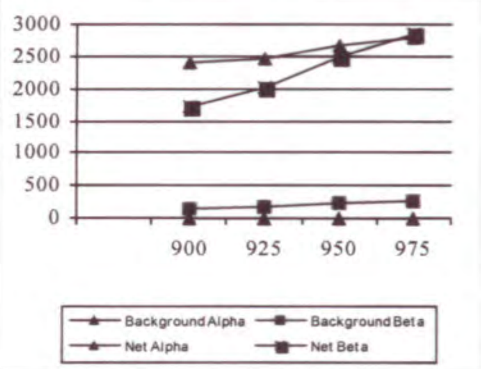
Meter: Manufacturer:	Ludlum	Model Number:	2360	Serial Number:	177184
Detector: Manufacturer:	Ludlum	Model Number:	43-93	Serial Number:	PR199827

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☐ F/S Response Check ☑ Meter Zeroed ☑ Reset Check
HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☑ Contact ☐ 6 inches ☐ Other:
Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 10'
Source Geometry: ☐ Side ☑ Below ☐ Other:
Temperature: 75 °F Relative Humidity 20 %
Alpha Threshold: 120 mV Beta Threshold: 4
Barometric Pressure: 24.57 inches Hg
Beta Window: 30 mV
Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count α	Integrated 1-Min. Count β
x 1000	400 Kcpm	400	400	399236	399167
x 1000	100 Kcpm	100	100		
x 100	40 Kcpm	400	400	39928	39927
x 100	10 Kcpm	100	100		
x 10	4 Kcpm	400	400	3993	3993
x 10	1 Kcpm	100	100		
x 1	400 cpm	400	400	399	399
x 1	100 cpm	100	100		

High Voltage	Alpha Source α	Alpha Source β	Beta Source α	Beta Source β	Background α	Background β
900	2422	401	7	1866	2	145
925	2477	517	7	2215	3	183
950	2670	575	7	2734	0	237
975	2795	788	9	3111	2	271

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =950

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932
Fluke multimeter serial number ☑ 8749012
☑ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03
☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03
☑ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03
☐ Other Source:

Calibrated By:
Calibration Date: 6-22-11
Calibration Due: 6-22-12

Reviewed By:
Date: 6/22/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

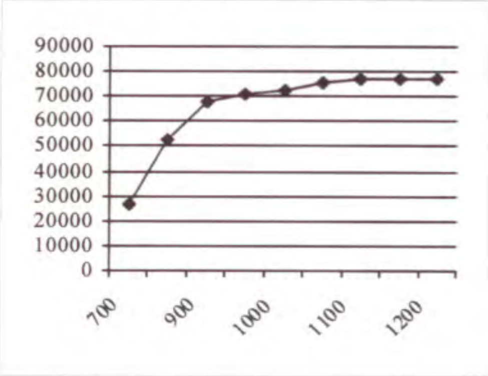
Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 268647
Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR150786

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☐ Contact ☑ 6 inches ☐ Other:
Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 10'
Source Geometry: ☑ Side ☐ Below ☐ Other:
Temperature: 77 °F Relative Humidity 20 %
Threshold: 10 mV Window:
Barometric Pressure: 24.54 inches Hg
Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	399840	400
x 1000	100	100	100		100
x 100	40	400	400	39985	400
x 100	10	100	100		100
x 10	4	400	400	3999	400
x 10	1	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	26979	
800	52792	
900	67942	
950	71158	
1000	72520	
1050	75628	
1100	76774	
1150	77337	11607
1200	77258	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932
Fluke multimeter serial number: ☐ 8749012
☐ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03
☑ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03
☐ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03
☐ Other Source:

Calibrated By:
Calibration Date: 6-22-11
Calibration Due: 6-22-11

Reviewed By:
Review Date: 6/22/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	262328
Detector:	Manufacturer:	Alpha Spectra	Model Number:	FIDLER	Serial Number:	010807C

☑ Mechanical Check ☑ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)

☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Source Distance: ☐ Contact ☐ 6 inches ☑ Other: 3/4"

Cable Length: ☐ 39-inch ☐ 72-inch ☑ Other: 10'

Source Geometry: ☐ Side ☑ Below ☐ Other:

Temperature: 78 °F Relative Humidity 20 %

Threshold: 10 mV Window:

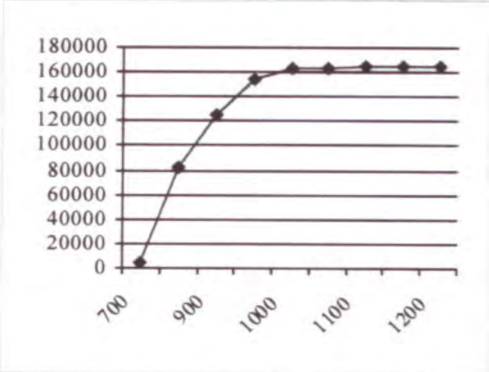
Barometric Pressure: 24.6 inches Hg

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398988	400
x 1000	100	100	100		100
x 100	40	400	400	39809	400
x 100	10	100	100		100
x 10	4	400	400	3992	400
x 10	1	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	3935	
800	83122	
900	125781	
950	153460	
1000	163779	
1050	163974	
1100	164852	6647
1150	164979	
1200	165283	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 0.5-min. Recommended HV =1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

Fluke multimeter serial number: ☐ 8749012

☐ Alpha Source: Th-230 @ 13,000 dpm (1/13/10) sn: 4098-03

☐ Gamma Source Cs-137 @ 5.37 uCi (1/13/10) sn: 4097-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/13/10) sn: 4099-03

☑ Other Source: Am-241 @ 1uCi

Calibrated By:

Calibration Date: 6-22-11

Calibration Due: 6-22-12

Reviewed By:

Review Date: 6/22/11

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

Appendix E

Investigation-Derived Waste Management

E-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 DP Site Aggregate Area Delayed Sites at Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or Laboratory).

All IDW generated during the field investigation was managed in accordance with Standard Operating Procedure (SOP) 5238, “Characterization and Management of Environmental Program (EP) 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 were used to complete the WCSF. The WCSF is included in this appendix as Attachment E-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 “Los Alamos National Laboratory Hazardous Waste Minimization Report.”

E-2.0 WASTE STREAMS

The IDW streams generated and managed during the investigation are described below and are summarized in Table E-2.0-1. The waste numbers correspond with those identified in the WCSF.

- *WCSF Waste Streams #1 and #2*: Drill cuttings and excavated environmental media consisted of soil and rock removed during hand-augering and structure excavation. Approximately 2.5 yd^3 of these waste streams was generated during this investigation and stored in a 55-gal. drum. The wastes were characterized per the WCSF, met the criteria in ENV-RCRA-QP-11.2, “Land Application of Drill Cuttings,” and were land-applied.
- *WCSF Waste Streams #3 and #5*: Excavated man-made debris consisted of tanks, asphalt, concrete, piping, and a sump. Contact waste consisted of personal protective equipment, contaminated sampling supplies, and dry-decontamination waste. These wastes were determined to be both industrial and low-level waste (LLW). Approximately 160 yd^3 of LLW and approximately 58 yd^3 of industrial waste were generated. These were stored in roll-off containers and disposed at an approved off-site facility.

- *WCSF Waste Stream #9*: Uncontainerized liquid consisted of fluids encountered inside the 3000-gal. aboveground storage tanks at Solid Waste Management Units (SWMUs) 21-004(b) and 21-004(c). This liquid was determined to be nonhazardous waste. The liquid waste was pumped from the tanks into two 400-gal. poly tanks and one 55-gal. drum (50% full). The waste was treated at Technical Area 50 (TA-50) and disposed of at TA-53.
- *WCSF Waste Streams #4, #6, #7, and #8*: No decontamination fluids were generated, no municipal solid waste was generated, no petroleum-contaminated soils were found, and no excess samples were generated or returned.

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

Waste Stream	Waste Type	Volume	Characterization Method	On-Site Management	Disposition
Drill Cuttings and Excavated Environmental Media	Nonhazardous	2.5 yd^3	Direct container sampling.	55-gal. drum	Land-applied
Excavation Waste/Contact Waste	Industrial	58 yd^3	Direct container sampling.	20-yd^3 roll-off bins	Authorized off-site disposal facility
Excavation Waste	LLW	160 yd^3	Direct container sampling.	20-yd^3 roll-off bins/IP-1 container	Authorized off-site disposal facility
Liquid	Nonhazardous	825 gal.	Direct container sampling.	400-gal. poly tanks; 55-gal. drum	Treated at TA-50 and disposed of at TA-53

Attachment E-1

Waste Characterization Strategy Form
(on CD included with this document)

Appendix F

Analytical Program

F-1.0 INTRODUCTION

This appendix discusses the analytical methods and data-quality review for samples collected during investigations addressed in this investigation report of the DP Site Aggregate Area sites at DP East 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 statement of work (SOW) for analytical laboratories (LANL 1995, 049738; LANL 2000, 071233; 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 included method blanks, matrix spikes (MSs), laboratory control samples (LCSs), internal standards (ISs), initial calibration verifications (ICVs) and continuing calibration verifications (CCVs), surrogates, and tracers.

The type and frequency of laboratory QC analyses are described in the SOW for analytical laboratories (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 eprr.lanl.gov were used for data validation:

- SOP-5161, “Routine Validation of Volatile Organic Compound (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-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 number), 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 C (on CD). The analytical data, instrument printouts, and data validation reports are also provided in Appendix C.

F-2.0 ANALYTICAL DATA ORGANIZATION

All data collected during 2010–2011 investigation activities are determined to be of sufficient quality for decision-making purposes.

F-3.0 INORGANIC CHEMICAL ANALYSES

A total of 76 samples (plus 8 field duplicates) collected from the sites addressed in this investigation report were analyzed for inorganic chemicals. Each of the 76 samples was analyzed for target analyte list (TAL) metals, nitrate, perchlorate, and total cyanide. The analytical methods used for inorganic chemicals are listed in Table F-3.0-1.

Tables in the investigation report summarize all samples collected and the analyses requested for the investigation of the DP Site Aggregate Area sites at DP East. All the analytical results are presented in Appendix C (on CD).

F-3.1 Inorganic Chemical QA/QC Samples

The use of QA/QC samples is designed to produce measures of 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, LCSs, preparation blanks, MSs, laboratory duplicate samples, interference check samples (ICSs), and serial dilution samples were analyzed as part of the investigation. Each of these QA/QC sample types is defined in the analytical services SOW (LANL 2008, 109962) and is described briefly in the sections 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%–125% (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%–125%, inclusive, for all spiked analytes (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 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%–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%.

F-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.

F-3.2.1 Maintenance of COC

SCL/COC forms were maintained properly for all samples analyzed for inorganic chemicals (Appendix C).

F-3.2.2 Sample Documentation

All samples analyzed for inorganic chemicals were properly documented on SCL/COC forms in the field (Appendix C).

F-3.2.3 Sample Dilutions

Some samples were diluted for inorganic chemical analyses. Some dilutions resulted in higher quantitation limits. No qualifiers were applied to any inorganic chemical sample results because of dilutions.

F-3.2.4 Sample Preservation

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

F-3.2.5 Holding Times

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

F-3.2.6 ICVs and CCVs

No qualifiers were applied to any inorganic chemical sample results because of ICV or CCV issues.

F-3.2.7 Interference Check Sample and/or Serial Dilutions

No qualifiers were applied to any inorganic chemical sample results because of ICS or serial dilution issues.

F-3.2.8 Laboratory Duplicate Samples

A total of 29 TAL metals results were qualified as estimated (J) because the sample and the laboratory duplicate sample results were greater than or equal to 5 times the reporting limit (RL) and the duplicate RPD was greater than 35% for soil samples.

F-3.2.9 Blanks

Four nitrate results, one perchlorate result, and sixty-one TAL metals results were qualified as not detected (U) because the sample results were less than or equal to 5 times the concentration of the related analytes in the equipment rinsate blank.

Six TAL metals results and four total cyanide results were qualified as not detected (U) because the sample result was less than or equal to 5 times the concentration of the related analyte in the preparation blank.

A total of 35 TAL metals results were qualified as estimated (J) because the sample result was greater than 5 times the concentration of the related analyte in the preparation blank.

A total of 15 TAL metals results were qualified as not detected (U) because the sample result was less than or equal to 5 times the concentration of the related analyte in the initial calibration blank/continuous calibration blank.

F-3.2.10 MS Samples

Two nitrate results and thirty-nine TAL metals results were qualified as estimated not detected (UJ) because the associated MS recovery was less than the lower acceptance limit (LAL) but greater than 10%.

Twelve TAL metals results were qualified as estimated and biased low (J-) because the associated MS recovery was less than the LAL but greater than 10%.

A total of 107 TAL metals results were qualified as estimated and biased high (J+) because the associated MS recovery was greater than the upper acceptance limit (UAL).

F-3.2.11 LCS Recoveries

Eleven TAL metals results were qualified as estimated not detected (UJ) because the LCS %R was less than the LAL but greater than 10%.

F-3.2.12 Detection Limits

No qualifiers were applied to any inorganic chemical results because of detection-limit issues.

F-3.2.13 Rejected Results

No inorganic results were qualified as rejected (R).

F-4.0 ORGANIC CHEMICAL ANALYSES

A total of 76 samples (plus 8 field duplicates) collected from the sites addressed in this investigation report were analyzed for organic chemicals. A total of 74 samples were analyzed for volatile organic compounds (VOCs), 76 samples were analyzed for semivolatile organic compounds (SVOCs), 28 samples were analyzed for polychlorinated biphenyls (PCBs), 9 samples were analyzed for dioxins/furans, and 9 samples were analyzed for explosive compounds. All QC procedures were followed as required by the analytical laboratory SOW (LANL 1995, 049738; LANL 2000, 071233). The analytical methods used for organic chemicals are listed in Table F-3.0-1.

Tables within the investigation report summarize all samples collected and the analyses requested from the DP Site Aggregate Area sites at DP East. All organic chemical results are provided in Appendix C (on CD).

F-4.1 Organic Chemical QA/QC Samples

The use of QA/QC samples is designed to produce measures of 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 the concentration reported is accurate. Calibration verifications, LCSs, method blanks, MSs, surrogates, and ISs were analyzed to assess the accuracy and precision of organic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOW (LANL 2008, 109962) and is described briefly 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. Initial calibration verifies the accuracy of the calibration curve as well as the individual calibration standards used to perform the calibration. Continuing calibration ensures the initial calibration is still holding and correct as the instrument is used to process samples. 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 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 a target analyte that is similar in composition and behavior to the target analyte but normally is not 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. ISs are used as the basis for quantitation of target analytes. The %R for ISs should be within the range of 50%–200%.

F-4.2 Data-Quality Results for Organic Chemicals

The majority of the analytical results for organic 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.

F-4.2.1 Maintenance of COC

SCL/COC forms were maintained properly for all samples analyzed for organic chemicals (Appendix C).

F-4.2.2 Sample Documentation

All samples analyzed for organic chemicals were properly documented on the SCL/COC forms in the field (Appendix C).

F-4.2.3 Sample Dilutions

Some samples were diluted for organic chemical analyses. Some dilutions resulted in higher quantitation limits. No qualifiers were applied to any organic chemical sample results because of dilutions.

F-4.2.4 Sample Preservation

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

F-4.2.5 Holding Times

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

F-4.2.6 ICVs and CCVs

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

Twenty SVOC results were qualified as estimated (J) because the ICV and/or CCV were not analyzed at the appropriate method frequency.

A total of 3 explosive-compound results, 260 SVOC results, and 301 VOC results were qualified as estimated not detected (UJ) because the ICV and/or CCV were recovered outside the method-specific limits.

A total of 108 SVOC results were qualified as estimated not detected (UJ) because the ICV and/or CCV were not analyzed at the appropriate method frequency.

A total of 12 explosive-compound results were qualified as estimated not detected (UJ) because they were analyzed with a relative response factor (RRF) of less than 0.05 in the initial calibration and/or CCV.

F-4.2.7 Surrogate Recoveries

No results were qualified with surrogate recovery issues.

F-4.2.8 IS Responses

No results were qualified with IS response issues.

F-4.2.9 Blanks

Seven dioxin/furan results were qualified as not detected (U) because the sample result was less than or equal to 5 times the concentration of the related analyte in the method blank.

Five VOCs were qualified as not detected (U) because the associated sample concentration was less than 5 times the amount in the trip or equipment rinsate blank.

F-4.2.10 MS Samples

Five explosive-compound results were qualified as estimated not detected (UJ) because the MS/matrix spike duplicate (MSD) RPD was greater than 30%.

F-4.2.11 Laboratory Duplicate Samples

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

F-4.2.12 LCS Recoveries

One explosive-compound result was qualified as estimated not detected (UJ) because the LCS %R was less than the LAL but greater than 10%.

F-4.2.13 Rejected Data

Two SVOC results were qualified as rejected (R) because the LCS %R was less than10%.

The rejected data were not used to characterize the nature and extent of contamination or 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.

F-5.0 RADIONUCLIDE ANALYSES

A total of 76 samples (plus 8 field duplicates) collected from the sites addressed in this investigation report were analyzed for radionuclides. A total of 76 samples were analyzed for gamma-emitting radionuclides, 76 samples were analyzed for isotopic plutonium, 76 samples were analyzed for isotopic uranium, 72 samples were analyzed for isotopic thorium, 76 samples were analyzed for technetium-99, 76 samples were analyzed for tritium, and 76 samples were analyzed for strontium-90. The analytical methods used for radionuclides are listed in Table F-3.0-1.

Tables in the investigation report summarize all samples collected and the analyses requested from the DP Site Aggregate Area sites at DP East. All radionuclide results are provided in Appendix C (on CD).

F-5.1 Radionuclide QA/QC Samples

To assess the accuracy and precision of radionuclide analyses, LCSs, method blanks, MS samples, laboratory duplicate samples, and tracers were analyzed as part of the investigations. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 2008, 109962) and is described briefly 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%–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 radionuclide 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%–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 analyte. 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 2008, 109962).

F-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.

All procedures were followed as required by the analytical services SOW (LANL 2008, 109962). Some sample results were qualified as not detected (U) because the associated sample concentration was less than or equal to the MDC. Some sample 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.

F-5.2.1 Maintenance of COC

SCL/COC forms were maintained properly for all samples (Appendix C).

F-5.2.2 Sample Documentation

All samples were properly documented on the SCL/COC forms in the field (Appendix C).

F-5.2.3 Sample Dilutions

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

F-5.2.4 Sample Preservation

Preservation criteria were met for all samples analyzed for radionuclides.

F-5.2.5 Holding Times

A total of 27 technetium-99 results were qualified as estimated not detected (UJ) because the holding time was greater than 1 and less than or equal to 2 times the applicable holding-time requirement.

A total of 36 isotopic thorium results were qualified as estimated biased low (J-) because the holding time was greater than 1 and less than or equal to 2 times the applicable holding-time requirement.

F-5.2.6 Method Blanks

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

F-5.2.7 MS Samples

MS criteria were met for all samples analyzed for radionuclides.

F-5.2.8 Tracer Recoveries

Three isotopic thorium results and five isotopic uranium results were qualified as estimated and biased high (J+) because the tracer recovery was greater than the UAL.

One americium-241 result, three isotopic thorium results, and two isotopic uranium results were qualified as estimated and biased low (J-) because the tracer recovery was less than the LAL but equal to or greater than 10%R.

Three technetium-99 results and one isotopic uranium result were qualified as estimated not detected (UJ) because the tracer recovery was less than the LAL but equal to or greater than 10%R.

F-5.2.9 LCS Recoveries

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

F-5.2.10 Laboratory Duplicate Samples Recoveries

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

F-5.2.11 Rejected Data

Twenty-nine cesium-134 results were qualified as rejected (R) because spectral interferences prevented positive identification of the analytes.

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.

F-6.0 REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

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)

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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 F-3.0-1
Inorganic Chemical, Organic Chemical, and Radionuclide Analytical Methods for Samples Collected for DP Site Aggregate Area Sites at DP East

Analytical Method	Analytical Description	Analytical Suite
Inorganic Chemicals		
EPA 300.0	Ion chromatography	Anions (nitrate)
EPA SW-846: 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, uranium, 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, vanadium, and zinc (TAL metals)
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 (GC)	PCBs
EPA SW-846:8240 EPA SW-846:8260 EPA SW-846:8260B	Gas chromatography/mass spectrometry (GC/MS)	VOCs
EPA SW-846:8270C	GC/MS	SVOCs
EPA SW-846: 8321A _MOD	High-performance liquid chromatography	Explosive compounds
SW-846:8290	High-resolution GC/high-resolution MS	Dioxins, furans
Radionuclides		
EPA 901.1	Gamma spectroscopy	Cesium-134, cesium-137, cobalt-60, sodium-22
HASL Method 300:Am-241 HASL Method 300:ISOPU HASL Method 300:ISOU HASL Method 300:ISOTH	Alpha spectroscopy, gas-flow proportional counting	Americium-241 Isotopic plutonium Isotopic uranium Isotopic thorium
HASL Method 300:Tc-99	Gamma spectroscopy	Technetium-99
EPA 905.0	Gas proportional counting	Strontium-90
EPA 906.0	Liquid scintillation	Tritium

Appendix G

Box Plots and Statistical Results

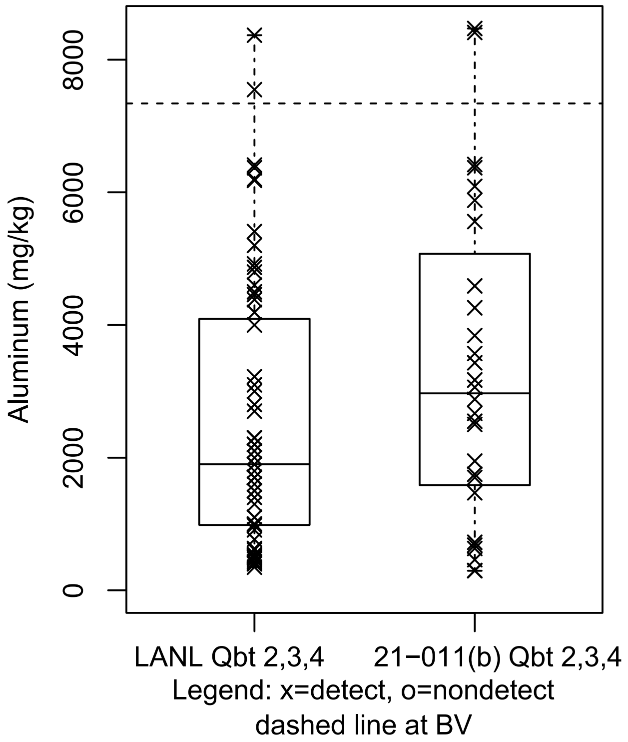

Figure G-1 **Box plot for aluminum in tuff at SWMU 21-011(b)**

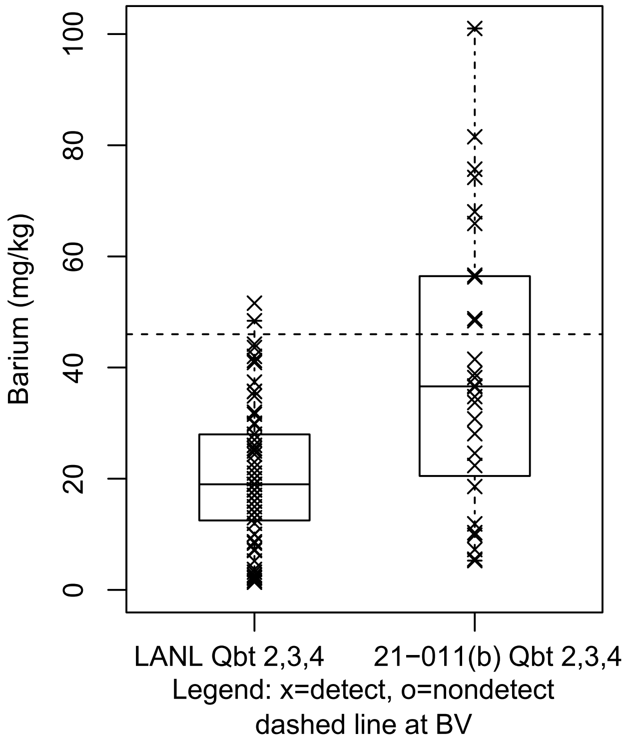

Figure G-2 **Box plot for barium in tuff at SWMU 21-011(b)**

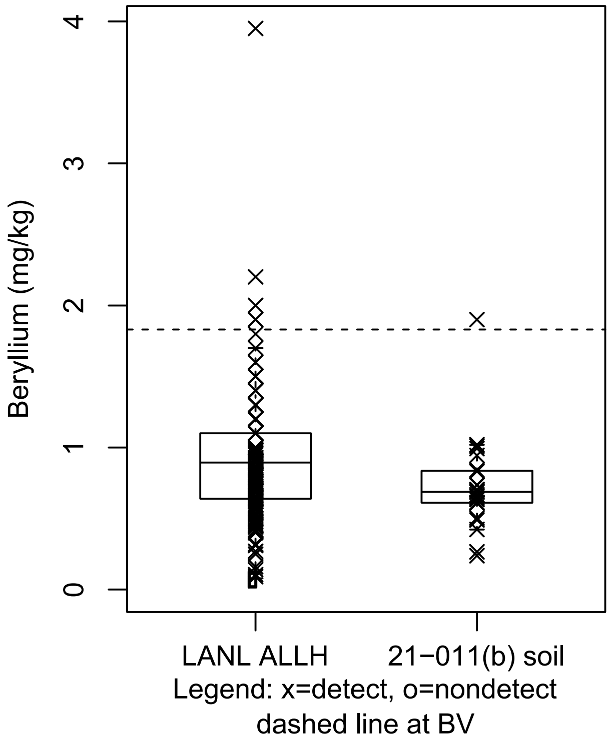

Figure G-3 Box plot for beryllium in soil at SWMU 21-011(b)

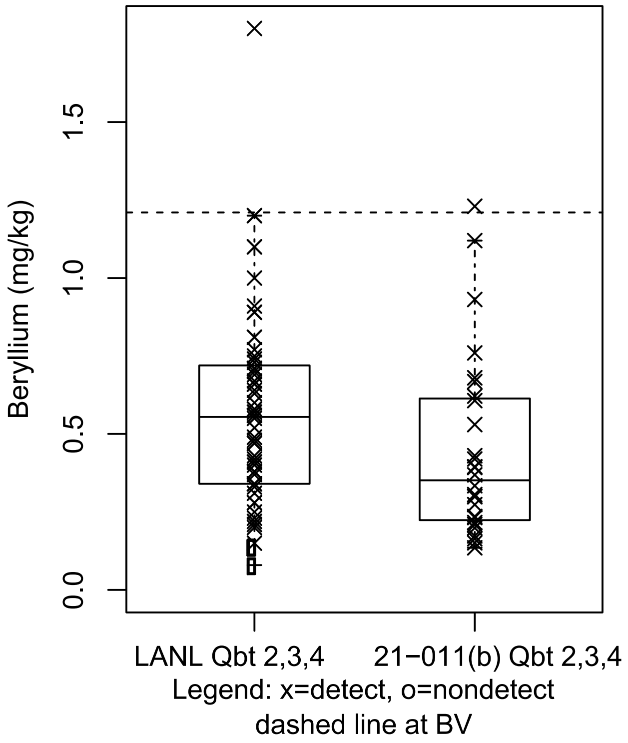

Figure G-4 Box plot for beryllium in tuff at SWMU 21-011(b)

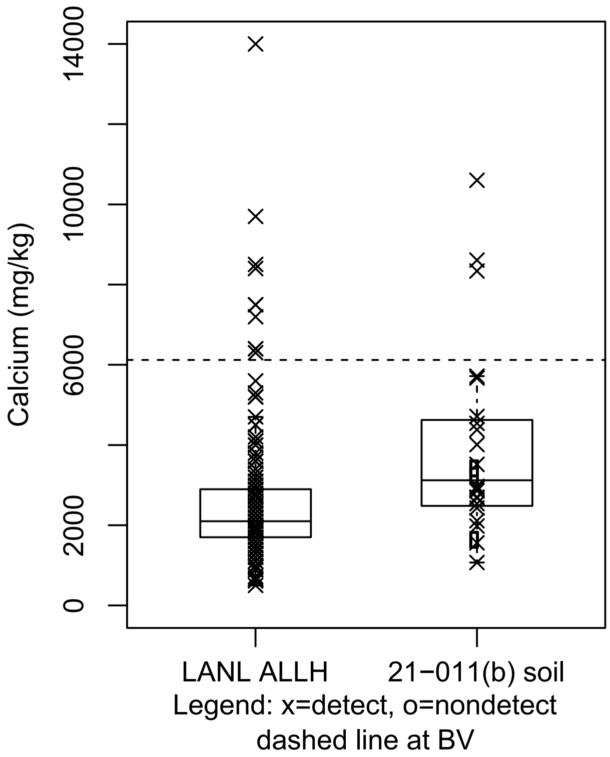

Figure G-5 Box plot for calcium in soil at SWMU 21-011(b)

