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Interim Measure Report for Solid Waste Management Unit 01-001(f) and Los Alamos Site Monitoring Area 2

Los Alamos
NATIONAL LABORATORY
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Prepared by the Environmental Programs Directorate

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EXECUTIVE SUMMARY

This report describes interim measure activities conducted from October 2009 to February 2010 in the drainage downgradient of Solid Waste Management Unit (SWMU) 01-001(f), also referred to as the Los Alamos Site Monitoring Area 2 (LA-SMA-2) drainage, in former Technical Area 01 (TA-01) within the Upper Los Alamos Canyon Aggregate Area.

The interim measure activities were implemented within the SWMU 01-001(f) outfall and drainage areas to mitigate contaminant migration to and within Los Alamos Canyon. Releases from SWMU 01-001(f), a former septic system, have resulted in the presence of contaminants, primarily polychlorinated biphenyls (PCBs), in the SWMU 01-001(f) drainage. The interim measure activities included removal of contaminated environmental media from the drainage downgradient of SWMU 01-001(f); installation of best management practices to prevent contaminants from the mesa top from migrating into the drainage downgradient of SWMU 01-001(f); construction of surface water retention and sediment deposition basins in Los Alamos Canyon below the SWMU 01-001(f) drainage; and characterization and disposal of waste generated during removal activities in accordance with applicable regulatory requirements.

To date, 304 yd^3 of sediment and 192 yd^3 of rock contaminated with PCBs have been removed from the drainage below SMWU 01-001(f). At the base of the drainage, where a large body of sediment has accumulated, 2290 yd^3 of PCB-contaminated sediment has been removed. Following removal of contaminated media, a total of 94 confirmation samples were collected from the site.

Following removal of the sediment, two surface water retention basins were installed to prevent migration of sediment from the site. The average basin depth exceeds 4 ft. The two basins are connected by the spillway and elevated outlet discharge pipe in the western berm. The elevation of the berm in the western basin (7050 ft above mean sea level) will allow water to basin at least 150 ft upstream. Therefore, as constructed, the surface water retention basins meet the requirements set forth by the New Mexico Environment Department.

Based on the confirmation sampling data, additional removal actions are necessary in the SWMU 01-001(f) drainage. In some areas, most noticeably in weathered tuff and residual soils at the SWMU 01-001(f) outfall, PCB levels increase significantly with depth; therefore, vertical extent has not yet been defined in these areas. Based on confirmation sampling results received to date, concentrations at very few locations within the drainage itself exceed the recreational soil screening levels because sediment between the outfall and the deposition area has been almost completely removed as part of the interim measure activities. Once removal activities are complete for the entire site, the corrective action will be evaluated to ensure it is protective of human health and the environment

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Acronyms and Abbreviations

AOC	area of concern
BMP	best management practice
COPC	chemical of potential concern
CWA	Clean Water Act
DOE	Department of Energy (U.S.)
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency (U.S.)
FFCA	Federal Facility Compliance Agreement
GPS	global-positioning system
LA-SMA	Los Alamos Site Monitoring Area
LANL	Los Alamos National Laboratory
LLW	low-level radioactive waste
MSGP	Multi-Sector General Permit
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System

NOD	notice of disapproval
RPF	Records Processing Facility
SMA	site monitoring area
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
T&E	threatened and endangered
TA	technical area
TAL	target action level
TSCA	Toxic Substances Control Act
VCA	voluntary corrective action
VOC	volatile organic compound

1.0 INTRODUCTION

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

The Laboratory's Environmental Programs (EP) Directorate is participating in a national effort by the U.S. Department of Energy (DOE) to clean up sites and facilities formerly involved in weapons research and development. The goal of EP 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, EP is currently investigating sites potentially contaminated by past Laboratory operations. The sites under investigation are designated as either solid waste management units (SWMUs) or areas of concern (AOCs).

This report describes interim measure activities conducted in the drainage downgradient of SWMU 01-001(f), also referred to as the Los Alamos Site Monitoring Area 2 (LA-SMA-2) drainage, in former Technical Area 01 (TA-01) within the Upper Los Alamos Canyon Aggregate Area. SWMU 01-001(f) is contaminated with hazardous chemicals and radionuclides. Corrective actions at the Laboratory are subject to the Compliance Order on Consent (the Consent Order). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to the New Mexico Environment Department (NMED) in accordance with DOE policy.

1.1 Location of Interim Measure Activities

The interim measure activities described in this report were implemented within the drainage downgradient of the SWMU 01-001(f) outfall in former TA-01 within the Upper Los Alamos Canyon Aggregate Area. Figure 1.1-1 shows the location of Upper Los Alamos Canyon Aggregate Area with respect to the Laboratory and surrounding land holdings. Figure 1.1-2 shows the location of SWMU 01-001(f) and the drainage area where the interim measure activities were performed.

1.2 Purpose of Interim Measure Activities

The purpose of interim measure activities implemented within the SWMU 01-001(f) outfall area and within the LA-SMA-2 drainage is to mitigate contaminant migration to and within Los Alamos Canyon (NMED 2008, 103007). Releases from SWMU 01-001(f), a former septic system, have resulted in the presence of contaminants, primarily polychlorinated biphenyls (PCBs), in the LA-SMA-2 drainage. Interim measure activities implemented to date include removal of contaminated environmental media from the drainage downgradient of SWMU 01-001(f); installation of best management practices (BMPs) to prevent contaminants from the mesa top from migrating into the drainage downgradient of SWMU 01-001(f); construction of surface water retention and sediment deposition basins in Los Alamos Canyon below the SWMU 01-001(f) drainage; and characterization and disposal of waste generated during removal activities in accordance with applicable regulatory requirements.

1.3 Report Overview

This interim measure report describes activities performed in the drainage downgradient of SWMU 01-001(f) and provides confirmation sampling results from these activities. Section 2 presents background information on the site, including a site description, operational history, types of waste historically present at the site, and a summary of previous investigations. Section 3 summarizes the regulatory background for this work. Section 4 provides a description of interim measure activities implemented in accordance with the approved interim measure and monitoring plan (LANL 2008, 104020; NMED 2009, 105858); confirmation sampling results; deviations from the interim measure and monitoring plan; and waste management. Section 5 presents the results of the interim measure activities implemented in late 2009 and early 2010. Section 6 presents conclusions and recommendations for additional work, and section 7 includes the proposed schedule for additional work. Section 8 lists the references cited in this report and the map data sources. Appendix A presents photographs taken during the interim measure and monitoring plan implementation, and Appendix B presents the geomorphology of the deposition area at the base of the drainage area below SWMU 01-001(f). Appendix C (on CD) provides copies of the field forms. Appendix D presents the engineering drawing of the surface water retention basins. Appendix E (on CD) contains sample collection logs, screening data, analytical data, data packages, data validation reports, and chain-of-custody forms. Appendix F (on CD) provides copies of waste management data, disposal records, and waste tracking tables.

2.0 BACKGROUND

2.1 Site Description and Operational History

2.1.1 SWMU 01-001(f), Septic Tank 140

SWMU 01-001(f) is the former location of Septic Tank 140 (former structure 01-140) and its associated inlet and outlet drainlines, and outfall in former TA-01 (Figure 1.1-2). The septic tank was constructed of reinforced concrete in 1945 and measured 3 ft by 6 ft by 5 ft deep (LANL 2001, 069946, p. 36). The septic system outfall discharged into Los Alamos Canyon to an area later designated as Hillside 140. Although the septic system is located in former TA-01, in what is now a residential area, Hillside 140 falls within the boundaries of TA-43. The septic tank was located west of former building K-1 and served former buildings HT (former building 01-29) and FP (former structure 01-20). Building HT was used to heat-treat and machine natural and enriched uranium. The heat treatment operations probably resulted in discharges of radioactive waste to the tank. Building FP was a foundry for nonradioactive and nonferrous metals and was not radiologically contaminated (Buckland 1964, 004810; Ahlquist et al. 1977, 005710, p. 39). The septic system ceased to be used in 1965, and it was removed in 1976 (Ahlquist et al. 1977, 005710, p. 39).

Currently, the entire mesa-top area of SWMU 01-001(f) is developed. The former drainline locations are under the pavement and buildings of Ridge Park Village, and the former septic tank location is partially covered by a building. The outfall is on undeveloped land owned by DOE.

2.1.2 LA-SMA-2

Since the promulgation of stormwater regulations in 1990 under the National Pollutant Discharge Elimination System (NPDES) program and the Clean Water Act (CWA), the Laboratory has been proactive in the pursuit of appropriate permit coverage for stormwater discharges. Originally, the Laboratory implemented a stormwater management program to cover activities under the NPDES General Permit. In 1995, the U.S. Environment Protection Agency (EPA) modified the General Permit and issued an industrial “sector”-driven permit (Multi-Sector General Permit or MSGP). The Laboratory and DOE applied for and received coverage under the MSGP.

In February 2005, DOE and EPA Region 6 entered into the Federal Facility Compliance Agreement (FFCA) for the purpose of establishing an interim compliance program to regulate stormwater discharges from SWMUs and AOCs (collectively referred to as "sites") at the Laboratory and to allow adequate time to submit an individual stormwater permit application. The March 2005 NPDES individual permit application was intended to separate the sites regulated under the MSGP into an individual NPDES permit (individual permit) that focused primarily on requirements for stormwater discharge from sites.

The individual permit was issued in February 2009 and became effective on April 1, 2009. The individual permit was subsequently appealed by a coalition of regional citizens' groups. Since then the final conditions of the individual permit continue to be negotiated under a proposed settlement agreement between Los Alamos National Security, LLC; DOE; EPA; and the citizens' groups. As a result of the permit appeal negotiations, a modified individual permit is expected to be issued in 2010.

The FFCA and individual permit require monitoring of stormwater discharges from regulated SWMUs and AOCs. In many cases, runoff from SWMUs and AOCs combines in common drainages. Site monitoring areas (SMAs) were developed to sample runoff from several SWMUs and/or AOCs having common drainages. LA-SMA-2 was established under the FFCA to monitor runoff from SWMUs 01-001(f) and 01-006(b) (which is also monitored by LA-SMA-4). Under the FFCA, the LA-SMA-2 is located at the base of the drainage below SWMU 01-001(f). The drainage area above LA-SMA-2 is approximately 17.3 acres (Figure 1.1-2).

2.2 Description of Releases

Wastewater was discharged to Septic Tank 140 from former buildings HT and FP from 1945 to 1965. Before it was removed in 1976, Septic Tank 140 was found to be filled with sludge with 60,000 cpm of uranium activity, and both inlet and outlet lines were found to be contaminated along with surrounding soil (Ahlquist et al. 1977, 005710, p. 111). Solvents and machining oil possibly contaminated with PCBs were potentially discharged to the septic system from former building HT. Chemicals of potential concern (COPCs) include PCBs, petroleum hydrocarbons, volatile organic chemicals (VOCs), inorganic chemicals, semivolatile organic chemicals (SVOCs), and radionuclides.

2.3 Previous Investigation and Remediation Activities

Previous investigation and remediation activities that have taken place at SWMU 01-001(f) include the following.

- 1974 to 1976: During the Ahlquist Radiological Survey, the tank was found to be filled with sludge that had 60,000 cpm of uranium activity (Ahlquist et al. 1977, 005710, p. 111). Both inlet and outlet lines were contaminated. The tank, its inlet and outlet lines, and approximately 351 yd^3 of surrounding soil were removed in 1976 (Ahlquist et al. 1977, 005710, pp. 40, 111). Of the 56 soil samples taken from the pit or trenches, only 5 had gross-alpha activity greater than 20 pCi/g, with a maximum activity of 48 pCi/g. Although the mesa-top area of Septic Tank 140 was determined to be decontaminated, steep terrain prevented the removal of all known contamination to the west of the outlet excavation (Ahlquist et al. 1977, 005710, p. 111).
- 1992 and 1993: Both the canyon rim area and Hillside 140 of SWMU 01-001(f) were extensively sampled during Phase I Resource Conservation and Recovery Act facility investigation activities. The hillside area included the entire drainage pathway for Hillside 140 from the mesa top to the bottom of Los Alamos Canyon. Samples were analyzed for inorganic chemicals, SVOCs, cesium-137, isotopic plutonium, and isotopic uranium at the Chemical Sciences and Technology Division on-site laboratory. Samples were also analyzed for inorganic chemicals, SVOCs, and isotopic

plutonium at off-site laboratories. Stormwater samples were collected along the primary drainage pathway of Hillside 140 and analyzed for selected inorganic chemicals and radionuclides. COPCs identified in soil samples included total uranium; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; uranium-234; uranium-235; and uranium-238. The COPCs identified in stormwater samples included lead and total uranium.

- 1996: A voluntary corrective action (VCA) was conducted at the outfall area of SWMU 01-001(f) as a BMP. The site was first surveyed for radiation, and a correlation was then established between uranium concentrations and the Ludlum radiation detection instrument. A cleanup level of 6000 cpm (as measured by the Ludlum instrument) was used in the field. Contaminated soil above the 6000-cpm level was excavated. The total volume of soil removed from Hillside 140 was approximately 15 yd^3. Verification samples were not collected because cleanup activities were driven by the use of real-time radiological screening data (LANL 1996, 053797, p. 3).
- 2008 to 2009: As part of Upper Los Alamos Canyon Aggregate Area investigation, a total of 43 samples were collected from 21 locations within the former location of Septic Tank 140, the outfall area, and in the drainage downgradient of the outfall. The samples were submitted for analysis of inorganic chemicals, organic chemicals, and radionuclides. The nature and extent of contamination at SWMU 01-001(f) are defined except for the vertical extent of cadmium and copper; the lateral and vertical extent of chromium and nickel; the lateral and vertical extent of Aroclor-1254; the lateral extent of polycyclic aromatic hydrocarbons and methylene chloride; and the lateral and vertical extent of plutonium-239/240, uranium-234, uranium-235/236, and uranium-238. Aroclor-1254 was detected at concentrations above the residential screening level (maximum 610 mg/kg) and thus warranted the removal of sediment and tuff in selected areas of SWMU 01-001(f) (LANL 2009, 106597; LANL 2010, 108528).

2.4 History of Response Actions

Following is the chronology of recent regulatory communications between NMED and the Laboratory regarding LA-SMA-2 and SWMU 01-001(f).

- August 30, 2007: NMED issued an approval with direction for Los Alamos and Pueblo Canyons supplemental investigation report (NMED 2007, 098284). One of the activities directed by NMED was to determine the source of PCBs detected in stormwater samples collected at LA-SMA-2. Specifically, the Laboratory was directed to determine if the PCBs were originating from SWMU 01-001(f) or from another source. The Laboratory was directed to submit a plan for investigating the source of PCBs at LA-SMA-2 by October 1, 2007.

- October 1, 2007: The Laboratory submitted a work plan to NMED for investigating the source of PCBs at LA-SMA-2 (LANL 2007, 099161). The plan stated that determining the source of PCBs at this site was within the scope of the investigation activities for Upper Los Alamos Canyon Aggregate Area, to be implemented in 2008. The work plan described the specific scope of the Upper Los Alamos Canyon Aggregate Area investigation that would determine the source of PCBs at SWMU 01-001(f).

- March 4, 2008: NMED issued a notice of disapproval (NOD) for the Laboratory’s work plan to investigate the source of PCBs at LA-SMA-2 (NMED 2008, 100545). The NOD specified additional investigation scope not included in the Upper Los Alamos investigation. The NOD required the Laboratory to submit a revised work plan by March 30, 2008.

- March 31, 2008: The Laboratory submitted a response to the March 4, 2008, NOD (LANL 2008, 101654). In its response, the Laboratory indicated the additional work requested by NMED, including stormwater monitoring and installation of BMPs, was already being implemented under the FFCA for stormwater discharges.

- July 18, 2008: NMED issued an approval with modifications to the Laboratory's February 2008 Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons (NMED 2008, 103007). The interim measures work plan was submitted to NMED in response to the August 30, 2007, approval with direction described above (NMED 2007, 098284). The July 2008 approval with modifications required that the Laboratory submit a work plan for interim measures for LA-SMA-2 and associated source area [SWMU 01-001(f)] that would control contaminant migration into the main Los Alamos Canyon stream channel. The proposed interim measures were to include source and inventory removal and diversion and control of stormwater run-on and runoff at the site. The interim measures work plan was due to NMED by November 3, 2008.

- November 3, 2008: The Laboratory submitted the Los Alamos Site Monitoring Area 2 Interim Measure and Monitoring Plan to NMED (LANL 2008, 104020). The work scope identified in the interim measure plan included the installation of initial BMPs, installation of new stormwater sampling stations, sediment and soil sampling and, as necessary, installation of enhanced permanent BMPs (i.e., retention basins in Los Alamos Canyon).

- May 5, 2009: NMED issued an approval with modifications to the November 2008 LA-SMA-2 interim measure and monitoring plan (NMED 2009, 105858). The approval with modifications required the Laboratory to (1) remove contaminated sediments in all areas of sediment accumulation for the drainage below SMWU 01-001(f); (2) collect samples from excavated areas at a frequency of one sample per 100 ft^2; (3) prevent mesa-top contaminants from migrating into the drainage below SWMU 01-001(f); (4) construct two connected surface water retention basins in Los Alamos Canyon; and (5) enhance the juniper bale BMPs in Los Alamos Canyon by covering them with geotextile fabric. The schedule called for construction of the retention basins and BMP enhancements by August 1, 2009; removal of contaminated sediments from the drainage below SWMU 01-001(f) by December 31, 2009; and submittal of a report documenting sediment removal, sampling, and waste disposal by May 1, 2010.

- July 17, 2009: The Laboratory requested an extension of the August 1, 2009, deadline for constructing the retention basins in Los Alamos Canyon to December 31, 2009 (LANL 2009, 106587). The extension was requested to avoid performing construction activities in the canyon during the monsoon season. The letter also documented concerns over construction of run-on controls at the head of the drainage and noted that the Laboratory would focus on risk-based removal of sediment and tuff.

- July 29, 2009: NMED approved the Laboratory's extension request for completion of the retention basins by December 31, 2009 (NMED 2009, 106702). The letter also required the Laboratory to install interim stormwater controls by August 1, 2009.

- August 28, 2009: The Laboratory submitted documentation of installation of the interim stormwater controls required by NMED's July 29, 2009, extension request approval (LANL 2009, 106799).