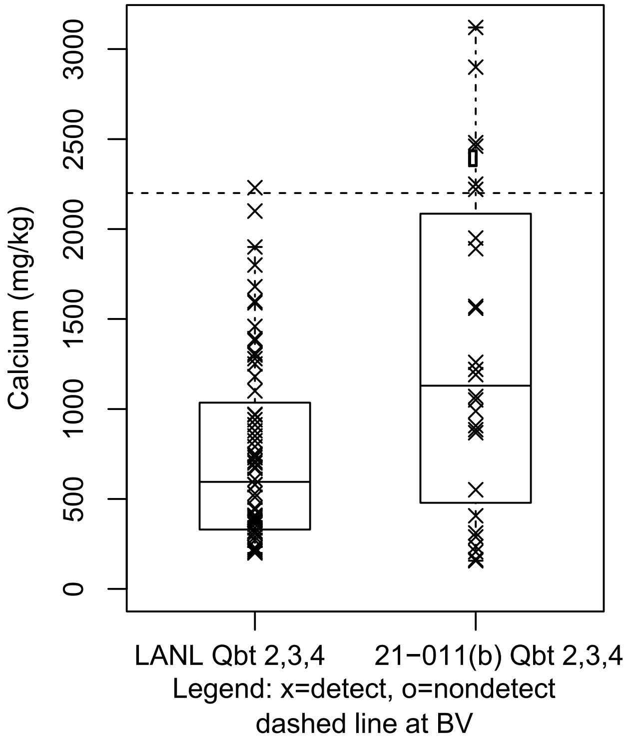

Figure G-6 Box plot for calcium in tuff at SWMU 21-011(b)

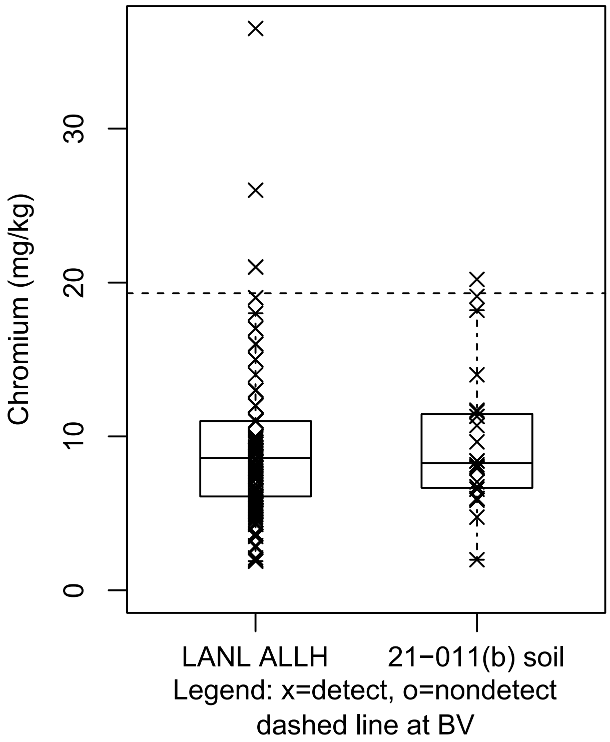

Figure G-7 **Box plot for chromium in soil at SWMU 21-011(b)**

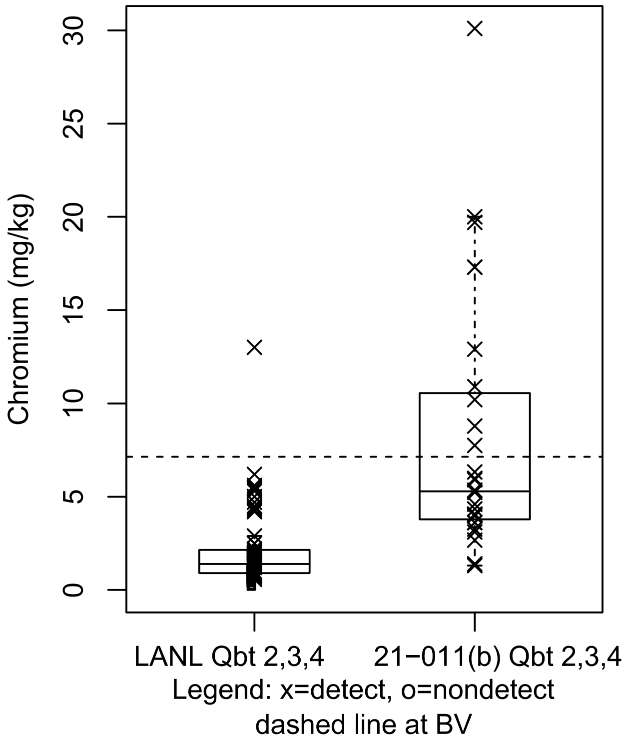

Figure G-8 **Box plot for chromium in tuff at SWMU 21-011(b)**

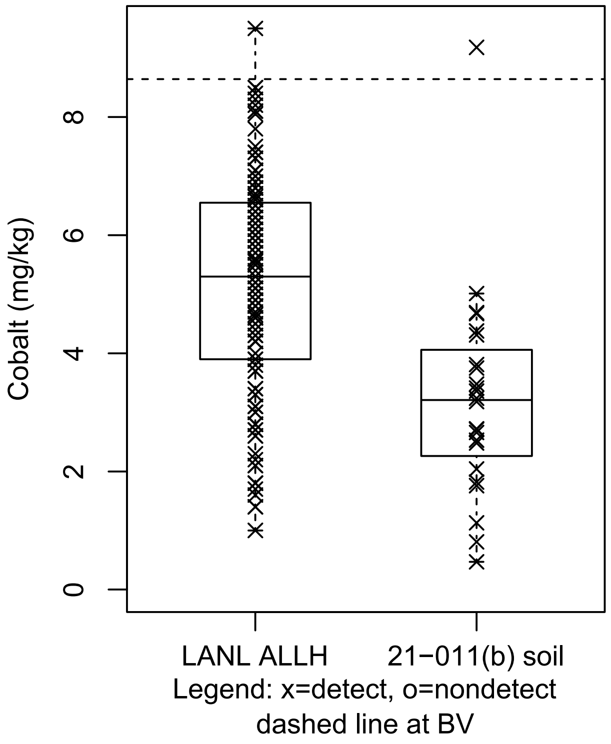

Figure G-9 Box plot for cobalt in soil at SWMU 21-011(b)

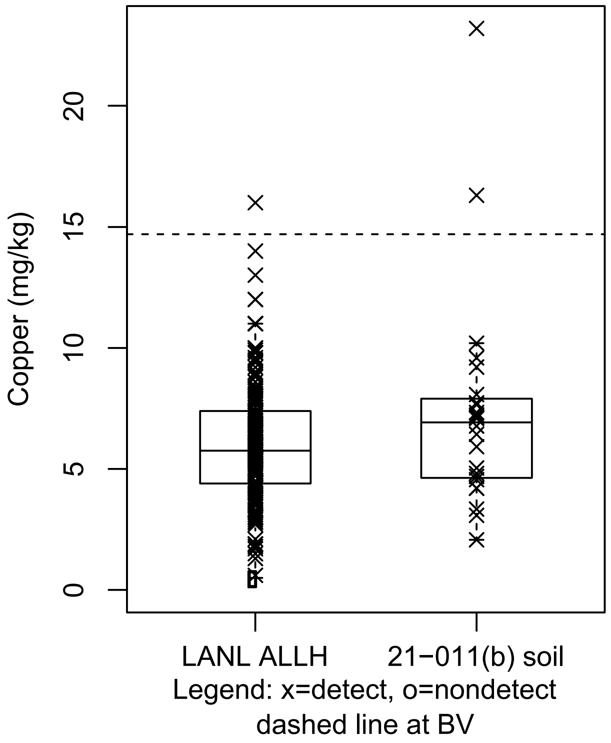

Figure G-10 Box plot for copper in soil at SWMU 21-011(b)

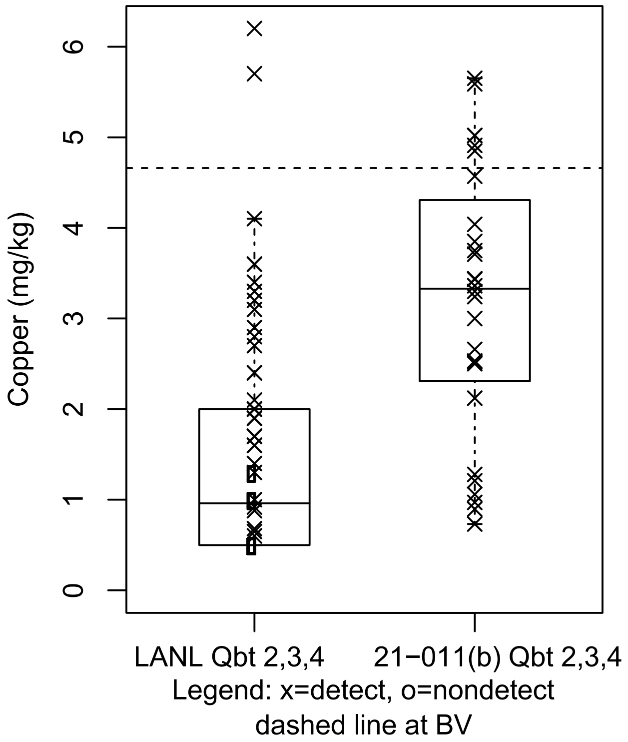

Figure G-11 **Box plot for copper in tuff at SWMU 21-011(b)**

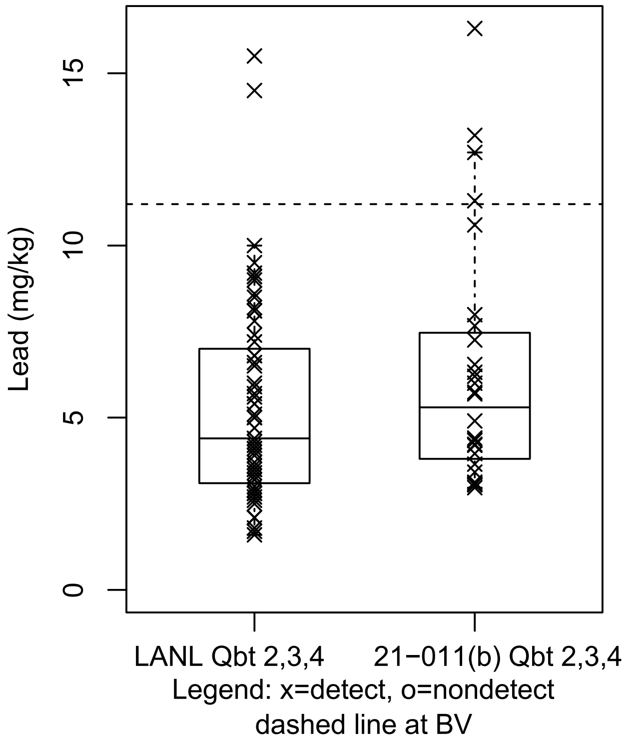

Figure G-12 **Box plot for lead in tuff at SWMU 21-011(b)**

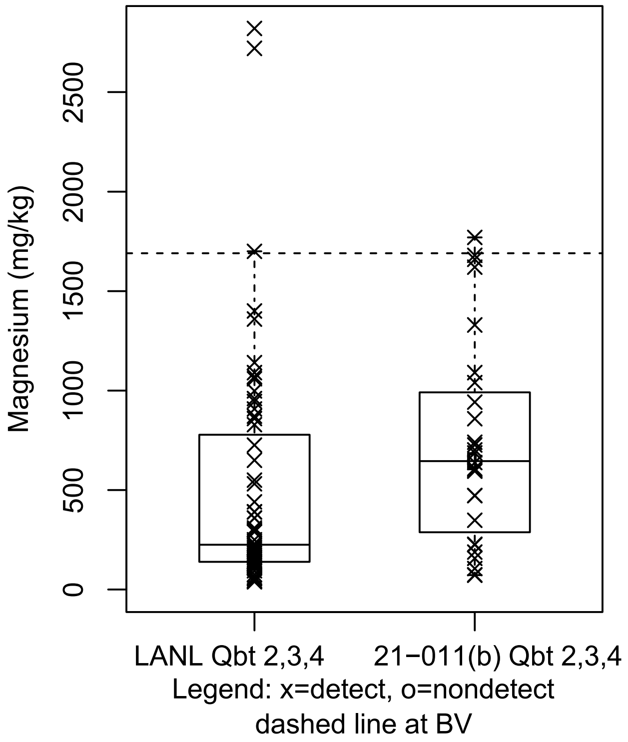

Figure G-13 **Box plot for magnesium in tuff at SWMU 21-011(b)**

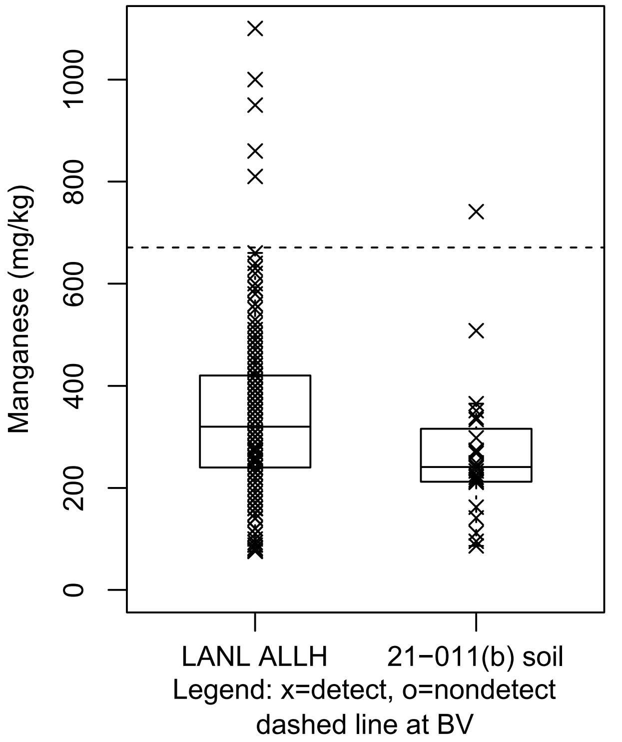

Figure G-14 **Box plot for manganese in soil at SWMU 21-011(b)**

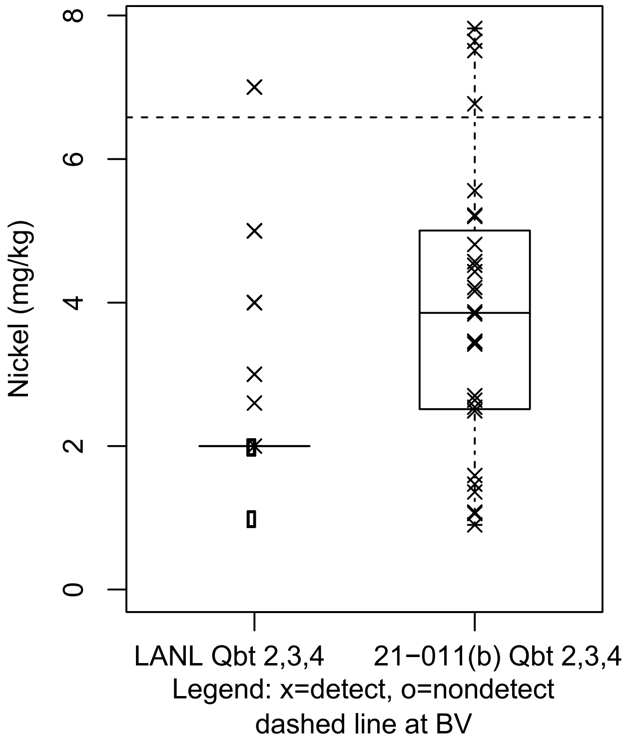

Figure G-15 Box plot for nickel in tuff at SWMU 21-011(b)

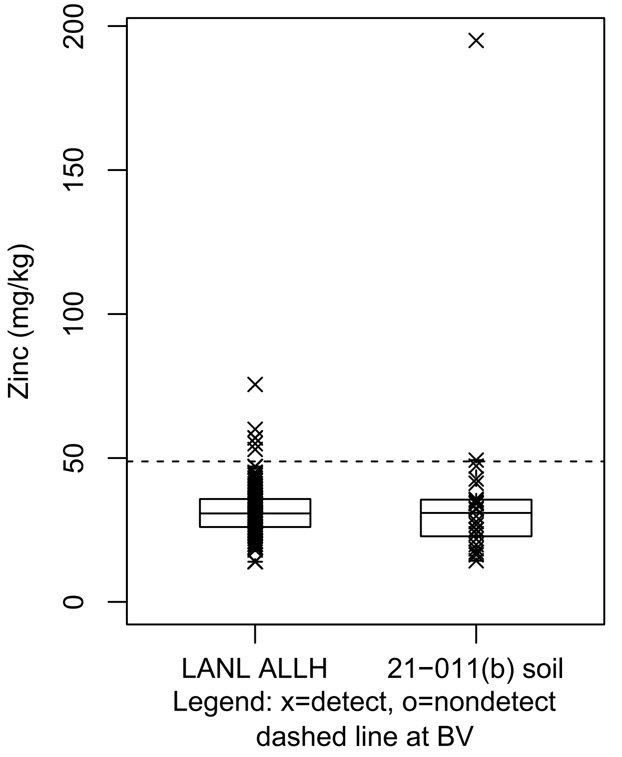

Figure G-16 Box plot for zinc in soil at SWMU 21-011(b)

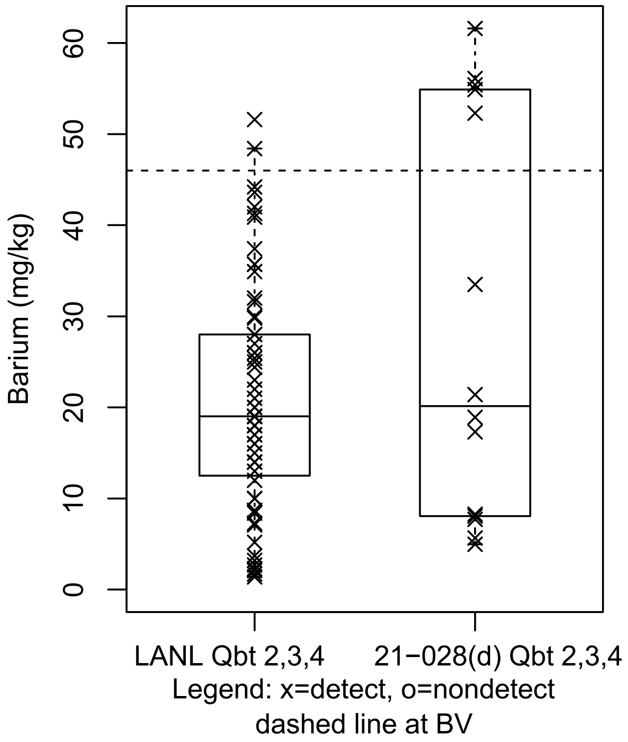

Figure G-17 **Box plot for barium in tuff at AOC 21-028(d)**

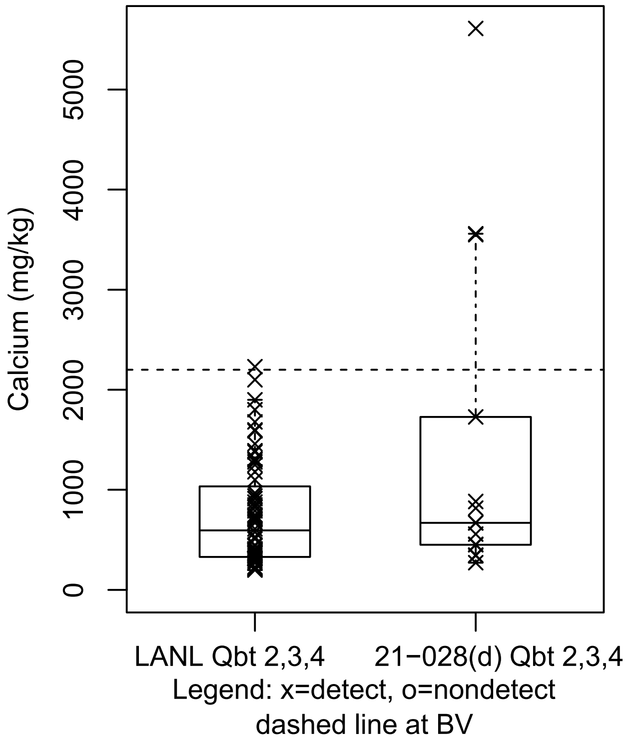

Figure G-18 **Box plot for calcium in tuff at AOC 21-028(d)**

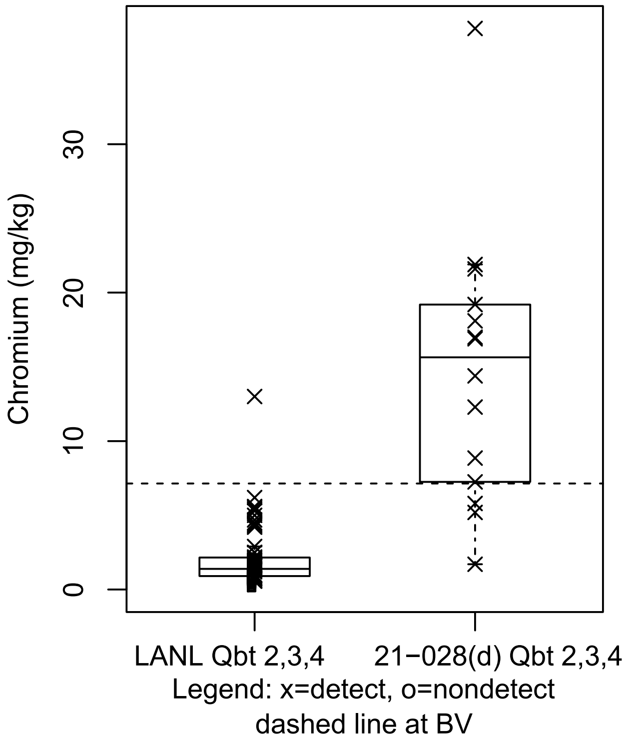

Figure G-19 **Box plot for chromium in tuff at AOC 21-028(d)**

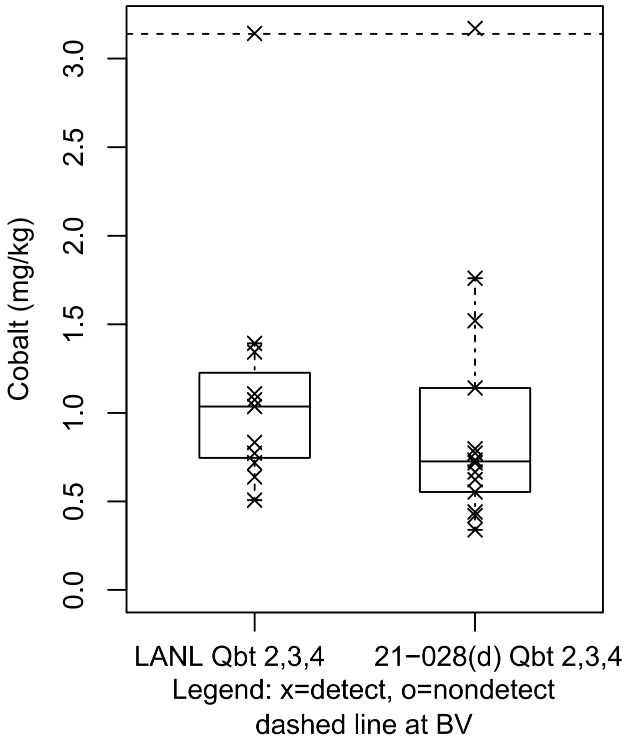

Figure G-20 **Box plot for cobalt in tuff at AOC 21-028(d)**

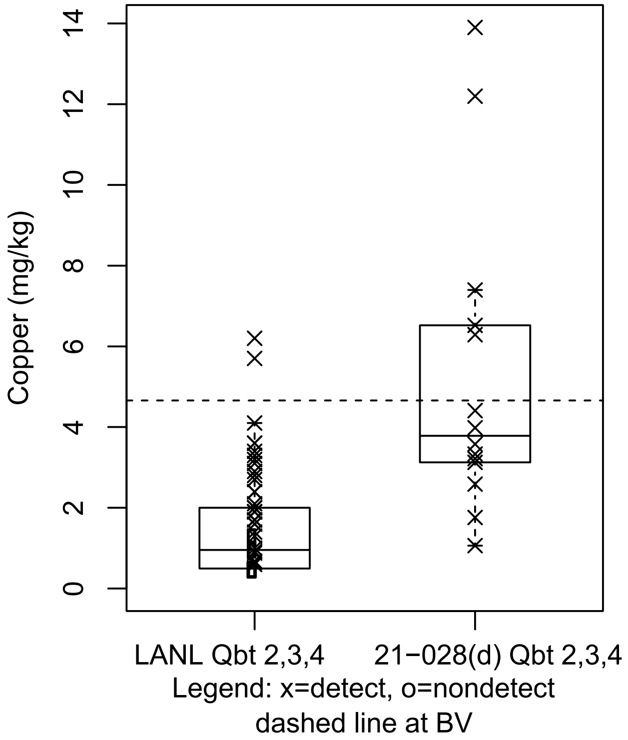

Figure G-21 **Box plot for copper in tuff at AOC 21-028(d)**

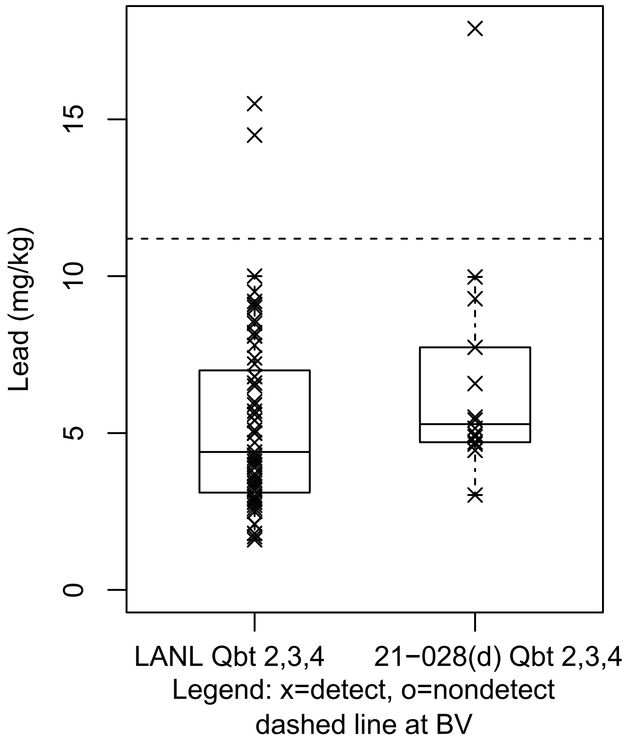

Figure G-22 **Box plot for lead in tuff at AOC 21-028(d)**

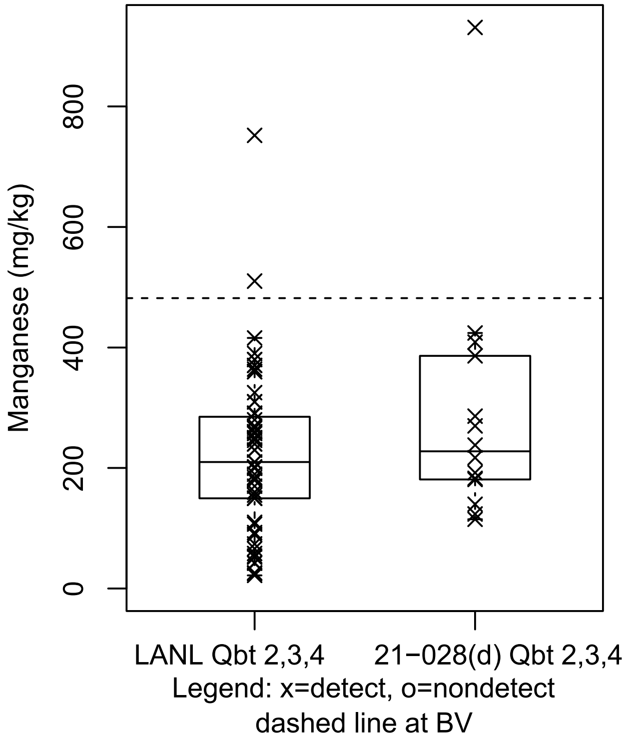

Figure G-23 Box plot for manganese in tuff at AOC 21-028(d)

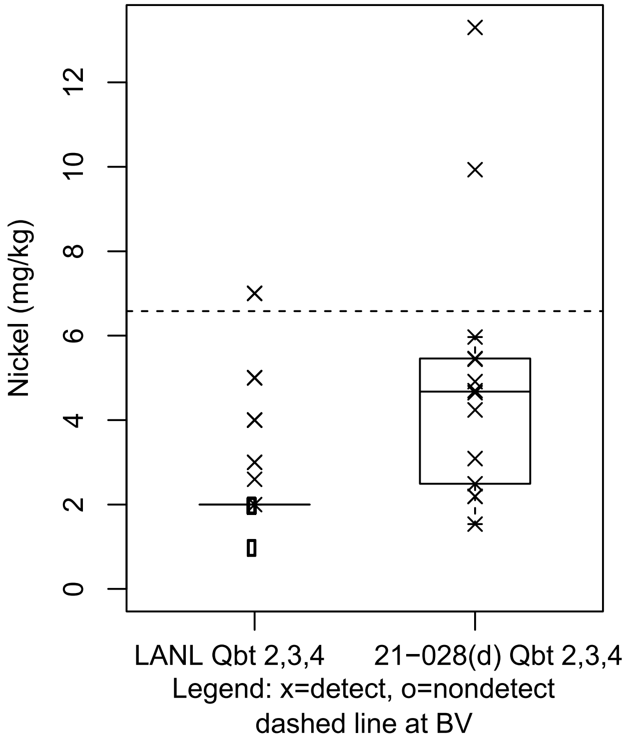

Figure G-24 Box plot for nickel in tuff at AOC 21-028(d)

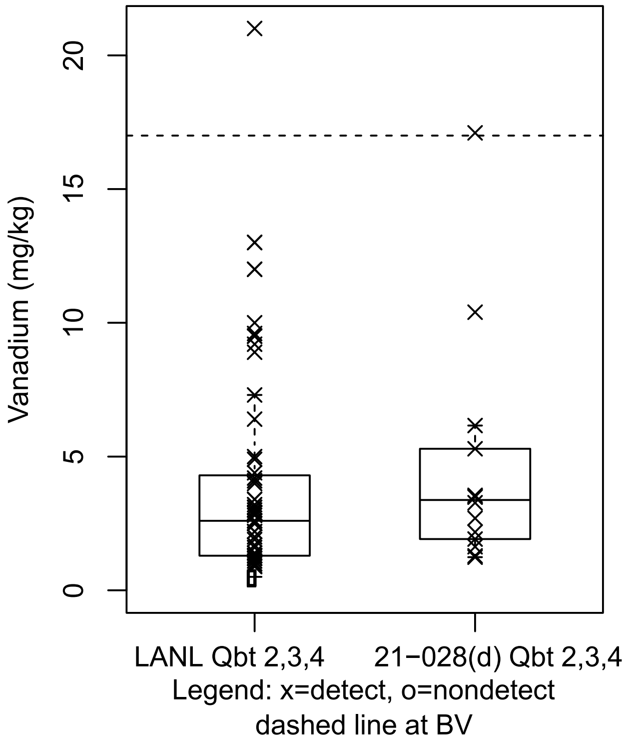

Figure G-25 **Box plot for vanadium in tuff at AOC 21-028(d)**

Table G-1
Results for Statistical Tests for Inorganic Chemicals in Tuff at SWMU 21-011(b)

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-Value	COPC?
Aluminum	0.0578	0.287	n/a*	No
Barium	0.000272	0.00301	<0.0001	Yes
Beryllium	0.974	0.872	n/a	No
Calcium	0.0123	0.00733	0.000528	Yes
Chromium	<0.0001	<0.0001	0.002	Yes
Copper	<0.0001	<0.0001	1	Yes
Lead	0.0824	0.717	n/a	No
Magnesium	0.00895	0.275	1	No
Nickel	n/a	0.00301	0.027	Yes

* n/a = Not applicable.

Table G-2
Results for Statistical Tests for Inorganic Chemicals in Soil at SWMU 21-011(b)

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-Value	COPC?
Beryllium	0.992	0.997	n/a*	No
Calcium	0.00282	0.0352	1	Yes
Chromium	0.261	0.0715	n/a	No
Cobalt	1	0.997	n/a	No
Copper	0.127	0.349	n/a	No
Manganese	0.996	0.973	n/a	No
Zinc	0.665	0.595	n/a	No

* n/a = Not applicable.

Table G-3
Results for Statistical Tests for Inorganic Chemicals in Tuff at AOC 21-028(d)

Analyte	Gehan Test p-Value	Quantile Test p-Value	Slippage p-Value	COPC?
Barium	0.208	0.097	n/a*	No
Calcium	0.14	0.263	n/a	No
Chromium	<0.0001	<0.0001	<0.0001	Yes
Cobalt	0.88	0.622	n/a	No
Copper	<0.0001	<0.0001	<0.0001	Yes
Lead	0.0461	0.599	0.182	No
Manganese	0.158	0.263	n/a	No
Nickel	n/a	0.000512	0.0311	Yes
Vanadium	0.138	0.810	n/a	No

* n/a = Not applicable.

Appendix H

Risk Assessments

CONTENTS

Figure

Tables

Attachments

H-1.0 INTRODUCTION

This appendix presents the results of the human health and ecological risk-screening evaluations conducted in support of the environmental characterization of the DP Site Aggregate Area sites at DP East, located in the northern portion of Los Alamos National Laboratory (LANL or the Laboratory). The evaluations of potential risk at four solid waste management units (SWMUs) and areas of concern (AOCs) are based on decision-level data from the 2010–2011 investigation.

H-2.0 BACKGROUND

Brief descriptions of the DP Site Aggregate Area sites at DP East assessed for potential risks and dose are presented below.

H-2.1 Site Descriptions and Operational History

Technical Area 21 (TA-21) is located on DP Mesa on the northern boundary of the Laboratory and is immediately east-southeast of the Los Alamos townsite. It extends from the mesa top to the stream channels in two adjacent canyons, DP Canyon to the north and Los Alamos Canyon to the south.

During World War II, the Laboratory was established for the research, development, and testing of the first deliverable nuclear weapon. In 1945, the operations for establishing the chemical and metallurgical properties of the nuclear material necessary to achieve and sustain a nuclear fission reaction were transferred to newly built facilities at TA-21. TA-21 includes five Material Disposal Areas (MDAs): A, B, T, U, and V.

DP East operations began in September 1945. These facilities were used to process polonium and actinium and to produce initiators (a nuclear weapons component). From 1952 through 1973, the facilities supported the Rover nuclear propulsion project. In 1964, building 21-209 was built to house research into high-temperature and actinide chemistry. Following the Rover project, the facilities supported fusion research. Building 21-155 housed the Tritium Systems Test Assembly (TSTA) for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels used in fusion reactors. Operations ceased and the DP East facilities were placed in safe shutdown in 2003.

H-2.1.1 SWMU 21-004(b) and SWMU 21-004(c)

SWMUs 21-004(b) and 21-004(c) were two aboveground stainless-steel tanks (structure 21-346) that were installed in 1979. These tanks were used as overflow holding tanks for liquid waste from chilled water systems and from Laboratory and radionuclide experimental operations in the TSTA facility (building 21-155). Each tank was 9 ft high and 8 ft in diameter with a capacity of 3000 gal. (LANL 1990, 007512). Both tanks were mounted on steel legs above the surface of an asphalt bermed area. The bermed area had a capacity of approximately 9600 gal. and measured 36 ft long by 18 ft wide. The tanks and asphalt were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded.

H-2.1.2 SWMU 21-011(b)

SWMU 21-011(b) consists of an acid waste sump (structure 21-223) and associated waste lines. The sump was located inside a small metal containment building that was located approximately 760 ft east of the TA-21 waste treatment plant (building 21-257) and 70 ft northwest of the TSTA (building 21-155). In 1965, a 4-in. waste line was installed to transport acid waste from building 21-155 to the sump. From the sump, a 3-in. waste line transported acid waste to the old waste treatment plant/laboratory (building 21-035) (LASL 1968, 089722; Francis 1997, 076126). The sump also connected to a 6-in. vitrified clay overflow pipe, which discharged to DP Canyon, eventually running into the same area as the discharge from the SWMU 21-024(h) septic system (LASL 1968, 089722). The SWMU 21-024(h) outfall was addressed in the DP Site Aggregate Area Phase I and II investigations (LANL 2004, 087461; NMED 2005, 089314; LANL 2008, 104989).

In 1967–1968, the old waste treatment plant/laboratory (building 21-035) was removed and the sump outlet line was extended to the new waste treatment plant (building 21-257) (LASL 1968, 089723; LASL 1975, 089724). In 1979, the sump overflow pipe was connected to the aboveground stainless-steel storage tanks ([structure 21-346, SWMUs 21-004(b) and 21-004(c)] LASL 1979, 089721). In the mid- to late-1980s, two new 4-in. acid waste steel or iron lines (LANL 1988, 087575) were connected from building 21-155 to a manhole (structure 21-222) to be pumped by the sump (LASL 1977, 089726). This line continued to another manhole (structure 21-221).

The sump and a portion of the line outside of the MDA T boundary were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded.

H-2.1.3 AOC 21-028(d)

AOC 21-028(d) consisted of a former container storage area located on a concrete loading dock at the northwest corner of building 21-209 (LANL 1991, 007529). The dock dimensions were approximately 8.5 ft wide by 60 ft long by 3.25 ft deep. The dock and the foundations were removed in 2010 during demolition and decommissioning (D&D) activities (LANL 2011, 206183). The AOC has been covered with approximately 1 ft of clean backfill/gravel.

Storage of containers on the loading dock likely began in 1965 when building 21-209 was constructed (LANL 1991, 007529, p. 14-39). The dock was used to store 55-gal. drums of lithium-deuterium waste; 30- and 55-gal. drums of fissionable waste (waste containing natural uranium, natural thorium, uranium-235, uranium-238, thorium-228, thorium-230, and thorium-232); and gas cylinders of tritium-contaminated hydrogen and argon gas (LANL 1991, 007529, p. 14-39). Containers of product stored in the same area included cylinders of deuterium, argon, nitrogen, helium, and compressed hydrogen; 55-gal. drums of oil; acetone; Convoil 20 (a multipurpose vacuum pump fluid); ethanol; ethyl alcohol; and various solvents stored in a chemical safety cabinet (LANL 1991, 007529, p. 14-39).

H-2.2 Investigation Sampling

The final data set used to identify chemicals of potential concern (COPCs) for the DP Site Aggregate Area sites at DP East and used in this appendix to evaluate the potential risks to human health and the environment are the qualified analytical results from the 2010–2011 investigation. Only those data determined to be of decision-level quality following the data quality assessment (Appendix F) are included in the final data set evaluated in this appendix.

H-2.3 Determination of COPCs

Section 5.0 of the investigation report summarizes the COPC selection process. Only COPCs detected above background (inorganic chemicals and naturally occurring radionuclides), with detection limits greater than background values (BVs) (inorganic chemicals); and detected organic chemicals, inorganic chemicals with no BVs, and fallout radionuclides were retained. The industrial scenario and the ecological screening used data for samples collected from 0.0 to 1.0 ft and 0.0 to 5.0 ft below ground surface (bgs), respectively. The residential and construction worker scenarios used data for samples collected from 0.0 to 10.0 ft bgs. However, sampling depths often overlapped because of multiple investigations; therefore, samples with a starting depth less than the lower bound of the interval were included in the risk-screening assessments for a given scenario as appropriate.

Tables H-2.3-1 to H-2.3-10 summarize the COPCs evaluated for potential risk for each of the sites in the DP Site Aggregate Area at DP East. Some of the COPCs identified in this report may not be evaluated for potential risk under one or more scenarios because they were not within the specified depth intervals associated with a given scenario.

H-3.0 CONCEPTUAL SITE MODEL

The primary mechanisms of release related to historical contaminant sources are described in detail in the historical investigation report appendix of the investigation work plan for MDA T (LANL 2004, 085641, Appendix B) and summarized in section 2.0 of the approved investigation work plan (LANL 2009, 108166.9; NMED 2010, 108443). Releases from the DP Site Aggregate Area sites at DP East may have occurred as a result of air emissions, surface releases, subsurface leaks, or effluent discharges. Previous sampling results indicated contamination from inorganic chemicals, organic chemicals, and radionuclides (LANL 2012, 213390).

H-3.1 Receptors and Exposure Pathways

The primary exposure pathway for human receptors is surface soil and subsurface soil/tuff that may be brought to the surface through intrusive activities. Migration of contamination to groundwater through the vadose zone is unlikely given the depth to groundwater (approximately 700 to 1100 ft bgs). 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 the resident and the construction worker. The exposure pathways are the same as those for surface soil. Sources, exposure pathways, and receptors are shown in the conceptual site model (CSM) (Figure H-3.1-1).

New Mexico Environment Department (NMED) guidance (NMED 2017, 602273) requires that sites larger than 2 acres be evaluated to determine if beef ingestion is a plausible and complete exposure pathway. The sites in the DP Site Aggregate Area at DP East are smaller than 2 acres. In addition, grazing is not allowed on Laboratory property. Therefore, further evaluation of the beef ingestion pathway is not necessary.

The DP Site Aggregate Area at DP East is an industrial area on Laboratory property. Some of the sites are active and others are inactive or removed and provide habitat for ecological receptors. 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 5.0 ft (ecological) or 10.0 ft (human health) are not complete unless contaminated soil or tuff has been excavated and brought to the surface.

Considering unpaved sites or areas where potential habitat is present, exposure pathways are complete to surface soil and tuff for ecological receptors. The potential pathways are root uptake by plants, inhalation of vapors (burrowing animals only), 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 exposure was not evaluated because of the lack of surface water features. Sources, exposure pathways, and receptors are presented in the CSM (Figure H-3.1-1).

H-3.2 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes affecting the persistence of chemicals in the environment, and the evaluation of transport addresses the physical processes affecting mobility along a migration pathway. Migration into soil and tuff depends on precipitation or snowmelt, soil moisture content, depth of soil, soil 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 also limited by a lack of hydrostatic pressure as well as the 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 in the investigation report. Results from the deepest samples collected at most sites showed either no detected concentrations of COPCs or low- to 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 discussed above. Given how long the contamination has been present in the subsurface, the physical and chemical properties of the COPCs, and the lack of saturated conditions, the potential for contaminant migration to groundwater is very low.

NMED guidance (NMED 2017, 602273) includes 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) may 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., migration to groundwater is assumed to have already occurred). This assumption, however, is inappropriate for cases such as the sites in the DP Site Aggregate Area at DP East where sampling has shown that contamination is vertically bounded near the surface and the distance from the surface to the water table is large. 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 and the potential for ion exchange (barium and other inorganic chemicals) 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.

Current potential transport mechanisms that may lead to exposure include

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

Contaminant distributions at the sites indicate that after the initial deposition of contaminants from operational activities and historical remediation efforts, elevated levels of COPCs tend to remain concentrated in the vicinity of the original release points. The primary potential release and transport mechanisms identified for sites in the DP Site Aggregate Area at DP East include direct discharge; precipitation, sorption, and mechanical transport; dissolution and advective transport in water; and volatilization, diffusion, and dispersion. Less significant transport mechanisms include wind entrainment and, given the asphalt pavement covering most sites, dispersal of surface soil and uptake of contaminants from soil and water by biota.

Gas or vapor-phase contaminants such as VOCs are likely to volatilize to the atmosphere from near-surface soil and sediment and/or migrate by diffusion through air-filled pores in the vadose zone. Migration of vapor-phase contaminants from tuff into ambient air may occur by diffusion or advection driven by barometric pressure changes.

H-3.2.1 Inorganic Chemicals

In general, and particularly in a semiarid climate, inorganic chemicals are not highly soluble or mobile in the environment, although there are exceptions. The physical and chemical factors that determine the distribution of inorganic COPCs within the soil and tuff at sites in the DP Site Aggregate Area at DP East are the soil-water partition coefficient (K_d) of the inorganic chemicals, the pH of the soil, soil characteristics (such as sand or clay content), and the redox potential (Eh). The interaction of these factors is complex, but 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 ones. 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 H-3.2-1 presents the K_d values and water solubility for the inorganic COPCs for sites in the DP Site Aggregate Area at DP East. Based on this criterion, the following COPCs have a low potential to mobilize and migrate through soil and the vadose zone: antimony, barium, cadmium, chromium, lead, mercury, nickel, and zinc. The K_d values for copper, cyanide, nitrate, perchlorate, selenium, and silver are less than 40 and may indicate a greater potential to mobilize and migrate through soil and the vadose zone beneath the sites.

It is important to note that other factors besides the K_d values (e.g., speciation in soil, oxidation-reduction potential, pH, and soil mineralogy) also play significant roles in the likelihood that inorganic chemicals will migrate. The COPCs with K_d values less than 40 are discussed further below. 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 1997, 056531, and http://www.atsdr.cdc.gov/toxpro2).

Copper movement in soil is determined by physical and chemical interactions with the soil components. Most copper deposited in soil will be strongly adsorbed and remains in the upper few centimeters of soil. Copper will adsorb to organic matter, carbonate minerals, clay minerals, or 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. Soil in the area is neutral to slightly alkaline, so the leaching of copper is not a concern at these sites. 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.

Cyanide tends to adsorb onto various natural media, including clay and sediment; however, sorption is insignificant relative to the potential for cyanide to volatilize and/or biodegrade. At soil surfaces, volatilization of hydrogen cyanide is a significant mechanism for cyanide loss. Cyanide at low concentrations in subsurface soil is likely to biodegrade under both aerobic and anaerobic conditions. Cyanide is present at the sites in trace to low levels and is not expected to be mobile.

Nitrate is highly soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath the DP Site Aggregate Area sites at DP East has low moisture content, which inhibits the mobility of nitrate as well as most other inorganic chemicals.

Perchlorate is somewhat soluble in water and may migrate with water molecules in saturated soil. As noted above, the subsurface material beneath the sites has low moisture content, which inhibits the mobility of 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 soil pH at sites in the DP Site Aggregate Area at DP East is neutral to slightly alkaline, indicating that selenium is not likely to migrate.

Silver sorbs onto soil and sediment and tends to form complexes with inorganic chemicals and humic substances in soil. Natural processes, such as the weathering of rock and the erosion of soil, release silver to air and water. Organic matter complexes with silver and reduces its mobility. Silver compounds tend to leach from well-drained soil so that it may potentially migrate into the subsurface.

H-3.2.2 Organic Chemicals

Table H-3.2-2 presents the physical and chemical properties (organic carbon-water partition coefficient [K_{oc}], logarithm to the base 10 octanol/water partition coefficient [log K_{ow}], and solubility) of the organic COPCs identified for sites in the DP Site Aggregate Area at DP East. The 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 of COPCs at sites in the DP Site Aggregate Area at DP East. 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. Several chemicals detected at sites in the DP Site Aggregate Area at DP East have water solubilities greater than 1000 mg/L, including acetone, 2-hexanone, diethylphthalate, and methylene chloride.

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, are slightly prone to biodegradation, and are metabolized in plants and animals. The chemicals identified as having water solubilities less than 10 mg/L are the polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), bis(2-ethylhexyl)phthalate, and dibenzofuran.

Vapor pressure is a characteristic used to evaluate the tendency of organic chemicals to volatilize. Chemicals with vapor pressure greater than 0.01 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 towards groundwater. Acetone; ethylbenzene; 2-hexanone; 4-isopropyltoluene; methylene chloride; 2-methylnaphthalene; naphthalene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene have vapor pressures greater than 0.01 mm Hg.

Chemicals with vapor pressures less than 0.000001 mm Hg are less likely to volatilize and therefore tend to remain immobile. Benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; bis(2-ethylhexyl)phthalate; chrysene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene have vapor pressures less than 0.000001 mm Hg.

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} above 1000, the greater the affinity the chemical has for bioaccumulation/bioconcentration in the food chain, the greater the potential for sorption in the soil, and the lower the mobility (Ney 1995, 058210).

Acenaphthene; anthracene; Aroclor-1242; Aroclor-1254; 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; dibenzofuran; ethylbenzene; fluoranthene; indeno(1,2,3-cd)pyrene; 4-isopropyltoluene; 2-methylnaphthalene; naphthalene; phenanthrene; pyrene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene all have a K_{ow} greater than 1000. A K_{ow} of less than 500 indicates high water solubility, mobility, little to no affinity for bioaccumulation, and degradability by microbes, plants, and animals. Acetone, 2-hexanone, diethylphthalate, and methylene chloride have a K_{ow} much less than 500.

The K_{oc} measures the tendency of a chemical to adsorb to organic carbon in soil. K_{oc} values above 500 cm^3/g indicate a strong tendency to adsorb to soil, leading to low mobility (NMED 2017, 602273). Most organic chemicals detected have K_{oc} values above 500 cm^3/g, indicating a very low potential to migrate toward groundwater. The organic chemicals with K_{oc} values less than 500 cm^3/g include acetone; diethylphthalate; 2-hexanone; methylene chloride; toluene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

The PAHs, PCBs, and bis(2-ethylhexyl)phthalate are the least mobile and the most likely to bioaccumulate. Acetone, 2-hexanone, methylene chloride, and toluene are more soluble and volatile and are more likely to travel toward the atmosphere and not migrate toward groundwater. Because the organic chemicals detected were at low concentrations and extent is defined, they are not likely to migrate to groundwater.

H-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 H-3.2-3 gives physical and chemical properties of the radionuclide COPCs identified at sites in the DP Site Aggregate Area at DP East. Based on K_d values, americium-241, cesium-137, plutonium-238, and plutonium-239/240 have a very low potential to migrate towards groundwater at the sites in the DP Site Aggregate Area at DP East. The K_d value for tritium is less than 40 and indicates a potential to migrate towards groundwater.

Tritium's initial behavior in the environment is determined by the source. If it is released as a gas or vapor to the atmosphere, substantial dispersion can be expected, and the rapidity of deposition is dependent on climatic factors. If tritium is released in liquid form, it is diluted in surface water and is subject to physical dispersion, percolation, and evaporation (Whicker and Schultz 1982, 058209, p.147). Tritium concentrations in the subsurface at the area of elevated radioactivity are low (<1 pCi/g), indicating the area of elevated radioactivity is not a significant source of tritium, although this radionuclide is relatively mobile. Because tritium migrates in association with moisture, the low moisture content of the subsurface limits the potential for tritium to migrate to groundwater.

H-3.3 Exposure Point Concentration Calculations

The exposure point concentrations (EPCs) represent upper-bound concentrations of COPCs. For comparison with risk-screening levels, the upper confidence limit (UCL) of the arithmetic mean was calculated when possible and used as the EPC. The UCLs were calculated using all available decision-level data within the depth range of interest. If an appropriate UCL of the mean could not be calculated or if the UCL exceeded the maximum concentration, the maximum detected concentration of the COPC was used as the EPC (maximum detection limits were used as the EPCs for some inorganic COPCs). 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 H-2.3-1 to H-2.3-10.

Calculation of UCLs of the mean concentrations was done using the U.S. Environmental Protection Agency (EPA) ProUCL 5.1.002 software (EPA 2015, 601725), which is based on EPA guidance (EPA 2002, 085640). Consistent with the "ProUCL Version 5.1.002 Technical Guide," a minimum of 8 samples and 5 detections are needed to calculate UCLs (EPA 2015, 601724). The ProUCL program calculates 95%, 97.5%, and 99% UCLs and recommends a distribution and UCL. The 95% UCL for the recommended calculation method was used as the EPC. 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. 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. The maximum detected concentration was used to represent the EPC for COPCs only when there were too few detections to calculate a UCL. Input and output data files for ProUCL calculations are provided on CD as Attachment H-1.

H-4.0 HUMAN HEALTH RISK-SCREENING EVALUATIONS

The human health risk-screening assessments were conducted for sites in the DP Site Aggregate Area at DP East. All sites were screened for the residential and construction worker scenarios using data from 0.0 to 10.0 ft bgs. Sites were also screened for the industrial scenario using data from 0.0 to 1.0 ft bgs, where available. The human health risk-screening assessments compared either the 95% UCL of the mean concentration, the maximum detected concentration, or the maximum detection limit of each COPC with SSLs for chemicals and screening action levels (SALs) for radionuclides.

H-4.1 Human Health SSLs and SALs

Human health risk-screening assessments were conducted using SSLs for the industrial, construction worker, and residential scenarios obtained from NMED guidance (NMED 2017, 602273). The NMED SSLs are based on a target hazard quotient (HQ) of 1 and a target cancer risk of 1×10^{-5} (NMED 2017, 602273). If SSLs were not available from NMED guidance, the EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017) were used. EPA regional screening levels are not available for construction workers; therefore, when regional screening levels were used for a COPC, the construction worker SSLs were calculated using toxicity values from EPA regional screening (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017) and exposure parameters from NMED guidance (NMED 2017, 602273). The EPA regional screening levels 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 also used for some COPCs without an SSL, based on structural similarity or because the COPC is a breakdown product (NMED 2003, 081172). Exposure parameters used to calculate the industrial, construction worker, and residential SSLs are presented in Table H-4.1-1.

Radionuclide SALs were used for comparison with radionuclide COPC EPCs and were derived using the RESRAD model, Version 7.0 (LANL 2015, 600929). The SALs are based on a 25-mrem/yr dose as authorized by DOE Order 458.1. Exposure parameters used to calculate the SALs are presented in Tables H-4.1-2 and H-4.1-3.

H-4.2 Results of Human Health Screening Evaluation

The EPC of each COPC was compared with the SSLs for the industrial, construction worker, and residential scenarios, as appropriate. For carcinogenic chemicals, the EPCs were divided by the SSL and multiplied by 1×10^{-5}. The sum of the carcinogenic risks was compared with the NMED target cancer risk level of 1×10^{-5}. For noncarcinogenic chemicals, an HQ was generated for each 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. The radionuclide EPCs were divided by the SAL and multiplied by 25 mrem/yr. The total doses were compared with the DOE target level of 25 mrem/yr, as authorized by DOE Order 458.1. The results are presented in Tables H-4.2-1 to H-4.2-30 and are described below for each SWMU and AOC evaluated.

H-4.2.1 SWMU 21-004(b)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-1, H-4.2-2, and H-4.2-3. The total excess cancer risk for the industrial scenario is 1×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The industrial HI is 0.002, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.02 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the construction worker scenario are presented in Tables H-4.2-4, H-4.2-5, and H-4.2-6. The total excess cancer risk for the construction worker scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.4, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.03 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-7, H-4.2-8, and H-4.2-9. The total excess cancer risk for the residential scenario is 6×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.08, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

H-4.2.2 SWMU 21-004(c)

The results of the risk-screening assessment for the industrial scenario are presented in Tables H-4.2-10, H-4.2-11, and H-4.2-12. The total excess cancer risk for the industrial scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The industrial HI is 0.003, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.001 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the construction worker scenario are presented in Tables H-4.2-13, H-4.2-14, and H-4.2-15. The total excess cancer risk for the construction worker scenario is 9×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.3, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.007 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-16, H-4.2-17, and H-4.2-18. The total excess cancer risk for the residential scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.03, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.02 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

H-4.2.3 SWMU 21-011(b)

The samples at SWMU 21-011(b) were collected from depths greater than 0.0 to 1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

The results of the risk-screening assessment for the construction worker scenario are presented in Tables H-4.2-19, H-4.2-20, and H-4.2-21. The total excess cancer risk for the construction worker scenario is 2×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.1, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 30 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-22, H-4.2-23, and H-4.2-24. The total excess cancer risk for the residential scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.08, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 70 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

H-4.2.4 AOC 21-028(d)

The samples at AOC 21-028(d) were collected from depths greater than 0.0 to 1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

The results of the risk-screening assessment for the construction worker scenario are presented in Tables H-4.2-25, H-4.2-26, and H-4.2-27. The total excess cancer risk for the construction worker scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.4, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.0005 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

The results of the risk-screening assessment for the residential scenario are presented in Tables H-4.2-28, H-4.2-29, and H-4.2-30. The total excess cancer risk for the residential scenario is 5×10^{-4}, which is greater than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.3, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1.

H-4.3 Vapor-Intrusion Pathway

NMED guidance (NMED 2017, 602273) requires an evaluation of the vapor-intrusion pathway. The vapor-intrusion pathway of VOCs into a building was evaluated where appropriate. The evaluation can be qualitative for a potentially complete pathway if the following criteria are met:

- Volatile and toxic compounds are minimally detected.
- Concentrations are below NMED's vapor-intrusion screening levels for soil-gas and/or groundwater. There is no suspected source(s) for volatile and toxic compounds.
- Concentrations are decreasing with depth (for soil).

Because only bulk soil data are available for thee sites, the vapor-intrusion screening levels are not applicable for the evaluation. The vapor-intrusion pathway was qualitatively evaluated as part of the residential scenario for some of the sites in this report. Among the factors considered for the vapor-intrusion pathway to be relevant to human health risk is the current extent of structures and their proximity to the VOC source. No structures exist in the DP Site Aggregate Area at DP East SWMUs or AOC. One may also consider if construction of buildings is possible or proposed in the reasonably foreseeable future.

No VOCs were detected at SWMU 21-004(b). Therefore, the vapor-intrusion pathway is incomplete for this site. The potential for the vapor-intrusion pathway is discussed for each of the remaining sites.

H-4.3.1 SWMU 21-004(c)

SWMU 21-004(c) was one of two aboveground stainless-steel tanks (structure 21-346) that was installed in 1979. These tanks were used as overflow holding tanks for liquid waste from chilled water systems and from Laboratory and radionuclide experimental operations in the TSTA facility (building 21-155). Each tank was 9 ft high and 8 ft in diameter with a capacity of 3000 gal. (LANL 1990, 007512). Both tanks were mounted on steel legs above the surface of an asphalt bermed area. The bermed area had a capacity of approximately 9600 gal. and measured 36 ft long by 18 ft wide. The tanks, headwall, waste lines, and asphalt were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded.