- December 22, 2009: The Laboratory requested an extension of the December 31, 2009, deadline for constructing the retention basins in Los Alamos Canyon to March 1, 2010 (LANL 2009, 108188). The extension request letter also documented completion of removal of contaminated sediments from the upper drainage on December 20, 2009, and indicated that removal of other contaminated media (e.g., from the banks of the upper drainage and from the base of the drainage) would be completed by March 1, 2010.

- December 23, 2009: NMED approved the Laboratory's extension request for completion of the retention basins by March 1, 2010 (NMED 2009, 108208). The approval letter also required the Laboratory to install interim stormwater controls at the base of the LA-SMA-2 drainage by February 1, 2009 (this year was a typographical error and should have been 2010); complete removal of PCB-contaminated soils from the LA-SMA-2 drainage by March 1, 2010; and submit a report documenting results of sediment removal, sampling, waste disposal, construction of the retention basins, and installation of a permanent monitoring station at the base of the drainage by May 1, 2010.
- January 11, 2010: NMED approved the Los Alamos and Pueblo Canyons Sediment Transport Monitoring Plan with modifications (NMED 2010, 108444). This plan was submitted to NMED on October 15, 2009 (LANL 2009, 107457) and included specified monitoring points in the main channel in Los Alamos Canyon but did not include monitoring specifically associated with the LA-SMA-2 drainage. In the approval with modifications, however, NMED directed the Laboratory also to monitor directly below the spillway of the lower retention basin. Further, the approval with modifications directed the Laboratory to measure the amount of infilling in the retention basins on an annual basis.
- February 25, 2010: The Laboratory requested an extension for completing removal of PCB-contaminated soil from the LA-SMA-2 drainage until sometime after the threatened and endangered (T&E) species surveys are completed, on or about May 15, 2010 (LANL 2009, 108806). The Laboratory indicated that a report presenting the results of the current PCB removal and stabilization activities will be submitted by May 1, 2010.
- March 8, 2010: NMED approved the Laboratory's extension request for completing removal of PCB-contaminated soil (NMED 2010, 109035) and required the Laboratory to submit a report summarizing all activities conducted to date at LA-SMA-2 by May 1, 2010. NMED directed the Laboratory to submit a supplemental report documenting completion of required removal of PCB-contaminated soils from the LA-SMA-2 drainage by October 1, 2010.

3.0 REGULATORY CONTEXT AND CRITERIA

The work described in this report is part of the actions being performed by the Laboratory, pursuant to the Consent Order, to mitigate contaminated sediment transport in Los Alamos and Pueblo Canyons. These actions were directed by NMED's August 2007 approval with directions for the Los Alamos and Pueblo Canyons supplemental investigation report (NMED 2007, 098284). The work described in section 4.0 of this report was conducted pursuant to an interim measure plan prepared by the Laboratory in November 2008 (LANL 2008, 104020) and approved with modifications by NMED on May 5, 2009 (NMED 2009, 105858).

As described in Section VII.B.1 of the Consent Order, interim measures are performed to reduce or prevent migration of contaminants while long-term corrective action remedies are evaluated and implemented. Therefore, the actions described in this report are not final corrective measures and are not intended to meet cleanup levels or other criteria that would result in corrective action complete status. The specific requirements for the interim measure are contained in the approval with modifications (NMED 2009, 105858) and are summarized below.

- Source Removal: This requirement includes removing contaminated sediments in all areas of sediment accumulation from the drainage below SWMU 01-001(f). Confirmation samples are to be collected to demonstrate the soil cleanup levels for PCBs in Section VIII.B.1.a of the Consent Order are met. Confirmation samples are to be collected at a frequency of one sample per 100 ft^2.
- Prevention of Contaminant Migration from above the LA-SMA-2 Drainage: This requirement includes measures to prevent contaminants from the mesa top from migrating into the drainage below SWMU 01-001(f). These actions are to address contaminant transport from portions of SWMU 01-001(f) that have not yet been addressed by Upper Los Alamos Canyon Aggregate Area work.
- Construction of Surface Water Retention Basins: This requirement includes construction of two connected surface water retention basins below the LA-SMA-2 drainage. The basins are to be designed to impound water for a distance of 150 ft upstream of the drainage. In addition, existing juniper bale BMPs below the LA-SMA-2 drainage are to be enhanced by covering them with geotextile fabric.
- Remediation Waste Disposal: This requirement includes characterization and disposal of all waste generated from sediment removal and construction of the retention basin.

The current status with respect to these requirements is described below, along with the status of additional requirements under the Consent Order and the NPDES individual permit.

3.1 Source Removal

The approval with modifications required removal of contaminated sediments from the drainage below SWMU 01-001(f) by December 31, 2009 (NMED 2009, 105858). Removal of virtually all sediments from the drainage was completed on December 20, 2009, and a notification was submitted to NMED on December 22, 2009 (LANL 2009, 108188). As noted in the submittal, during the course of removing sediments from the drainage, PCB-contaminated soil was discovered within the banks above the high-water mark (LANL 2009, 106587). In addition, the tuff underlying the sediments within the drainage was also impacted by PCB contamination. These PCB-contaminated soils and tuff were removed to the extent possible before the March 1, 2010, annual shutdown to conduct surveys of T&E species in the area. The results of confirmation sampling indicate that additional removal of soil and tuff is needed and will begin again after the T&E surveys are concluded. The Laboratory anticipates this removal will be completed before the 2010 monsoon season (LANL 2009, 108806). A report documenting completion of the removal must be submitted to NMED by October 1, 2010 (NMED 2010, 109035).

The PCB target cleanup levels for this interim measure are recreational soil screening levels (SSLs) (LANL 2007, 094496). These SSLs are 6.65 mg/kg for Aroclor-1254 and 10.5 mg/kg for Aroclor-1260, the only Aroclors present at the site. These interim measure cleanup levels were selected to be protective of current land use until corrective actions for SWMU 01-001(f) are completed. Section VIII.B.1.a of the Consent Order specifies that PCBs should be cleaned up to a default concentration of 1 mg/kg or to a risk-based concentration established through a health risk assessment. Upon the completion of PCB removal activities at SWMU 01-001(f), the Laboratory will perform risk assessments to demonstrate any residual PCB contamination does not pose a potential unacceptable risk to human health or the environment.

Before contaminated sediment at the base of the drainage below SWMU 01-001(f) was removed, the area of sediment deposition was geomorphically mapped and sampled to determine waste volumes and types. The results of the geomorphic mapping and sampling are presented in Appendix B.

Removal of contaminated sediment, soil, and tuff and confirmation sampling results is discussed in section 4.1.

3.2 Run-on Contaminant Migration Prevention

Because installing measures to control potential migration of contaminants from the mesa top into the drainage below SWMU 01-001(f) requires activities to be performed on private property, the Laboratory assessed the feasibility of installing run-on controls at the head of the drainage during a July 9, 2009, site visit with NMED. As a result of this assessment, the Laboratory proposed to NMED that work focus on remediation and stabilization activities in the drainage rather than on the mesa top (LANL 2009, 106587). In responding to the Laboratory's proposal, NMED requested the Laboratory address the issue of installing run-on controls on private property in the May 1, 2010, report (NMED 2009, 106702).

Future actions at potential contaminant sources above the drainage are being evaluated as part of the Upper Los Alamos Canyon Aggregate Area investigation and the Laboratory's individual NPDES permit for stormwater discharges from SWMUs and AOCs. The Upper Los Alamos Canyon Aggregate Area investigation report indicated that further investigation and/or remediation activities were needed at a number of sites, including SWMU 01-001(f) (LANL 2010, 108528). NMED's notice of approval for the investigation report requires the Laboratory submit a Phase II investigation work plan for Upper Los Alamos Canyon Aggregate Area by October 21, 2010 (NMED 2010, 109195). The specific requirements of the investigation and the submittal date of the Phase II work plan will be provided by NMED in the future. Additional actions to be taken at SWMU 01-001(f), including those to be implemented above the drainage, will be identified in the Phase II work plan.

SWMU 01-001(f) is also included in the Laboratory's individual permit, which is expected to become effective in 2010. Once the permit is in effect, the Laboratory will be required to conduct stormwater sampling and implement BMPs in accordance with the individual permit. The Laboratory will be required to install baseline control measures to minimize stormwater pollutant discharges as necessary to meet nonnumeric effluent limits established in the individual permit. These requirements are discussed in section 3.6.

3.3 Surface Water Retention Basin Construction

Before the surface water retention ponds were constructed, enhancements to the juniper bale BMPs were made, as required by NMED's approval with modifications (NMED 2009, 105858). The enhancements were completed by August 1, 2009, and were documented in a letter to NMED dated August 28, 2009 (LANL 2009, 106799). Installation of BMPs is described in section 4.2.

In accordance with the NMED requirements, two connected surface water retention basins, constructed to depths of approximately 4 ft below the ground surface, were completed by February 1, 2010. NMED further required that the spillway from the upper (westernnmost) basin be at an elevation sufficient to allow surface water to pond for a distance of approximately 150 ft upstream of the discharge from the drainage (NMED 2009, 105858). Installation of the basins is described in section 4.3.

3.4 Remediation Waste Disposal

Remediation wastes were characterized as required by NMED (2009, 105858). Waste characterization and disposal activities are summarized in section 4.6, and available waste management documentation is included in Appendix F (on CD).

3.5 Consent Order

Interim measures have been implemented to control the potential migration of contaminated sediments. These interim measures will be completed through removal of contaminated soil and tuff as described in section 3.1. If necessary, additional corrective measures under the Consent Order will be implemented as part of the investigation and remediation activities for the Upper Los Alamos Canyon Aggregate Area. As noted above, a Phase II investigation work plan for the Upper Los Alamos Canyon Aggregate Area will be prepared and submitted to NMED. Based on the conditions existing after completion of the interim measures, the Phase II work plan will propose additional investigation and/or remediation activities needed to demonstrate that the nature and extent of contamination have been defined and that the site poses no unacceptable risk to human health and the environment under current and reasonably foreseeable future land use.

3.6 NPDES Individual Permit

Activities conducted under the individual permit will be used to demonstrate compliance with the NPDES individual permit and target action levels (TALs). Under the individual permit, the LA-SMA-2 monitoring point will be replaced by LA-SMA-2.1, which will be used to monitor stormwater discharges from SWMU 01-001(f), and LA-SMA-4.1, which will be used to monitor stormwater discharges from SWMU 01-006(b). Also under the individual permit, the Laboratory will be required to implement corrective actions at LA-SMA-2.1 if the results of stormwater monitoring show contaminants above TALs. Further actions to be taken at SWMU 01-001(f) under the individual permit will be coordinated with those required under the Consent Order.

4.0 INTERIM MEASURE ACTIVITIES

4.1 Removal Activities

4.1.1 Preexcavation Sampling

Because the nature and extent of PCB contamination were not defined by the 2008 characterization sampling (section 2.3), additional sampling of the drainage below SWMU 01-001(f) was conducted before the start of interim measure activities (LANL 2010, 108528). Twenty preexcavation samples were collected from the basin area in Los Alamos Canyon in July 2009 to verify the material to be excavated would not be classified as Toxic Substances Control Act (TSCA) waste. The sampling locations and results are shown in Figure B-2.0-1 in Appendix B. The results ranged from 0.266 mg/kg to 15 mg/kg for Aroclor-1254, with Aroclor-1260 at roughly half those concentrations, confirming the material to be excavated from this area could be managed as low-level radioactive waste (LLW) because of its uranium content and would not be considered TSCA waste. All the material sampled was excavated and no longer represents site conditions; therefore, these data were not used to evaluate the interim measure.

In addition to the 20 samples collected from the basin area, five samples were collected from the bench above (north of) the basins and two samples were collected upcanyon (west) of the basins to bound contamination at the base of the drainage. Results from 2008 samples from six locations at the top of the drainage were used to bound the extent of contamination upgradient of the point where effluent from SWMU 01-001(f) entered the drainage.

4.1.2 Contaminated Sediment, Soil, and Rock Removal Activities

Two vacuum trucks and hand-digging methods were used to remove a total of 304 yd^3 of contaminated sediment from the drainage channel below SWMU 01-001(f) (Appendix A). Contaminated sediment removal activities began within the drainage below the SWMU 01-001(f) outfall on November 12, 2009, and were deemed complete on December 20, 2009, based on results of screening-level analyses (Appendixes A and C). Elevated moisture content in the sediment from numerous snowstorms caused the vacuum hoses to become plugged on a daily basis, and the site experienced extremely cold weather and snowstorms from December 10 to 23, 2009 (Appendix A).

When work resumed after the holidays, the soil over weathered tuff located at the SWMU 01-001(f) outfall was removed from January 6 to January 17, 2010.

Sampling data from tuff samples collected in the drainage following sediment removal showed elevated PCB concentrations in the tuff. Therefore, removal of contaminated rock from the drainage began on January 9, 2010. The rock was loaded into wrangler bags and moved down the drainage to the bottom of the canyon using zip lines. Residual rock was subsequently removed using the vacuum truck (Appendix A). Rock removal activities continued until confirmation samples indicated recreational SSLs were met. Rock removal from the drainage was deemed complete on January 25, 2010. A total of 192 yd^3 of rock was removed from the SWMU 01-001(f) drainage; 17.5 yd^3 of rock was removed using the vacuum trucks, and the remaining 174.5 yd^3 was removed from the drainage using wrangler bags and zip lines (Appendixes A and C). Sediment removal from Los Alamos Canyon below the SWMU 01-001(f) drainage, before the two retention basins were constructed, began in November 2009 and continued until January 19, 2010 (Appendix A). A total of 2290 yd^3 of contaminated sediment was removed from the deposition area in Los Alamos Canyon. The site experienced extremely cold weather and snowstorms from January 4 to March 1, 2010, hampering sediment and rock removal and waste-packaging activities (Appendixes A and C).

4.1.3 Screening and Confirmation Sampling

Samples collected during and after the interim measure activities included both screening-level samples (sent to a fixed laboratory for expedited screening analysis) as well as confirmation samples submitted for level-4 fixed-laboratory analysis by EPA Method SW-846:8082. In some cases where screening-level analytical results indicated that cleanup levels had been met or more definitive results were needed, screening-level samples were resubmitted for level-4 analysis, resulting in some samples producing both screening and level-4 data.

Removal of environmental media in the drainage below SWMU 01-001(f) was guided by the results of screening-level samples collected during removal activities. From November 1, 2009, through February 16, 2010, 85 sediment, tuff, and soil samples collected from the upper drainage and 20 sediment samples collected from the deposition area at the base of the drainage were screened for PCBs to determine the extent of contamination within the drainage. Based on screening data, all the sediment in the drainage was targeted for excavation. In addition, screening data indicated that colluvial soils above the high-water mark contained concentrations of PCBs above the cleanup levels. The presence of PCB contamination above the high-water mark was not anticipated based on the data from the 2008 characterization sampling as well as on the physical properties of the drainage. The results of the screening samples are discussed in section 5.1.

Once screening-level data indicated an area was clean, either the screening samples were rerun for level-4 analysis or additional confirmation samples were collected. Confirmation samples in the drainage were collected at a frequency of approximately one sample per 100 ft^2 (NMED 2009, 105858). Where the drainage was 10 ft across, samples were collected every 10 linear ft. Where the drainage was narrower or wider, sample collection was adjusted accordingly. Samples from the area of the retention basins were collected at a frequency of approximately one sample per 500 ft^2. A total of 64 confirmation samples were collected from drainage below SWMU 01-001(f), and 30 confirmation samples were collected from Los Alamos Canyon before construction of the surface water retention basins began. All confirmation samples were analyzed for level-4 PCB data by EPA Method SW-846:8082. Confirmation sampling locations are shown in Figure 4.1-1, and confirmation sampling results are discussed in section 5.1.

4.2 BMP Installation

In July and August 2009, interim stormwater control measures were installed as BMPs in the sediment deposition zone at the base of the drainage below SWMU 01-001(f) in accordance with direction from (NMED 2009, 105858). The following BMPs were put in place to enhance stormwater migration, infiltration, and sediment deposition across the sediment deposition/floodplain area during the 2009 monsoon season.

- Juniper bales were staked in the main flow channel as small check dams. The upstream juniper bales were staked into place in the channel to capture heavier organic material. A second set of filter-wrapped juniper bales was staked into place approximately 20 ft downstream of the location where juniper bale were initially installed to capture finer sediments. Existing downstream juniper bales were staked, and every other one was wrapped in filter fabric.
- Sediment retention in the deposition zone outside the channel was enhanced with the use of straw wattles as wings from the juniper bales.
- Terra-Tubes (designed to trap, filter, and treat [with polymer] sediment-laden runoff) were installed along the first juniper bale/wattle check dam and at the head of the channel.
- Downed logs just below the upper channel section were removed to allow stormwater to disperse out over the well-vegetated deposition zone.
- The upstream culvert was monitored and maintained to ensure it was not plugged.

Documentation of the BMP implementation was provided to NMED on August 28, 2009 (LANL 2009, 106799).

Following installation of the updated BMPs, surface flows from rain events infiltrated the alluvium within 100 to 150 ft of flow across the deposition/flood zone. No sign of erosion and minimal flow across the deposition/flood zone were observed after the 1-in. October 19, 2009, rain event. It is estimated that all flow infiltrated within 100 ft of flow across the deposition area with minimal sediment movement onto the zone from the above drainage system. The stormwater infiltrated very quickly and moved through the deposition zone towards the east where it was slowly released in the last 50 to 65 ft of thick vegetation (grasses, bushes and trees) above the east culvert. Based on rain events following the control measure installations and the amount/variety of permanent vegetation, the controls appeared to have worked as intended.

Most of the interim BMPs installed to protect the deposition area in the period before the surface water retention basins were constructed have now been removed to allow for construction of the retention basins. However, following construction of the retention basins (discussed in section 4.3), additional stabilization measures were taken in the drainage. On March 23, 2010, 320 willow stakes were planted downgradient of the easternmost berm. This area has also been hand-seeded with grass seed. This work was done without heavy equipment and thus could be performed during the shutdown for T&E species surveys because it did not significantly increase noise levels in the canyon.

4.3 Surface Water Retention Basin Construction

The LA-SMA-2 drainage area plus the basin area total approximately 22 acres (Figure 1.1-2). Approximately half the contributing drainage area consists primarily of residences (apartment buildings and single-family homes), office buildings, associated paved roadways, and parking areas. The remaining drainage area consists of forested and rocky areas associated with the steep side canyon that conveys runoff from the mesa top to the bottom of Los Alamos Canyon.