Two VOCs (acetone and 4-isopropyltoluene) were detected at this site with either one or two detected concentrations in two samples collected from a single location; the detected concentrations were basically the same as the estimated quantitation limit (EQL). Acetone was detected in both the sample from 2.5 to 3.5 ft bgs (0.0118 mg/kg) and from 5.0 to 6.0 ft bgs (0.0046 mg/kg). Isopropyltoluene[4-] was detected in the sample collected from 2.5 to 3.5 ft bgs (0.00031 mg/kg) and was not detected in deeper sample collected from this location.

The site description indicated that solvents were not used so no sources of VOCs are present. In addition, the tank has been removed and the site is inactive. The vapor-intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2017, 602273) but no additional evaluation is necessary.

H-4.3.2 SWMU 21-011(b)

SWMU 21-011(b) consists of a radioactive liquid waste sump (structure 21-223) and associated waste lines. Constructed in 1965, the subsurface concrete sump housed a mechanical pump and was located inside a small metal containment building (no structure number assigned) that was located approximately 760 ft east of the TA-21 waste treatment plant (building 21-257) and 70 ft northwest of the TSTA (building 21-155). In 1965, a 4-in. waste line was installed to transport acid waste from building 21-155 to the sump. From the sump, a 3-in. waste line transported acid waste to the old waste treatment plant/laboratory (building 21-035) (LASL 1968, 089722; Francis 1997, 076126). The sump also connected to a 6-in. vitrified clay overflow pipe, which discharged to DP Canyon, eventually running into the same area as the discharge from the SWMU 21-024(h) septic system (LASL 1968, 089722). The SWMU 21-024(h) outfall was addressed in the DP Site Aggregate Area Phase I and II investigations (LANL 2004, 087461; NMED 2005, 089314; LANL 2008, 104989).

In 1967–1968, the old waste treatment plant/laboratory (building 21-035) was removed and the sump outlet line was extended to the new waste treatment plant (building 21-257) (LASL 1968, 089723; LASL 1975, 089724). In 1979, the sump overflow pipe was connected to the aboveground stainless-steel storage tanks ([structure 21-346, SWMUs 21-004(b) and 21-004(c)] LASL 1979, 089721). In the mid- to late-1980s, two new 4-in. acid waste steel or iron lines (LANL 1988, 087575) were connected from building 21-155 to a manhole (structure 21-222) to be pumped by the sump pump (LASL 1977, 089726). This line continued to another manhole (structure 21-221).

The sump and a portion of the line outside of the MDA T boundary were removed during investigation activities, and the site has been backfilled to the surrounding site grade and seeded. The two manholes along the industrial waste lines associated with former buildings 21-155 and 21-152 (former structures 21-221 and 21-222) were partially removed. The concrete that formed the bottom of the manholes was left in place because the concrete was formed to the underlying tuff and was more than 10 ft bgs.

Four VOCs (acetone, 2-hexanone, 4-isopropyltoluene, and methylene chloride) were detected. The detected concentrations were less than the EQLs. Acetone was detected in 7 of 52 samples with concentrations ranging from 0.00176 mg/kg to 0.00337 mg/kg; the depths of these samples was up to 13.0 ft bgs and the maximum detected concentration was from a depth of 8.0 to 9.0 ft bgs. Hexanone[2-] was detected in 1 of 52 samples at a concentration of 0.0939 mg/kg; the detection was collected from a depth of 6.0 to 7.0 ft bgs. Isopropyltoluene[4-] was detected in 1 of 52 samples at a concentration of 0.000943 mg/kg; the detection was collected from a depth of 6.0 to 7.0 ft bgs. Isopropyltoluene[4-] was not detected in the deeper sample from the same location. Methylene chloride was detected in 1 of 52 samples at a concentration of 0.00249 mg/kg; the detection was collected from a depth of 5.0 to 6.0 ft bgs. Methylene chloride was not detected in the deeper sample from the same location.

The site description indicated that solvents were not used so no sources of VOCs are present. In addition, the sump and some of the drainline has been removed and the site is inactive. The vapor-intrusion pathway is therefore potentially complete based on NMED guidance (NMED 2017, 602273) but no additional evaluation is necessary.

H-4.3.3 AOC 21-028(d)

This AOC consisted of a former storage site located on a concrete loading dock at the northwest corner of former building 21-209 (LANL 1991, 007529). The dock dimensions were approximately 8.5 ft wide by 60 ft long by 3.25 ft deep. The dock and the foundations were removed in 2010 along with building 21-209 during D&D activities (LANL 2011, 206183). The AOC has been covered with approximately 1 ft of clean backfill/gravel. Storage of containers on the loading dock likely began in 1965 when building 21-209 was constructed (LANL 1991, 007529, p. 14-39). The dock was used to store 55-gal. drums of lithium-deuterium waste; 30- and 55-gal. drums of fissionable waste (waste containing natural uranium, natural thorium, uranium-235, uranium-238, thorium-228, thorium-230, and thorium-232); and gas cylinders of tritium-contaminated hydrogen and argon gas (LANL 1991, 007529, p. 14-39). Containers of product stored in the same area included cylinders of deuterium, argon, nitrogen, helium, and compressed hydrogen; 55-gal. drums of oil; acetone; Convoil 20 (a multipurpose vacuum pump fluid); ethanol; ethyl alcohol; and various solvents stored in a chemical safety cabinet (LANL 1991, 007529, pp. 14-39).

Methylnaphthalene[2-] and naphthalene were both frequently detected and with some concentrations substantially greater than the EQLs. Other VOCs (acetone; ethylbenzene; methylene chloride; toluene; 1,2,4-trimethylbenzene;, 1,2-xylene; and 1,3-xylene+1,4-xylene) were minimally detected at this site with 1, 2, or 3 detected concentrations in 18 samples. The detected concentrations were less than the EQLs for this larger group of VOCs.

Methylnaphthalene[2-] was detected in 10 of 18 samples with concentrations ranging from 0.0239 mg/kg to 7.06 mg/kg; the depths of these samples was up to 11.0 ft bgs and the maximum detected concentration was from a depth of 1.0 to 2.0 ft bgs. All of the larger detected concentrations were from the 1.0 to 2.0 ft bgs interval (0.0811 to 7.06 mg/kg). Of the 12 samples collected below 2.0 ft bgs, 4 were detections (0.0239 to 0.0426 mg/kg from depths of 5.0 to 6.0 ft bgs or 10.0 to 11.0 ft bgs). Naphthalene was detected in 11 of 18 samples with concentrations ranging from 0.0272 mg/kg to 32.5 mg/kg; the depths of these samples was up to 11.0 ft bgs and the maximum detected concentration was from a depth of 1.0 to 2.0 ft bgs. All of the larger detected concentrations were from the 1.0 to 2.0 ft bgs interval (0.132 to 32.5 mg/kg). Of the 12 samples collected below 2.0 ft bgs 5 were detections (0.0272 to 0.199 mg/kg from depths of 5.0 to 6.0 ft bgs or 10.0 to 11.0 ft bgs).

For the other VOCs (acetone; ethylbenzene; methylene chloride; toluene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene), the detected concentrations were all from the 1.0 to 2.0 ft bgs interval except for two of the three detections of acetone. For acetone, the detected values were 0.00625 mg/kg (5.0 to 6.0 ft bgs), 0.00415 mg/kg (1.0 to 2.0 ft bgs), and 0.00408 mg/kg (10.0 to 11.0 ft bgs). These concentrations are less than the EQL. The ethylbenzene detected concentration was 0.000607 mg/kg. Methylene chloride detected concentrations were 0.00242 mg/kg and 0.00252 mg/kg. Toluene detected concentrations were 0.000438 mg/kg and 0.000883 mg/kg. The 1,2,4-trimethylbenzene concentration was 0.000346 mg/kg and 0.00162 mg/kg. The 1,2-xylene detected concentration was 0.000486 mg/kg. The 1,3-xylene+1,4-xylene detected concentrations were 0.000374 mg/kg and 0.00115 mg/kg.

The site description indicated that solvents were stored so sources of VOCs would have been present. However, the loading dock and its foundation have been removed and the site is inactive. In addition, no structures are nearby. The vapor-intrusion pathway is potentially complete based on NMED guidance (NMED 2017, 602273) and additional evaluation and assessment for 2-methylnaphthalene and naphthalene should be considered following completion of Phase II sampling and remediation.

H-4.4 Essential Nutrients

NMED has SSLs for evaluation of essential nutrients (NMED 2017, 602273). The maximum detected concentrations of calcium and magnesium were compared with the appropriate NMED SSLs at those sites where they were identified as COPCs. The results of the comparisons found calcium concentrations to be substantially less than the SSLs as presented in Table H-4.4-1. Further evaluation of calcium at these sites is not necessary.

H-4.5 Uncertainty Analysis

H-4.5.1 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 the chemicals detected or that have detection limits above background are retained for further analysis. There are no established BVs for organic chemicals, and all detected organic chemicals are identified as COPCs and are retained for further analysis. Other uncertainties may include errors in sampling, laboratory analysis, and data analysis. However, because concentrations used in the risk-screening evaluations include those detected below the EQLs and nondetections above BVs, data evaluation uncertainties are expected to have little effect on the risk-screening results.

H-4.5.2 Exposure Evaluation

The current and reasonably foreseeable future land use at DP Site Aggregate Area 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 industrial SSLs. For the sites evaluated, individuals might not be on-site at present or in the future for the assumed frequency and duration. The construction worker assumptions for the SSLs are that the potentially exposed individual is outside on-site for 8 h/d, 250 d/yr, and 1 yr (NMED 2017, 602273). The industrial assumptions for the SSLs are that the potentially exposed individual is outside on-site for 8 h/d, 225 d/yr, and 25 yr (NMED 2017, 602273). The residential SSLs are based on exposure of 24 h/d, 350 d/yr, and 30 yr (NMED 2017, 602273). As a result, the industrial, contraction worker, 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, completeness of a given pathway, 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 2017, 602273). When several upper-bound values (as are found in NMED 2017, 602273) are combined to estimate exposure for any one pathway, the resulting risk estimate 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 result in exposure in the same manner as if they were in soil overestimates the potential exposure and risk to receptors.

Uncertainty is introduced in the concentration aggregation of data for estimating the EPCs at a site. Risk from a single location or area with relatively high COPC concentrations may be underestimated by using a representative sitewide value. The use of a UCL is intended to provide a protective upper-bound (i.e., conservative) COPC concentration and is assumed to be representative of the 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. In addition, the maximum detection limit was used as the EPC for some inorganic COPCs with elevated detection limits above BVs.

H-4.5.3 Toxicity Evaluation

The primary uncertainty associated with the SSLs is related to the derivation of toxicity values used in their calculation. Toxicity values (reference doses [RfDs] and slope factors [SFs]) were used to derive the SSLs used in this risk-screening evaluation (NMED 2017, 602273). Uncertainties were identified in five areas with respect to the toxicity values: (1) extrapolation from animals to humans, (2) interindividual variability in the human population, (3) the derivation of RfDs and SFs, (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 in chemical absorption, metabolism, excretion, and toxic responses between animals and humans. 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 in each of these steps, resulting in the overestimation of potential risk.

Individual Variability in the Human Population. For noncarcinogenic effects, the degree of variability in human physical characteristics is important both in determining the risks that can be expected at low exposures and in defining the no observed adverse effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a 10-fold factor to reflect individual variability within 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 RfDs and SFs. The RfDs and SFs 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 environment matrix and not available for absorption into the human body. However, the COPCs are assumed to be 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 the risk assessment. Surrogates were used to provide SSLs for benzo(g,h,i)perylene; 4-isopropyltoluene; and 1,3-xylene+1,4-xylene based on structural similarity. The overall impact of surrogates on the risk assessment is minimal because these COPCs were detected infrequently and at low concentrations.

H-4.5.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally unknown, and possible interactions could be synergistic or antagonistic, resulting in either an overestimation 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 or by different modes of action but are addressed additively.

H-4.6 Interpretation of Human Health Risk Screening Results

H-4.6.1 SWMU 21-004(b)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 1×10^{-7}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The industrial HI is 0.002, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.02 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 4×10^{-7}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 1×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.4, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.03 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the construction worker scenario is equivalent to a total risk of 2×10^{-8}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Residential Scenario

The total excess cancer risk for the residential scenario is 6×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.08, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.1 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1×10^{-6}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

H-4.6.2 SWMU 21-004(c)

Industrial Scenario

The total excess cancer risk for the industrial scenario is 2 × 10^{-7}, which is less than the NMED target risk level of 1 × 10^{-5} (NMED 2017, 602273). The industrial HI is 0.003, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.001 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the industrial scenario is equivalent to a total risk of 5 × 10^{-9}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 9 × 10^{-7}, which is less than the NMED target risk level of 1 × 10^{-5} (NMED 2017, 602273). The construction worker HI is 0.3, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.007 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the construction worker scenario is equivalent to a total risk of 1 × 10^{-9}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Residential Scenario

The total excess cancer risk for the residential scenario is 4 × 10^{-6}, which is less than the NMED target risk level of 1 × 10^{-5} (NMED 2017, 602273). The residential HI is 0.03, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.02 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 2 × 10^{-8}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

H-4.6.3 SWMU 21-011(b)

Industrial Scenario

The samples at SWMU 21-011(b) were collected from depths greater than 0.0 to 1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 2 × 10^{-7}, which is less than the NMED target risk level of 1 × 10^{-5} (NMED 2017, 602273). The construction worker HI is 0.1, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 30 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the construction worker scenario is equivalent to a total risk of 5 × 10^{-6}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Residential Scenario

The total excess cancer risk for the residential scenario is 1 × 10^{-6}, which is less than the NMED target risk level of 1 × 10^{-5} (NMED 2017, 602273). The residential HI is 0.08, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 70 mrem/yr, which is greater than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 1 × 10^{-4}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

H-4.6.4 AOC 21-028(d)

Industrial Scenario

The samples at AOC 21-028(d) were collected from depths greater than 0.0 to 1.0 ft bgs; therefore, no complete exposure pathways exist for the industrial scenario.

Construction Worker Scenario

The total excess cancer risk for the construction worker scenario is 4×10^{-6}, which is less than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The construction worker HI is 0.4, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.0005 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the construction worker scenario is equivalent to a total risk of 4×10^{-9}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Residential Scenario

The total excess cancer risk for the residential scenario is 5×10^{-4}, which is greater than the NMED target risk level of 1×10^{-5} (NMED 2017, 602273). The residential HI is 0.3, which is less than the NMED target HI of 1 (NMED 2017, 602273). The total dose is 0.5 mrem/yr, which is less than the target dose of 25 mrem/yr as authorized by DOE Order 458.1. The total dose for the residential scenario is equivalent to a total risk of 5×10^{-6}, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

H-5.0 ECOLOGICAL RISK-SCREENING EVALUATIONS

The approach for conducting ecological evaluations is described in “Screening Level Ecological Risk Evaluation Methods, Revision 5” (LANL 2017, 602649). The evaluation consists of four parts: a scoping evaluation, a screening evaluation, an uncertainty analysis, and an interpretation of the results.

H-5.1 Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the screening evaluation. The ecological scoping checklist (Attachment H-2) is a useful tool for organizing existing ecological information. The information was used to identify the types of ecological receptors that might be present, determine whether ecological receptors might be affected, and develop the ecological CSM for sites in the DP Site Aggregate Area at DP East. Although the quality of the habitat varies, most of the land within the aggregate area has native grasses, forbs, and trees that can be suitable habitat for ecological receptors.

The scoping evaluation indicated that terrestrial receptors were appropriate for evaluating the concentrations of COPCs in soil and tuff. Exposure is assessed across a site to a depth of 0.0 to 5.0 ft bgs. Aquatic receptors were not evaluated because no aquatic communities and no aquatic habitat or perennial source of water exist at any of the sites. The depth of the regional aquifer (greater than 700 ft bgs) and the semiarid climate limit transport to groundwater. The potential exposure pathways for terrestrial receptors in soil and tuff are root uptake, inhalation, soil ingestion, dermal contact, and food web transport. 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 unavailable to receptors.

The potential risk was evaluated in the risk-screening assessments for the following ecological receptors representing several trophic levels:

- plants
- soil-dwelling invertebrates (represented by the earthworm)
- the deer mouse (mammalian omnivore)
- the montane shrew (mammalian insectivore)
- cottontail (mammalian herbivore)
- fox (mammalian carnivore)
- American robin (avian insectivore, avian omnivore, and avian herbivore)
- American kestrel (avian insectivore and avian carnivore [surrogate for threatened and endangered (T&E) species (primarily the Mexican spotted owl)])

The rationale for using these receptors is presented in “Screening Level Ecological Risk Evaluation Methods, Revision 5” (LANL 2017, 602649). The Mexican spotted owl is the only T&E species known to frequent the area and may use the DP Site Aggregate Area at DP East for foraging.

H-5.2 Ecological Risk-Screening Evaluation

The ecological risk-screening evaluation considers relevant ecological assessment endpoints. An assessment endpoint is an explicit expression of the environmental value to be protected. The 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 ecological evaluation, receptors represent the populations and/or communities, and assessment endpoints are any adverse effects on the chosen ecological receptors. The purpose of the ecological evaluation is to protect populations and communities of biota rather than individual organisms, except for listed or candidate T&E species and treaty-protected species, when individuals must be protected (EPA 1999, 070086). Populations of protected species tend to be small, and the loss of an individual adversely affects the species as a whole (EPA 1997, 059370).

In accordance with this guidance, the Laboratory developed generic assessment endpoints (LANL 1999, 064137) to ensure that values at all levels of ecological organization are considered in the ecological screening process. 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 toxicity reference values (TRVs). Toxicity studies used in the development of TRVs included only studies in which the adverse effect evaluated 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 the applicability to the ecosystem of concern.

The ecological screening evaluation identifies chemicals of potential ecological concern (COPECs) and is based on the comparison of EPCs (95% UCLs, maximum detected concentrations, or maximum detection limits) to ecological screening levels (ESLs). The EPCs used in the assessments for the DP Site Aggregate Area at DP East are presented in Tables H-2.3-1 through H-2.3-10.

The ESLs were obtained from the ECORISK Database, Release 4.1 (LANL 2017, 602538) and are presented in Table H-5.2-1. 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 TRVs, are presented in the ECORISK Database, Release 4.1 (LANL 2017, 602538).

The analysis begins with a comparison of the minimum ESL for a given COPC to the EPC. The HQ is defined as the ratio of the EPC to the concentration that has been determined to be acceptable to a given ecological receptor (i.e., the ESL). The higher the contaminant levels relative to the ESLs, the higher the potential risk to receptors; conversely, the higher the ESLs relative to the contaminant levels, the lower the potential risk to receptors. HQs greater than 0.3 are used to identify COPECs requiring additional evaluation (LANL 2017, 602649). Individual HQs for a receptor are summed to derive an HI; COPCs without ESLs are retained as COPECs and evaluated further in section H-5.3.8. An HI greater than 1 indicates further assessment may be needed to ensure exposure to multiple COPECs at a site will not lead to 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.

H-5.2.1 SWMU 21-004(b)

The results of the minimum ESL comparisons are presented in Table H-5.2-2. Chromium (total), copper, nickel, and selenium are retained as COPECs because the HQs were greater than 0.3.

Calcium does not have ESLs, is retained as a COPEC, and is discussed in section H-5.3.8.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.2-3. The HI analysis indicates that robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HIs for the fox, kestrel (top carnivore and intermediate carnivore), cottontail, and earthworm were less than 1. The COPECs and receptors are discussed in section H-5.3.

H-5.2.2 SWMU 21-004(c)

The results of the minimum ESL comparisons are presented in Table H-5.2-4. Antimony, chromium (total), copper, nickel, selenium, and silver are retained as COPECs because the HQs were greater than 0.3.

Isopropyltoluene[4-] does not have ESLs, is retained as a COPEC, and is discussed in section H-5.3.8.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.2-5. The HI analysis indicates that the robin (all feeding guilds), shrew, deer mouse, and plant have HIs greater than 1. The HI for the cottontail was equivalent to 1 and the HIs for the fox, kestrel (top carnivore and intermediate carnivore), and earthworm were less than 1. The COPECs and receptors are discussed in section H-5.3.

H-5.2.3 SWMU 21-011(b)

The results of the minimum ESL comparisons are presented in Table H-5.2-6. Antimony, barium, chromium (total), copper, cyanide (total), mercury, nickel, selenium, and bis(2-ethylhexyl)phthalate are retained as COPECs because the HQs were greater than 0.3.

Nitrate does not have ESLs, is retained as a COPEC, and is discussed in section H-5.3.8.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.2-7. The HI analysis indicates that the kestrel (intermediate carnivore), robin (all feeding guilds), shrew, deer mouse, earthworm, and plant have HIs greater than 1. The HI for the cottontail was equivalent to 1 and the HIs for the fox and kestrel (top carnivore) were less than 1. The COPECs and receptors are discussed in section H-5.3.

H-5.2.4 AOC 21-028(d)

The results of the minimum ESL comparisons are presented in Table H-5.2-8. Antimony, chromium (total), copper, nickel, perchlorate, selenium, zinc, acenaphthene, anthracene, Aroclor-1242, Aroclor-1254, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, bis(2-ethylhexyl)phthalate, chrysene, dibenzofuran, fluoranthene, fluorene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene are retained as COPECs because the HQs were greater than 0.3.

Calcium; ethylbenzene; 1,2,4-trimethylbenzene; and 1,2-xylene do not have ESLs, are retained as COPECs, and are discussed in section H-5.3.8.

The HQs and HIs for each COPEC and receptor combination are presented in Table H-5.2-9. The HI analysis indicates that the kestrel (intermediate carnivore), robin (all feeding guilds), cottontail, shrew, deer mouse, earthworm, and plant have HIs greater than 1. The HI for the kestrel (top carnivore) was equivalent to 1 and the HI for the fox was less than 1. The COPECs and receptors are discussed in section H-5.3.

H-5.3 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 for sites. The following narrative contains a qualitative uncertainty analysis of the issues relevant to evaluating the potential ecological risk at the DP Site Aggregate Area at DP East.

H-5.3.1 Chemical Form

The assumptions used in the ESL derivations were 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. Most of these factors tend to result in conservative estimates of the ESLs, 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, largely a limitation on analytical quantitation of individual chemical species. Toxicological data are typically based on the most toxic and bioavailable chemical species not likely found in the environment. The inorganic, organic, and radionuclide, COPECs are generally not 100% bioavailable to receptors in the natural environment because of 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 2017, 602649), and the values were biased toward overestimating the potential risk to receptors.

H-5.3.2 Exposure Assumptions

The EPCs used in the calculations of HQs were the 95% UCL, the maximum detected concentration, or the maximum detection limit to a depth of 5.0 ft, thereby conservatively estimating the exposure to each COPC. As a result, the exposure of individuals within a population was evaluated using this specific concentration, which was assumed constant throughout the exposure area. The sampling also 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. The assumptions made regarding exposure for terrestrial receptors results in an overestimation of the potential exposure and risk because COPECs varied across the site and were infrequently detected.

H-5.3.3 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 likely 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 may result in an under- or overestimation of potential risk.

H-5.3.4 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 a receptor is likely to spend within the contaminated areas based on the size of the receptor’s home range (HR). The AUF for individual organisms is calculated 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. The HR for the Mexican spotted owl is 366 ha (EPA 1993, 059384). The site areas and AUFs for each site are presented in Table H-5.3-1. The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl.

One site had the HI for the kestrel (top carnivore) equivalent to 1 [AOC 21-028(d)]. Application of the AUF for the Mexican spotted owl to the HI for the kestrel (top carnivore) resulted in an adjusted HI of 0.00002. Therefore, there are no potential adverse impacts to the Mexican spotted owl at any of the sites.

H-5.3.5 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 at these sites in the DP Site Aggregate Area at DP East is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for a receptor is based on the individual receptor HR and its dispersal distance. 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 (Bowman et al. 2002, 073475), the median dispersal distance becomes 3.6 times the square root of the HR (R^2=0.91). If it is assumed that the receptors can disperse 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 can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The HRs used to calculate the population areas for the kestrel, robin, deer mouse, shrew, cottontail, and fox were determined using the data in EPA's "Wildlife Exposure Factors Handbook" (EPA 1993, 059384). The HRs were either for specific environments or averages of different environments presented in the respective exposure parameter/population dynamic tables (EPA 1993, 059384). "Screening Level Ecological Risk Evaluation Methods, Revision 5" (LANL 2017, 602649, Table 3.3-1) presents how the EPA data were used to derive the HRs for each receptor.

H-5.3.5.1 SWMU 21-004(b)

The area of SWMU 21-004(b) is approximately 0.00697 ha. The population area use factors (PAUFs) are estimated by dividing the site area by the population area of each receptor population (Table H-5.3-2). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 21-004(b) are less than 1 for all receptors (Table H-5.3-3). The plant had an unadjusted HI of 2 and the earthworm had an unadjusted HI of 0.4 (Table H-5.3-3).

H-5.3.5.2 SWMU 21-004(c)

The area of SWMU 21-004(c) is approximately 0.00697 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.3-4). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 21-004(c) are less than 1 for all receptors (Table H-5.3-5). The plant had an unadjusted HI of 2 and the earthworm had an unadjusted HI of 0.4 (Table H-5.3-5).

H-5.3.5.3 SWMU 21-011(b)

The area of SWMU 21-011(b) is approximately 0.109 ha. The PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.3-6). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for SWMU 21-011(b) are less than 1 for all receptors (Table H-5.3-7). The plant had an unadjusted HI of 4 and the earthworm had an unadjusted HI of 3 (Table H-5.3-7).

H-5.3.5.4 AOC 21-028(d)

The area of AOC 21-028(d) is approximately 0.00584 ha. PAUFs are estimated by dividing the site area by the population area of each receptor population (Table H-5.3-8). The HQs and HIs are recalculated using the PAUFs. The HIs for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs.

The adjusted HIs for AOC 21-028(d) are less than 1 for all receptors (Table H-5.3-9). The plant had an unadjusted HI of 95 and the earthworm had an unadjusted HI of 34 (Table H-5.3-9).

H-5.3.6 LOAEL Analysis

All of the sites have HIs greater than 1 for one or more receptors. To address the HIs and reduce the associated uncertainty, 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 4.1 (LANL 2017, 602538) and are presented in Table H-5.3-10. The analyses address some of the uncertainties and conservativeness of the ESLs used in the initial screening assessments. HI analyses and adjusted HI analyses were conducted using the LOAEL-based ESLs for COPECs having unadjusted or PAUF-adjusted HQs greater than 0.1 and a receptor HI greater than 1.

H-5.3.7 Site Discussions

H-5.3.7.1 SWMU 21-004(b)

The plant HI for SWMU 21-004(b) is greater than 1, with copper, nickel, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.4 for the plant (Table H-5.3-11).

H-5.3.7.2 SWMU 21-004(c)

The plant HI for SWMU 21-004(c) is greater than 1, with copper, nickel, and selenium being the primary COPECs. The HI analysis using LOAEL-based ESLs resulted in an HI of 0.4 for the plant (Table H-5.3-12).

H-5.3.7.3 SWMU 21-011(b)

The HIs for SWMU 21-011(b) are greater than 1 for the earthworm and plant, with antimony, barium, copper, mercury, nickel, and selenium being the primary COPECs for one or more receptors. The HI analysis using LOAEL-based ESLs resulted in HIs of 0.3 for the earthworm and 0.8 for the plant (Table H-5.3-13).

H-5.3.7.4 AOC 21-028(d)

The HIs for AOC 21-028(d) are equivalent to or greater than 1 for the earthworm and plant, with antimony, copper, nickel, selenium, zinc, acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzofuran, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene being the primary COPECs for one or more receptors. The HI analysis using LOAEL-based ESLs resulted in HIs of 14 for the earthworm and 13 for the plant (Table H-5.3-14). The COPECs with LOAEL-based HQs equivalent to or greater than 1 are all PAHs (acenaphthene, anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene).

PAHs were generally detected in all six samples in the 0.0 to 5.0 ft depth interval. For example, phenanthrene has the largest LOAEL-based HQs at approximately 7. All six phenanthrene results were detections and the EPC was the maximum concentration (83.6 mg/kg, sample ID RE21-11-10242). The second largest phenanthrene result was 12 mg/kg (sample ID RE21-11-10239), which is equal to the earthworm LOAEL-based ESL. As noted above, the area of AOC 21-028(d) is approximately 0.00584 ha. The small area of the site indicates the plant and soil invertebrate communities, as a whole, are not impacted. Therefore, the potential ecological risk to plants and earthworms is overestimated.

In addition, field observations made during the site visit found no indication of adverse effects from COPECs on the plant community (Attachment H-2). The site currently has no active operations and is becoming naturalized, with abundant habitat for ecological receptors, including plants. Therefore, the HI may not indicate potential risk to plants and soil invertebrates.

H-5.3.8 Chemicals without ESLs

Several COPECs do not have ESLs for any receptor in Release 4.1 of the ECORISK Database (LANL 2017, 602538). In an effort to address this uncertainty and to provide a quantitative assessment of potential ecological risk, several online toxicity databases searches were conducted to determine if any relevant toxicity information is available. The online searches of the following databases were conducted: EPA ECOTOX Database, EPA Office of Pesticide Programs Aquatic Life Benchmarks, U.S. Army Corps of Engineers/EPA Environmental Residue-Effects, California CalEcotox Database, Pesticide Action Network Pesticide Database, U.S. Army Wildlife Toxicity Assessment Program, U.S. Department of Agriculture Integrated Pesticide Management Database, American Bird Conservancy Pesticide Toxicity Database, and Oak Ridge National Laboratory Risk Assessment Information System. 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.

In the absence of a chemical-specific ESL, COPEC concentrations can be compared with ESLs for a surrogate chemical. Comparison with 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 with residential human health SSLs are presented as part of a qualitative assessment. The comparison of COPEC concentrations with residential human health SSLs is a viable alternative for several reasons. Animal studies are used to infer effects on humans and are 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 that 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). The COPECs without ESLs were common to many of the sites and are discussed below for each site.

Toxicity data are not available for calcium; nitrate; ethylbenzene; 4-isopropyltoluene; 1,2,4-trimethylbenzene; and 1,2-xylene. For calcium and nitrate, no surrogate or other toxicity information is available. For ethylbenzene; 4-isopropyltoluene; 1,2,4-trimethylbenzene; and 1,2-xylene; a surrogate is used based on structural similarity to evaluate the potential toxicity.

Calcium was identified as a COPC from 0.0 to 5.0 ft at three sites with maximum concentrations ranging from 10,600 mg/kg to 21,900 mg/kg. As presented in Table H-4.4-1, concentrations of calcium are substantially less than the NMED essential nutrient SSLs. Calcium is eliminated as a COPEC.

Nitrate was identified as a COPC from 0.0 to 5.0 ft at two sites with maximum concentrations of 8.4 mg/kg and 10.3 mg/kg. The NMED residential SSL for nitrate is 125,000 mg/kg, indicating that potential toxicity is very low. Because nitrate concentrations are about four orders of magnitude less than the SSL, nitrate is eliminated as a COPEC.

Ethylbenzene was identified as a COPC from 0.0 to 5.0 ft at one site based on a single detected concentration of 0.000607 mg/kg [one detection in six samples from AOC 21-028(d)]. The minimum ESL for benzene (24 mg/kg for the deer mouse) is used to screen the ethylbenzene concentrations and results in a maximum HQ of 0.00003. Because the maximum HQ is less than 0.3, ethylbenzene is eliminated as a COPEC.

Isopropyltoluene[4-] was identified as a COPC from 0.0 to 5.0 ft at SWMU 21-004(c) at a concentration of 0.00117 mg/kg (one detection in two samples). The minimum ESL for toluene (23 mg/kg for the shrew) is used to screen the 4-isopropyltoluene concentration and results in a maximum HQ of 0.00005. Because the maximum HQ is less than 0.3, 4-isopropyltoluene is eliminated as a COPEC.

Trimethylbenzene[1,2,4-] was detected at one site from 0.0 to 5.0 ft with maximum concentration of 0.00162 mg/kg [two detections in six samples at AOC 21-028(d)]. The minimum ESL for benzene (24 mg/kg for the deer mouse) is used to screen the 1,2,4-trimethylbenzene concentrations and results in a maximum HQ of 0.00007. Because the maximum HQ is less than 0.3, 1,2,4-trimethylbenzene is not retained as a COPEC.

Xylene[1,2-] was identified as a COPC from 0.0 to 5.0 ft at AOC 21-028(d). The maximum concentration was 0.000486 mg/kg (one detection in six samples). The minimum ESL for total xylene (1.4 mg/kg for the shrew) is used to screen the 1,2-xylene concentrations and results in a maximum HQ of 0.0003. Because the maximum HQ is less than 0.3, 1,2-xylene is eliminated as a COPEC.

H-5.4 Interpretation of Ecological Risk-Screening Results

H-5.4.1 Receptor Lines of Evidence

Based on the ecological risk-screening assessments, several COPECs (including COPECs without an ESL) were identified for the DP Site Aggregate Area at DP East. Receptors were evaluated using several lines of evidence: minimum ESL comparisons, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, and the relationship of detected concentrations and detection limits to background concentrations.

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.
- The HIs were greater than 1 for the plant at all sites.
- The HI analyses using the LOAEL-based ESLs resulted in HIs less than or equivalent to 1 for SWMUs 21-004(b), 21-004(c), and 21-011(b). LOAEL-based HIs and HQs for some PAHs are greater than 1 at AOC 21-028(d).
- Field observations made during the site visits found no indication of adverse effects on the plant community from COPECs. These TA-21 sites currently have minimal active operations and are becoming naturalized, with abundant habitat for ecological receptors, including plants.
- As discussed in section H-5.3.7, the potential risks to the plants are overestimated.

These lines of evidence support the conclusion that no potential ecological risk to the plants exists at the DP Site Aggregate Area at DP East.

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 HIs were or greater than 1 for the earthworm at SWMU 21-011(b) and AOC 21-028(d).
- The HI analyses using the LOAEL-based ESLs resulted in HIs less than 1 for SWMU 21-011(b). LOAEL-based HIs and HQs for some PAHs are greater than 1 at AOC 21-028(d).
- Field observations made during the site visits found no indication of adverse effects on the plant community from COPECs. The TA-21 sites currently have minimal active operations and are becoming naturalized, with abundant habitat for ecological receptors, including plants and other biota.
- As discussed in section H-5.3.7, the potential risks to the earthworms are overestimated.

These lines of evidence support the conclusion no potential ecological risk to the earthworm exists at the DP Site Aggregate Area at DP East.

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.
- The HIs were greater than 1 for the shrew at all sites.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the shrew population area. The adjusted HIs were less than 1 for all sites.

These lines of evidence support the conclusion that no potential ecological risk to the montane shrew exists at the DP Site Aggregate Area at DP East.

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.
- The HIs were greater than 1 for the deer mouse at all sites.
- The HIs were adjusted by the PAUF, which is the ratio of the site area to the deer mouse population area. The adjusted HIs were less than 1 for all sites.

These lines of evidence support the conclusion that no potential ecological risk to the deer mouse exists at the DP Site Aggregate Area at DP East.

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 HIs were equivalent to or less than 1 for the cottontail at all sites, except at AOC 21-028(d).
- The HIs were adjusted by the PAUFs, which is the ratio of the site area to the cottontail population area. The adjusted HIs were less than 1 at all sites.

These lines of evidence support the conclusion that no potential ecological risk to the cottontail exists at the DP Site Aggregate Area at DP East.

Fox (Carnivore)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the fox, were less than 0.3.
- The HIs were less than 1 for the fox at all sites.

These lines of evidence support the conclusion that no potential ecological risk to the fox exists at the DP Site Aggregate Area at DP East.

Robin (All Feeding Guilds)

- Initial screening using the minimum ESLs eliminated a number of COPECs because the HQs for all of the receptors, including the robin, were less than 0.3.
- The HIs were greater than 1 for the robin (all feeding guilds) at all sites.
- The HIs were adjusted by the PAUFs. The adjusted HIs were less than 1 at all sites.

These lines of evidence support the conclusion that no potential ecological risk to the robin (all feeding guilds) exists at the DP Site Aggregate Area at DP East.

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 (intermediate carnivore), were less than 0.3.
- The HIs were less than 1 for the kestrel (intermediate carnivore) at SWMUs 21-004(b) and 21-004(c).
- The HIs 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 all sites.

These lines of evidence support the conclusion that no potential ecological risk to the kestrel (intermediate carnivore) exists at the DP Site Aggregate Area at DP East.

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 HIs were less than or equivalent to 1 for the kestrel (top carnivore) at all sites.
- The HIs 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 all sites.
- The kestrel (top carnivore) is a surrogate for the Mexican spotted owl. The HIs were adjusted by the Mexican spotted owl AUFs. The adjusted HIs were less than 1 at all sites.

These lines of evidence support the conclusion that no potential ecological risks to the kestrel (top carnivore) and the Mexican spotted owl exist at the DP Site Aggregate Area at DP East.

H-5.4.2 COPECs with No ESLs

COPECs without ESLs were eliminated based on comparisons with surrogate ESLs or human health SSLs. The analysis of COPECs without ESLs supports the conclusion that no potential ecological risk to receptors exists at the DP Site Aggregate Area at DP East.

H-5.4.3 Summary

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, the relationship of detected concentrations and screening levels to background concentrations, and COPECs without ESLs for the remaining sites, no potential ecological risks to the earthworm, plant, robin, kestrel, deer mouse, montane shrew, cottontail, fox, and Mexican spotted owl exist for the DP Site Aggregate Area at DP East.

H-6.0 CONCLUSIONS

H-6.1 Human Health Risk

The total excess cancer risks were less than the target risk level of 1×10^{-5} and the HIs were less than the target HI of 1 for the industrial, construction worker, and residential scenarios at all sites with the exception of the residential risks at AOC 21-028(d). Carcinogenic risks at AOC 21-028(d) are related to concentrations of PAHs, and the highest PAH concentrations were in the shallowest samples (1-2 ft bgs interval).

The total doses were below the target dose limit of 25 mrem/yr as authorized by DOE Order 458.1 for the industrial, construction worker, and residential scenarios at all sites, except for dose to the construction worker and resident at SWMU 21-011(b). The total doses were equivalent to total risks ranging from 5×10^{-9} to 4×10^{-7} for the industrial scenario, from 1×10^{-9} to 5×10^{-6} for the construction worker scenario, and from 2×10^{-8} to 1×10^{-4} for the residential scenario, based on conversion from dose using RESRAD Version 7.0 (LANL 2015, 600929).

Sites in the DP Site Aggregate Area at DP East are not accessible by the public and are not planned for release by DOE in the foreseeable future. Therefore, an as low as reasonably achievable (ALARA) evaluation for radiological exposure to the public is not currently required. Should DOE’s plans for releasing these areas change, an ALARA evaluation will be conducted at that time.

H-6.2 Ecological Risk

Based on evaluations of the minimum ESLs, HI analyses, potential effects to populations (individuals for T&E species), LOAEL analyses, the relationship of detected concentrations and screening levels to background concentrations, and COPECs without ESLs for the other sites, no potential ecological risks to the earthworm, plant, robin, kestrel, deer mouse, montane shrew, cottontail, fox, and Mexican spotted owl exist in the DP Site Aggregate Area at DP East.

H-7.0 REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory’s Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory’s Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B’s Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

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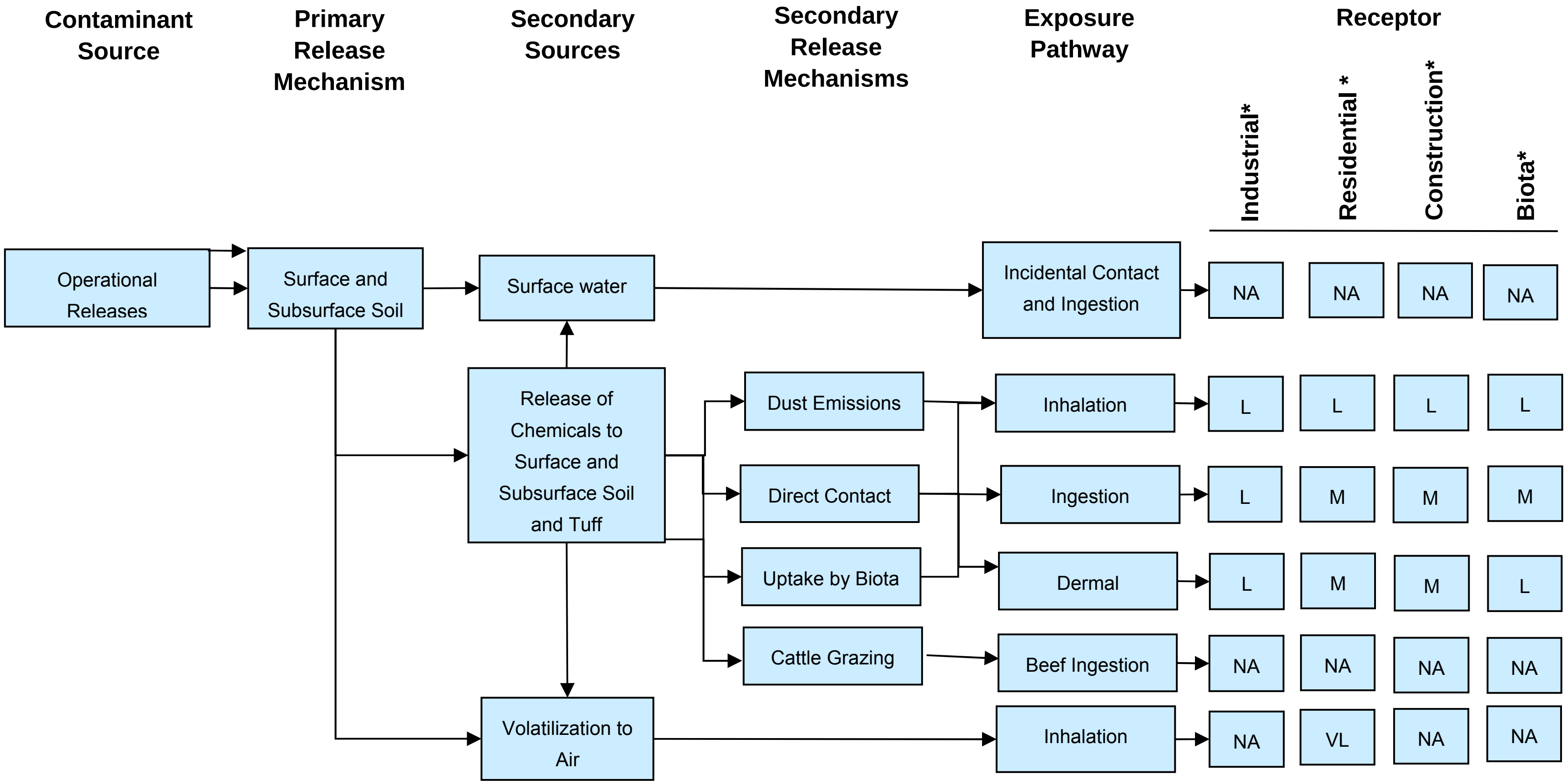


* Very Low (VL), Low (L), and Moderate (M) designations indicate the pathway is a potentially complete pathway and is evaluated in the risk assessments.
Not Applicable (NA) indicates the pathway is incomplete and is not evaluated in the risk assessments.

Figure H-3.1-1 Conceptual site model for DP Site Aggregate Area sites at DP East

Table H-2.3-1
EPCs at SWMU 21-004(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	1	0	0.978(U)	0.978 (U)	n/a*	0.978 (U)	Maximum detection limit
Chromium	1	1	5.74	5.74	n/a	5.74	Maximum detected concentration
Copper	1	0	5.35 (U)	5.35 (U)	n/a	5.35 (U)	Maximum detection limit
Nickel	1	1	4.08	4.08	n/a	4.08	Maximum detected concentration
Selenium	1	0	0.999 (U)	0.999 (U)	n/a	0.999 (U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Diethylphthalate	1	1	0.136	0.136	n/a	0.136	Maximum detected concentration
Radionuclides (pCi/g)							
Cesium-137	1	1	0.0376	0.0376	n/a	0.0376	Maximum detected concentration
Plutonium-239/240	1	1	0.0625	0.0625	n/a	0.0625	Maximum detected concentration
Tritium	1	1	0.0151	0.0151	n/a	0.0151	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-2.3-2
EPCs at SWMU 21-004(b) for the Construction Worker and Residential Scenarios

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	3	2	0.62	0.978 (U)	n/a*	0.751	Maximum detected concentration
Chromium	3	3	5.74	51.8	n/a	51.8	Maximum detected concentration
Copper	3	0	5.35 (U)	13 (U)	n/a	13 (U)	Maximum detection limit
Nickel	3	3	4.08	13	n/a	13	Maximum detected concentration
Selenium	3	0	0.999 (U)	1.01 (U)	n/a	1.01 (U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Aroclor-1254	1	1	0.0459	0.0459	n/a	0.0459	Maximum detected concentration
Aroclor-1260	1	1	0.0208	0.0208	n/a	0.0208	Maximum detected concentration
Diethylphthalate	3	3	0.136	0.145	n/a	0.145	Maximum detected concentration
Radionuclides (pCi/g)							
Cesium-137	3	1	-0.0266 (U)	0.0376	n/a	0.0376	Maximum detected concentration
Plutonium-239/240	3	1	0 (U)	0.0625	n/a	0.0625	Maximum detected concentration
Tritium	3	3	0.0151	0.127	n/a	0.127	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-2.3-3
EPCs at SWMU 21-004(b) for Ecological Receptors

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	2	1	0.62	0.978 (U)	n/a*	0.62	Maximum detected concentration
Chromium	2	2	5.74	43.1	n/a	43.1	Maximum detected concentration
Copper	2	0	5.35 (U)	10.5 (U)	n/a	10.5 (U)	Maximum detection limit
Nickel	2	2	4.08	12.9	n/a	12.9	Maximum detected concentration
Selenium	2	0	0.999 (U)	1 (U)	n/a	1 (U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Diethylphthalate	2	2	0.136	0.142	n/a	0.142	Maximum detected concentration
Radionuclides (pCi/g)							
Cesium-137	2	1	−0.0266 (U)	0.0376	n/a	0.0376	Maximum detected concentration
Plutonium-239/240	2	1	0.00116 (U)	0.0625	n/a	0.0625	Maximum detected concentration
Tritium	2	2	0.0151	0.022	n/a	0.022	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-2.3-4
EPCs at SWMU 21-004(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	1	0	1 (U)	1 (U)	n/a*	1 (U)	Maximum detection limit
Chromium	1	1	8.52	8.52	n/a	8.52	Maximum detected concentration
Copper	1	0	7.21 (U)	7.21 (U)	n/a	7.21 (U)	Maximum detection limit
Nickel	1	1	4.67	4.67	n/a	4.67	Maximum detected concentration
Selenium	1	0	0.888 (U)	0.888 (U)	n/a	0.888 (U)	Maximum detection limit
Silver	1	1	1.17	1.17	n/a	1.17	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	1	1	0.0544	0.0544	n/a	0.0544	Maximum detected concentration
Tritium	1	1	0.00776	0.00776	n/a	0.00776	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-2.3-5
EPCs at SWMU 21-004(c) for the Construction Worker and Residential Scenarios

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	3	1	0.446	1 (U)	n/a*	0.446	Maximum detected concentration
Chromium	3	3	8.52	40.8	n/a	40.8	Maximum detected concentration
Copper	3	0	5.57 (U)	7.21 (U)	n/a	7.21 (U)	Maximum detection limit
Nickel	3	3	4.67	7.84	n/a	7.84	Maximum detected concentration
Selenium	3	0	0.888 (U)	0.979 (U)	n/a	0.979 (U)	Maximum detection limit
Silver	3	3	0.123	1.17	n/a	1.17	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acetone	2	2	0.0046	0.0118	n/a	0.0118	Maximum detected concentration
Aroclor-1254	3	1	0.0015	0.0034 (U)	n/a	0.0015	Maximum detected concentration
Diethylphthalate	3	1	0.103	0.341 (U)	n/a	0.103	Maximum detected concentration
Isopropyltoluene[4-]	2	1	0.00104 (U)	0.00117	n/a	0.00117	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	3	1	−0.00264 (U)	0.0544	n/a	0.0544	Maximum detected concentration
Tritium	3	3	0.00776	0.0265	n/a	0.0265	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-2.3-6
EPCs at SWMU 21-004(c) for Ecological Receptors

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	2	0	0.971 (U)	1 (U)	n/a*	1 (U)	Maximum detection limit
Chromium	2	2	8.52	40.8	n/a	40.8	Maximum detected concentration
Copper	2	0	7.19 (U)	7.21 (U)	n/a	7.21 (U)	Maximum detection limit
Nickel	2	2	4.67	7.5	n/a	7.5	Maximum detected concentration
Selenium	2	0	0.888 (U)	0.96 (U)	n/a	0.96 (U)	Maximum detection limit
Silver	2	2	1.07	1.17	n/a	1.17	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acetone	1	1	0.0046	0.0046	n/a	0.0046	Maximum detected concentration
Isopropyltoluene[4-]	1	1	0.00117	0.00117	n/a	0.00117	Maximum detected concentration
Radionuclides (pCi/g)							
Plutonium-239/240	2	1	0.00237 (U)	0.0544	n/a	0.0544	Maximum detected concentration
Tritium	2	2	0.00776	0.0237	n/a	0.0237	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-2.3-7
EPCs at SWMU 21-011(b) for the Construction Worker and Residential Scenarios

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	46	1	0.382 (U)	1.25 (U)	n/a[a]	0.653	Maximum detected concentration
Barium	46	46	5.26	140	Normal	75.2	95% Student's-t
Chromium	46	46	1.31	20.2	Normal	8.64	95% Student's-t
Copper	46	46	0.732	23.2	Gamma	6.31	95% Adjusted gamma
Cyanide (total)	46	5	0.0919	2.04	Nonparametric	0.371	95% KM[b] (Chebyshev)
Mercury	46	42	0.00468	0.258	Lognormal	0.0619	95% BCA[c] bootstrap
Nickel	46	46	0.903	15.2	Normal	6.2	95% Student's-t
Nitrate	46	38	1.02 (U)	10.3	Nonparametric	3.17	95% KM (Chebyshev)
Perchlorate	46	9	0.000689	0.00286	Gamma	0.00101	95% KM Adjusted gamma
Selenium	46	0	0.93 (UJ)	1.23 (UJ)	n/a	1.23 (UJ)	Maximum detection limit
Organic Chemicals (mg/kg)							
Acetone	46	2	0.00176	0.00624 (U)	n/a	0.00337	Maximum detected concentration
Aroclor-1254	4	2	0.0045	0.0191 (U)	n/a	0.0106	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	46	2	0.114	2.34	n/a	2.34	Maximum detected concentration
Diethylphthalate	46	2	0.339 (U)	3.06	n/a	3.06	Maximum detected concentration
Hexanone[2-]	46	1	0.00509 (U)	0.0939	n/a	0.0939	Maximum detected concentration
Isopropyltoluene[4-]	46	1	0.000943	0.00125 (U)	n/a	0.000943	Maximum detected concentration
Methylene chloride	46	1	0.00232 (U)	0.00608 (U)	n/a	0.00249	Maximum detected concentration
Radionuclides (pCi/g)							
Americium-241	46	14	−0.00115 (U)	40.6	Nonparametric	5.26	95% KM Chebyshev
Cesium-137	45	2	−0.0606 (U)	0.209	n/a	0.209	Maximum detected concentration
Plutonium-238	46	2	−0.00535 (U)	17 (U)	n/a	0.0299	Maximum detected concentration
Plutonium-239/240	46	32	0 (U)	1620	Nonparametric	212	95% KM Chebyshev
Tritium	46	45	0.0111 (U)	1560	Lognormal	192	95% KM Chebyshev

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] KM = Kaplan-Meier.

[c] BCA= Bias-corrected and accelerated.

Table H-2.3-8
EPCs at SWMU 21-011(b) for Ecological Receptors

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	15	0	0.382 (U)	1.2 (U)	n/a[a]	1.2 (U)	Maximum detection limit
Barium	15	15	11.9	117	Normal	87.9	95% Student's-t
Chromium	15	15	1.4	14	Normal	8.17	95% Student's-t
Copper	15	15	1.21	23.2	Gamma	8.23	95% Adjusted gamma
Cyanide (total)	15	3	0.0919	0.287 (U)	n/a	0.186	Maximum detected concentration
Mercury	15	14	0.0094	0.181	Gamma	0.106	95% KM[b] adjusted gamma
Nickel	15	15	1.47	8.95	Normal	6.06	95% Student's-t
Nitrate	15	14	1.15	10.3	Nonparametric	4.99	95% KM (Chebyshev)
Perchlorate	15	3	0.000786	0.00243 (U)	n/a	0.00122	Maximum detected concentration
Selenium	15	0	1 (U)	1.2 (U)	n/a	1.2 (U)	Maximum detection limit
Organic Chemicals (mg/kg)							
Aroclor-1254	2	2	0.0045	0.0106	n/a	0.0106	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	15	1	0.343 (U)	2.34	n/a	2.34	Maximum detected concentration
Radionuclides (pCi/g)							
Americium-241	15	7	0(U)	0.0697	Normal	0.0289	95% KM (t)
Cesium-137	15	2	−0.0291 (U)	0.209	n/a	0.209	Maximum detected concentration
Plutonium-238	15	2	−0.00359 (U)	0.0299	n/a	0.0299	Maximum detected concentration
Plutonium-239/240	15	10	0 (U)	5.81	Nonparametric	2.31	95% KM Chebyshev
Tritium	15	15	0.0219	1560	Nonparametric	576	95% Chebyshev(mean, SD[c])

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] KM = Kaplan-Meier.

[c] SD = Standard deviation.

Table H-2.3-9
EPCs at AOC 21-028(d) for the Construction Worker and Residential Scenarios

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	12	4	0.405	1.6	n/a[a]	1.6	Maximum detected concentration
Chromium	12	12	5.05	37.8	Normal	22.4	95% Student's-t
Copper	12	12	1.76	14.8	Normal	9.26	95% Student's-t
Nickel	12	12	1.54	13.3	Normal	7.31	95% Student's-t
Perchlorate	12	3	0.000774	0.0831	n/a	0.0831	Maximum detected concentration
Selenium	12	1	0.679	1.1 (U)	n/a	0.679	Maximum detected concentration
Zinc	12	12	11.4	120	Gamma	52.5	95% Adjusted gamma
Organic Chemicals (mg/kg)							
Acenaphthene	12	8	0.0196	13	Gamma	11.3	95% KM[b] bootstrap t
Acetone	12	2	0.00415	0.00625	n/a	0.00625	Maximum detected concentration
Anthracene	12	8	0.0371 (U)	24	Gamma	23.2	95% KM bootstrap t
Aroclor-1242	12	2	0.00371 (U)	0.17	n/a	0.17	Maximum detected concentration
Aroclor-1254	12	5	0.00371 (U)	0.177	Normal	0.058	95% KM (t)
Aroclor-1260	12	2	0.00371 (U)	0.0733 (U)	n/a	0.0265	Maximum detected concentration
Benzo(a)anthracene	12	8	0.0371 (U)	22.8	Gamma	19.8	95% KM bootstrap t
Benzo(a)pyrene	12	8	0.0371 (U)	19.1	Gamma	17.5	95% KM bootstrap t
Benzo(b)fluoranthene	12	8	0.0371 (U)	21.8	Gamma	17.7	95% KM bootstrap t
Benzo(g,h,i)perylene	12	8	0.023	9.09	Gamma	6.63	95% KM bootstrap t
Benzo(k)fluoranthene	12	8	0.0234	8.21	Gamma	6.54	95% KM bootstrap t
Bis(2-ethylhexyl)phthalate	12	1	0.222	18.3 (U)	n/a	0.222	Maximum detected concentration
Chrysene	12	8	0.0371 (U)	24.3	Gamma	23.2	95% KM bootstrap t
Dibenz(a,h)anthracene	12	5	0.0169	3.21	Normal	0.903	95% KM (t)
Dibenzofuran	12	5	0.17	9.9	Gamma	4.93	95% Gamma adjusted KM
Diethylphthalate	12	1	0.284	18.3 (U)	n/a	0.284	Maximum detected concentration

Table H-2.3-9 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Ethylbenzene	12	1	0.000607	0.00116 (U)	n/a	0.000607	Maximum detected concentration
Fluoranthene	12	11	0.0114	69.2	Gamma	57.5	95% KM bootstrap t
Fluorene	12	8	0.0238	15.4	Gamma	7.34	95% Gamma adjusted KM
Indeno(1,2,3-cd)pyrene	12	8	0.0207	9.29	Gamma	7.3	95% KM bootstrap t
Methylene chloride	12	2	0.00242	0.00578 (U)	n/a	0.00252	Maximum detected concentration
Methylnaphthalene[2-]	12	7	0.0331	7.06	Gamma	3.12	95% Gamma adjusted KM
Naphthalene	12	8	0.0272	32.5	Gamma	16.3	95% Gamma adjusted KM
Phenanthrene	12	11	0.0121	83.6	Gamma	77.4	95% KM bootstrap t
Pyrene	12	11	0.0129	61.9	Gamma	52.2	95% KM bootstrap t
Toluene	12	2	0.000438	0.00116 (U)	n/a	0.000883	Maximum detected concentration
Trimethylbenzene[1,2,4-]	12	2	0.000346	0.00162	n/a	0.00162	Maximum detected concentration
Xylene[1,2-]	12	1	0.000486	0.00116 (U)	n/a	0.000486	Maximum detected concentration
Xylene[1,3-]+xylene[1,4-]	12	2	0.000374	0.00231 (U)	n/a	0.00115	Maximum detected concentration
Radionuclides (pCi/g)							
Tritium	12	10	1.11	61.7	Gamma	31.2	95% KM bootstrap t

Note: Data qualifiers are defined in Appendix A.

[a] n/a = Not applicable.

[b] KM = Kaplan-Meier.