The surface water retention basins were designed to balance retention volume with site constraints. An operating roadway occupies the relatively narrow canyon floor, leaving limited area available for storage capacity. In addition, the presence of shallow alluvial groundwater minimizes the potential to increase retention volumes by increasing the depth of the basins. Another important part of the interim measure design is an enhanced control measure consisting of a bioswale and riparian vegetation that will be established between the eastern basin and the downstream culvert to approximate preconstruction drainage conditions. This enhanced control measure, which is anticipated to provide additional polishing of stormwater runoff from the site, requires additional space downgradient of the retention structures. Currently, this area consists of planted willow stakes and grass seed (section 4.2).

The retention basin design includes contingency for large storm events. The water retained from these events must be released without damage to the retention basins. In addition, antecedent storm events (storms that occur right after a storm event that results in the basins filling) can also cause the basin capacity to be exceeded, and the water must be released safely. An emergency spillway was placed in the western berm, and culverts were installed in each berm to allow larger storm events to pass through the retention basins without causing damage.

4.4 Monitoring

Monitoring of the site will be conducted in accordance with the individual permit and in coordination with NMED. Currently, discharges from the retention basin will be monitored at a location at the outlet of the culvert in the eastern berm (Figure 1.1-2) (NMED 2010, 108444). It is anticipated that the monitoring location may be moved to the downgradient end of the enhanced control measures (described in section 4.3) once the vegetation is established. Monitoring locations may be adjusted or added in the future to meet the requirements of the individual permit as well as to test the performance of the interim measure.

4.5 Waste Management

Waste generated during cleanup efforts at SWMU 01-001(f) included PCB-contaminated soil, sediment, and rock; contact waste; and removed vegetation.

The contaminated environmental waste was categorized as TSCA (greater than 50 mg/kg PCBs) and non-TSCA (less than 50 mg/kg PCBs). All the environmental media from the site was categorized as LLW because radionuclides (primarily isotopes of uranium) were detected above background values. Approximately 342 yd^3 of TSCA LLW was generated from the drainage below SWMU 01-001(f) during removal. Approximately 2300 yd^3 of non-TSCA LLW was generated within the canyon floor drainage (in the area of the retention basins) during the removal of contaminated sediments.

Contact waste was managed in accordance with the materials it came into contact with (i.e., either TSCA LLW or non-TSCA LLW) and disposed of with the PCB-contaminated soil, sediment, and rock. The vegetation, which was primarily removed from the area of the surface water retention basins, was managed as non-TSCA LLW.

To date, 342 yd^3 of TSCA LLW and 30 yd^3 of non-TSCA LLW have been shipped to the Energy Solutions facility in Clive, UT. All available waste documentation is presented in Appendix F.

5.0 INTERIM MEASURE RESULTS

5.1 Confirmation of Source Removal

Both screening-level and confirmation samples submitted for level-4 fixed-laboratory analysis were used to guide removal of PCB-contaminated media within the drainage below SWMU 01-001(f). Some samples were submitted for both screening-level and level-4 analysis. Screening-level data are presented in Table 5.1-1, and level-4 confirmation data are presented in Table 5.1-2 and shown on Plate 1.

Sampling data for 14 of the SWMU 01-001(f) drainage confirmation sampling locations, primarily at or just below the former outfall, show PCB concentrations above recreational SSLs. At some outfall sampling locations, contamination increased significantly with depth and confirmation sampling results for locations within the bottom of the excavated area exceed the original 2008 sample results for media that have since been excavated.

Data from the 3 out of the 30 confirmation samples collected within the location of the surface water retention basins show PCB concentrations above recreational SSLs. The expedited solvent (xylene) extraction screening analysis did not result in a complete extraction of PCBs from these samples. Therefore, although screening-level data indicated residential SSLs had been met, level-4 data showed PCB concentrations in excess of the residential SSLs. Screening results are shown in Table 5.1-1, and where applicable, are compared to the level-4 data for the same sample.

Data from samples collected during the Upper Los Alamos Canyon Aggregate Area investigation at the head of the SWMU 01-001(f) drainage (sampling locations 00-603830, 00-603832, 00-603833, 00-603834, 00-603835, and 00-603836) showed PCB concentrations below recreational SSLs (LANL 2009, 106597; LANL 2010, 108528). Data from samples collected from the bench above the area of the retention basins (sampling locations 01-609991, 01-609992, 01-609993, 01-609994, and 01-609995) also showed PCB concentrations well below recreational SSLs, indicating no impact from SWMU 01-001(f). Data from the preexcavation sample collected at the east end of the deposition area (sampling location LA-605587 [see Appendix B]) did not exceed recreational SSLs. Lastly, PCB concentrations did not exceed detection limits in samples collected from the canyon floor upstream of the SWMU 01-001(f) drainage (sampling locations LA-611127 and LA-611128. Together, these samples define the extent of contamination and bound the area requiring remediation.

5.2 Construction of Surface Water Retention Basins

Appendix D presents an engineering drawing of the surface water retention basins. Following excavation of the PCB-contaminated material from the area where the basins were constructed, a base-course marker layer was placed at the base of the excavation. North-south-trending berms were then constructed to create and separate the eastern and western basins. An east-west-trending berm was constructed along the southern edge of the site to separate the basins from the roadway. Because of the shallow alluvial groundwater, it was necessary to extend the berms above the original grade to increase the capacity of the retention basins.

The retention basin berms were designed to assist in controlling the inflow and outflow, to provide maximum storage time, and to maximize sediment removal. Berm fill material consists of compacted base course. The berms have 2:1 side slopes and an 8- to 10-ft top width. Both basins have an elevated outlet discharge pipe, and the western basin has an emergency spillway. Riprap was used to armor the outlet pipe discharge areas and the base of the emergency spillway.

The average basin depth exceeds 4 ft. The two basins are connected by the spillway and elevated outlet discharge pipe in the western berm. The elevation of the berm in the western basin (7050 ft above mean sea level) will allow water to basin at least 150 ft upstream. Therefore, as constructed, the surface water retention basins meet the requirements set forth by NMED (2009, 105858).

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the confirmation sampling data, additional removal actions are necessary in the SWMU 01-001(f) drainage. In some areas, most noticeably in weathered tuff and residual soils at the SWMU 01-001(f) outfall, PCB levels increase significantly with depth; therefore, vertical extent has not yet been defined in these areas. Additional removal of tuff and soil will be necessary at the outfall and just below the outfall where the effluent from the SWMU 01-001(f) septic system entered the drainage. Based on confirmation sampling results received to date, concentrations at very few locations within the drainage itself exceed the recreational SSLs because sediment between the outfall and the deposition area along Omega Road has been almost completely removed.

Although 10% (3 out of 30) of the samples collected in the footprint of the retention basins exceeded the recreational SSL for Aroclor-1254, they exceed the recreational SSL by less than 2 times and are covered with the base course used to construct the basins. Therefore, no pathway for exposure exists, and the site as a whole is not likely to pose a potential unacceptable risk. However, once removal activities are complete for the entire site, the corrective action will be evaluated to ensure it is protective of human health and the environment.

During the field work to remove known PCB contamination in rock and sediment within the SWMU 01-001(f) drainage, the presence of PCBs above recreational SSLs in colluvial soils was discovered. Although removing these soils was not in the original scope of the interim measure, most of this material was removed as of March 1, 2010. However, additional removal and confirmation sampling must be conducted following completion of T&E surveys in upper Los Alamos Canyon.

Construction of the surface water retention basins was completed on February 1, 2010. Additional enhancements to the retention structures were carried out in February and March 2010. The structures currently hold small amounts of water from recent snow, rainfall, and intermittent thaw events. Discharges from the retention basins will be monitored as described in section 4.4.

7.0 SCHEDULE FOR ADDITIONAL WORK

Based on communication from NMED (2009, 109035), additional removal actions will be completed by the time the 2010 monsoon season arrives, anticipated to be at the end of June 2010. A supplemental report detailing this next removal effort is due to NMED on or before October 1, 2010.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

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

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

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LANL (Los Alamos National Laboratory), February 1996. "Voluntary Corrective Action Completion Report for Potential Release Site 1-001(f), Hillside 140 Septic Outfall," Los Alamos National Laboratory document LA-UR-96-473, Los Alamos, New Mexico. (LANL 1996, 053797)

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LANL (Los Alamos National Laboratory), March 31, 2008. "Response to the Notice of Disapproval for the Work Plan to Investigate the Source of Polychlorinated Biphenyls at LA-SMA-2," Los Alamos National Laboratory document LA-UR-08-1964, Los Alamos, New Mexico. (LANL 2008, 101654)

LANL (Los Alamos National Laboratory), November 2008. "Los Alamos Site Monitoring Area 2 Interim Measure and Monitoring Plan," Los Alamos National Laboratory document LA-UR-08-6891, Los Alamos, New Mexico. (LANL 2008, 104020)

LANL (Los Alamos National Laboratory), February 25, 2010. "Request for Extension to Remove Polychlorinated Biphenyl-Contaminated Soils from LA-SMA-2 Due to Force Majeure," Los Alamos National Laboratory letter (EP2010-0099) to J.P. Bearzi (NMED-HWB) from M.J. Graham (LANL) and D.R. Gregory (DOE-LASO), Los Alamos, New Mexico. (LANL 2009, 108806)

LANL (Los Alamos National Laboratory), May 2009. "Investigation Report for Upper Los Alamos Canyon Aggregate Area," Los Alamos National Laboratory document LA-UR-09-3325, Los Alamos, New Mexico. (LANL 2009, 106597)

LANL (Los Alamos National Laboratory), July 17, 2009. "Request for Extension for Installation of Retention Ponds in the Los Alamos Site Monitoring Area 2 Drainage," Los Alamos National Laboratory letter (EP2009-0331) to J.P. Bearzi (NMED-HWB) from M.J. Graham (LANL) and D.R. Gregory (DOE-LASO), Los Alamos, New Mexico. (LANL 2009, 106587)

LANL (Los Alamos National Laboratory), August 28, 2009. "Documentation of Installation of Stormwater Controls at Los Alamos Site Monitoring Area 2," Los Alamos National Laboratory letter (EP2009-0408) to J.P. Bearzi (NMED-HWB) from M.J. Graham (LANL) and D.R. Gregory (DOE-LASO), Los Alamos, New Mexico. (LANL 2009, 106799)

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LANL (Los Alamos National Laboratory), February 2010. "Investigation Report for Upper Los Alamos Canyon Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-10-0422, Los Alamos, New Mexico. (LANL 2010, 108528)

NMED (New Mexico Environment Department), August 30, 2007. "Approval with Direction, Los Alamos and Pueblo Canyons Supplemental Investigation Report," 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 2007, 098284)

NMED (New Mexico Environment Department), March 4, 2008. "Notice of Disapproval, Work Plan to Investigate the Source of Polychlorinated Biphenyls at LA-SMA-2," 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 2008, 100545)

NMED (New Mexico Environment Department), July 18, 2008. "Approval with Modifications, Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," 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 2008, 103007)

NMED (New Mexico Environment Department), May 5, 2009. "Approval with Modifications, Los Alamos Site Monitoring Area 2 (LA-SMA-2) Interim Measure and Monitoring Plan to Mitigate Contaminated Sediment Transport in Los Alamos Canyon," 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, 105858)

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NMED (New Mexico Environment Department), March 8, 2010. "Approval of Extension Request, Removal of Polychlorinated Biphenyls (PCBs), Los Alamos Site Monitoring Area 2 (LA-SMA-2)," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 109035)

NMED (New Mexico Environment Department), April 21, 2010. "Notice of Approval Investigation Report for Upper Los Alamos Canyon Aggregate Area, Revision 1," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and M. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 109195)

8.2 Map Data Sources

Former Structures of the Los Alamos Site, Line Feature Representation; Los Alamos National Laboratory, Environment and Remediation Support Services Division, EP2010-0170; 1:2,500 Scale Data; 09 April 2010.

Former Structures of the Los Alamos Site; Los Alamos National Laboratory, Waste and Environmental Services Division, 2010-0A; 1:2,500 Scale Data; 09 April 2010.

Potential Release Sites; Los Alamos National Laboratory, Waste and Environmental Services Division, Environmental Data and Analysis Group, EP2009-0633; 1:2,500 Scale Data; 25 January 2010.

Orthophotography, 2008 Los Alamos National Laboratory Aerial Photography, Site Planning and Project Initiation Group, February 2009.

Former FFCA sampler, Current sampler, FFCA drainage area, Expanded drainage area; Unpublished 2009 data, Project 09-0004. Contains GPS locations, planned locations, field verified drainages, modeled expanded drainages. Los Alamos National Laboratory, ADEP-CAP Storm Water Program

LA Canyon berm/basin contour data; CAD export from Brown and Caldwell.

Watercourse; Los Alamos National Laboratory, ENV Water Quality & Hydrology Group; 05 April 2005.

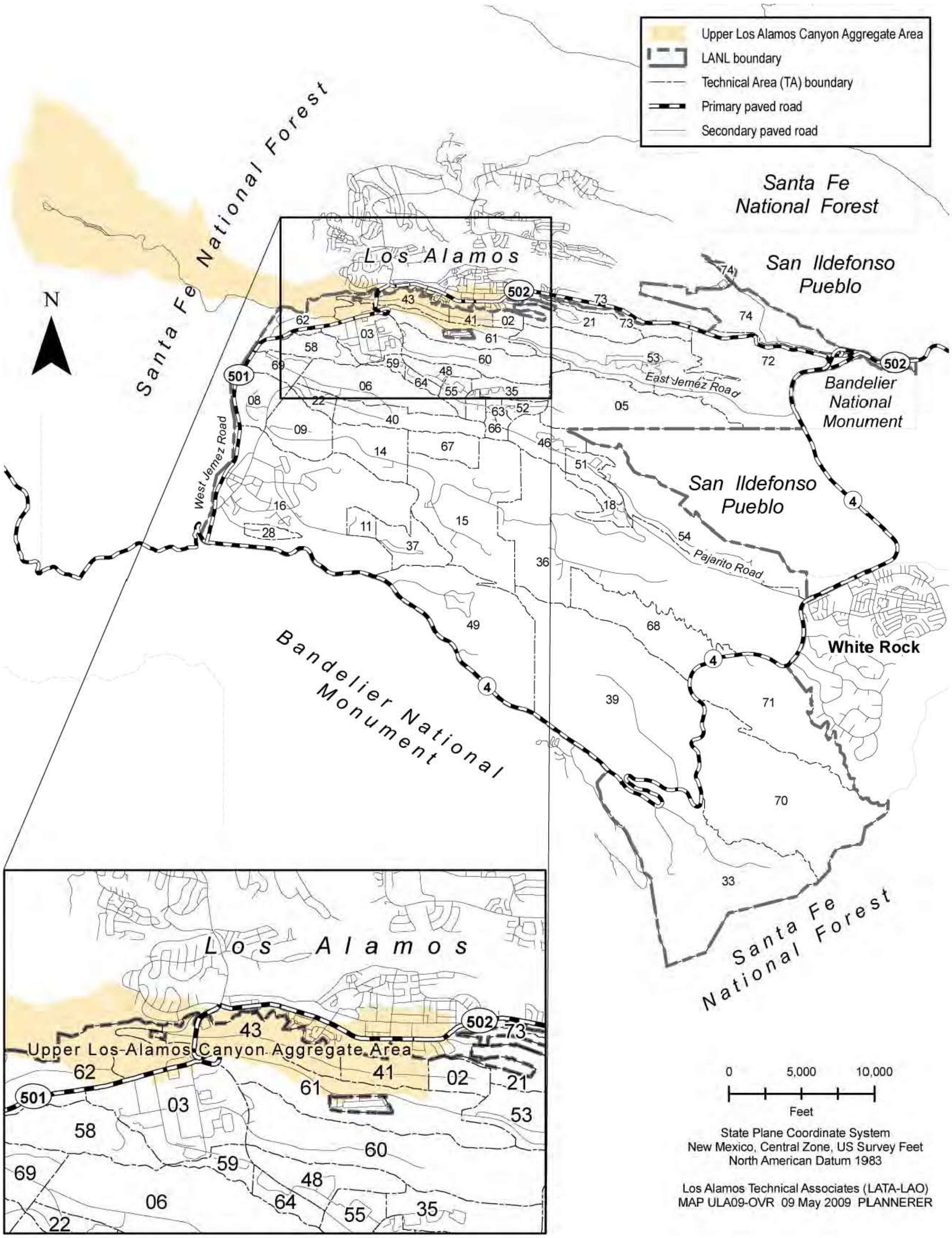


Figure 1.1-1 Location of Upper Los Alamos Canyon Aggregate Area and surrounding technical areas