Table H-2.3-10
EPCs at AOC 21-028(d) for Ecological Receptors

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Inorganic Chemicals (mg/kg)							
Antimony	6	3	1.02 (UJ)	1.6	n/a*	1.6	Maximum detected concentration
Chromium	6	6	5.05	37.8	n/a	37.8	Maximum detected concentration
Copper	6	6	5.88	14.8	n/a	14.8	Maximum detected concentration
Nickel	6	6	3.92	6.08	n/a	6.08	Maximum detected concentration
Perchlorate	6	2	0.0015	0.0831	n/a	0.0831	Maximum detected concentration
Selenium	6	0	0.915 (U)	1.04 (U)	n/a	1.04 (U)	Maximum detection limit
Zinc	6	6	25.7	120	n/a	120	Maximum detected concentration
Organic Chemicals (mg/kg)							
Acenaphthene	6	6	0.102	13	n/a	13	Maximum detected concentration
Acetone	6	1	0.00415	0.00554 (UJ)	n/a	0.00415	Maximum detected concentration
Anthracene	6	6	0.181	24	n/a	24	Maximum detected concentration
Aroclor-1242	6	2	0.018 (U)	0.17	n/a	0.17	Maximum detected concentration
Aroclor-1254	6	4	0.016	0.177	n/a	0.177	Maximum detected concentration
Aroclor-1260	6	2	0.018 (U)	0.0733 (U)	n/a	0.0265	Maximum detected concentration
Benzo(a)anthracene	6	6	0.273	22.8	n/a	22.8	Maximum detected concentration
Benzo(a)pyrene	6	6	0.248	19.1	n/a	19.1	Maximum detected concentration
Benzo(b)fluoranthene	6	6	0.261	21.8	n/a	21.8	Maximum detected concentration
Benzo(g,h,i)perylene	6	6	0.168	9.09	n/a	9.09	Maximum detected concentration
Benzo(k)fluoranthene	6	6	0.115	8.21	n/a	8.21	Maximum detected concentration
Bis(2-ethylhexyl)phthalate	6	1	0.222	18.3 (U)	n/a	0.222	Maximum detected concentration
Chrysene	6	6	0.275	24.3	n/a	24.3	Maximum detected concentration
Dibenz(a,h)anthracene	6	3	0.036 (U)	3.21	n/a	3.21	Maximum detected concentration
Dibenzofuran	6	5	0.17	9.9	n/a	9.9	Maximum detected concentration
Ethylbenzene	6	1	0.000607	0.00111 (U)	n/a	0.000607	Maximum detected concentration

Table H-2.3-10 (continued)

COPC	Number of Analyses	Number of Detects	Minimum Concentration	Maximum Concentration	Distribution	EPC	EPC Method
Fluoranthene	6	6	0.692	69.2	n/a	69.2	Maximum detected concentration
Fluorene	6	6	0.101	15.4	n/a	15.4	Maximum detected concentration
Indeno(1,2,3-cd)pyrene	6	6	0.152	9.29	n/a	9.29	Maximum detected concentration
Methylene chloride	6	2	0.00242	0.00554 (U)	n/a	0.00252	Maximum detected concentration
Methylnaphthalene[2-]	6	6	0.0331	7.06	n/a	7.06	Maximum detected concentration
Naphthalene	6	6	0.132	32.5	n/a	32.5	Maximum detected concentration
Phenanthrene	6	6	0.653	83.6	n/a	83.6	Maximum detected concentration
Pyrene	6	6	0.603	61.9	n/a	61.9	Maximum detected concentration
Toluene	6	2	0.000438	0.00111 (U)	n/a	0.000883	Maximum detected concentration
Trimethylbenzene[1,2,4-]	6	2	0.000346	0.00162	n/a	0.00162	Maximum detected concentration
Xylene[1,2-]	6	1	0.000486	0.00111 (U)	n/a	0.000486	Maximum detected concentration
Xylene[1,3-]+xylene[1,4-]	6	2	0.000374	0.00222 (U)	n/a	0.00115	Maximum detected concentration
Radionuclides (pCi/g)							
Tritium	6	6	8.58	61.7	n/a	61.7	Maximum detected concentration

Note: Data qualifiers are defined in Appendix A.

* n/a = Not applicable.

Table H-3.2-1
Physical and Chemical Properties of Inorganic COPCs for DP Site Aggregate Area Sites at DP East

COPC	K_d[a] (cm^3/g)	Water Solubility[a,b] (g/L)
Antimony	45	Insoluble
Barium	41	Insoluble
Cadmium	75	Insoluble
Chromium (total)	850	Insoluble
Copper	35	Insoluble
Cyanide (total)	9.9	na[c]
Lead	900	Insoluble
Mercury	52	Insoluble
Nickel	65	Insoluble
Nitrate	na	Soluble
Perchlorate	na	245
Selenium	5	Insoluble
Silver	8.3	Insoluble
Zinc	62	Insoluble

[a] Information from http://rais.ornl.gov/cgi-bin/tools/TOX_search .

[b] Denotes reference information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

[c] na = Not available.

Table H-3.2-2
Physical and Chemical Properties of Organic COPCs for DP Site Aggregate Area at DP East

COPC	Water Solubility[a] (mg/L)	Organic Carbon Coefficient K_{oc}[a] (L/kg)	Log Octanol-Water Partition Coefficient K_{ow}[a]	Vapor Pressure[a] (mm Hg at 25°C)
Acenaphthene	3.90E+00	5.03E+03	3.92E+00	2.15E-03
Acetone	1.00E+06	2.36E+00	−2.40E-01	2.32E+02
Anthracene	4.34E-02	1.64E+04	4.45E+00	6.53E-06
Aroclor-1242	2.77E-01	7.81E+04	6.34E+00	8.63E-05
Aroclor-1254	4.30E-02	1.30E+05	6.50E+00	7.71E-05
Aroclor-1260	1.44E-02	3.50E+05	7.55E+00	4.05E-05
Benzo(a)anthracene	9.40E-03[b]	2.31E+05[b]	5.76+00[b]	1.90E-06[b]
Benzo(a)pyrene	1.62E-03	5.87E+05	6.13E+00	5.49E-09
Benzo(b)fluoranthene	1.50E-03	5.99E+05	5.78E+00	5.00E-07
Benzo(g,h,i)perylene	2.60E-04	1.95E+06	6.63E+00	1.00E-10
Benzo(k)fluoranthene	8.00E-04	5.87E+05	6.11E+00	9.65E-10
Bis(2-ethylhexyl)phthalate	2.70E-01	1.20E+05	7.60E+00	1.42E-07
Chrysene	2.00E-03	1.80E+05	5.81E+00	6.23E-09
Dibenz(a,h)anthracene	2.49E-03	1.91E+06	6.75E+00	9.55E-10
Dibenzofuran	3.10E+00	9.16E+04	4.12E+00	2.48E-03
Diethylphthalate	1.08E+03	1.05E+02	2.42E+00	2.10E-03
Ethylbenzene	1.69E+02	4.46E+02	3.15E+00	9.60E+00
Fluoranthene	2.60E-01	5.54E+04	5.16E+00	9.22E-06
Fluorene	1.69E+00	9.16E+03	4.18E+00	6.00E-04
Hexanone[2-]	1.72E+04	1.50E+01	1.38E+00	1.16E+01
Indeno(1,2,3-cd)pyrene	1.90E-04	1.95E+06	6.70E+00	1.25E-12
Isopropyltoluene[4-]	2.34E+01	1.12E+03	4.10E+00	1.46E+00
Methylene chloride	1.30E+04	2.17E+01	1.25E+00	4.30E+02
Methylnaphthalene[2-]	2.46E+01	2.48E+03	3.86E+00	4.35E-02
Naphthalene	3.10E+01	1.54E+03	3.30E+00	8.50E-02
Phenanthrene	1.15E+00	1.67E+04	4.46E+00	1.21E-04
Pyrene	1.35E-01	5.43E+04	4.88E+00	4.50E-06
Toluene	5.26E+02	2.34E+02	2.73E+00	2.84E+01
Trimethylbenzene[1,2,4-]	5.70E+01	6.14E+02	3.63E+00	2.10E+00
Xylene[1,2-]	1.61E+02	4.34E+02	3.20E+00	8.29E+00
Xylene[1,3-]+1,4-xylene[c]	1.78E+02	3.83E+02	3.12E+00	7.99E+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] Xylenes used as a surrogate.

Table H-3.2-3
Physical and Chemical Properties of Radionuclide COPCs for DP Site Aggregate Area at DP East

COPC	Soil-Water Partition Coefficient, K_d[a] (cm^3/g)	Water Solubility[b] (g/L)
Americium-241	680	Insoluble
Cesium-137	1000	Insoluble
Plutonium-239	4500	Insoluble
Plutonium-239/240	4500	Insoluble
Tritium	9.9	Soluble

[a] Superfund Chemical Data Matrix (EPA 1996, 064708).

[b] Information from http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.

Table H-4.1-1
Exposure Parameters Used to Calculate Chemical SSLs for the Industrial, Construction Worker, and Residential Scenarios

Parameter	Industrial Value	Construction Worker Value	Residential Value
Target HQ	1	1	1
Target cancer risk	10^{-5}	10^{-5}	10^{-5}
Averaging time (carcinogen/mutagen)	70 yr × 365 d	70 yr × 365 d	70 yr × 365 d
Averaging time (noncarcinogen)	ED[a] × 365 d	ED × 365 d	ED × 365 d
Skin absorption factor	SVOC[b] = 0.1	SVOC = 0.1	SVOC = 0.1
	Chemical-specific	Chemical-specific	Chemical-specific
Adherence factor–child	n/a[c]	n/a	0.2 mg/cm^2
Body weight–child	n/a	$(mg/kg\text{-}d)^{-1}$	15 kg (0–6 yr of age)
Cancer slope factor–oral (chemical-specific)	$(mg/kg\text{-}d)^{-1}$	$(mg/kg\text{-}d)^{-1}$	$(mg/kg\text{-}d)^{-1}$
Inhalation unit risk (chemical-specific)	$(\mu g/m^3)$	$(\mu g/m^3)$	$(\mu g/m^3)$
Exposure frequency	225 d/yr	250 d/yr	350 d/yr
Exposure time	8 h/day	n/a	24 h/d
Exposure duration–child	n/a	n/a	6 yr[d]
Age-adjusted ingestion factor for carcinogens	n/a	n/a	36,750 mg/kg
Age-adjusted ingestion factor for mutagens	n/a	n/a	25,550 mg/kg
Soil ingestion rate–child	n/a	n/a	200 mg/d
Particulate emission factor	6.61×10^9 m^3/kg	2.1×10^6 m^3/kg	6.61×10^9 m^3/kg
Reference dose–oral (chemical-specific)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)
Reference dose–inhalation (chemical-specific)	(mg/kg-d)	(mg/kg-d)	(mg/kg-d)
Exposed surface area–child	n/a	n/a	2690 cm^2/d
Age-adjusted skin contact factor for carcinogens	n/a	n/a	112,266 mg/kg

Table H-4.1-1 (continued)

Parameter	Industrial Value	Construction Worker Value	Residential Value
Age-adjusted skin contact factor for mutagens	n/a	n/a	166,833 mg/kg
Volatilization factor for soil (chemical-specific)	(m^3/kg)	(m^3/kg)	(m^3/kg)
Body weight–adult	80 kg	80 kg	80 kg
Exposure duration[e]	25 yr	1 yr	30 yr[f]
Adherence factor–adult	0.12 mg/cm^2	0.3 mg/cm^2	0.07 mg/cm^2
Soil ingestion rate–adult	100 mg/d	330 mg/d	100 mg/d
Exposed surface area–adult	3470 cm^2/d	3300 cm^2/d	6032 cm^2/d

Note: Parameter values from NMED (2017, 602273).

[a] ED = Exposure duration.

[b] SVOC = Semivolatile organic compound.

[c] n/a = Not applicable.

[d] The child ED for mutagens is subdivided into 0–2 yr and 2–6 yr.

[e] ED for lifetime resident is 26 yr. For carcinogens, the exposures are combined for child (6 yr) and adult (20 yr).

[f] The adult ED for mutagens is subdivided into 6–16 yr and 16–30 yr.

Table H-4.1-2
Parameter Values Used to Calculate Radionuclide SALs for the Residential Scenario

Parameter	Residential, Child	Residential, Adult
Inhalation rate (m^3/yr)	4712[a]	7780[b]
Mass loading (g/m^3)	1.5 × 10−7[c]	1.5 × 10−7[c]
Outdoor time fraction	0.0926[d]	0.0934[e]
Indoor-time fraction	0.8656[f]	0.8648[g]
Soil ingestion (g/yr)	73[h]	36.5[i]

[a] Calculated as 12.9 m^3/d × 365.25 d/yr, where 12.9 m^3/d is the mean upper percentile daily inhalation rate of a child (EPA 2011, 208374, Table 6-1).

[b] Calculated as 21.3 m^3/d × 365.25 d/yr, where 21.3 m^3/d is the mean upper percentile daily inhalation rate of an adult from 21 to less than 61 yr old (EPA 2011, 208374, Table 6-1).

[c] Calculated as (1 / 6.6 × 10^9 m^3/kg) × 1000 g/kg, where 6.6 × 10^9 m^3/kg is the particulate emission factor (NMED 2015, 600915).

[d] Calculated as (2.32 h/d × 350 d/yr) / 8766 h/yr, where 2.32 h/d (139 min) is the largest amount of time spent outdoors for child age groups between 1 to less than 3 mo and 3 to less than 6 yr (EPA 2011, 208374, Table 16-1) and is comparable with the adult time spent outdoors at a residence.

[e] Calculated as (2.34 h/d × 350 d/yr) / 8766 h/yr, where 4.68 h/d is the average total time spent outdoors for adults age 18 to less than 65 yr in all environments (EPA 2011, 208374, Table 16-1); 50% of this value (2.34 h/d) was applied to time spent outdoors at a residence and is similar to mean time outdoors at a residence for this age group (EPA 2011, 208374, Table 16-22).

[f] Calculated as [(24 h/d–2.32 h/d) × 350 d/yr] / 8766 h/yr.

[g] Calculated as [(24 h/d–2.34 h/d) × 350 d/yr] / 8766 h/yr.

[h] The soil ingestion rate compensates for the time-based occupancy factor applied by RESRAD (LANL 2015, 600929) in calculating exposure from the soil ingestion pathway. Calculated as [0.2 g/d × 350 d/yr]/[indoor + outdoor time fractions], where 0.2 g/d is the upper percentile site-related daily child soil ingestion rate (NMED 2015, 600915; EPA 2011, 208374, Table 5-1).

[i] The soil ingestion rate compensates for the time-based occupancy factor applied by RESRAD (LANL 2015, 600929) in calculating exposure from the soil ingestion pathway. Calculated as [0.1 g/d × 350 d/yr]/[indoor + outdoor time fractions], where 0.1 g/d is the site-related daily adult soil ingestion rate (NMED 2015, 600915).

Table H-4.1-3
Parameter Values Used to Calculate Radionuclide SALs for the Industrial and Construction Worker Scenarios

Parameter	Industrial, Adult	Construction Worker, Adult
Inhalation rate (m^3/yr)	7780[a]	7780[a]
Mass loading (g/m^3)	1.51×10^{-7}[b]	4.76×10^{-7}[c]
Outdoor time fraction	0.2053[d]	0.2282[e]
Indoor time fraction	0[f]	0
Soil ingestion (g/yr)	109.6[g]	362[h]

[a] Calculated as [21.3 m^3/d × 365.25 d/yr], where 21.3 m^3/d is the upper percentile daily inhalation rate of an adult from 21 to less than 61 yr old (EPA 2011, 208374, Table 6-1).

[b] Calculated as (1 / 6.6×10^9 m^3/kg) x 1000 g/kg, where 6.6×10^9 m^3/kg is the particulate emission factor (NMED 2015, 600915).

[c] Calculated as (1 / 2.1×10^6 m^3/kg) x 1000 g/kg, where 2.1×10^6 m^3/kg is the particulate emission factor (NMED 2015, 600915).

[d] 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 and 225 d/yr is the exposure frequency (NMED 2015, 600915).

[e] Calculated as (8 h/d × 250 d/yr) / 8766 h/yr, where 8 h/d is an estimate of the average length of the work day and 250 d/yr is the exposure frequency (NMED 2015, 600915).

[f] The commercial/industrial worker is defined as someone who “spends most of the work day conducting maintenance or manual labor activities outdoors” (NMED 2015, 600915).

[g] The soil-ingestion rate compensates for the time-based occupancy factor applied by RESRAD (LANL 2015, 600929) in calculating exposure from the soil-ingestion pathway. Calculated as [0.1 g/d × 225 d/yr] / [indoor + outdoor time fractions], where 0.1 g/d is the site-related daily adult soil-ingestion rate (NMED 2015, 600915).

[h] The soil-ingestion rate compensates for the time-based occupancy factor applied by RESRAD (LANL 2015, 600929)in calculating exposure from the soil-ingestion pathway. Calculated as [0.33 g/d × 250 d/yr] / [indoor + outdoor time fractions], where 0.33 g/d is the site-related daily adult soil-ingestion rate (NMED 2015, 600915).

Table H-4.2-1
Industrial Carcinogenic Screening Evaluation for SWMU 21-004(b)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	Cancer Risk
Chromium (total)	5.74	505	1.14E-07
Nickel	4.08	2,890,000	1.41E-11
		Total Excess Cancer Risk	**1E-07**

* SSLs from NMED (2017, 602273).

Table H-4.2-2
Industrial Noncarcinogenic Screening Evaluation for SWMU 21-004(b)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	HQ
Antimony	0.978 (U)	519	1.88E-03
Chromium (total)	5.74	314,000	1.83E-05
Copper	5.35 (U)	51,900	1.03E-04
Nickel	4.08	25,700	1.59E-04
Selenium	0.999 (U)	6490	1.54E-04
Diethylphthalate	0.136	733,000	1.86E-07
		HI	**0.002**

* SSLs from NMED (2017, 602273).

Table H-4.2-3
Industrial Radionuclide Screening Evaluation for SWMU 21-004(b)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Dose (mrem/yr)
Cesium-137	0.0376	41	2.29E-02
Plutonium-239/240	0.0625	1200	1.30E-03
Tritium	0.0151	2,400,000	1.57E-07
		Total Dose	**0.02**

* SALs from LANL (2015, 600929).

Table H-4.2-4
Construction Worker Carcinogenic Screening Evaluation for SWMU 21-004(b)

COPC	EPC (mg/kg)	Construction Worker SSL* (mg/kg)	Cancer Risk
Chromium (total)	51.8	468	1.11E-06
Nickel	13	25,000	5.20E-09
Aroclor-1254	0.0459	85.3	5.38E-09
Aroclor-1260	0.0208	85.3	2.44E-09
		Total Excess Cancer Risk	**1E-06**

* SSLs from NMED (2017, 602273).

Table H-4.2-5
Construction Worker Noncarcinogenic Screening Evaluation for SWMU 21-004(b)

COPC	EPC (mg/kg)	Construction Worker SSL* (mg/kg)	HQ
Antimony	0.751	142	5.29E-03
Chromium (total)	51.8	134	3.87E-01
Copper	13 (U)	14,200	9.15E-04
Nickel	13	753	1.73E-02
Selenium	1.01 (U)	1750	5.77E-04
Aroclor-1254	0.0459	4.91	9.35E-03
Diethylphthalate	0.145	215,000	6.74E-07
		HI	**0.4**

* SSLs from NMED (2017, 602273).

Table H-4.2-6
Construction Worker Radionuclide Screening Evaluation for SWMU 21-004(b)

COPC	EPC (pCi/g)	Construction Worker SAL* (pCi/g)	Dose (mrem/yr)
Cesium-137	0.0376	37	2.54E-02
Plutonium-239/240	0.0625	200	7.81E-03
Tritium	0.127	1,600,000	1.98E-06
		Total Dose	**0.03**

* SALs from LANL (2015, 600929).

Table H-4.2-7
Residential Carcinogenic Screening Evaluation for SWMU 21-004(b)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Chromium (total)	51.8	96.6	5.36E-06
Nickel	13	595,000	2.18E-10
Aroclor-1254	0.0459	2.43	1.89E-07
Aroclor-1260	0.0208	2.43	8.56E-08
		Total Excess Cancer Risk	**6E-06**

* SSLs from NMED (2017, 602273).

Table H-4.2-8
Residential Noncarcinogenic Screening Evaluation for SWMU 21-004(b)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	HQ
Antimony	0.751	31.3	2.40E-02
Chromium (total)	51.8	45,200	1.15E-03
Copper	13 (U)	3130	4.15E-03
Nickel	13	1560	8.33E-03
Selenium	1.01 (U)	391	2.58E-03
Aroclor-1254	0.0459	1.14	4.03E-02
Diethylphthalate	0.145	49,300	2.94E-06
		HI	**0.08**

* SSLs from NMED (2017, 602273).

Table H-4.2-9
Residential Radionuclide Screening Evaluation for SWMU 21-004(b)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Dose (mrem/yr)
Cesium-137	0.0376	12	7.83E-02
Plutonium-239/240	0.0625	79	1.98E-02
Tritium	0.127	1700	1.87E-03
		Total Dose	**0.1**

* SALs from LANL (2015, 600929).

Table H-4.2-10
Industrial Carcinogenic Screening Evaluation for SWMU 21-004(c)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	Cancer Risk
Chromium (total)	8.52	505	1.69E-07
Nickel	4.67	2,890,000	1.62E-11
		Total Excess Cancer Risk	**2E-07**

* SSLs from NMED (2017, 602273).

Table H-4.2-11
Industrial Noncarcinogenic Screening Evaluation for SWMU 21-004(c)

COPC	EPC (mg/kg)	Industrial SSL* (mg/kg)	HQ
Antimony	1(U)	519	1.93E-03
Chromium (total)	8.52	314,000	2.71E-05
Copper	7.21 (U)	51,900	1.39E-04
Nickel	4.67	25,700	1.82E-04
Selenium	0.888 (U)	6490	1.37E-04
Silver	1.17	6490	1.80E-04
		HI	**0.003**

* SSLs from NMED (2017, 602273).

Table H-4.2-12
Industrial Radionuclide Screening Evaluation for SWMU 21-004(c)

COPC	EPC (pCi/g)	Industrial SAL* (pCi/g)	Dose (mrem/yr)
Plutonium-239/240	0.0544	1200	1.13E-03
Tritium	0.00776	2,400,000	8.08E-08
		Total Dose	**0.001**

* SALs from LANL (2015, 600929).

Table H-4.2-13
Construction Worker Carcinogenic Screening Evaluation for SWMU 21-004(c)

COPC	EPC (mg/kg)	Construction Worker SSL* (mg/kg)	Cancer Risk
Chromium (total)	40.8	468	8.72E-07
Nickel	7.84	25,000	3.14E-09
Aroclor-1254	0.0015	85.3	1.76E-10
		Total Excess Cancer Risk	**9E-07**

* SSLs from NMED (2017, 602273).

Table H-4.2-14
Construction Worker Noncarcinogenic Screening Evaluation for SWMU 21-004(c)

COPC	EPC (mg/kg)	Construction Worker SSL[a] (mg/kg)	HQ
Antimony	0.446	142	3.14E-03
Chromium (total)	40.8	134	3.04E-01
Copper	7.21 (U)	14,200	5.08E-04
Nickel	7.84	753	1.04E-02
Selenium	0.979 (U)	1750	5.59E-04
Silver	1.17	1770	6.61E-04
Acetone	0.0118	241,000	4.90E-08
Aroclor-1254	0.0015	4.91	3.05E-04
Diethylphthalate	0.103	215,000	4.79E-07
Isopropyltoluene[4-]	0.00117	2710[b]	4.32E-07
		HI	**0.3**

[a] SSLs from NMED (2017, 602273) unless otherwise indicated.

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

Table H-4.2-15
Construction Worker Radionuclide Screening Evaluation for SWMU 21-004(c)

COPC	EPC (pCi/g)	Construction Worker SAL* (pCi/g)	Dose (mrem/yr)
Plutonium-239/240	0.0544	200	6.80E-03
Tritium	0.0265	1,600,000	4.14E-07
		Total Dose	**0.007**

* SALs from LANL (2015, 600929).

Table H-4.2-16
Residential Carcinogenic Screening Evaluation for SWMU 21-004(c)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	Cancer Risk
Chromium (total)	40.8	96.6	4.22E-06
Nickel	7.84	595,000	1.32E-10
Aroclor-1254	0.0015	2.43	6.17E-09
		Total Excess Cancer Risk	**4E-06**

* SSLs from NMED (2017, 602273).

Table H-4.2-17
Residential Noncarcinogenic Screening Evaluation for SWMU 21-004(c)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.446	31.3	1.42E-02
Chromium (total)	40.8	45,200	9.03E-04
Copper	7.21 (U)	3130	2.30E-03
Nickel	7.84	1560	5.03E-03
Selenium	0.979 (U)	391	2.50E-03
Silver	1.17	391	2.99E-03
Acetone	0.0118	66,300	1.78E-07
Aroclor-1254	0.0015	1.14	1.32E-03
Diethylphthalate	0.103	49,300	2.09E-06
Isopropyltoluene[4-]	0.00117	2350[b]	4.98E-07
		HI	**0.03**

[a] SSLs from NMED (2017, 602273) unless otherwise indicated.

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

Table H-4.2-18
Residential Radionuclide Screening Evaluation for SWMU 21-004(c)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Dose (mrem/yr)
Plutonium-239/240	0.0544	79	1.72E-02
Tritium	0.0265	1700	3.90E-04
		Total Dose	**0.02**

* SALs from LANL (2015, 600929).

Table H-4.2-19
Construction Worker Carcinogenic Screening Evaluation for SWMU 21-011(b)

COPC	EPC (mg/kg)	Construction Worker SSL* (mg/kg)	HQ
Chromium (total)	8.64	468	1.85E-07
Nickel	6.2	25,000	2.48E-09
Aroclor-1254	0.0106	85.3	1.24E-09
Bis(2-ethylhexyl)phthalate	2.34	13,400	1.75E-09
Methylene chloride	0.00249	89,300	2.79E-13
		Total Excess Cancer Risk	**2E-07**

* SSLs from NMED (2017, 602273).

Table H-4.2-20
Construction Worker Noncarcinogenic Screening Evaluation for SWMU 21-011(b)

COPC	EPC (mg/kg)	Construction Worker SSL[a] (mg/kg)	HQ
Antimony	0.653	142	4.60E-03
Barium	75.2	4390	1.71E-02
Chromium (total)	8.64	134	6.45E-02
Copper	6.31	14,200	4.44E-04
Cyanide (total)	0.371	12	3.09E-02
Mercury	0.0619	77.1	8.03E-04
Nickel	6.2	753	8.23E-03
Nitrate	3.17	566,000	5.60E-06
Perchlorate	0.00101	248	4.07E-06
Selenium	1.23 (UJ)	1750	7.03E-04
Acetone	0.00337	241,000	1.40E-08
Aroclor-1254	0.0106	4.91	2.16E-03
Bis(2-ethylhexyl)phthalate	2.34	5380	4.35E-04
Diethylphthalate	3.06	215,000	1.42E-05
Hexanone[2-]	0.0939	1760[b]	5.34E-05
Isopropyltoluene[4-]	0.000943	2710[c]	3.48E-07
Methylene chloride	0.00249	1200	2.08E-06
		HI	**0.1**

[a] SSLs from NMED (2017, 602273) unless otherwise indicated.

[b] Construction worker SSL calculated using toxicity value from EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017), and the equation and parameters are from NMED (2017, 602273).

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

Table H-4.2-21
Construction Worker Radionuclide Screening Evaluation for SWMU 21-011(b)

COPC	EPC (pCi/g)	Construction Worker SAL* (pCi/g)	Dose (mrem/yr)
Americium-241	5.26	230	5.72E-01
Cesium-137	0.209	37	1.41E-01
Plutonium-238	0.0299	230	3.25E-03
Plutonium-239/240	212	200	2.65E+01
Tritium	192	1,600,000	3.00E-03
		Total Dose	**30**

* SALs from LANL (2015, 600929).

Table H-4.2-22
Residential Carcinogenic Screening Evaluation for SWMU 21-011(b)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	HQ
Chromium (total)	8.64	96.6	8.94E-07
Nickel	6.2	595,000	1.04E-10
Aroclor-1254	0.0106	2.43	4.36E-08
Bis(2-ethylhexyl)phthalate	2.34	380	6.16E-08
Methylene chloride	0.00249	766	3.25E-11
		Total Excess Cancer Risk	**1E-06**

* SSLs from NMED (2017, 602273).

Table H-4.2-23
Residential Noncarcinogenic Screening Evaluation for SWMU 21-011(b)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	0.653	31.3	2.09E-02
Barium	75.2	15,600	4.82E-03
Chromium (total)	8.64	45,200	1.91E-04
Copper	6.31	3130	2.02E-03
Cyanide (total)	0.371	11.1	3.34E-02
Mercury	0.0619	23.5	2.63E-03
Nickel	6.2	1560	3.97E-03
Nitrate	3.17	125,000	2.54E-05
Perchlorate	0.00101	54.8	1.84E-05
Selenium	1.23 (UJ)	391	3.15E-03
Acetone	0.00337	66,300	5.08E-08
Aroclor-1254	0.0106	1.14	9.30E-03
Bis(2-ethylhexyl)phthalate	2.34	1230	1.90E-03
Diethylphthalate	3.06	49,300	6.21E-05
Hexanone[2-]	0.0939	200[b]	4.70E-04
Isopropyltoluene[4-]	0.000943	2350[c]	4.01E-07
Methylene chloride	0.00249	409	6.09E-06
		HI	**0.08**

[a] SSLs from NMED (2017, 602273) unless otherwise indicated.