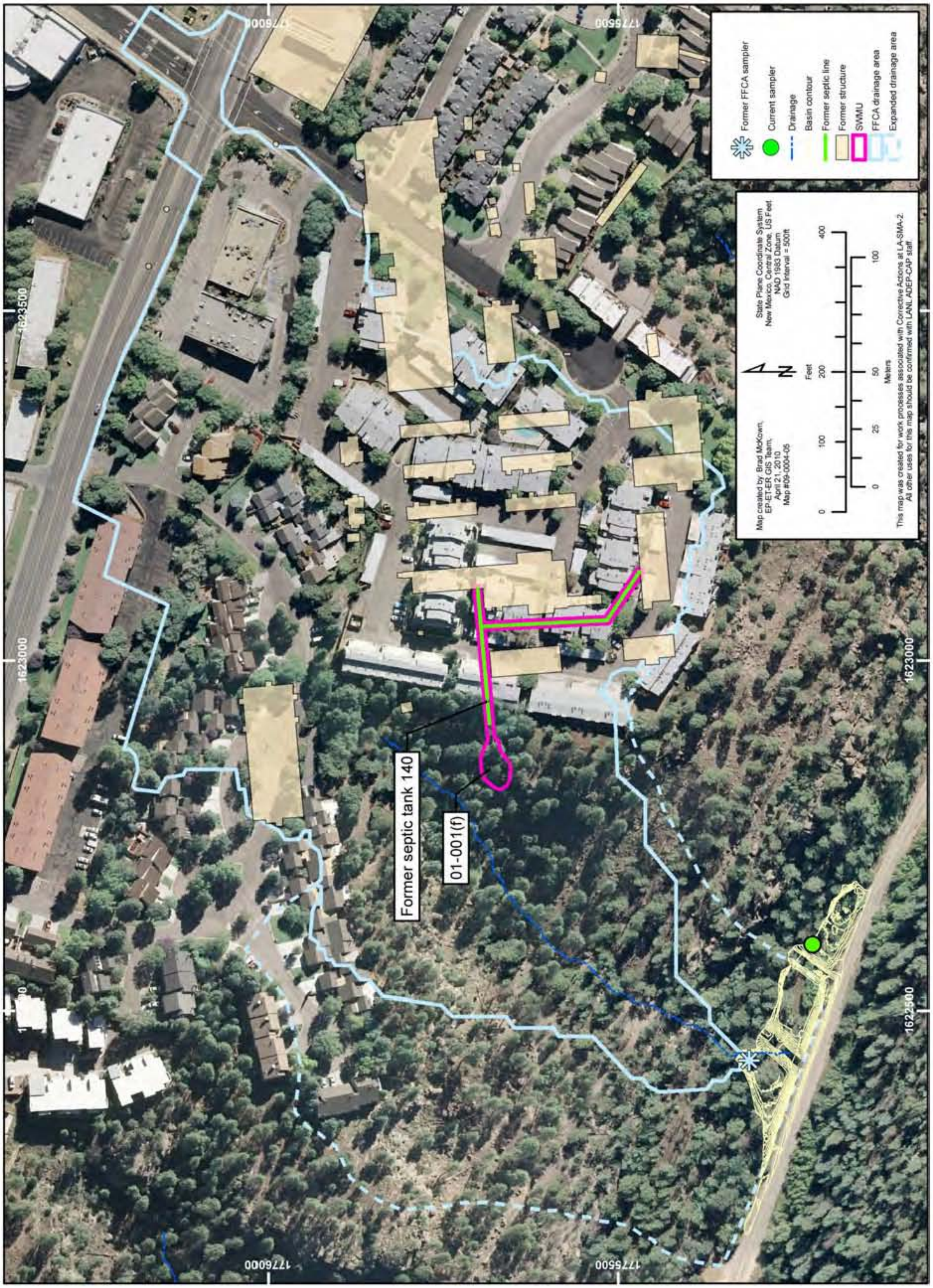


Figure 1.1-2 Locations of SWMU 01-001(f) and associated drainage

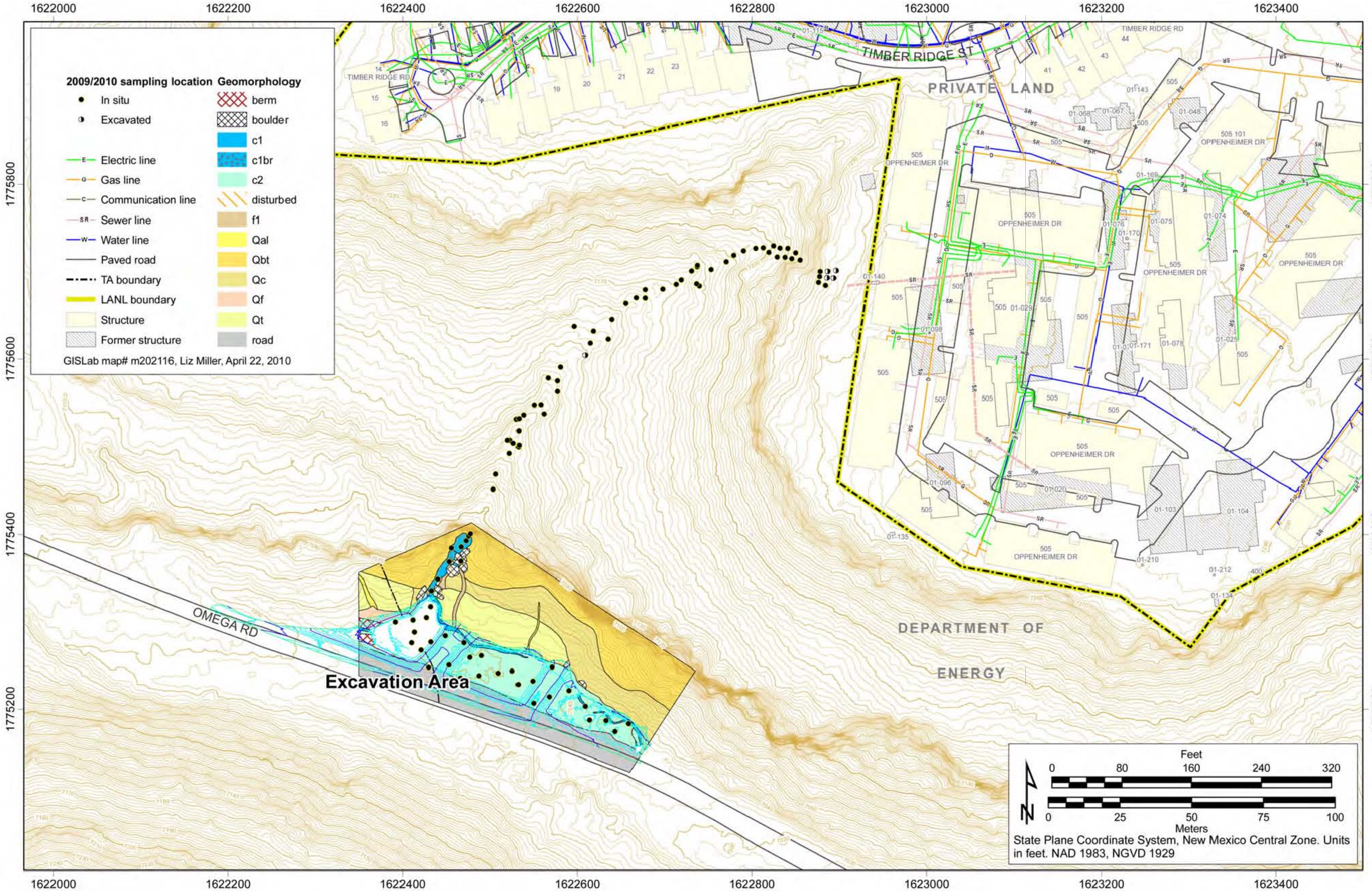


Figure 4.1-1 Sampling locations at SWMU 01-001(f), former septic tank and outfall

Table 4.1-1
Samples Collected and Analysis Requested at SWMU 01-001(f)

Sample ID	Location ID	Depth (ft)	Media	PCB*
RE00-08-16146	00-603830	0–1.25	SED	09-242
RE00-08-16147	00-603830	1.25–3.25	QBT3	09-242
RE00-08-16150	00-603832	0–1.25	SED	09-236
RE00-08-16151	00-603832	1.25–2.5	QBT3	09-236
RE00-08-16152	00-603833	0–1	SED	09-236
RE00-08-16153	00-603833	1–2	QBT3	09-236
RE00-08-16154	00-603834	0–1	SED	09-236
RE00-08-16155	00-603834	1.25–2.25	QBT3	09-236
RE00-08-16156	00-603835	0–1	SED	09-236
RE00-08-16157	00-603835	1–2	QBT3	09-236
RE00-08-16158	00-603836	0–1	SED	09-220
RE00-08-16159	00-603836	1.75–2.75	QBT3	09-220
RE01-10-5536	01-609991	0–0.04	SED	10-525
RE01-10-5537	01-609992	0–5.25	SED	10-525
RE01-10-5538	01-609993	0–2	SED	10-525
RE01-10-5539	01-609994	0–1.41	QAL	10-525
RE01-10-5540	01-609995	0–4.13	SED	10-525
RE01-10-11576	01-611286	0–0.25	SOIL	10-1307
RE01-10-11577	01-611287	0–0.25	SOIL	10-1307
RE01-10-11578	01-611288	0–0.25	SOIL	10-1307
RE01-10-11579	01-611289	0–0.25	SOIL	10-1307
RE01-10-11580	01-611290	0–0.25	SOIL	10-1307
RE01-10-11581	01-611291	0–0.25	SOIL	10-1307
RE01-10-11582	01-611292	0–0.25	SOIL	10-1307
RE01-10-11583	01-611293	0–0.25	SOIL	10-1307
RE01-10-11584	01-611294	0–0.25	SOIL	10-1307
RE01-10-11585	01-611295	0–0.25	SOIL	10-1307
RE01-10-11586	01-611296	0–0.25	SOIL	10-1307
RE01-10-11587	01-611297	0–0.25	SOIL	10-1307
CALA-10-11222	LA-609812	3–3.5	QBT3	10-1889
CALA-10-11223	LA-609813	3–3.5	QBT3	10-1889
CALA-10-11224	LA-609814	3–3.5	SOIL	10-1889
CALA-10-11225	LA-609817	3–3.5	SOIL	10-1889
CALA-10-9847	LA-610960	0–0.25	SED	10-1064
CALA-10-9848	LA-610961	0–0.25	SED	10-1064
CALA-10-9849	LA-610962	0–0.25	SED	10-1064
CALA-10-9850	LA-610963	0–0.25	SED	10-1064
CALA-10-9851	LA-610964	0–0.25	SED	10-1064

Table 4.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	PCB*
CALA-10-9852	LA-610965	0–0.25	SED	10-1064
CALA-10-9853	LA-610966	0–0.25	SED	10-1064
CALA-10-9854	LA-610967	0–0.25	SED	10-1064
CALA-10-9855	LA-610968	0–0.25	SED	10-1064
CALA-10-9856	LA-610969	0–0.25	SED	10-1064
CALA-10-9857	LA-610970	0–0.25	SED	10-1064
CALA-10-9858	LA-610971	0–0.25	SED	10-1064
CALA-10-9859	LA-610972	0–0.25	SED	10-1064
CALA-10-9860	LA-610973	0–0.25	SED	10-1064
CALA-10-9862	LA-610975	0–0.25	SED	10-1064
CALA-10-9863	LA-610976	0–0.25	SED	10-1064
CALA-10-9864	LA-610977	0–0.25	SED	10-1064
CALA-10-9866	LA-610979	0–0.25	SED	10-1064
CALA-10-11204	LA-611125	0–0.5	QBT3	10-1691
CALA-10-11201	LA-611127	0–1	SOIL	10-1308
CALA-10-11203	LA-611126	0–0.5	QBT3	10-1691
CALA-10-11202	LA-611128	0–1	SOIL	10-1308
CALA-10-11205	LA-611129	0–0.5	QBT3	10-1691
CALA-10-11206	LA-611130	0–0.5	QBT3	10-1691
CALA-10-11207	LA-611131	0–0.5	QBT3	10-1691
CALA-10-11208	LA-611132	0–0.5	QBT3	10-1691
CALA-10-11209	LA-611133	0–0.5	QBT3	10-1691
CALA-10-11210	LA-611134	0–0.5	QBT3	10-1691
CALA-10-11211	LA-611135	0–0.5	QBT3	10-1691
CALA-10-11212	LA-611136	0–0.5	QBT3	10-1691
CALA-10-11213	LA-611137	0–0.5	QBT3	10-1691
CALA-10-11215	LA-611139	0–0.5	QBT3	10-1691
CALA-10-11216	LA-611140	0–0.5	QBT3	10-1691
CALA-10-11217	LA-611141	0–0.5	QBT3	10-1691
CALA-10-11218	LA-611142	0–0.5	QBT3	10-1691
CALA-10-11219	LA-611143	0–0.5	QBT3	10-1691
CALA-10-11220	LA-611144	0–0.5	QBT3	10-1691
CALA-10-11221	LA-611145	0–0.5	QBT3	10-1691
CALA-10-11226	LA-611150	0–0.5	SOIL	10-1889
CALA-10-11227	LA-611151	0–0.5	SOIL	10-1889
CALA-10-11228	LA-611152	0.5–1	SOIL	10-1889
CALA-10-11229	LA-611153	0–1	SOIL	10-1889
CALA-10-11230	LA-611154	0–0.25	SOIL	10-1889
CALA-10-11231	LA-611155	0–0.33	SOIL	10-1889

Table 4.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	PCB*
CALA-10-11232	LA-611156	0–0.33	SOIL	10-1889
CALA-10-11233	LA-611157	0–0.166	SOIL	10-1889
CALA-10-11234	LA-611158	0–0.5	SOIL	10-1889
CALA-10-11235	LA-611158	0.5–1.5	SOIL	10-1889
CALA-10-11236	LA-611160	0–0.5	SOIL	10-1889
CALA-10-11237	LA-611160	0.5–1.5	SOIL	10-1889
CALA-10-11238	LA-611162	0–6	SOIL	10-1889
CALA-10-11239	LA-611162	6–12	SOIL	10-1889
CALA-10-11240	LA-611164	0–0.5	QBT3	10-2100
CALA-10-11241	LA-611165	0–0.5	QBT3	10-2100
CALA-10-11242	LA-611166	0–0.5	QBT3	10-2100
CALA-10-11243	LA-611167	0–0.5	QBT3	10-2100
CALA-10-11244	LA-611168	0–0.5	QBT3	10-2100
CALA-10-11245	LA-611169	0–0.5	QBT3	10-2100
CALA-10-11246	LA-611170	0–0.5	QBT3	10-2100
CALA-10-11247	LA-611171	0–0.5	QBT3	10-2100
CALA-10-11248	LA-611172	0–0.5	SED	10-2100
CALA-10-11249	LA-611173	0–0.5	SOIL	10-2100
CALA-10-11250	LA-611174	0–0.5	QBT3	10-2100
CALA-10-11251	LA-611175	0–0.5	QBT3	10-2100
CALA-10-11252	LA-611176	0–0.5	QBT3	10-2100
CALA-10-11253	LA-611177	0–0.5	QBT3	10-2100
CALA-10-11254	LA-611178	0–0.5	QBT3	10-2100
CALA-10-11255	LA-611179	0–0.5	QBT3	10-2100
CALA-10-11256	LA-611180	0–0.5	QBT3	10-2100
CALA-10-11257	LA-611181	0–0.5	QBT3	10-2100
CALA-10-11258	LA-611182	0–0.5	QBT3	10-2100
CALA-10-11259	LA-611183	0–0.5	SED	10-2100
CALA-10-11260	LA-611184	0–0.5	QBT3	10-2100
CALA-10-11261	LA-611185	0–0.5	QBT3	10-2100
CALA-10-11262	LA-611186	0–0.5	QBT3	10-2142
CALA-10-11263	LA-611187	0–0.5	SED	10-2142
CALA-10-11264	LA-611188	0–0.5	QBT3	10-2142
CALA-10-11265	LA-611189	0–0.5	QBT3	10-2142
CALA-10-11266	LA-611190	0–0.5	QBT3	10-2142
CALA-10-11267	LA-611191	0–0.5	QBT3	10-2142
CALA-10-11268	LA-611192	0–0.5	QBT3	10-2142
CALA-10-11269	LA-611193	0–0.5	QBT3	10-2142
CALA-10-11270	LA-611194	0–0.5	QBT3	10-2142

*Numbers in this column are analytical request numbers.

Table 5.1-1
Screening-Level Analytical Results

Sample ID	Location ID	Depth (ft)	Media Code	Screening-Level Analytical Result (mg/kg)	Screening Aroclors Detected	Confirmation Results (Level-4 Data)	
						Aroclor-1254 (mg/kg)	Aroclor-1260 (mg/kg)
CALA-10-4590	LA-609787	0–0.5	ALLH	80	1254 and 1260	NA[a]	NA
CALA-10-4591	LA-609788	0–1	QBT3	11	1254 and 1260	NA	NA
CALA-10-4592	LA-609789	0–1	QBT3	26	1254 and 1260	NA	NA
CALA-10-4593	LA-609790	0–1	QBT3	19	1254 and 1260	NA	NA
CALA-10-4594	LA-609791	0–1	QBT3	232	1254 and 1260	NA	NA
CALA-10-4595	LA-609792	0–0.5	ALLH	98	1254 and 1260	NA	NA
CALA-10-4596	LA-609793	0–0.5	ALLH	108	1254 and 1260	NA	NA
CALA-10-4597	LA-609794	0–0.5	ALLH	253	1254 and 1260	NA	NA
CALA-10-4598	LA-609795	0–0.5	ALLH	26	1254 and 1260	NA	NA
CALA-10-4599	LA-609796	0–0.5	ALLH	115	1254 and 1260	NA	NA
CALA-10-4600	LA-609797	0–0.5	ALLH	123	1254 and 1260	NA	NA
CALA-10-4601	LA-609798	0–0.5	ALLH	117	1254 and 1260	NA	NA
CALA-10-4602	LA-609799	0–0.5	ALLH	73	1254 and 1260	NA	NA
CALA-10-4603	LA-609800	0–0.5	QBT2	3	1254 and 1260	NA	NA
CALA-10-4604	LA-609801	0–0.5	QBT2	27	1254 and 1260	NA	NA
CALA-10-4605	LA-609802	0–0.5	QBT2	6	1254 and 1260	NA	NA
CALA-10-4606	LA-609803	0–0.5	QBT2	39	1254 and 1260	NA	NA
CALA-10-4607	LA-609804	0–0.5	QBT2	<1.0	1254 and 1260	NA	NA
CALA-10-4608	LA-609805	0–0.5	ALLH	20	1254 and 1260	NA	NA
CALA-10-4609	LA-609806	0–0.5	ALLH	162	1254 and 1260	NA	NA
CALA-10-4610	LA-609807	0–0.5	ALLH	15	1254 and 1260	NA	NA
CALA-10-4611	LA-609808	0–0.5	ALLH	139	1254 and 1260	NA	NA
CALA-10-4612	LA-609809	0–0.5	ALLH	400	1254 and 1260	NA	NA
CALA-10-4613	LA-609810	0–0.5	ALLH	ND[b]	1254 and 1260	NA	NA
CALA-10-4614	LA-609811	0–0.5	ALLH	ND	1254 and 1260	NA	NA
CALA-10-4615	LA-609812	0–0.5	ALLH	7.1	1254 and 1260	NA	NA
CALA-10-4616	LA-609813	0–0.5	ALLH	109	1254 and 1260	NA	NA
CALA-10-4617	LA-609814	0–0.5	ALLH	230	1254 and 1260	NA	NA
CALA-10-4618	LA-609815	0–0.5	ALLH	ND	1254 and 1260	NA	NA
CALA-10-4619	LA-609816	0–0.5	ALLH	2.4	1254 and 1260	NA	NA
CALA-10-4620	LA-609817	0–0.5	ALLH	6.1	1254 and 1260	NA	NA
CALA-10-4621	LA-609818	0–0.5	ALLH	17	1254 and 1260	NA	NA
CALA-10-4622	LA-609819	0–0.5	ALLH	50	1254 and 1260	NA	NA
CALA-10-4623	LA-609820	0–0.5	ALLH	4.6	1254 and 1260	NA	NA