[b] SSL from EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).

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

Table H-4.2-24
Residential Radionuclide Screening Evaluation for SWMU 21-011(b)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Dose (mrem/yr)
Americium-241	5.26	83	1.58E+00
Cesium-137	0.209	12	4.35E-01
Plutonium-238	0.0299	84	8.90E-03
Plutonium-239/240	212	79	6.71E+01
Tritium	192	1700	2.82E+00
		Total Dose	**70**

* SALs from LANL (2015, 600929).

Table H-4.2-25
Construction Worker Carcinogenic Screening Evaluation for AOC 21-028(d)

COPC	EPC (mg/kg)	Construction Worker SSL* (mg/kg)	HQ
Chromium (total)	22.4	468	4.79E-07
Nickel	7.31	25,000	2.92E-09
Aroclor-1242	0.17	85.3	1.99E-08
Aroclor-1254	0.058	85.3	6.80E-09
Aroclor-1260	0.0265	85.3	3.11E-09
Benzo(a)anthracene	19.8	240	8.25E-07
Benzo(a)pyrene	17.5	173	1.01E-06
Benzo(b)fluoranthene	17.7	240	7.38E-07
Benzo(k)fluoranthene	6.54	2310	2.83E-08
Bis(2-ethylhexyl)phthalate	0.222	13,400	1.66E-10
Chrysene	23.2	23,100	1.00E-08
Dibenz(a,h)anthracene	0.903	24	3.76E-07
Ethylbenzene	0.000607	1760	3.45E-12
Indeno(1,2,3-cd)pyrene	7.3	240	3.04E-07
Methylene chloride	0.00252	89,300	2.82E-13
		Total Excess Cancer Risk	**4E-06**

* SSLs from NMED (2017, 602273).

Table H-4.2-26
Construction Worker Noncarcinogenic Screening Evaluation for AOC 21-028(d)

COPC	EPC (mg/kg)	Construction Worker SSL[a] (mg/kg)	HQ
Antimony	1.6	142	1.13E-02
Chromium (total)	22.4	134	1.67E-01
Copper	9.26	14,200	6.52E-04
Nickel	7.31	753	9.71E-03
Perchlorate	0.0831	248	3.35E-04
Selenium	0.679	1750	3.88E-04
Zinc	52.5	106,000	4.95E-04
Acenaphthene	11.3	15,100	7.48E-04
Acetone	0.00625	241,000	2.59E-08
Anthracene	23.2	75,300	3.08E-04
Aroclor-1254	0.058	4.91	1.18E-02
Benzo(a)pyrene	17.5	106	1.65E-01
Benzo(g,h,i)perylene	6.63	7530[b]	8.80E-04
Bis(2-ethylhexyl)phthalate	0.222	5380	4.13E-05
Dibenzofuran	4.93	354[c]	1.39E-02
Diethylphthalate	0.284	215,000	1.32E-06
Ethylbenzene	0.000607	5750	1.06E-07
Fluoranthene	57.5	10,000	5.75E-03
Fluorene	7.34	10,000	7.34E-04
Methylene chloride	0.00252	1200	2.10E-06
Methylnaphthalene[2-]	3.12	1000	3.12E-03
Naphthalene	16.3	5020	3.25E-03
Phenanthrene	77.4	7530	1.03E-02
Pyrene	52.2	7530	6.93E-03
Toluene	0.000883	14,000	6.31E-08
Trimethylbenzene[1,2,4-]	0.00162	329[c]	4.92E-06
Xylene[1,2-]	0.000486	729	6.67E-07
Xylene[1,3-]+xylene[1,4-]	0.00115	791[d]	1.13E-02
		HI	**0.4**

[a] SSLs from NMED (2017, 602273) unless otherwise indicated.

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

[c] Construction worker SSLs calculated using toxicity values from EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017), and the equation and parameters are from NMED (2017, 602273).

[d] Xylenes used as a surrogate based on structural similarity.

Table H-4.2-27
Construction Worker Radionuclide Screening Evaluation for AOC 21-028(d)

COPC	EPC (pCi/g)	Construction Worker SAL* (pCi/g)	Dose (mrem/yr)
Tritium	31.3	1,600,000	4.89E-04
		Total Dose	**0.0005**

* SALs from LANL (2015, 600929).

Table H-4.2-28
Residential Carcinogenic Screening Evaluation for AOC 21-028(d)

COPC	EPC (mg/kg)	Residential SSL* (mg/kg)	HQ
Chromium (total)	22.4	96.6	2.32E-06
Nickel	7.31	595,000	1.23E-10
Aroclor-1242	0.17	2.43	7.00E-07
Aroclor-1254	0.058	2.43	2.39E-07
Aroclor-1260	0.0265	2.43	1.09E-07
Benzo(a)anthracene	19.8	1.53	1.29E-04
Benzo(a)pyrene	17.5	1.12	1.56E-04
Benzo(b)fluoranthene	17.7	1.53	1.16E-04
Benzo(k)fluoranthene	6.54	15.3	4.27E-06
Bis(2-ethylhexyl)phthalate	0.222	380	5.84E-09
Chrysene	23.2	153	1.52E-06
Dibenz(a,h)anthracene	0.903	0.15	6.02E-05
Ethylbenzene	0.000607	74.5	8.15E-11
Indeno(1,2,3-cd)pyrene	7.3	1.53	4.77E-05
Methylene chloride	0.00252	766	3.29E-11
		Total Excess Cancer Risk	**5E-04**

* SSLs from NMED (2017, 602273).

Table H-4.2-29
Residential Noncarcinogenic Screening Evaluation for AOC 21-028(d)

COPC	EPC (mg/kg)	Residential SSL[a] (mg/kg)	HQ
Antimony	1.6	31.3	5.11E-02
Chromium (total)	22.4	45,200	4.96E-04
Copper	9.26	3130	2.96E-03
Nickel	7.31	1560	4.69E-03
Perchlorate	0.0831	54.8	1.52E-03
Selenium	0.679	391	1.74E-03
Zinc	52.5	23,500	2.23E-03
Acenaphthene	11.3	3480	3.25E-03
Acetone	0.00625	66,300	9.43E-08
Anthracene	23.2	17,400	1.33E-03
Aroclor-1254	0.058	1.14	5.09E-02
Benzo(g,h,i)perylene	6.63	1740[b]	3.81E-03
Bis(2-ethylhexyl)phthalate	0.222	1230	1.80E-04
Dibenzofuran	4.93	73[c]	6.75E-02
Diethylphthalate	0.284	49,300	5.76E-06
Ethylbenzene	0.000607	3920	1.55E-07
Fluoranthene	57.5	2320	2.48E-02
Fluorene	7.34	2320	3.16E-03
Methylene chloride	0.00252	409	6.16E-06
Methylnaphthalene[2-]	3.12	232	1.34E-02
Naphthalene	16.3	1160	1.41E-02
Phenanthrene	77.4	1740	4.45E-02
Pyrene	52.2	1740	3.00E-02
Toluene	0.000883	5220	1.69E-07
Trimethylbenzene[1,2,4-]	0.00162	300[c]	5.40E-06
Xylene[1,2-]	0.000486	798	6.09E-07
Xylene[1,3-]+xylene[1,4-]	0.00115	863[d]	1.33E-06
		HI	**0.3**

[a] SSLs from NMED (2017, 602273) unless otherwise indicated.

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

[c] Construction worker SSLs calculated using toxicity values from EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017), and the equation and parameters are from NMED (2017, 602273).

[d] Xylenes used as a surrogate based on structural similarity.

Table H-4.2-30
Residential Radionuclide Screening Evaluation for AOC 21-028(d)

COPC	EPC (pCi/g)	Residential SAL* (pCi/g)	Dose (mrem/yr)
Tritium	31.3	1700	4.60E-01
		Total Dose	**0.5**

* SALs from LANL (2015, 600929).

Table H-4.4-1
Essential Nutrient Screening Assessment

SWMU / AOC	Scenario	COPC	Maximum Concentration (mg/kg)	SSL (mg/kg)*	Ratio
SWMU 21-004(b)	Industrial worker	Calcium	16,200	40,600,000	0.00040
SWMU 21-004(b)	Construction worker	Calcium	16,200	11,100,000	0.0015
SWMU 21-004(b)	Resident	Calcium	16,200	13,000,000	0.0013
SWMU 21-011(b)	Construction worker	Calcium	10,600	11,100,000	0.00095
SWMU 21-011(b)	Resident	Calcium	10,600	13,000,000	0.00082
AOC 21-028(d)	Construction worker	Calcium	21,900	11,100,000	0.0020
AOC 21-028(d)	Resident	Calcium	21,900	13,000,000	0.0017

* SSLs from NMED (2017, 602273).

Table H-5.2-1
Ecological Screening Levels for Terrestrial Receptors

COPEC	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Deer Mouse (mammalian omnivore)	Montane Shrew (mammalian insectivore)	Earthworm (soil-dwelling invertebrate)	Generic Plant (terrestrial autotroph-producer)
Inorganic Chemicals (mg/kg)											
Antimony	46	na*	na	na	na	na	2.7	2.3	7.9	78	11
Barium	41,000	24,000	7500	720	770	820	2900	1800	2100	330	110
Chromium (total)	1800	860	170	51	32	23	410	110	63	na	na
Copper	4000	1100	80	34	20	14	260	63	42	80	70
Cyanide (total)	3300	0.59	0.36	0.1	0.099	0.098	790	330	330	na	na
Lead	3700	540	83	18	14	11	310	120	93	1700	120
Mercury	76	0.32	0.058	0.067	0.022	0.013	23	3	1.7	0.05	34
Nickel	1200	2000	110	120	35	20	270	20	10	280	38
Perchlorate	3.3	2	3.9	0.12	0.24	31	0.26	0.21	31	3.5	40
Selenium	92	74	3.7	0.98	0.83	0.71	2.2	0.82	0.7	4.1	0.52
Silver	4400	600	13	10	4.1	2.6	150	24	14	na	560
Zinc	9600	2600	220	330	83	47	1800	170	99	120	160
Organic Chemicals (mg/kg)											
Acenaphthene	29,000	na	na	na	na	na	530	160	130	na	0.25
Acetone	7800	66,000	840	7.5	14	170	1.6	1.2	15	na	na
Anthracene	38,000	na	na	na	na	na	1200	300	210	na	6.8
Aroclor-1242	100	6.2	0.19	0.92	0.078	0.041	27	0.75	0.39	na	na
Aroclor-1254	7.2	7.6	0.19	1.1	0.079	0.041	44	0.87	0.45	na	160
Aroclor-1260	15	400	4.2	37	1.7	0.88	1800	20	10	na	na
Benzo(a)anthracene	110	28	6.4	0.73	0.8	0.88	6.1	3.4	4	na	18

Table H-5.2-1 (cont.)

COPEC	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Deer Mouse (mammalian omnivore)	Montane Shrew (mammalian insectivore)	Earthworm (soil-dwelling invertebrate)	Generic Plant (terrestrial autotroph-producer)
Benzo(a)pyrene	3400	na	na	na	na	na	260	62	84	na	na
Benzo(b)fluoranthene	2400	na	na	na	na	na	130	44	51	na	18
Benzo(g,h,i)perylene	3600	na	na	na	na	na	470	25	46	na	na
Benzo(k)fluoranthene	4300	na	na	na	na	na	330	71	99	na	na
Bis(2-ethylhexyl)phthalate	500	9.3	0.096	16	0.04	0.02	1900	0.6	1.1	na	na
Chrysene	110	na	na	na	na	na	6.3	3.1	3.1	na	na
Dibenz(a,h)anthracene	850	na	na	na	na	na	84	14	22	na	na
Dibenzofuran	na	na	na	na	na	na	na	na	na	na	6.1
Diethylphthalate	2,500,000	na	na	na	na	na	8800	3600	3600	na	100
Fluoranthene	3900	na	na	na	na	na	270	22	38	10	na
Fluorene	50,000	na	na	na	na	na	1100	250	340	3.7	na
Hexanone[2-]	5900	290	1.7	0.47	0.41	0.36	17	5.4	6.1	na	na
Indeno(1,2,3-cd)pyrene	4600	na	na	na	na	na	510	71	110	na	na
Methylene chloride	4300	na	na	na	na	na	3.8	9.2	2.6	na	1600
Methylnaphthalene[2-]	4900	na	na	na	na	na	110	16	24	na	na
Naphthalene	5800	2100	78	3.4	5.7	15	14	28	9.6	na	1
Phenanthrene	1900	na	na	na	na	na	62	11	15	5.5	na
Pyrene	3100	3000	160	68	44	33	110	23	31	10	na
Toluene	12,000	na	na	na	na	na	66	23	25	na	200
Xylene[1,3-]+xylene[1,4-]	750	13,000	190	89	56	41	7.6	1.4	1.9	na	100

Table H-5.2-1 (cont.)

COPEC	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Generic Plant (terrestrial autotroph-producer)
Radionuclides (pCi/g)											
Americium-241	26,000	57,000	43,000	4600	6100	10,000	26,000	33,000	34,000	190	500
Cesium-137	1500	3700	4200	1400	2600	4500	1700	2300	2400	2300	1500
Plutonium-238	45,000	110,000	100,000	4300	5900	10,000	75,000	170,000	190,000	820	1800
Plutonium-239/240	51,000	130,000	120,000	4400	6100	10,000	94,000	280,000	320,000	870	1900
Tritium	240,000	550,000	610,000	300,000	440,000	600,000	270,000	330,000	340,000	48,000	36,000

*na = Not available.

Table H-5.2-2
Minimum ESL Comparison for SWMU 21-004(b)

COPC	EPC (mg/kg)	ESL (mg/kg)	Receptor	HQ
Inorganic Chemicals (mg/kg)				
Antimony	0.62	2.3	Deer mouse	0.27
Chromium (total)	43.1	23	Robin (insectivore)	**1.87**
Copper	10.5 (U)	14	Robin (insectivore)	**0.75**
Nickel	12.9	10	Shrew	**1.29**
Selenium	1 (U)	0.52	Plant	**1.92**
Organic Chemicals (mg/kg)				
Diethylphthalate	0.142	100	Plant	0.0014
Radionuclides (pCi/g)				
Cesium-137	0.0376	1400	Robin (herbivore)	0.000027
Plutonium-239/240	0.0625	870	Earthworm	0.000072
Tritium	0.022	36,000	Plant	0.00000061

Notes: Bolded values indicate HQs greater than 0.3. Data qualifiers are defined in Appendix A.

Table H-5.2-3
HI Analysis for SWMU 21-004(b)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Chromium (total)	43.1	0.024	0.05	0.25	**0.85**	**1.35**	**1.87**	0.11	**0.68**	**0.39**	na*	na
Copper	10.5 (U)	0.0026	9.5E-03	0.13	**0.31**	**0.53**	**0.75**	0.04	0.25	0.17	0.13	0.15
Nickel	12.9	0.011	6.5E-03	0.12	0.11	**0.37**	**0.65**	0.048	**1.29**	**0.65**	0.046	**0.34**
Selenium	1 (U)	0.011	0.014	0.27	**1.02**	**1.2**	**1.41**	**0.45**	**1.43**	**1.22**	0.24	**1.92**
HI		0.05	0.08	0.8	**2**	**3**	**5**	0.6	**4**	**2**	0.4	**2**

Note: Bolded values indicate HQs greater than 0.3 or HI greater than 1.

*na = Not available.

Table H-5.2-4
Minimum ESL Comparison for SWMU 21-004(c)

COPC	EPC (mg/kg)	ESL (mg/kg)	Receptor	HQ
Inorganic Chemicals (mg/kg)				
Antimony	1 (U)	2.3	Deer mouse	**0.43**
Chromium (total)	40.8	23	Robin (insectivore)	**1.77**
Copper	7.21 (U)	14	Robin (insectivore)	**0.52**
Nickel	7.5	10	Shrew	**0.75**
Selenium	0.96 (U)	0.52	Plant	**1.85**
Silver	1.17	2.6	Robin (insectivore)	**0.45**
Organic Chemicals (mg/kg)				
Acetone	0.0046	1.2	Deer mouse	0.0038
Radionuclides (pCi/g)				
Plutonium-239/240	0.0544	870	Earthworm	0.000063
Tritium	0.0237	36000	Plant	0.00000066

Notes: Bolded values indicate HQs greater than 0.3. Data qualifiers are defined in Appendix A.

Table H-5.2-5
HI Analysis for SWMU 21-004(c)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	1 (U)	0.022	na*	na	na	na	na	**0.37**	0.13	**0.43**	0.013	0.091
Chromium (total)	40.8	0.023	0.047	0.24	**0.8**	**1.28**	**1.77**	0.1	**0.65**	**0.37**	na	na
Copper	7.21 (U)	1.8E-03	6.6E-03	0.09	0.21	**0.36**	**0.52**	0.028	0.17	0.11	0.09	0.1
Nickel	7.5	6.3E-03	3.8E-03	0.068	0.063	0.21	**0.38**	0.028	**0.75**	**0.38**	0.027	0.2
Selenium	0.96 (U)	0.01	0.013	0.26	**0.98**	**1.16**	**1.35**	**0.44**	**1.37**	**1.17**	0.23	**1.85**
Silver	1.17	2.7E-04	2.0E-03	0.09	0.12	0.29	**0.45**	7.8E-03	0.084	0.049	na	2.1E-03
HI		0.06	0.07	0.7	**2**	**3**	**4**	1	**3**	**3**	0.4	**2**

Notes: Bolded values indicate HQs greater than 0.3 or HI greater than 1. Data qualifiers are defined in Appendix A.

*na = Not available.

Table H-5.2-6
Minimum ESL Comparison for SWMU 21-011(b)

COPC	EPC (mg/kg)	ESL (mg/kg)	Receptor	HQ
Inorganic Chemicals (mg/kg)				
Antimony	1.2 (U)	2.3	Deer mouse	**0.52**
Barium	87.9	110	Plant	**0.8**
Chromium (total)	8.17	23	Robin (insectivore)	**0.36**
Copper	8.23	14	Robin (insectivore)	**0.59**
Cyanide (total)	0.186	0.098	Robin (insectivore)	**1.9**
Mercury	0.106	0.013	Robin (insectivore)	**8.15**
Nickel	6.06	10	Shrew	**0.61**
Perchlorate	0.00122	0.12	Robin (herbivore)	0.01
Selenium	1.2 (U)	0.52	Plant	**2.31**
Organic Chemicals (mg/kg)				
Aroclor-1254	0.0106	0.041	Robin (insectivore)	0.26
Bis(2-ethylhexyl)phthalate	2.34	0.02	Robin (insectivore)	**117**
Radionuclides (pCi/g)				
Americium-241	0.0289	190	Earthworm	0.00015
Cesium-137	0.209	1400	Robin (herbivore)	0.00015
Plutonium-238	0.0299	820	Earthworm	0.000036
Plutonium-239/240	2.31	870	Earthworm	0.0027
Tritium	576	36,000	Plant	0.016

Notes: Bolded values indicate HQs greater than 0.3. Data qualifiers are defined in Appendix A.

Table H-5.2-7
HI Analysis for SWMU 21-011(b)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	1.2 (U)	0.026	na*	na	na	na	na	**0.44**	0.15	**0.52**	0.015	0.11
Barium	87.9	2.1E-03	3.7E-03	0.012	0.12	0.11	0.11	0.03	0.042	0.049	0.27	**0.8**
Chromium (total)	8.17	4.5E-03	9.5E-03	0.048	0.16	0.26	**0.36**	0.02	0.13	0.074	na	na
Copper	8.23	2.1E-03	7.5E-03	0.1	0.24	**0.41**	**0.59**	0.032	0.2	0.13	0.1	0.12
Cyanide (total)	0.186	5.6E-05	**0.32**	**0.52**	**1.86**	**1.88**	**1.9**	2.4E-04	5.6E-04	5.6E-04	na	na
Mercury	0.106	1.4E-03	**0.33**	**1.83**	**1.58**	**4.82**	**8.15**	4.6E-03	0.062	0.035	**2.12**	3.1E-03
Nickel	6.06	5.1E-03	3.0E-03	0.055	0.051	0.17	0.3	0.022	**0.61**	0.3	0.022	0.16
Selenium	1.2 (U)	0.013	0.016	**0.32**	**1.22**	**1.45**	**1.69**	**0.55**	**1.71**	**1.46**	0.29	**2.31**
Bis(2-ethylhexyl)phthalate	2.34	4.7E-03	0.25	**24.4**	0.15	**58.5**	**117**	1.2E-03	**3.9**	**2.13**	na	na
HI		0.06	0.9	**27**	**5**	**68**	**130**	1	**7**	**5**	**3**	**4**

Note: Bolded values indicate HQs greater than 0.3 or HI greater than 1.

*na = Not available.

Table H-5.2-8
Minimum ESL Comparison for AOC 21-028(d)

COPC	EPC (mg/kg)	ESL (mg/kg)	Receptor	HQ
Inorganic Chemicals (mg/kg)				
Antimony	1.6	2.3	Deer mouse	**0.7**
Chromium (total)	37.8	23	Robin (insectivore)	**1.64**
Copper	14.8	14	Robin (insectivore)	**1.06**
Nickel	6.08	10	Shrew	**0.61**
Perchlorate	0.0831	0.12	Robin (herbivore)	**0.69**
Selenium	1.04 (U)	0.52	Plant	**2**
Zinc	120	47	Robin (insectivore)	**2.55**
Organic Chemicals (mg/kg)				
Acenaphthene	13	0.25	Plant	**52**
Acetone	0.00415	1.2	Deer mouse	0.0035
Anthracene	24	6.8	Plant	**3.53**
Aroclor-1242	0.17	0.041	Robin (insectivore)	**4.15**
Aroclor-1254	0.177	0.041	Robin (insectivore)	**4.32**
Aroclor-1260	0.0265	0.88	Robin (insectivore)	0.03
Benzo(a)anthracene	22.8	0.73	Robin (herbivore)	**31.2**
Benzo(a)pyrene	19.1	62	Shrew	**0.31**
Benzo(b)fluoranthene	21.8	18	Plant	**1.21**
Benzo(g,h,i)perylene	9.09	25	Shrew	**0.36**
Benzo(k)fluoranthene	8.21	71	Shrew	0.12
Bis(2-ethylhexyl)phthalate	0.222	0.02	Robin (insectivore)	**11.1**
Chrysene	24.3	3.1	Shrew	**7.84**
Dibenz(a,h)anthracene	3.21	14	Shrew	0.23
Dibenzofuran	9.9	6.1	Plant	**1.62**
Fluoranthene	69.2	10	Earthworm	**6.92**
Fluorene	15.4	3.7	Earthworm	**4.16**
Indeno(1,2,3-cd)pyrene	9.29	71	Shrew	0.13
Methylene chloride	0.00252	2.6	Deer mouse	0.00097
Methylnaphthalene[2-]	7.06	16	Shrew	**0.44**
Naphthalene	32.5	1	Plant	**32.5**
Phenanthrene	83.6	5.5	Earthworm	**15.2**
Pyrene	61.9	10	Earthworm	**6.19**
Toluene	0.000883	23	Shrew	0.000038
Xylene[1,3-]+xylene[1,4-]	0.00115	1.4	Shrew	0.00082
Radionuclides (pCi/g)				
Tritium	61.7	36,000	Plant	0.0017

Notes: Bolded values indicate HQs greater than 0.3. Data qualifiers are defined in Appendix A.

Table H-5.2-9
HI Analysis for AOC 21-028(d)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	1.6	0.035	na*	na	na	na	na	**0.59**	0.2	**0.7**	0.021	0.15
Chromium (total)	37.8	0.021	0.044	0.22	**0.74**	**1.18**	**1.64**	0.092	**0.6**	**0.34**	na	na
Copper	14.8	3.7E-03	0.013	0.19	**0.44**	**0.74**	**1.06**	0.057	**0.35**	0.23	0.19	0.21
Nickel	6.08	5.1E-03	3.0E-03	0.055	0.051	0.17	0.3	0.023	**0.61**	0.3	0.022	0.16
Perchlorate	0.0831	0.025	0.042	0.021	**0.69**	**0.35**	2.7E-03	**0.32**	2.7E-03	**0.4**	0.024	2.1E-03
Selenium	1.04 (U)	0.011	0.014	0.28	**1.06**	**1.25**	**1.46**	**0.47**	**1.49**	**1.27**	0.25	**2**
Zinc	120	0.013	0.046	**0.55**	**0.36**	**1.45**	**2.55**	0.067	**1.21**	**0.71**	**1**	**0.75**
Acenaphthene	13	4.5E-04	na	na	na	na	na	0.025	0.1	0.081	na	**52**
Anthracene	24	6.3E-04	na	na	na	na	na	0.02	0.11	0.08	na	**3.53**
Aroclor-1242	0.17	1.7E-03	0.027	**0.89**	0.18	**2.18**	**4.15**	6.3E-03	**0.44**	0.23	na	na
Aroclor-1254	0.177	0.025	0.023	**0.93**	0.16	**2.24**	**4.32**	4.0E-03	**0.39**	0.2	na	1.1E-03
Benzo(a)anthracene	22.8	0.21	**0.81**	**3.56**	**31.2**	**28.5**	**25.9**	**3.74**	**5.7**	**6.71**	na	**1.27**
Benzo(a)pyrene	19.1	5.6E-03	na	na	na	na	na	0.073	**0.31**	0.23	na	na
Benzo(b)fluoranthene	21.8	9.1E-03	na	na	na	na	na	0.17	**0.5**	**0.43**	na	**1.21**
Benzo(g,h,i)perylene	9.09	2.5E-03	na	na	na	na	na	0.019	**0.36**	0.2	na	na
Bis(2-ethylhexyl)phthalate	0.222	4.4E-04	0.024	**2.31**	0.014	**5.55**	**11.1**	1.2E-04	**0.37**	0.2	na	na
Chrysene	24.3	0.22	na	na	na	na	na	**3.86**	**7.84**	**7.84**	na	na
Dibenzofuran	9.9	na	na	na	na	na	na	na	na	na	na	**1.62**
Fluoranthene	69.2	0.018	na	na	na	na	na	0.26	**3.15**	**1.82**	**6.92**	na

Table H-5.2-9 (continued)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Fluorene	15.4	3.1E-04	na	na	na	na	na	0.014	0.062	0.045	**4.16**	na
Methylnaphthalene[2-]	7.06	1.4E-03	na	na	na	na	na	0.064	**0.44**	0.29	na	na
Naphthalene	32.5	5.6E-03	0.015	**0.42**	**9.56**	**5.7**	**2.17**	**2.32**	**1.16**	**3.39**	na	**32.5**
Phenanthrene	83.6	0.044	na	na	na	na	na	**1.35**	**7.6**	**5.57**	**15.2**	na
Pyrene	61.9	0.02	0.021	**0.39**	**0.91**	**1.41**	**1.88**	**0.56**	**2.69**	**2**	**6.19**	na
HI		0.7	1	**10**	**45**	**51**	**57**	**14**	**36**	**33**	**34**	**95**

Note: Bolded values indicate HQs greater than 0.3 or HI greater than 1.

*na = Not available.

Table H-5.3-1
Mexican Spotted Owl AUFs for DP Site Aggregate Area

Site	Site Area (ha)	AUF*
SWMU 21-004(b)	0.00697	0.000019
SWMU 21-004(c)	0.00697	0.000019
SWMU 21-011(b)	0.109	0.000299
AOC 21-028(d)	0.00584	0.000016

*AUF is calculated as the area of the site divided by the owl HR of 366 ha.

Table H-5.3-2
PAUFs for Ecological Receptors for SWMU 21-004(b)

Receptor	HR (ha)[a]	Population Area (ha)	PAUF[b]
American Kestrel	106	4240	1.64E-06
American Robin	0.42	16.8	4.15E-04
Deer Mouse	0.077	3	2.32E-03
Cottontail	3.1	124	5.62E-05
Montane Shrew	0.39	15.6	4.47E-04
Fox	1038	41,520	1.68E-07

[a] Values from EPA (1993, 059384).

[b] PAUF is calculated as the area of the site (0.00697 ha) divided by the population area.

Table H-5.3-3
Adjusted HIs for SWMU 21-004(b)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Chromium (total)	43.1	4.0E-09	8.2E-08	4.2E-07	3.5E-04	5.6E-04	7.8E-04	5.9E-06	3.1E-04	9.1E-04	na*	na
Copper	10.5 (U)	4.4E-10	1.6E-08	2.2E-07	1.3E-04	2.2E-04	3.1E-04	2.3E-06	1.1E-04	3.9E-04	0.13	0.15
Nickel	12.9	1.8E-09	1.1E-08	1.9E-07	4.5E-05	1.5E-04	2.7E-04	2.7E-06	5.8E-04	1.5E-03	0.046	**0.34**
Selenium	1 (U)	1.8E-09	2.2E-08	4.4E-07	4.2E-04	5.0E-04	5.8E-04	2.6E-05	6.4E-04	2.8E-03	0.24	**1.92**
Adjusted HI		8E-09	1E-07	1E-06	9E-04	0.001	0.002	4E-05	0.002	0.006	0.4	**2**

Note: Bolded values indicate HQs greater than 0.1 or HI greater than 1.