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Media Code	Screening-Level Analytical Result (mg/kg)	Screening Aroclors Detected	Confirmation Results (Level-4 Data)	
						Aroclor-1254 (mg/kg)	Aroclor-1260 (mg/kg)
CALA-10-4624	LA-609821	0–0.5	ALLH	35	1254 and 1260	NA	NA
CALA-10-4625	LA-609822	0–0.5	ALLH	2.1	1254 and 1260	NA	NA
CALA-10-4626	LA-609823	0–0.5	QBT3	<0.15	1254 and 1260	NA	NA
CALA-10-4627	LA-609824	0.5–1	QBT3	<0.15	1254 and 1260	NA	NA
CALA-10-4628	LA-609825	0–0.5	QBT3	3.2	1254 and 1260	NA	NA
CALA-10-4629	LA-609826	0.5–1	QBT3	<0.15	1254 and 1260	NA	NA
CALA-10-4630	LA-609827	0–0.5	QBT3	15.6	1254 and 1260	NA	NA
CALA-10-4631	LA-609828	0.5–0.8	QBT3	20	1254 and 1260	NA	NA
CALA-10-4632	LA-609829	0–0.5	QBT3	17	1254 and 1260	NA	NA
CALA-10-4633	LA-609830	0.5–1	QBT3	2	1254 and 1260	NA	NA
CALA-10-4634	LA-609812	2–2.5	ALLH	38	1254	NA	NA
CALA-10-4635	LA-609813	2–2.5	ALLH	190	1254	NA	NA
CALA-10-4636	LA-609814	2–2.5	ALLH	8	1254	NA	NA
CALA-10-4637	LA-609817	2–2.5	ALLH	9	1254	NA	NA
CALA-10-11203	LA-611126	0–0.5	QBT3	0.35	1254 and 1260	0.23 (J)[c]	0.11
CALA-10-11204	LA-611125	0–0.5	QBT3	0.34	1254 and 1260	0.23 (J)	0.1
CALA-10-11205	LA-611129	0–0.5	QBT3	0.38	1254	0.38 (J)	0.15 (J)
CALA-10-11206	LA-611130	0–0.5	QBT3	0.66	1254	0.66 (J)	0.3 (J)
CALA-10-11207	LA-611131	0–0.5	QBT3	<0.15	Total	0.033 (J)	0.014 (J)
CALA-10-11208	LA-611132	0–0.5	QBT3	<0.15	Total	0.11 (J)	0.047
CALA-10-11209	LA-611133	0–0.5	QBT3	<0.15	Total	0.1 (J)	0.043
CALA-10-11210	LA-611134	0–0.5	QBT3	<0.15	Total	0.13 (J)	0.058
CALA-10-11211	LA-611135	0–0.5	QBT3	<0.15	Total	0.13 (J)	0.06
CALA-10-11212	LA-611136	0–0.5	QBT3	4.5	1254 and 1260	3.6 (J)	2.1 (J)
CALA-10-11213	LA-611137	0–0.5	QBT3	1.7	1254 and 1260	1.5 (J)	0.63 (J)
CALA-10-11214	LA-611138	0–0.5	QBT3	13	1254 and 1260	NA	NA
CALA-10-11215	LA-611139	0–0.5	QBT3	3.3	1254 and 1260	3.2 (J)	1.6 (J)
CALA-10-11216	LA-611140	0–0.5	QBT3	<0.15	Total	0.031 (J)	0.03 (U)[d]
CALA-10-11217	LA-611141	0–0.5	QBT3	<0.15	Total	0.01 (J)	0.03 (U)
CALA-10-11218	LA-611142	0–0.5	QBT3	<0.15	Total	0.56 (J)	0.23
CALA-10-11219	LA-611143	0–0.5	QBT3	4.8	1254 and 1260	4.8 (J)	1.9 (J)
CALA-10-11220	LA-611144	0–0.5	QBT3	1.5	1254 and 1260	1.5 (J)	0.62 (J)
CALA-10-11221	LA-611145	0–0.5	QBT3	1.4	1254 and 1260	1.4 (J)	0.56 (J)
CALA-10-11222	LA-609812	3–3.5	QBT3	8.4	1254	8.4	2 (U)
CALA-10-11223	LA-609813	3–3.5	QBT3	1	1254	1	0.2 (U)
CALA-10-11224	LA-609814	3–3.5	QBT3	58	1254	59	2 (U)

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Media Code	Screening-Level Analytical Result (mg/kg)	Screening Aroclors Detected	Confirmation Results (Level-4 Data)	
						Aroclor-1254 (mg/kg)	Aroclor-1260 (mg/kg)
CALA-10-11225	LA-609817	3–3.5	ALLH	1100	1254	1100	20 (U)
CALA-10-11226	LA-611150	0–0.5	ALLH	22	Total	22	2 (U)
CALA-10-11227	LA-611151	0–0.5	ALLH	0.31	Total	0.31 (U)	0.2 (U)
CALA-10-11228	LA-611152	0.5–1	ALLH	0.17	Total	0.17 (U)	0.2 (U)
CALA-10-11229	LA-611153	0–1	SOIL	1.9	Total	1.9	0.2 (U)
CALA-10-11230	LA-611154	0–0.25	SOIL	0.86	Total	0.86	0.2 (U)
CALA-10-11231	LA-611155	0–0.33	SOIL	1.7/0.97	1254/1260	1.7	0.97
CALA-10-11232	LA-611156	0–0.33	ALLH	0.28	1254	0.28 (U)	0.2 (U)
CALA-10-11233	LA-611157	0–0.166	SOIL	0.98/0.47	1254/1260	0.98	0.47
CALA-10-11234	LA-611158	0–0.5	SOIL	3.0/1.4	1254/1260	3	1.4
CALA-10-11235	LA-611158	0.5–1.5	SOIL	0.64/0.31	1254/1260	0.64	0.31
CALA-10-11236	LA-611160	0–0.5	SOIL	6.3/3.0	1254/1260	6.3	3
CALA-10-11237	LA-611160	0.5–1.5	SOIL	1.6/0.72	1254/1260	1.6	0.72
CALA-10-11238	LA-611162	0–0.5	SOIL	2.2/0.98	1254/1260	2.2	0.98
CALA-10-11239	LA-611162	0.5–1	SOIL	0.85/0.40	1254/1260	0.85	0.4
CALA-10-9847	LA-610960	0–0.25	SED	2.8	Total	10 (J)	0.75 (U)
CALA-10-9848	LA-610961	0–0.25	SED	<0.15	Total	0.6 (J)	0.15 (U)
CALA-10-9849	LA-610962	0–0.25	SED	2.4	Total	3.6 (J)	0.75 (U)
CALA-10-9850	LA-610963	0–0.25	SED	<0.15	Total	0.37 (J)	0.15 (U)
CALA-10-9851	LA-610964	0–0.25	SED	4.5	Total	12 (J)	1.5 (U)
CALA-10-9852	LA-610965	0–0.25	SED	3	Total	5.4 (J)	0.75 (U)
CALA-10-9853	LA-610966	0–0.25	SED	5.5	Total	7.8 (J)	3 (U)
CALA-10-9854	LA-610967	0–0.25	SED	<0.15	Total	0.34 (J)	0.15 (U)
CALA-10-9855	LA-610968	0–0.25	SED	1	Total	1.7 (J)	0.3 (U)
CALA-10-9856	LA-610969	0–0.25	SED	3.4	Total	2.8 (J)	1.5 (U)
CALA-10-9857	LA-610970	0–0.25	SED	1.6	Total	0.76 (J)	0.75 (U)
CALA-10-9858	LA-610971	0–0.25	SED	<0.15	Total	0.16 (J)	0.15 (U)
CALA-10-9859	LA-610972	0–0.25	SED	0.7	Total	0.42 (J)	0.3 (U)
CALA-10-9860	LA-610973	0–0.25	SED	0.4	Total	0.51 (J)	0.15 (U)
CALA-10-9861	LA-610974	0–0.25	SED	8.7	Total	NA	NA
CALA-10-9862	LA-610975	0–0.25	SED	2.5	Total	1.6 (J)	0.75 (U)
CALA-10-9863	LA-610976	0–0.25	SED	<0.15	Total	0.12 (J)	0.15 (U)
CALA-10-9864	LA-610977	0–0.25	SED	1	Total	1.5 (J)	0.75 (U)

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft)	Media Code	Screening-Level Analytical Result (mg/kg)	Screening Aroclors Detected	Confirmation Results (Level-4 Data)	
						Aroclor-1254 (mg/kg)	Aroclor-1260 (mg/kg)
CALA-10-9865	LA-610978	0–0.25	SED	7.3	Total	NA	NA
CALA-10-9866	LA-610979	0–0.25	SED	0.7	Total	0.24 (J)	0.15 (U)

Notes: Shading indicates sampling area has been excavated.

[a] NA = Not analyzed.

[b] ND = Not detected.

[c] 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.

[d] U = The analyte was analyzed for but not detected.

Table 5.1-2
PCBs Detected in Confirmation Samples from SWMU 01-001(f)

Sample ID	Location ID	Depth (ft)	Media	Aroclor-1254	Aroclor-1260
Recreational SSL				**6.65**	**10.5**
RE00-08-16146	00-603830	0–1.25	SED	5.4 (J)[a]	—[b]
RE00-08-16147	00-603830	1.25–3.25	QBT3	0.55 (J)	—
RE00-08-16150	00-603832	0–1.25	SED	0.17 (J)	0.094
RE00-08-16152	00-603833	0–1	SED	0.038 (J)	0.036
RE00-08-16153	00-603833	1–2	QBT3	0.038 (J)	—
RE00-08-16154	00-603834	0–1	SED	0.089 (J)	0.066
RE00-08-16156	00-603835	0–1	SED	0.067 (J)	0.036
RE00-08-16158	00-603836	0–1	SED	0.5 (J)	—
RE00-08-16159	00-603836	1.75–2.75	QBT3	0.82 (J)	—
RE01-10-5537	01-609992	0–5.25	SED	0.0215	0.0103
RE01-10-5538	01-609993	0–2	SED	0.0068	0.0057
RE01-10-5540	01-609995	0–4.13	SED	0.0028 (J)	0.0025 (J)
RE01-10-11577	01-611287	0–0.25	SOIL	0.36	—
RE01-10-11578	01-611288	0–0.25	SOIL	0.47	—
RE01-10-11579	01-611289	0–0.25	SOIL	0.23	—
RE01-10-11580	01-611290	0–0.25	SOIL	0.99	—
RE01-10-11581	01-611291	0–0.25	SOIL	0.32	—
RE01-10-11582	01-611292	0–0.25	SOIL	0.16	—
RE01-10-11583	01-611293	0–0.25	SOIL	5.4	—
RE01-10-11584	01-611294	0–0.25	SOIL	1.6	—
RE01-10-11585	01-611295	0–0.25	SOIL	0.26	—
RE01-10-11586	01-611296	0–0.25	SOIL	3.3	—
RE01-10-11587	01-611297	0–0.25	SOIL	5.8	—
CALA-10-11222	LA-609812	3–3.5	QBT3	8.4	—
CALA-10-11223	LA-609813	3–3.5	QBT3	1	—
CALA-10-11224	LA-609814	3–3.5	SOIL	59	—
CALA-10-11225	LA-609817	3–3.5	SOIL	1100	—
CALA-10-9847	LA-610960	0–0.25	SED	10 (J)	—
CALA-10-9848	LA-610961	0–0.25	SED	0.6 (J)	—
CALA-10-9849	LA-610962	0–0.25	SED	3.6 (J)	—
CALA-10-9850	LA-610963	0–0.25	SED	0.37 (J)	—
CALA-10-9851	LA-610964	0–0.25	SED	12 (J)	—
CALA-10-9852	LA-610965	0–0.25	SED	5.4 (J)	—
CALA-10-9853	LA-610966	0–0.25	SED	7.8 (J)	—
CALA-10-9854	LA-610967	0–0.25	SED	0.34 (J)	—

Table 5.1-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aroclor-1254	Aroclor-1260
Recreational SSL				**6.65**	**10.5**
CALA-10-9855	LA-610968	0–0.25	SED	1.7 (J)	—
CALA-10-9856	LA-610969	0–0.25	SED	2.8 (J)	—
CALA-10-9857	LA-610970	0–0.25	SED	0.76 (J)	—
CALA-10-9858	LA-610971	0–0.25	SED	0.16 (J)	—
CALA-10-9859	LA-610972	0–0.25	SED	0.42 (J)	—
CALA-10-9860	LA-610973	0–0.25	SED	0.51 (J)	—
CALA-10-9862	LA-610975	0–0.25	SED	1.6 (J)	—
CALA-10-9863	LA-610976	0–0.25	SED	0.12 (J)	—
CALA-10-9864	LA-610977	0–0.25	SED	1.5 (J)	—
CALA-10-9866	LA-610979	0–0.25	SED	0.24 (J)	—
CALA-10-11204	LA-611125	0–0.5	QBT3	0.23 (J)	0.1
CALA-10-11203	LA-611126	0–0.5	QBT3	0.23 (J)	0.11
CALA-10-11205	LA-611129	0–0.5	QBT3	0.38 (J)	0.15 (J)
CALA-10-11206	LA-611130	0–0.5	QBT3	0.66 (J)	0.3 (J)
CALA-10-11207	LA-611131	0–0.5	QBT3	0.033 (J)	0.014 (J)
CALA-10-11208	LA-611132	0–0.5	QBT3	0.11 (J)	0.047
CALA-10-11209	LA-611133	0–0.5	QBT3	0.1 (J)	0.043
CALA-10-11210	LA-611134	0–0.5	QBT3	0.13 (J)	0.058
CALA-10-11211	LA-611135	0–0.5	QBT3	0.13 (J)	0.06
CALA-10-11212	LA-611136	0–0.5	QBT3	3.6 (J)	2.1 (J)
CALA-10-11213	LA-611137	0–0.5	QBT3	1.5 (J)	0.63 (J)
CALA-10-11215	LA-611139	0–0.5	QBT3	3.2 (J)	1.6 (J)
CALA-10-11216	LA-611140	0–0.5	QBT3	0.031 (J)	—
CALA-10-11217	LA-611141	0–0.5	QBT3	0.01 (J)	—
CALA-10-11218	LA-611142	0–0.5	QBT3	0.56 (J)	0.23
CALA-10-11219	LA-611143	0–0.5	QBT3	4.8 (J)	1.9 (J)
CALA-10-11220	LA-611144	0–0.5	QBT3	1.5 (J)	0.62 (J)
CALA-10-11221	LA-611145	0–0.5	QBT3	1.4 (J)	0.56 (J)
CALA-10-11226	LA-611150	0–0.5	SOIL	22	—
CALA-10-11229	LA-611153	0–1	SOIL	1.9	—
CALA-10-11230	LA-611154	0–0.25	SOIL	0.86	—
CALA-10-11231	LA-611155	0–0.33	SOIL	1.7	0.97
CALA-10-11233	LA-611157	0–0.166	SOIL	0.98	0.47
CALA-10-11234	LA-611158	0–0.5	SOIL	3	1.4
CALA-10-11235	LA-611158	0.5–1.5	SOIL	0.64	0.31
CALA-10-11236	LA-611160	0–0.5	SOIL	6.3	3
CALA-10-11237	LA-611160	0.5–1.5	SOIL	1.6	0.72

Table 5.1-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	Aroclor-1254	Aroclor-1260
Recreational SSL				**6.65**	**10.5**
CALA-10-11238	LA-611162	0–0.5	SOIL	2.2	0.98
CALA-10-11239	LA-611162	0.5–1	SOIL	0.85	0.4
CALA-10-11240	LA-611164	0–0.5	QBT3	3.3	1.53
CALA-10-11241	LA-611165	0–0.5	QBT3	1.16	0.443
CALA-10-11242	LA-611166	0–0.5	QBT3	8.57	4.55
CALA-10-11243	LA-611167	0–0.5	QBT3	0.829	0.503
CALA-10-11244	LA-611168	0–0.5	QBT3	53.2	21.1
CALA-10-11245	LA-611169	0–0.5	QBT3	175	63.8
CALA-10-11246	LA-611170	0–0.5	QBT3	22.3	9.5
CALA-10-11247	LA-611171	0–0.5	QBT3	4.49	1.88
CALA-10-11248	LA-611172	0–0.5	SED	240	94.4
CALA-10-11249	LA-611173	0–0.5	SOIL	179	73
CALA-10-11250	LA-611174	0–0.5	QBT3	7.46	3.82
CALA-10-11251	LA-611175	0–0.5	QBT3	2.28	1.06
CALA-10-11252	LA-611176	0–0.5	QBT3	1.63	0.624
CALA-10-11253	LA-611177	0–0.5	QBT3	3.04	1.65 (J)
CALA-10-11254	LA-611178	0–0.5	QBT3	39.3	18.4
CALA-10-11255	LA-611179	0–0.5	QBT3	0.254	0.145
CALA-10-11256	LA-611180	0–0.5	QBT3	0.163	0.0848
CALA-10-11257	LA-611181	0–0.5	QBT3	0.252	0.122
CALA-10-11258	LA-611182	0–0.5	QBT3	5.88	2.48
CALA-10-11259	LA-611183	0–0.5	SED	12.6	5.32
CALA-10-11260	LA-611184	0–0.5	QBT3	0.541	0.322
CALA-10-11261	LA-611185	0–0.5	QBT3	16.9	6.61
CALA-10-11262	LA-611186	0–0.5	QBT3	0.0362	0.0248
CALA-10-11263	LA-611187	0–0.5	SED	4.27	2.31
CALA-10-11264	LA-611188	0–0.5	QBT3	0.573	0.304
CALA-10-11265	LA-611189	0–0.5	QBT3	2.48	1.34
CALA-10-11266	LA-611190	0–0.5	QBT3	0.895	0.485
CALA-10-11267	LA-611191	0–0.5	QBT3	6.31	3.21
CALA-10-11268	LA-611192	0–0.5	QBT3	0.342	0.171
CALA-10-11269	LA-611193	0–0.5	QBT3	2.27	1.2
CALA-10-11270	LA-611194	0–0.5	QBT3	0.225	0.184

Note: Units are in mg/kg.

[a] 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.

[b] — = Not detected.