*na = Not available.

Table H-5.3-4
PAUFs for Ecological Receptors for SWMU 21-004(c)

Receptor	HR (ha)[a]	Population Area (ha)	PAUF[b]
American Kestrel	106	4240	1.64E-06
American Robin	0.42	16.8	4.15E-04
Deer Mouse	0.077	3	2.32E-03
Cottontail	3.1	124	5.62E-05
Montane Shrew	0.39	15.6	4.47E-04
Fox	1038	41,520	1.68E-07

[a] Values from EPA (1993, 059384).

[b] PAUF is calculated as the area of the site (0.00697 ha) divided by the population area.

Table H-5.3-5
Adjusted HIs for SWMU 21-004(c)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	1(U)	3.6E-09	na*	na	na	na	na	2.1E-05	5.7E-05	1.0E-03	0.013	0.091
Chromium (total)	40.8	3.8E-09	7.8E-08	3.9E-07	3.3E-04	5.3E-04	7.4E-04	5.6E-06	2.9E-04	8.6E-04	na	na
Copper	7.21(U)	3.0E-10	1.1E-08	1.5E-07	8.8E-05	1.5E-04	2.1E-04	1.6E-06	7.7E-05	2.7E-04	0.09	0.1
Nickel	7.5	1.0E-09	6.2E-09	1.1E-07	2.6E-05	8.9E-05	1.6E-04	1.6E-06	3.3E-04	8.7E-04	0.027	0.2
Selenium	0.96(U)	1.8E-09	2.1E-08	4.3E-07	4.1E-04	4.8E-04	5.6E-04	2.5E-05	6.1E-04	2.7E-03	0.23	**1.85**
Silver	1.17	4.5E-11	3.2E-09	1.5E-07	4.9E-05	1.2E-04	1.9E-04	4.4E-07	3.7E-05	1.1E-04	na	2.1E-03
Adjusted HI		1.E-08	1.E-07	1.E-06	9.E-04	0.001	0.002	6.E-05	0.001	0.006	0.4	**2**

Note: Bolded values indicate HQs greater than 0.1 or HI greater than 1.

*na = Not available.

Table H-5.3-6
PAUFs for Ecological Receptors for SWMU 21-011(b)

Receptor	HR (ha)[a]	Population Area (ha)	PAUF[b]
American Kestrel	106	4240	2.57E-05
American Robin	0.42	16.8	6.49E-03
Deer Mouse	0.077	3	3.63E-02
Cottontail	3.1	124	8.79E-04
Montane Shrew	0.39	15.6	6.99E-03
Fox	1038	41,520	2.63E-06

[a] Values from EPA (1993, 059384).

[b] PAUF is calculated as the area of the site (0.109 ha) divided by the population area.

Table H-5.3-7
Adjusted HIs for SWMU 21-011(b)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian Top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	1.2(U)	6.9E-08	na*	na	na	na	na	3.9E-04	1.1E-03	0.019	0.015	0.11
Barium	87.9	5.6E-09	9.4E-08	3.0E-07	7.9E-04	7.4E-04	7.0E-04	2.7E-05	2.9E-04	1.8E-03	0.27	**0.8**
Chromium (total)	8.17	1.2E-08	2.4E-07	1.2E-06	1.0E-03	1.7E-03	2.3E-03	1.8E-05	9.1E-04	2.7E-03	na	na
Copper	8.23	5.4E-09	1.9E-07	2.7E-06	1.6E-03	2.7E-03	3.8E-03	2.8E-05	1.4E-03	4.8E-03	0.1	0.12
Cyanide (total)	0.186	1.5E-10	8.1E-06	1.3E-05	0.012	0.012	0.012	2.1E-07	3.9E-06	2.1E-05	na	na
Mercury	0.106	3.7E-09	8.5E-06	4.7E-05	0.01	0.031	0.053	4.1E-06	4.4E-04	1.3E-03	**2.12**	3.1E-03
Nickel	6.06	1.3E-08	7.8E-08	1.4E-06	3.3E-04	1.1E-03	2.0E-03	2.0E-05	4.2E-03	0.011	0.022	0.16
Selenium	1.2(U)	3.4E-08	4.2E-07	8.4E-06	8.0E-03	9.4E-03	0.011	4.8E-04	0.012	0.053	0.29	**2.31**
Bis(2-ethylhexyl)phthalate	2.34	1.2E-08	6.5E-06	6.3E-04	9.5E-04	**0.38**	**0.76**	1.1E-06	0.027	0.077	na	na
Adjusted HI		2.E-07	2.E-05	7.E-04	0.03	0.4	0.8	0.001	0.05	0.2	**3**	**4**

Note: Bolded values indicate HQs greater than 0.1 or HI greater than 1.

*na = Not available.

Table H-5.3-8
PAUFs for Ecological Receptors for AOC 21-028(d)

Receptor	HR (ha)[a]	Population Area (ha)	PAUF[b]
American Kestrel	106	4240	1.38E-06
American Robin	0.42	16.8	3.48E-04
Deer Mouse	0.077	3	1.95E-03
Cottontail	3.1	124	4.71E-05
Montane Shrew	0.39	15.6	3.74E-04
Fox	1038	41,520	1.41E-07

[a] Values from EPA (1993, 059384).

[b] PAUF is calculated as the area of the site (0.00584 ha) divided by the population area.

Table H-5.3-9
Adjusted HIs for AOC 21-028(d)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Antimony	1.6	4.9E-09	na*	na	na	na	na	2.8E-05	7.6E-05	1.4E-03	0.021	0.15
Chromium (total)	37.8	3.0E-09	6.1E-08	3.1E-07	2.6E-04	4.1E-04	5.7E-04	4.3E-06	2.2E-04	6.7E-04	na	na
Copper	14.8	5.2E-08	1.9E-08	2.6E-07	1.5E-04	2.6E-04	3.7E-04	2.7E-06	1.3E-04	4.6E-04	0.19	0.21
Nickel	6.08	7.1E-08	4.2E-09	7.6E-08	1.8E-05	6.0E-05	1.1E-04	1.1E-06	2.3E-04	5.9E-04	0.022	0.16
Perchlorate	0.0831	3.5E-09	5.7E-08	2.9E-08	2.4E-04	1.2E-04	9.3E-07	1.5E-05	1.0E-06	7.7E-04	0.024	2.1E-03
Selenium	1.04(U)	1.6E-09	1.9E-08	3.9E-07	3.7E-04	4.4E-04	5.1E-04	2.2E-05	5.6E-04	2.5E-03	0.25	**2**
Zinc	120	1.8E-09	6.4E-08	7.5E-07	1.3E-04	5.0E-04	8.9E-04	3.1E-06	4.5E-04	1.4E-03	**1**	**0.75**
Acenaphthene	13	6.3E-11	na	na	na	na	na	1.2E-06	3.7E-05	1.6E-04	na	**52**
Anthracene	24	8.9E-11	na	na	na	na	na	9.4E-07	4.3E-05	1.6E-04	na	**3.53**
Aroclor-1242	0.17	2.4E-10	3.8E-08	1.2E-06	6.4E-05	7.6E-04	1.4E-03	3.0E-07	1.6E-04	4.4E-04	na	na
Aroclor-1254	0.177	3.5E-09	3.2E-08	1.3E-06	5.6E-05	7.8E-04	1.5E-03	1.9E-07	1.5E-04	4.0E-04	na	1.1E-03
Benzo(a)anthracene	22.8	2.9E-08	1.1E-06	4.9E-06	0.011	9.9E-03	9.0E-03	1.8E-04	2.1E-03	0.013	na	**1.27**
Benzo(a)pyrene	19.1	7.9E-08	na	na	na	na	na	3.5E-06	1.2E-04	4.4E-04	na	na
Benzo(b)fluoranthene	21.8	1.3E-09	na	na	na	na	na	7.9E-06	1.9E-04	8.3E-04	na	**1.21**
Benzo(g,h,i)perylene	9.09	3.6E-08	na	na	na	na	na	9.1E-07	1.4E-04	3.8E-04	na	na
Bis(2-ethylhexyl)phthalate	0.222	6.2E-11	3.3E-08	3.2E-06	4.8E-06	1.9E-03	3.9E-03	5.5E-09	1.4E-04	3.9E-04	na	na
Chrysene	24.3	3.1E-08	na	na	na	na	na	1.8E-04	2.9E-03	0.015	na	na
Dibenzofuran	9.9	na	na	na	na	na	na	na	na	na	na	**1.62**
Fluoranthene	69.2	2.5E-09	na	na	na	na	na	1.2E-05	1.2E-03	3.5E-03	**6.92**	na

Table H-5.3-9 (continued)

COPEC	EPC (mg/kg)	Fox (mammalian top carnivore)	American Kestrel (avian top carnivore)	American Kestrel (avian intermediate carnivore)	American Robin (avian herbivore)	American Robin (avian omnivore)	American Robin (avian insectivore)	Cottontail (mammalian herbivore)	Montane Shrew (mammalian insectivore)	Deer Mouse (mammalian omnivore)	Earthworm (soil-dwelling invertebrate)	Plant (terrestrial autotroph-producer)
Fluorene	15.4	4.3E-11	na	na	na	na	na	6.6E-07	2.3E-05	8.8E-05	**4.16**	na
Methylnaphthalene[2-]	7.06	2.0E-10	na	na	na	na	na	3.0E-06	1.7E-04	5.7E-04	na	na
Naphthalene	32.5	7.9E-08	2.1E-08	5.7E-07	3.3E-03	2.0E-03	7.5E-04	1.1E-04	4.3E-04	6.6E-03	na	**32.5**
Phenanthrene	83.6	6.2E-09	na	na	na	na	na	6.4E-05	2.8E-03	0.011	**15.2**	na
Pyrene	61.9	2.8E-09	2.8E-08	5.3E-07	3.2E-04	4.9E-04	6.5E-04	2.7E-05	1.0E-03	3.9E-03	**6.19**	na
Adjusted HI		4.E-07	1.E-06	1.E-05	0.02	0.02	0.02	7.E-04	0.01	0.06	**34**	**95**

Note: Bolded values indicate HQs greater than 0.1 or HI greater than 1.

*na = Not available.

Table H-5.3-10
Summary of LOAEL-Based ESLs for Terrestrial Receptors

COPEC	Receptor	LOAEL-Based ESL* (mg/kg)
Antimony	Plant	58
Barium	Plant	260
	Earthworm	3200
Copper	Plant	490
	Earthworm	530
Mercury	Earthworm	0.5
Nickel	Plant	270
Selenium	Plant	3
	Earthworm	4.1
Zinc	Plant	810
	Earthworm	930
Acenaphthene	Plant	2
Anthracene	Plant	9
Benzo(a)anthracene	Plant	180
Benzo(b)fluoranthene	Plant	180
Dibenzofuran	Plant	61
Fluoranthene	Earthworm	23
Fluorene	Earthworm	19
Naphthalene	Plant	10
Phenanthrene	Earthworm	12
Pyrene	Earthworm	20

*LOAEL-based ESLs from ECORISK Database, Release 4.1 (LANL 2017, 602538).

Table H-5.3-11
HI Analysis Using
LOAEL-Based ESLs for SWMU 21-004(b)

COPEC	EPC (mg/kg)	Plant
Copper	10.5 (U)	0.021
Nickel	12.9	0.048
Selenium	1 (U)	**0.33**
	HI	0.4

Note: Bolded values indicate HQ greater than 0.1 or HI greater than 1.

Table H-5.3-12
HI Analysis Using LOAEL-Based ESLs for SWMU 21-004(c)

COPEC	EPC (mg/kg)	Plant
Copper	7.21(U)	0.015
Nickel	7.5	0.028
Selenium	0.96(U)	**0.32**
HI	0.4	

Note: Bolded values indicate HQ greater than 0.1 or HI greater than 1.

Table H-5.3-13
HI Analysis Using LOAEL-Based ESLs for SWMU 20-011(b)

COPEC	EPC (mg/kg)	Earthworm	Plant
Antimony	1.2 (U)	n/a*	0.021
Barium	87.9	0.027	**0.34**
Copper	8.23	0.016	0.017
Mercury	0.106	0.21	n/a
Nickel	6.06	n/a	0.022
Selenium	1.2 (U)	0.029	**0.4**
	HI	0.3	0.8

Note: Bolded values indicate HQ greater than 0.1 or HI greater than 1.

* n/a = Not applicable.

Table H-5.3-14
HI Analysis Using LOAEL-Based ESLs for AOC 21-028(d)

COPEC	EPC (mg/kg)	Earthworm	Plant
Antimony	1.6	n/a[a]	0.028
Copper	14.8	0.028	0.03
Nickel	6.08	n/a	0.023
Selenium	1.04(U)	0.025	**0.35**
Zinc	120	0.13	0.15
Acenaphthene	13	na[b]	**6.5**
Anthracene	24	na	**2.67**
Benzo(a)anthracene	22.8	na	0.13
Benzo(b)fluoranthene	21.8	na	0.12
Dibenzofuran	9.9	na	0.16
Fluoranthene	69.2	**3.01**	na
Fluorene	15.4	0.81	na
Naphthalene	32.5	na	**3.25**
Phenanthrene	83.6	**6.97**	na
Pyrene	61.9	**3.1**	na
	HI	**14**	**13**

Note: Bolded values indicate HQ greater than 0.1 or HI greater than 1.

[a] n/a = Not applicable.

[b] na = Not available.

Attachment H-1

ProUCL Files
(on CD included with this document)

Attachment H-2

Ecological Scoping Checklist

H2-1.0 PART A—SCOPING MEETING DOCUMENTATION

Site IDs	Solid Waste Management Units (SWMUs) 21-004(b), 21-004(c), 21-011(b), Area of Concern (AOC) 21-028(d)
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.	Technical Area 21 (TA-21) is located on DP Mesa on the northern boundary of the Laboratory and is immediately east-southeast of the Los Alamos townsite. DP East operations began in September 1945. These facilities were used to process polonium and actinium and to produce initiators (a nuclear weapons component). In 1964, building 21-209 was built to house research into high-temperature and actinide chemistry. Building 21-155 housed the Tritium Systems Test Assembly (TSTA) for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels used in fusion reactors. Spatially, these sites are located within relatively close proximity to each other. SWMU 21-004(b) is an aboveground stainless-steel tank (structure 21-346) that was installed in 1979. This tank was used as an overflow holding tank for liquid waste from chilled water systems and from Laboratory and radionuclide experimental operations in the TSTA facility (building 21 155). SWMU 21-004(c) is the second aboveground stainless-steel tank (also structure 21-346) that was installed in 1979. This tank was also used as an overflow holding tank for liquid waste from chilled water systems and from Laboratory and radionuclide experimental operations in the TSTA facility (building 21 155). SWMU 21-011(b) is an radioactive liquid waste sump (structure 21-223) and associated waste lines. The sump was located inside a small metal containment building that was located approximately 760 ft east of the TA-21 waste treatment plant (building 21-257) and 70 ft northwest of the TSTA (building 21-155). AOC 21-028(d) is a former storage site located on a concrete loading dock at the northwest corner of building 21-209. Potential releases were to surface and subsurface media.
List of Primary Impacted Media **(Indicate all that apply.)**	**Surface soil –** X **Surface water/sediment –** Not applicable (NA) **Subsurface –** X **Groundwater –** NA **Other, explain –** NA
Vegetation Class Based on graphic information system (GIS) Vegetation Coverage **(Indicate all that apply.)**	**Water** – NA **Bare ground/unvegetated** – X **Spruce/fir/aspen/mixed conifer** – NA **Ponderosa pine –** X **Piñon juniper/juniper savannah** – NA **Grassland/shrubland** – X **Developed** – X **Burned –** NA

Is threatened and endangered (T&E) habitat present? **If applicable, list species known or suspected of using the site for breeding or foraging.**	No T&E species nesting habitat is present at the site. However, the area is within the foraging range of the Mexican spotted owl.
Provide list of neighboring/ contiguous/upgradient sites, include a brief summary of chemicals of potential concern (COPCs) and the form of releases for relevant sites, and reference a map as appropriate. **(Use this information to evaluate the need to aggregate sites for screening.)**	Material Disposal Area (MDA) A; MDA T; MDA U; AOC 21-004(d); and SWMUs 21-022(f), 21-024(h); 21-024(i), 21-024(j), 21-024(k), and 21-024(n). Releases from these sites include hazardous constituents and radionuclides in liquid, vapor, and solid forms through the mechanisms of spills, dumping, drainages, outfalls, and material disposal/storage. The COPCs for the contiguous/upgradient sites include, but are not limited to, volatile organic compounds (VOCs), semivolatile organic compounds, inorganic chemicals, and radionuclides.
Surface Water Erosion Potential Information Surface water erosion potential is based on site observations	Run-on to sites occurs from storm water. Runoff from sites may infiltrate the surface and subsurface media and move as sheet flow or through small drainage channels into DP Canyon.

H2-2.0 PART B—SITE VISIT DOCUMENTATION

Site ID	SWMUs 21-004(b), 21-004(c), 21-011(b), AOC 21-028(d)
Dates of Site Visits	12/20/2017
Site Visit Conducted by	Randall Ryti, Kent Rich, Larry Salazar

Receptor Information:

Estimate cover.	**Relative vegetative cover (high, medium, low, none)** = Low to High **Relative wetland cover (high, medium, low, none)** = None **Relative structures/asphalt, etc., cover (high, medium, low, none)** = Low
Field Notes on the GIS Vegetation Class to Assist in Verifying the Arcview Information	These sites are located on the mesa top and in some cases have drainages toward the DP Canyon south-facing slope. The area was industrially developed with some habitat present on the mesa top and vegetation typical of south-facing slopes such as ponderosa pine, shrubs, and forbs-grasses. There are some large ponderosa pine and a dense cover of grass and forb in areas without shrub cover.
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 sites contain terrestrial biota such as reptiles, mammals, insects, birds, and plants. The quality of habitat at the sites is sustainable for native plant and animal species present in the area. Previous visits to DP Site have noted a mountain lion, bobcat, coyote, and deer.

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)	The sites on the mesa top have minimal to moderate potential for erosion because of their physical geographical location and the amount of vegetation located on the sites. However, minimal evidence of erosion was observed at and around the sites during the site visit. The terminal point of the surface water is the bottom of DP Canyon.
Are there any off-site transport pathways (surface water, air, or groundwater) **(yes/no/uncertain)?** **Provide explanation.**	The potential for surface water off-site transport pathways is minimal to moderate because of the physical geographical location and the amount of vegetation located within the sites. However, minimal evidence of erosion was observed at and around the sites during the site visit. Groundwater is located >700 ft below the surface.

Ecological Effects Information:

Physical Disturbance **(Provide list of major types of disturbances, including erosion and construction activities; review historical aerial photos where appropriate.)**	The sites located on the mesa top have a moderate amount of physical disturbances. The TA-21 area was moderately to highly developed, containing roads, buildings, fences, and operational structures. Many TA-21 buildings and other infrastructure have been removed.
Are there obvious ecological effects (yes/ no/uncertain)? **Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).**	No. The only obvious ecological effects are the result of the historical development in the area.

No Exposure/Transport Pathways:

If there are no complete exposure pathways to ecological receptors on-site and no transport pathways to off-site 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 the 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 and extent of contamination (yes/ no/uncertain)? **Provide explanation (consider whether the maximum value was captured by existing sample data).**	Yes. The sampling approach in the approved work plan included sampling to determine the nature and extent of contamination within the DP Site Aggregate Area.
Do existing or proposed data for the site address potential transport pathways of site contamination (yes/ no/uncertain)? **Provide explanation (consider whether other sites should be aggregated to characterize potential ecological risk).**	Yes. Data from samples collected within the SWMUs and AOCs address potential transport pathways and characterize the potential ecological risk. The results indicate that the nature and extent of contamination at most of the sites have been defined.

Additional Field Notes:

Provide additional field notes on the site setting and potential ecological receptors.
Notes on these TA-21 sites are presented below. **SWMUs 21-004(b) and 21-004(c)**. The location of these former tanks is minimally vegetated. Some sparse understory plants are noted. Medium-size ponderosa pine are nearby. **SWMU 21-011(b)**. Vegetative cover is moderate. Ponderosa pine are nearby. **AOC 21-028(d)**. The location of the former loading dock has moderate vegetative cover.

H2-3.0 PART C—ECOLOGICAL PATHWAYS CONCEPTUAL EXPOSURE MODEL

Provide answers to Questions A to V to develop the Ecological Pathways Conceptual Exposure Model

Question A:

Could soil contaminants reach receptors through vapors?

- **Volatility of the hazardous substance (volatile chemicals generally have Henry's law constant >10^{-5} atm-m^3/mol and molecular weight <200 g/mol).**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: VOCs were detected in soil and tuff. Most of the detected concentrations were below or similar to the estimated quantitation limits.

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): Likely

Provide explanation: Some COPCs were detected in the surface interval.

Question C:

Can contaminated soil be transported to aquatic ecological communities (use standard operating procedure (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 and/or AOC 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 whether aquatic receptors could be affected by contamination from this site.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: No aquatic communities are present within TA-21 or in close proximity.

Question D:

Is contaminated groundwater potentially available to biological receptors through seeps, springs, or shallow groundwater?

- **Known or suspected presence of contaminants in groundwater.**
- **The potential exists for contaminants to migrate through 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.**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: At TA-21, the depth to regional groundwater is approximately 700 to 1100 ft below ground surface (bgs). There are no seeps, springs, or shallow groundwater within TA-21.

Question E:

Is infiltration/percolation from contaminated subsurface material a viable transport and exposure pathway?

- **The potential exists for contaminants to migrate to groundwater.**
- **The potential exists for contaminants to migrate through 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.**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: At TA-21, the depth to regional groundwater is approximately 700 to 1100 ft bgs. There are no seeps, springs, or shallow groundwater within former TA-21.

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 applicable only 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: Most sites are not located near the main canyon edge, so mass wasting is not relevant. There is minimal evidence of erosion at the sites.

Question G:

Could airborne contaminants interact with receptors through the respiration of vapors?

- **Contaminants must be present as volatiles in the air.**
- **Consider the importance of the inhalation of vapors for burrowing animals.**
- **Foliar uptake of 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: 2

Terrestrial Animals: 2

Provide explanation: VOCs were detected but at low concentrations.

Question H:

Could airborne contaminants interact with plants through the deposition of particulates or with animals through the inhalation of fugitive dust?

- **Contaminants must be present as particulates in the air or as dust for this exposure pathway to be complete.**
- **Exposure through the 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: 3

Terrestrial Animals: 3

Provide explanation: Surface-soil contamination is present.

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 is 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: 3

Provide explanation: Surface-soil contamination is present.

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: 3

Provide explanation: COPCs are present in the surface soil.

Question K:

Could contaminants interact with receptors through the 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 groom themselves clean of soil.**

Provide quantification of exposure pathway (0 = no pathway, 1 = unlikely pathway, 2 = minor pathway, 3 = major pathway):

Terrestrial Animals: 3

Provide explanation: COPCs are present in the surface soil.

Question L:

Could contaminants interact with receptors through dermal contact with surficial soils?

- **Significant exposure through 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: Low to moderate concentrations of lipophilic COPCs were detected in surface soil.

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: 2

Terrestrial Animals: 2

Provide explanation: Some gamma-emitting radionuclides were identified as COPCs.

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 is no aquatic habitat present.

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 is no aquatic habitat present.

Question P:

Could contaminants interact with receptors through the 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 is no aquatic habitat present.

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 is no aquatic habitat present.

Question R:

Could suspended or sediment-based 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 is no aquatic habitat present.

Question S:

Could contaminants bioconcentrate in free-floating aquatic plants, 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 is no aquatic habitat present.

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 is no aquatic habitat present.

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 is no aquatic habitat present.

Question V:

Could contaminants interact with aquatic plants or animals through external irradiation?

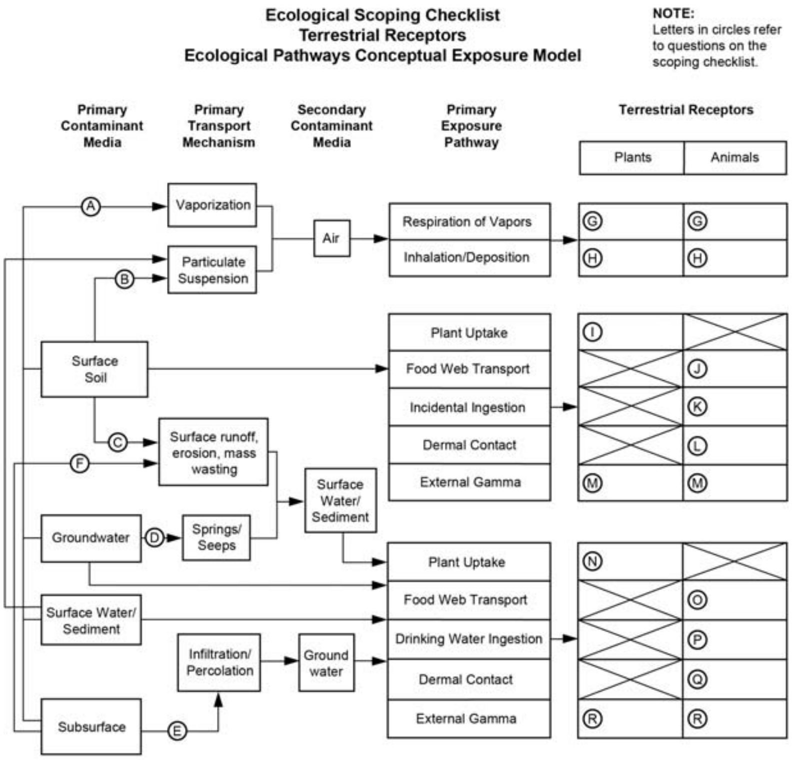
- **External irradiation effects are most relevant for gamma-emitting radionuclides.**
- **The water column acts to absorb radiation; therefore, external irradiation is typically more important for sediment-dwelling organisms.**

Provide quantification of exposure pathway (0 = no pathway, 1 = unlikely pathway, 2 = minor pathway, 3 = major pathway):

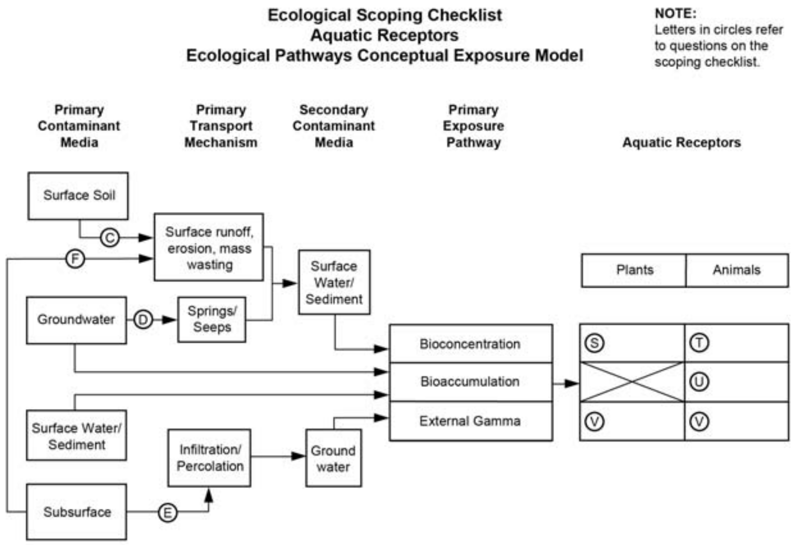
Aquatic Plants: 0

Aquatic Animals: 0

Provide explanation: There is no aquatic habitat present.



Minor Pathway	Minor Pathway
Major Pathway	Major Pathway
Major Pathway	
	Major Pathway
	Major Pathway
	Minor Pathway
Minor Pathway	Minor Pathway
No Pathway	
	No Pathway
	No Pathway
	No Pathway
No Pathway	No Pathway



No Pathway	No Pathway
	No Pathway
No Pathway	No Pathway

SIGNATURES AND CERTIFICATION

Checklist completed by:

Name (printed): Randall Ryti
Name (signature): Randall Ryti
Organization: Neptune and Company, Inc.
Date completed: December 20, 2017

Checklist reviewed by:

Name (printed): Kent Rich
Name (signature):
Organization: Los Alamos National Laboratory
Date reviewed: June 7, 2018

H2-4.0 REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

LANL (Los Alamos National Laboratory), July 2009. "Investigation Work Plan for Lower Sandia Canyon Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-09-4329, Los Alamos, New Mexico. (LANL 2009, 106660.14)

NMED (New Mexico Environment Department), August 6, 2009. "Notice of Approval for the Response to the Notice of Disapproval for the Investigation Work Plan for Lower Sandia Canyon Aggregate Area and Revision 1," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 106703)