Appendix A

Site Photographs

A-1.0 PREREMEDIATION CONDITIONS AND 2008–2009 INVESTIGATION SAMPLING LOCATIONS

Looking east towards the 01-001(f) outfall, before remediation of the drainage

Location ID 603833

Location ID 603835

Historical trail crossing looking south (downstream)

Location ID 603843

Looking north towards cliff at the bottom of the drainage

Original location of LA-SMA-2 sampler

Sediment deposition area at base of drainage, looking north

Sediment deposition area at base of drainage, looking west

A-2.0 REMOVAL ACTIVITIES IN SOLID WASTE MANAGEMENT UNIT 01-001(f) DRAINAGE

Vacuum truck staged in canyon bottom at base of drainage

Vacuum truck staged in canyon bottom at base of drainage

Crews setting up vacuum piping within drainage

View of vacuum piping from bottom drainage

View of vacuum piping from bottom of drainage

View of crews setting up vacuum piping from drainage looking toward canyon bottom

Crews vacuuming contaminated sediment from drainage

Crews vacuuming contaminated sediment from drainage

Crews vacuuming contaminated sediment between boulders in drainage

Crews vacuuming contaminated sediment from drainage

Crews vacuuming contaminated sediment from drainage

Crews vacuuming contaminated sediment from drainage

View of vacuum trucks from drainage

View from vacuum truck looking up to drainage from canyon bottom

Vacuum operations within drainage

Vacuum truck emptying sediment into rolloff bin

View of sediment vacuumed from drainage in rolloff bin

Vacuum truck and rolloff bin

Vacuum pipe within drainage

View of vacuum pipe at bottom of drainage and canyon bottom

Jackhammer used to remove contaminated rock from drainage

Crews removing contaminated rock from drainage using jack hammers

View of drainage during rock removal activities

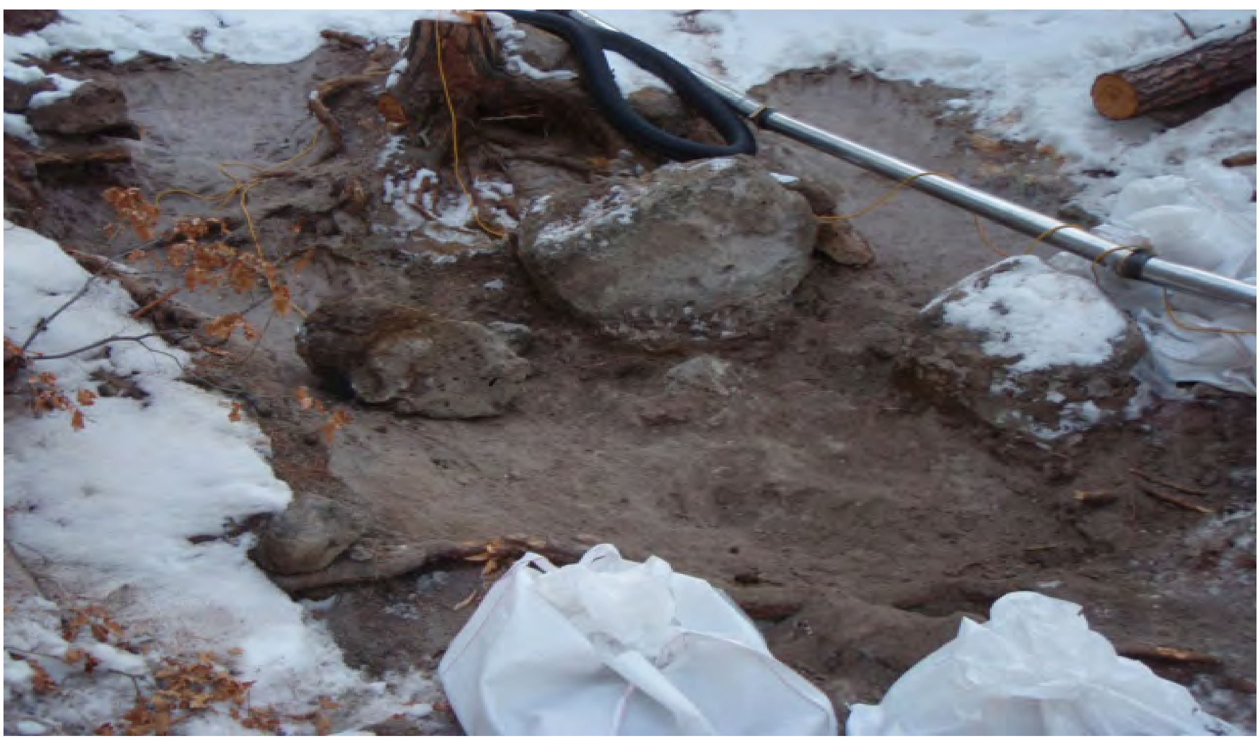
Contaminated tuff excavated from drainage following sediment removal

View of drainage during sediment and rock removal activities

Bottom of drainage and construction of new retention pond in canyon bottom below

Section of drainage following sediment and rock removal

Confirmation sampling location within drainage and bags of excavated rock



Bags of excavated rock and vacuum hose within drainage

Bags of excavated rock staged along drainage adjacent to vacuum line

Confirmation sampling location within drainage

Confirmation sampling location and vacuum pipe within drainage

Confirmation sampling location within drainage

Confirmation sampling location outside drainage

Snow and ice within drainage during removal and confirmation sampling activities

Transect sampling locations across drainage

Bags of excavated rock staged with drainage next to vacuum pipe

Rock removal and packaging activities within drainage

Collection of confirmation samples within drainage in snowy conditions

Collection of confirmation samples within drainage in snowy conditions

Surveying drainage and confirmation sampling locations

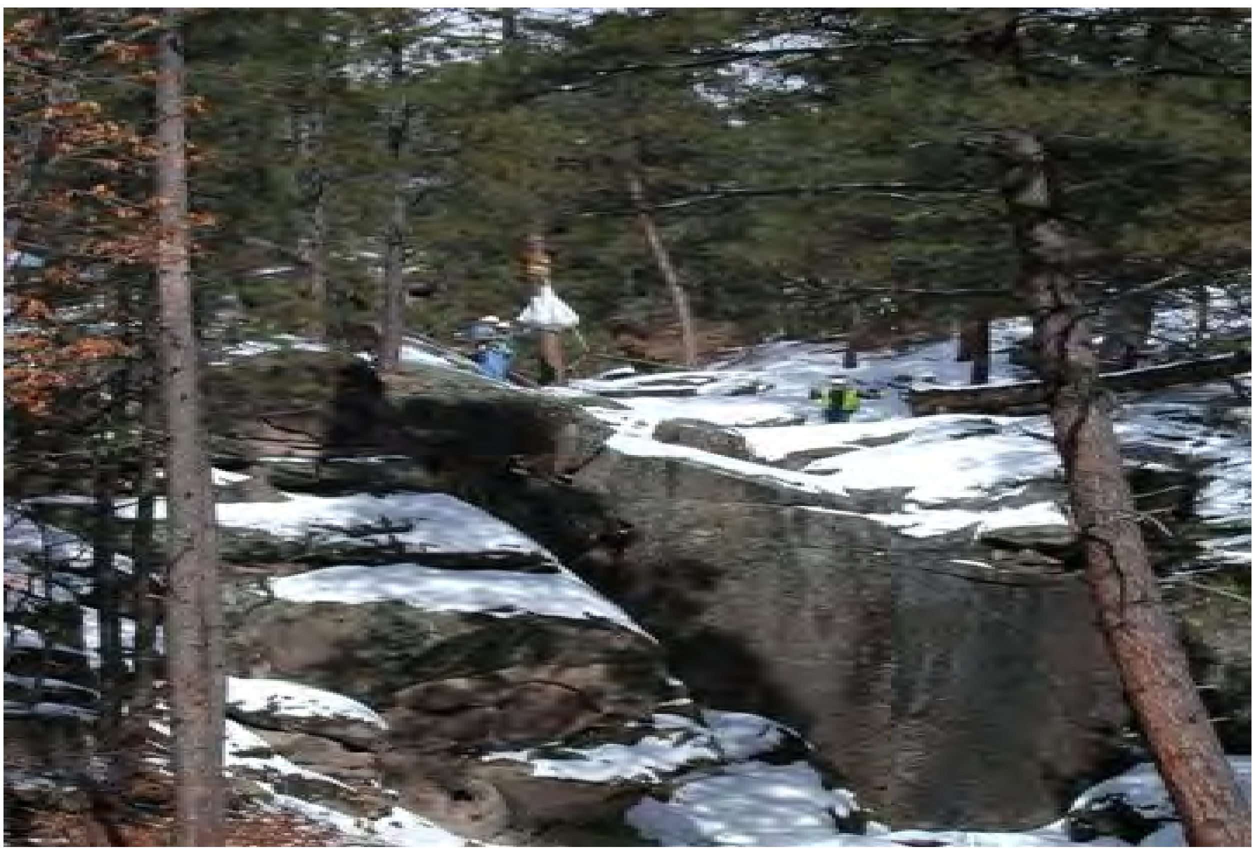
Surveying drainage and confirmation sampling locations

Crews loading bags of excavated rock onto slip line within drainage

Crews setting up slip line within drainage following snow storm

Bags of excavated rock coming down slip line in snowy conditions

Bags of excavated rock transported on slip line



Bags of excavated rock from drainage coming down slip line

Bags of excavated rock from drainage transported on slip line to rolloff bin

Bags of excavated rock coming down slip line to rolloff bins

Bags of excavated rock off-loaded from slip line

Bags of excavated rock placed into rolloff bin

Bags of contact waste in rolloff bin

Rolloff bins of excavated rock and sediment being loaded for transport

A-3.0 SEDIMENT REMOVAL AND RETENTION POND CONSTRUCTION TIMELINE

Lower LA-SMA-2

July 2009, looking west at juniper bales (wrapped in filter fabric and open). Bales placed in historical channel to enhance infiltration and sediment retention.

July 2009, looking east at filter wrapped juniper bales and wattles. Placed in historical channel and flood plain to enhance infiltration and sediment retention.

July 2009, Isco sampler in Geenlee box at west end of deposition zone. Note removal of woody debris to enhance infiltration in the deposition zone.

July 2009, Isco sampler at east end of deposition zone before it enters culvert

October 2009, looking east down canyon at the proposed pond area

October 2009, looking west up canyon at the proposed pond area

November 2009, looking downcanyon at brush/tree removal before pond construction

November 2009, initial pad construction for vacuum truck

November 2009 looking upcanyon. Trees and brush have been removed from proposed pond area and temporary best management practicess installed. Vacuum truck on pad.

November 2009, vacuum pipe installed updrainage

November 2009, multiple piping runs updrainage to facilitate the use of two vacuum trucks

November 2009, looking upcanyon at excavation of soil in the deposition zone

November 2009, looking downcanyon at excavation of soil in the deposition zone

December 2009, excavation of soil into dump truck

December 2009, looking downcanyon at excavation

December 2009, looking upcanyon at excavation

December 2009, collecting confirmation samples from excavation in winter conditions

December 2009, frequent snowy weather conditions

December 2009, view of excavated canyon floor drainage

January 2010, temporary earthern berm built before construction of the retention pond berms

February 2010, looking downcanyon at upper retention pond berm construction

February 2010, looking downcanyon at lower retention pond berm construction

February 2010, looking upcanyon from lower berm to upper berm

February 2010, looking downcanyon at upper retention pond spillway and overflow pipe

February 2010, looking upcanyon at lower and upper retention pond berms

March 2010, looking downcanyon at retention pond berms

March 2010, looking downcanyon at retention pond berms

March 2010, looking downcanyon at lower retention pond

March 2010, looking at willow sticks east of retention ponds

Before start of field work, area hiking trails were closed and posted.

Appendix B

Geomorphology

B-1.0 INTRODUCTION

Geomorphic characterization of sediments in the floor of Los Alamos Canyon below Solid Waste Management Unit (SWMU) 01-001(f) (also referred to as Hillside 140 or the Los Alamos Site Monitoring Area 2 [LA-SMA-2] drainage) was conducted in July 2009 to determine the volume of potentially contaminated post-1942 sediment deposits and to help focus sampling efforts. Data on sediment volume, combined with data on concentrations of polychlorinated biphenyls (PCBs), allow an estimation of the mass or inventory of PCBs contained in these sediments that can be compared with inventory estimates previously made elsewhere in Los Alamos Canyon (LANL 2008, 101714). In addition, measurement of the depth of burial of trees, combined with tree age estimates obtained from tree-ring-dating (dendrochronology), helps quantify the history of sediment deposition and allows an evaluation of possible variations in PCB concentrations in sediment over time in Los Alamos Canyon.

B-2.0 METHODS

Sediment deposits below SWMU 01-001(f) were investigated following the approach discussed in the Core Document for Canyons Investigations (LANL 1997, 055622). This work included geomorphic mapping and associated characterization of geomorphic units as well as sediment sampling for off-site analysis. A geomorphic map was prepared at a scale of 1:200 for a distance of 120 m between the culvert separating the SWMU 01-001(f) drainage area from the main Los Alamos Canyon channel and a prominent Bandelier Tuff cliff. Control points surveyed with a global-positioning system (GPS) and a total station were used to provide local ground control. Mapping focused on geomorphic units that may have been inundated by floods since Technical Area 01 (TA-01) was established and therefore may contain contaminants derived from operations at Los Alamos National Laboratory (the Laboratory). The geomorphic map is shown in Figure B-2.0-1, which also shows preexcavation sampling locations and analytical results, locations of stratigraphic descriptions in hand-dug test holes, and trees cored for dendrochronological analysis. Figure B-2.0-1 also shows the area where sediment was excavated in December 2009.

Basic geomorphic unit designations used in previous studies in other canyons were adopted here. The area of potential contamination was divided into areas occupied by the stream channel since 1942 (labeled “c”) and adjoining floodplain areas that experienced overbank flooding (labeled “f1”). Floodplain areas typically include pre-1943 trees, whereas only younger trees, shrubs, or grass are present on the abandoned channel surfaces. Channel areas were further subdivided into a well-defined active channel (c1) and abandoned channels or unchannelized areas that typically contain deposits of fine-grained sediment interstratified with coarse-grained channel deposits (c2). The active channel includes a short area where the channel flows on bedrock, with little or no sediment (c1br). Adjacent areas were also mapped using the standard geologic designation “Q” for Quaternary units (Qal = alluvium; Qbt = Bandelier Tuff; Qc = colluvium; Qf = fan; Qt = stream terrace).

Geomorphic characterization included observations of stratigraphy exposed in shallow hand-dug holes and determination of the depth of burial, if any, of trees by young sediment. Where hand-dug holes encountered alluvial groundwater beneath the site, additional stratigraphic information was obtained between the top of this water and the depth that could be penetrated with a hand auger with a 4-in. bucket (auger refusal, representing either weathered bedrock or coarse alluvium). Sediment layers were classified using visual observations into either fine facies or coarse facies (synonymous with fine-grained or coarse-grained sediments, respectively). The fine facies includes layers with median particle size of silt to medium sand, a size range that is typical of sediments transported in suspension in floods on the Pajarito Plateau (Malmon 2002, 076038; Malmon et al. 2004, 093018). The coarse facies includes layers with median particle size of medium to very coarse sand, a size range that is typical of sediments transported as bed load on the stream bed. A representative subset of these exposures was sampled for off-site analyses, including both near-surface and deeper sediment, and biased to fine-grained sediment layers where PCB concentrations were expected to be highest.

Dendrochronological analyses were obtained to provide supplemental information on the age of sampled sediment deposits. Sediments burying trees of known age are constrained to be younger than the trees, and sediments beneath the base of trees are constrained to be older. In some cases, nearby trees of different age can provide more precise determination of the ages of sediment deposits. For example, two adjacent trees of different ages can be buried by different thicknesses of sediment, recording a variable number of floods since the germination of each tree and approximate ages for such floods. Alternatively, different-age trees can be buried by the same thickness of sediment, recording the absence of deposition during specific time periods. Ages of specific flood deposits can sometimes be obtained where the flood damaged a tree, causing a change in growth and tree rings. Cores were collected from nine individual trees below the SWMU 01-001(f) drainage area using a 5-mm-diameter increment borer. Most of these trees are located at or near sediment sampling sites, and data on the tree diameter and the thickness of sediment burying each tree were recorded. These analyses followed the methodology described in Stokes and Smiley (1996, 057644) and Phipps (1985, 058477), and the process is discussed further in Reneau et al. (1998, 065407, Appendix B, Section B-1.0).

An estimate of the PCB inventory was made using data on unit areas, sediment density, average thickness of coarse-grained and fine-grained sediment in each unit, and average PCB concentrations in each facies. Sediment density was assumed to be the same as for texturally similar sediments in Los Alamos and Pueblo Canyons (Reneau et al. 1998, 059159). This inventory estimate follows the process used previously in canyons at the Laboratory (e.g., LANL 2004, 087390). An additional estimate was made of the inventory of PCBs removed in the December 2009 excavation in the canyon bottom.

B-3.0 PHYSICAL CHARACTERISTICS

The area affected by post-1942 flooding in the investigation area, before excavation, was up to 17 m wide. Most of the area, 87%, was in the c2 unit, 10% was in c1, 2% was in f1, and 1% was in c1br. Data on the thickness of coarse-grained and fine-grained post-1942 sediment in this area are presented in Table B-3.0-1 and are summarized in Table B-3.0-2. The maximum thickness of post-1942 sediment is at least 1 m, although a high water table prevented close examination of deeper sediment. An estimated 62% of the post-1942 sediment was coarse-grained. Particle-size data for samples from this site are presented in Table B-3.0-3.

Dendrochronological analyses indicate that up to at least 43 cm of sediment was deposited in the west-central part of the c2 unit since 1985 (Table B-3.0-4, LASMA2-d2 at LA-605590). At this site, a coarse sediment layer at a depth of 10–33 cm was associated with flood damage to a ponderosa pine that probably occurred in 1998; 10 cm of fine-grained sediment was deposited here between 1985 and 1998, and an additional 10 cm after 1998 (Figure B-3.0-1). Sediment thickness thins to the southwest and northwest from this sampling location, as shown in cross-section A-A’ (Figure B-3.0-2; cross-section location shown in Figure B-2.0-1). To the southwest, 17 cm of sediment was deposited after 1960, most or all of it after 1982 (Figure B-3.0-2). Near the upper end of the main sediment deposition area, only 22–25 cm of sediment was deposited after ca. 1937–1946 (Figure B-3.0-2).

B-4.0 PCB VARIATIONS WITH PARTICLE SIZE AND DEPTH

PCB concentrations at LA-SMA-2 tend to be higher in fine facies sediment samples than in coarse facies samples (average of 12.4 mg/kg versus 5.1 mg/kg), although the correlation between silt and clay content (r^2 = 0.35; Figure B-4.0-1) is only a weak positive one. The higher concentration in fine-grained sediment and the weak correlation in this area close to the source are consistent with results from other parts of the Laboratory (e.g., LANL 2004, 087390). The difference between contaminant concentrations in coarse and fine sediment and correlations with silt and clay content tend to increase farther from source areas with increased sediment mixing and sorting.

Comparison of PCB concentrations in samples with similar particle-size characteristics but different depths (and hence different ages) indicates no systematic changes have occurred over time in the investigation area over the last several decades. As an example, variations in PCB concentration and silt and clay content in five samples at location LA-605590 are shown in Figure B-3.0-1. Concentrations in fine-grained sediment at this location are very similar at depths of 0–10 cm (post-1998); 33–43 cm (post-1985, pre-1998); and 73–83 cm (pre-1985). Concentrations in coarse-grained sediment are also very similar to each other at depths of 10–33 cm (ca. 1998) and 43–73 cm (pre-1985). These results indicate little change has occurred in the concentrations of PCBs eroded from the upslope source area over the several decades represented in these sediment deposits.

The total thickness of post-1942 PCB-bearing sediment could not be established with certainty because of the difficulty of sampling below the water table, although some information was obtained from samples collected from auger holes. At one location (LA-605601), a coarse-grained sample collected from the 65–100 cm depth had 11.48 mg/kg PCBs, and at a second location (LA-605596) another coarse-grained sample collected from a depth of 90–152 cm had 1.36 mg/kg PCBs. These data indicate significant concentrations of PCBs (>1 mg/kg) in sediment at depths up to approximately 1 m, with lower concentrations beginning somewhere between 1 m and 1.5 m below ground surface. At both of these locations, auger refusal occurred at or near the base of the sampled layers, probably representing older, pre-1943 coarse gravel or tuff boulders (as indicated in the excavation).

B-5.0 PCB INVENTORY

An estimated 7.0 kg (15.5 lb) of PCBs was present in the canyon floor at LA-SMA-2 before excavation, as shown in Table B-5.0.1. Approximately 71% of this volume was Aroclor-1254, and the remainder was Aroclor-1260. Approximately 40% of the PCBs was contained in coarse facies sediment deposits and 60% in fine facies sediment deposits. In comparison, it had been previously estimated that approximately 6.3 kg (13.9 lb) of PCBs was present in sediment deposits along the main stream channels of Los Alamos and DP Canyons [excluding the area below the SWMU 01-001(f) drainage], predominantly Aroclor-1260 (82% of the total) (LANL 2008, 101714). Combining these estimates provides about 13.3 kg (29.4 lb) of PCBs in the bottom of Los Alamos and DP Canyons before the interim measure was implemented, 53% of which occurs in the area where the interim measure was conducted.

The previous data indicated that the main source of Aroclor-1254 was SWMU 01-001(f), with some additional Aroclor-1254 detected upstream (LANL 2004, 087390; LANL 2008, 101714). The previous data also indicated that Aroclor-1254 concentrations decreased fairly rapidly downcanyon from SWMU 01-001(f), with Aroclor-1254 not detected below the confluence with DP Canyon. In combination with the previous data, the data from the interim measure discussed in this appendix indicate most of the PCBs transported down the hillslope from SWMU 01-001(f) were deposited and buried in the canyon floor close to the source, and sediment excavation in during the interim measure removed over 80% of the Aroclor-1254 and over half the total PCBs present in the bottom of Los Alamos Canyon.

B-6.0 REFERENCES

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

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

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LANL (Los Alamos National Laboratory), April 2004. "Los Alamos and Pueblo Canyons Investigation Report," Los Alamos National Laboratory document LA-UR-04-2714, Los Alamos, New Mexico. (LANL 2004, 087390)

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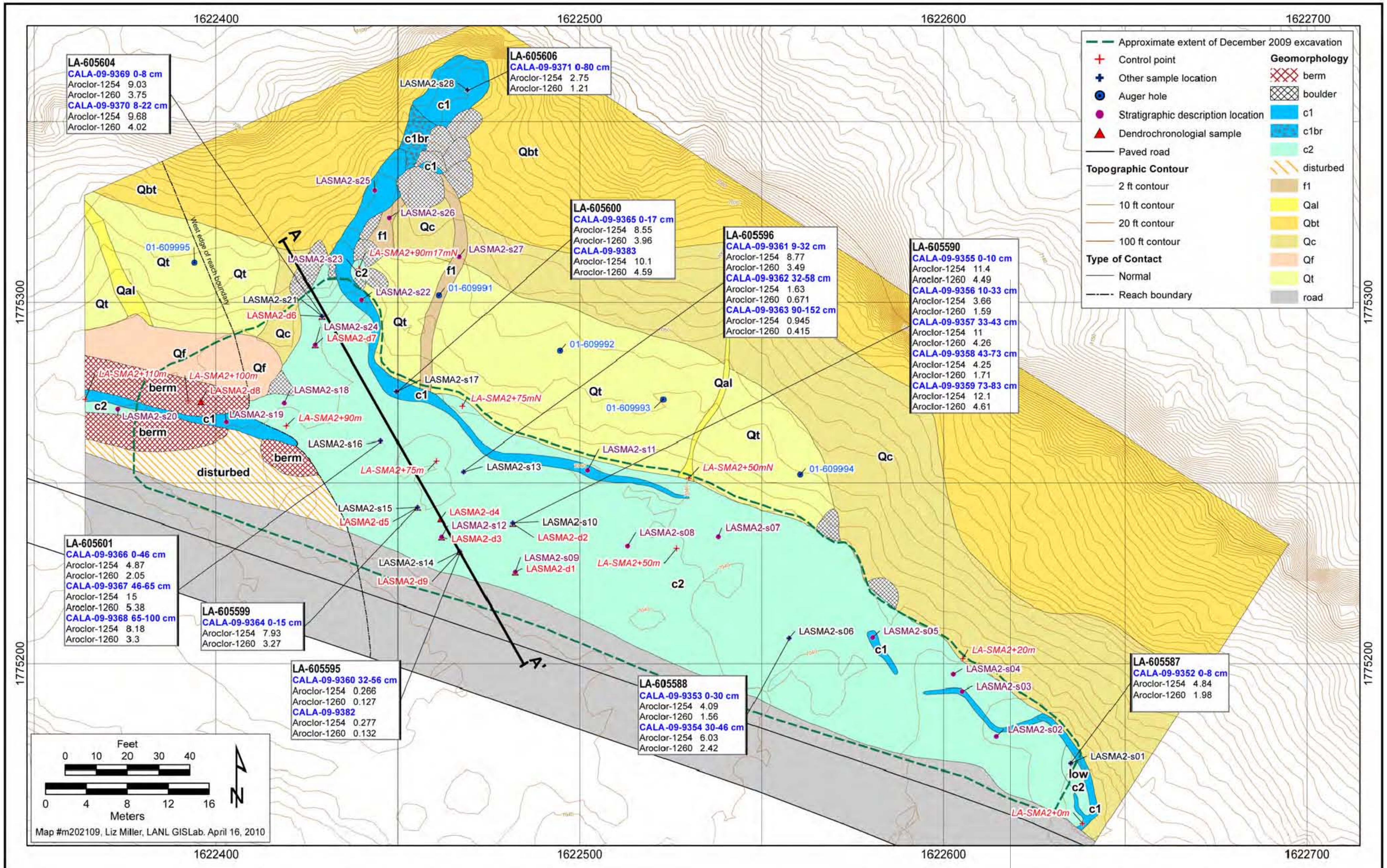


Figure B-2.0-1 Geomorphic map of LA-SMA-2 area showing sampling locations, stratigraphic description locations, line of cross-section shown in Figure B-3.0-2, and approximate limit of December 2009 sediment excavation

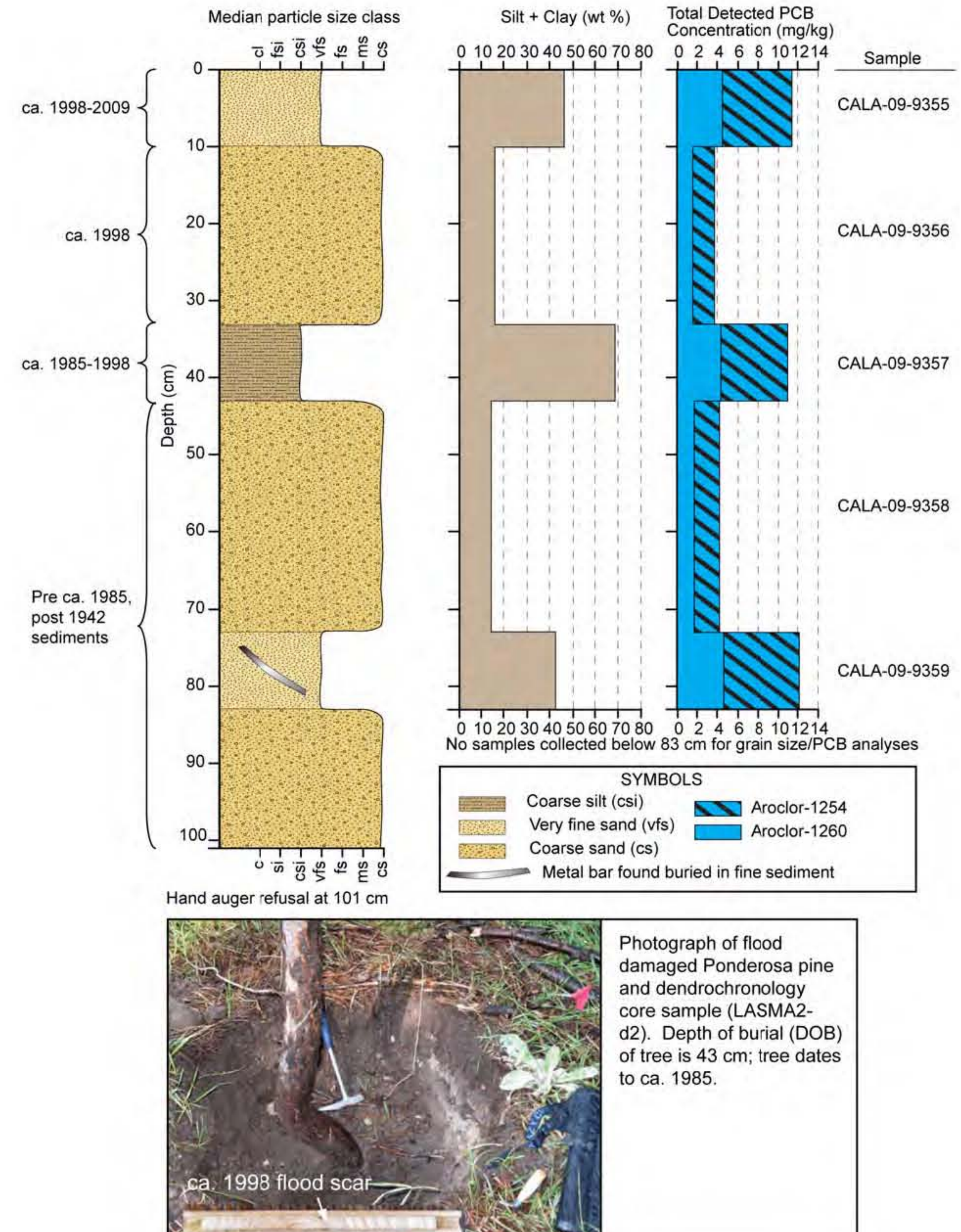


Figure B-3.0-1 Stratigraphy, sediment age estimates, and variations in silt and clay content and PCB concentrations at LA-605590

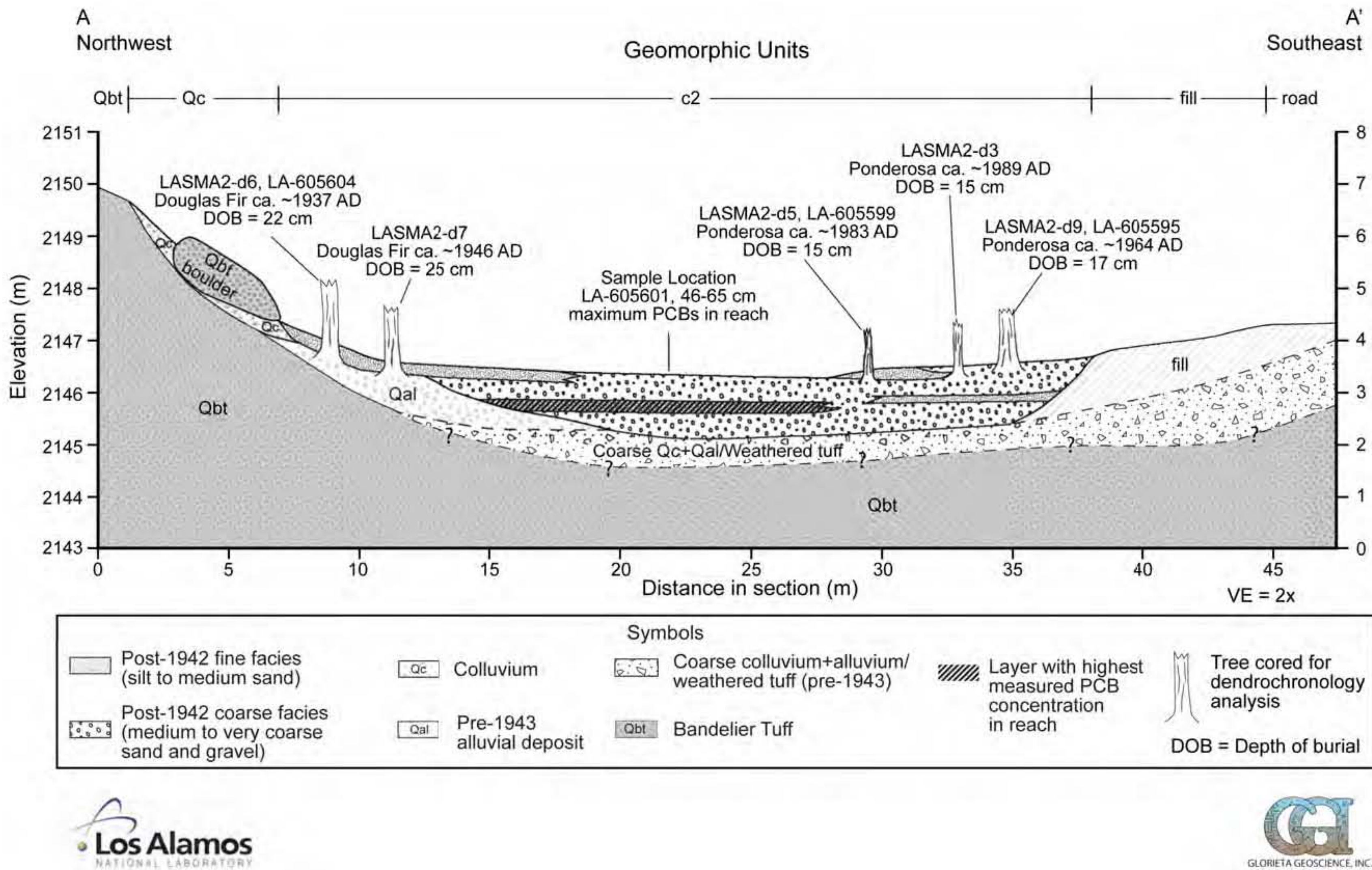


Figure B-3.0-2 Schematic cross-section across the western part of the LA-SMA-2 investigation area, showing sampling locations and trees cored for dendrochronological analysis

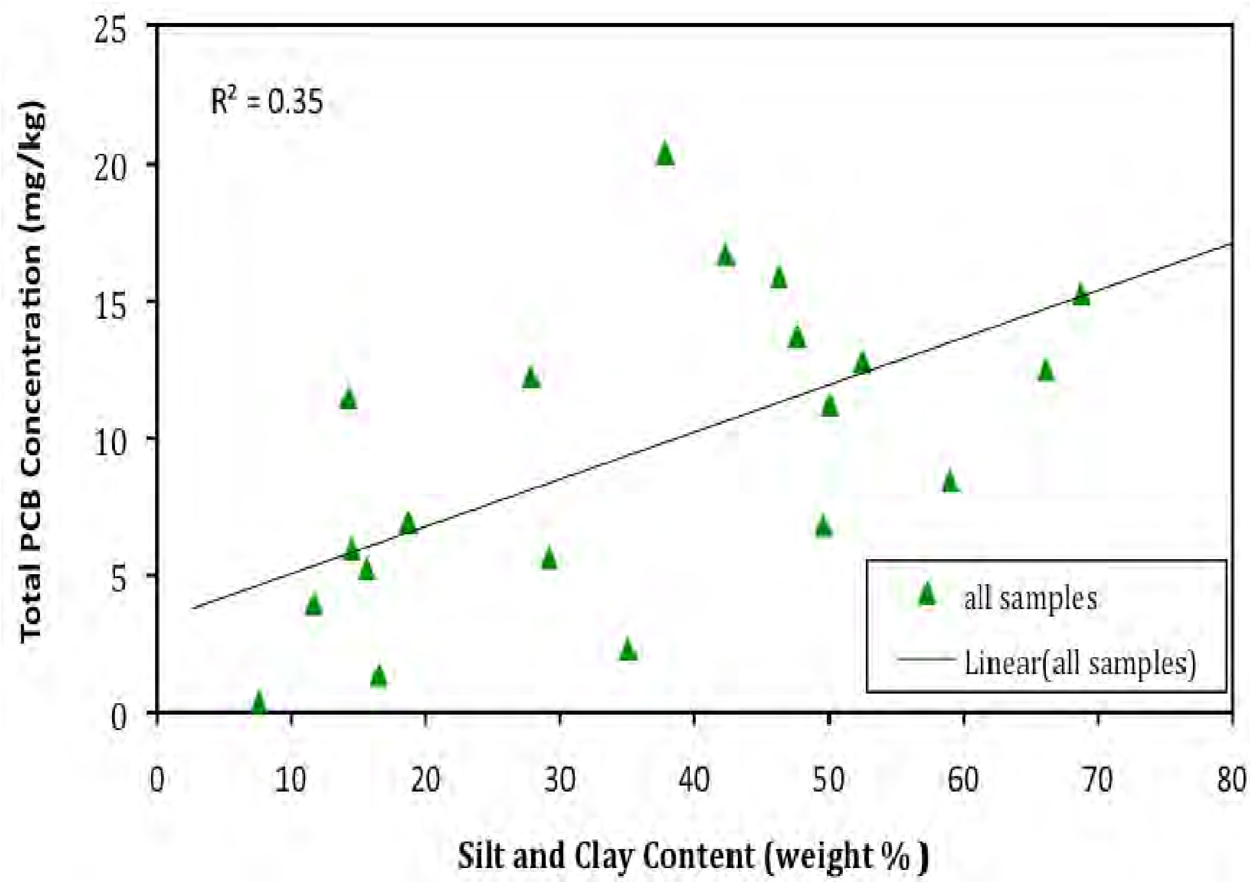


Figure B-4.0-1 Plot of total PCB concentration vs. silt and clay content at LA-SMA-2

Table B-3.0-1
Sediment Thickness Measurements from LA-SMA-2

Stratigraphic Description Location	Location ID	Distance above Culvert (m)	Geomorphic Unit	Fine Facies Thickness (cm)	Coarse Facies Thickness (cm)
LASMA2-s1	LA-605587	5	c2	8	57
LASMA2-s2	—*	12	c2	38	40
LASMA2-s3	—	17	c1	0	76
LASMA2-s4	—	19	c2	0	34
LASMA2-s5	—	29	c1	18	56
LASMA2-s6	LA-605588	36	c2	38	30
LASMA2-s7	—	42	c2	41	76
LASMA2-s8	—	55	c2	43	72
LASMA2-s9	—	64	c2	18	0
LASMA2-s10	LA-605590	65	c2	30	71
LASMA2-s11	—	61	c1	31	73
LASMA2-s12	—	72	c2	6	9
LASMA2-s13	LA-605596	72	c2	64	88
LASMA2-s14	LA-605595	69	c2	14	91
LASMA2-s15	LA-605599	76	c2	15	0
LASMA2-s16	LA-605601	81	c2	19	91
LASMA2-s17	LA-605600	82	c1	52	14
LASMA2-s18	—	91	c2	5	15
LASMA2-s19	—	97	c1	0	30
LASMA2-s20	—	107	c2	34	26
LASMA2-s21	LA-605604	94	c2	22	0
LASMA2-s22	—	96	c1	0	21
LASMA2-s23	—	99	c2	40	26
LASMA2-s24	—	91	c2	25	0
LASMA2-s25	—	107	c1	0	56
LASMA2-s26	—	106	f1	7	0
LASMA2-s27	—	106	f1	12	0
LASMA2-s28	LA-605606	120	c1	0	92

*— = No location ID.

Table B-3.0-2
Physical Characteristics of Post-1942 Geomorphic Units at LA-SMA-2

Geomorphic Unit	Unit Area (m^2)	Sediment Facies	Estimated Average Sediment Thickness (m)	Typical Median Particle Size Class (<2 mm fraction)	Notes
c1	141	Fine	0.13	Coarse silt	Active channel
		Coarse	0.52	Coarse sand	
c1br	11	n/a	0	n/a*	Active channel on bedrock
c2	1208	Fine	0.29	Very fine sand	Abandoned post-1942 channel and areas of dispersed flow
		Coarse	0.45	Coarse sand	
f1	33	Fine	0.10	Fine sand	Post-1942 floodplain
Total	**1393**				

*n/a = Not applicable.

Table B-3.0-3
Particle-Size and Organic-Matter Data from LA-SMA-2

Sample ID	Unit	Facies	Gravel (>2 mm) (wt%)	Very Coarse Sand (2–1 mm) (wt%)	Coarse Sand (1–0.5 mm) (wt%)	Medium Sand (0.5–0.25 mm) (wt%)	Fine Sand (0.25–0.125 mm) (wt%)	Very Fine Sand (0.125–0.0625 mm) (wt%)	Coarse Silt (62.5–15 µm) (wt%)	Fine Silt (15–2 µm) (wt%)	Clay (<2 µm) (wt%)	Median Particle Size Class*	Total Silt Clay (wt%)	Organic Matter (wt%)
CALA-09-9352	c2	fine	2.2	6.8	14.8	11.2	8.2	9.3	24.2	15.2	10.1	vfs	49.6	3.35
CALA-09-9353	c2	coarse	2.8	25.9	23.0	10.9	5.8	5.1	15.4	7.5	6.2	ms	29.2	1.57
CALA-09-9354	c2	fine	0.6	8.4	10.0	8.7	6.4	7.3	30.7	17.7	10.6	csi	59.0	1.76
CALA-09-9355	c2	fine	0.8	9.1	12.8	10.7	9.3	11.8	27.0	13.8	5.5	vfs	46.3	4.73
CALA-09-9356	c2	coarse	20.9	31.5	24.7	16.4	8.3	3.5	7.0	4.6	4.1	cs	15.6	1.10
CALA-09-9357	c2	fine	0.2	2.6	6.0	6.2	6.7	10.1	38.0	19.9	10.9	csi	68.8	2.42
CALA-09-9358	c2	coarse	46.2	47.9	24.9	8.5	2.9	1.5	4.3	5.8	4.4	cs	14.5	0.70
CALA-09-9359	c2	fine	6.5	9.2	8.7	8.4	13.9	17.4	26.4	7.5	8.4	vfs	42.3	1.47
CALA-09-9360	c2	coarse	19.5	41.5	31.8	13.3	4.3	1.7	2.7	2.0	2.9	cs	7.6	0.50
CALA-09-9361	c2	fine	4.0	17.8	17.9	16.2	11.8	8.6	15.4	7.0	5.5	ms	27.8	1.41
CALA-09-9362	c2	fine	10.4	24.9	18.6	10.2	7.4	3.8	20.7	8.3	6.1	ms	35.1	1.14
CALA-09-9363	c2	coarse	21.1	33.1	25.2	14.8	6.6	3.9	8.3	4.4	3.8	cs	16.5	0.68
CALA-09-9364	c2	fine	0.8	2.6	8.8	10.9	13.1	14.8	25.6	13.8	10.6	csi	50.1	3.71
CALA-09-9365	c1	fine	0.1	0.8	6.6	7.5	8.0	11.7	31.0	21.2	14.0	csi	66.1	4.52
CALA-09-9366	c2	coarse	6.1	37.5	25.1	11.0	5.2	2.9	8.3	5.8	4.6	cs	18.7	1.26
CALA-09-9367	c2	fine	9.0	20.8	18.8	11.5	6.2	4.9	15.0	13.8	9.0	ms	37.8	1.46
CALA-09-9368	c2	coarse	20.4	48.6	24.4	8.3	3.2	1.8	0.4	7.7	6.1	cs	14.3	0.75
CALA-09-9369	c2	fine	0.5	3.1	8.8	9.6	12.4	14.3	31.0	12.9	8.6	csi	52.5	4.64
CALA-09-9370	c2	fine	1.0	4.4	12.3	12.4	12.1	11.2	27.6	11.5	8.5	vfs	47.6	3.05
CALA-09-9371	c1	coarse	13.1	44.6	26.6	11.1	4.1	2.0	4.6	4.0	3.1	cs	11.7	0.68

*Median particle size class in <2-mm fraction; cs = coarse sand; csi = coarse silt; ms = medium sand; vfs = very fine sand.

Table B-3.0-4
Dendrochronological Analyses from LA-SMA-2

Core ID	Distance above Culvert (m)	Geomorphic Unit	Depth of Burial (cm)	Stratigraphic Description Location	Location ID	Species	Date of Pith Ring
LASMA2-d1A	64	c2	18	LASMA2-s9	—[a]	Ponderosa pine	1982[b]
LASMA2-d1B							1982[b]
LASMA2-d1C							1982
LASMA2-d1D							1982
LASMA2-d2A	65	c2	43	LASMA2-s10	LA-605590	Ponderosa pine	1988[b]
LASMA2-d2B							1988[b]
LASMA2-d2C							1988[b]
LASMA2-d2D							1988[b]
LASMA2-d2E							1985
LASMA2-d2F							1985
LASMA2-d3A	72	c2	15	LASMA2-s12	—	Ponderosa pine	1989
LASMA2-d3B							1989
LASMA2-d3C							1989[b]
LASMA2-d3D							1989[b]
LASMA2-d4A	72	c2	7	—	—	Ponderosa pine	1988[b]
LASMA2-d4B							1988[b]
LASMA2-d5A	76	c2	15	LASMA2-s15	LA-605599	Ponderosa pine	1983
LASMA2-d5B							1983
LASMA2-d6C	94	c2	22	LASMA2-s21	LA-605604	Douglas fir	1937[b]
LASMA2-d6D							1937[b]
LASMA2-d7B	91	c2	25	LASMA2-s24	—	Douglas fir	1946[b]
LASMA2-d7D							1946
LASMA2-d8C	98	berm	0	—	—	Ponderosa pine	1955[b]
LASMA2-d8D							1955[b]
LASMA2-d9A	69	c2	17	LASMA2-s14	LA-605595	Ponderosa pine	1960[b]
LASMA2-d9C							1960[b]

[a] — = Not sampled.

[b] Estimated age.

Table B-5.0-1
Estimated PCB Inventory at LA-SMA-2

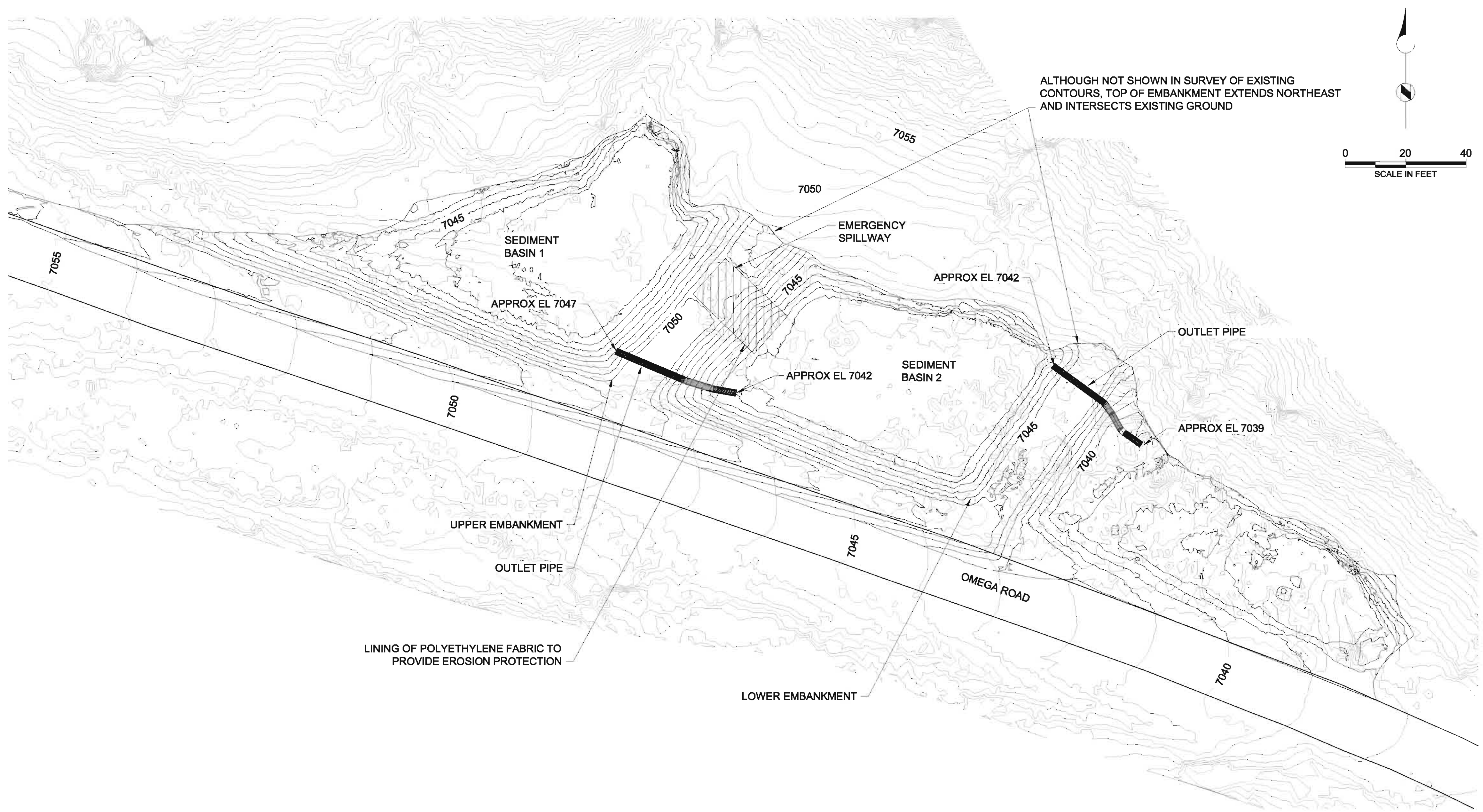
Geomorphic Unit	Sediment Facies	Area (m^2)	Estimated Average Thickness (m)	Estimated Volume (m^3)	Portion Nongravel	Estimated Density (g/cm^3)	Aroclor-1254			Aroclor-1260		
							Average Concentration (mg/kg)	Inventory (kg)	% of Total in Reach	Average Concentration (mg/kg)	Inventory (kg)	% of Total in Reach
c1	coarse	141	0.52	73	0.81	1.23	3.63	0.26	5%	1.50	0.11	5%
c2	coarse	1208	0.40	483	0.81	1.23	3.63	1.75	35%	1.50	0.72	36%
Coarse Facies Subtotal				**557**				**2.01**	**40%**		**0.83**	**41%**
c1	fine	141	0.13	18	0.97	1.04	8.83	0.16	3%	3.53	0.07	3%
c2	fine	1208	0.26	314	0.97	1.04	8.83	2.80	56%	3.53	1.12	55%
f1	fine	33	0.10	3	0.97	1.04	8.83	0.03	1%	3.53	0.01	1%
Fine Facies Subtotal				**336**				**2.99**	**60%**		**1.19**	**59%**
LA-SMA-2 Total				**892**				**5.00**	**100%**		**2.02**	**100%**

Appendix C

Field Forms
(on CD included with this document)

Appendix D

Surface Water Retention Basin Engineering Drawing



PLAN VIEW OF SITE

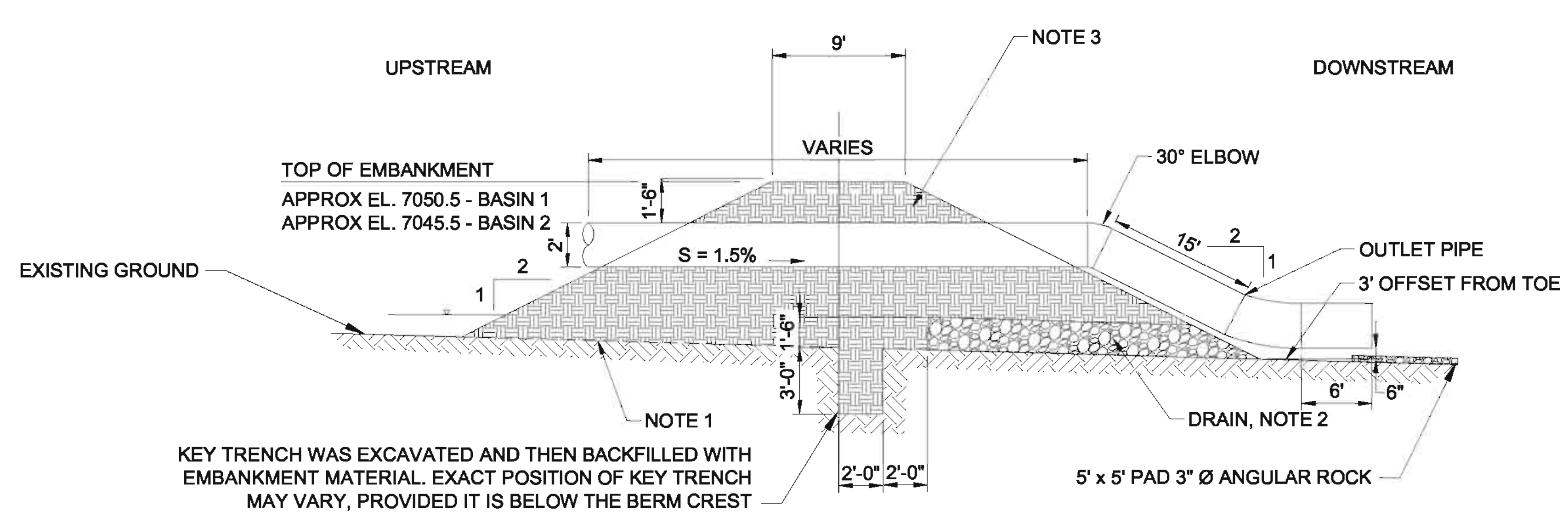
NOTE:

THE SURVEY OF MARCH 2010 TOPOGRAPHY DID NOT COVER AS MUCH AREA AS THE SURVEY OF PRE-PROJECT TOPOGRAPHY. AS A RESULT, SOME DISCONTINUITIES EXIST WHERE THE TWO SETS OF CONTOUR DATA MEET.

LEGEND

PRE-PROJECT CONTOURS

CONTOURS AS OF MARCH 2010



TYPICAL EMBANKMENT CROSS SECTION

NOT TO SCALE

NOTES:

1. UPSTREAM FOUNDATION WAS STABILIZED BY EITHER:
   A. EXCAVATION AND REPLACEMENT OF UNSUITABLE MATERIALS.
   B. PLACEMENT AND COMPACTION OF BALLAST AGGREGATE INCORPORATED INTO THE NATIVE SOIL.
2. DRAIN LAYER IS A MIX OF $\frac{1}{3}$ BASE COURSE WITH $\frac{2}{3}$ BALLAST AGGREGATE.
3. COMPACTED EMBANKMENT FILL CONSISTING OF BASE COURSE MATERIAL.
4. SIX 1/2" DIAMETER HOLES DRILLED IN 30° ELBOW TO RELIEVE AIR PRESSURE.

Brown AND Caldwell

ECN–10–TA–43–0000–0000–0071
LA–SMA–2 SEDIMENT BASINS

BLDG. NA TA–43

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

PI 102363 DATE 4–29–2010 PL NA

Appendix E

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

Appendix F

Waste Documentation
(on CD included with this document)