SUMMARY REPORT

Santa Susana Field Laboratory (SSFL)
Soil Partitioning Treatability Study

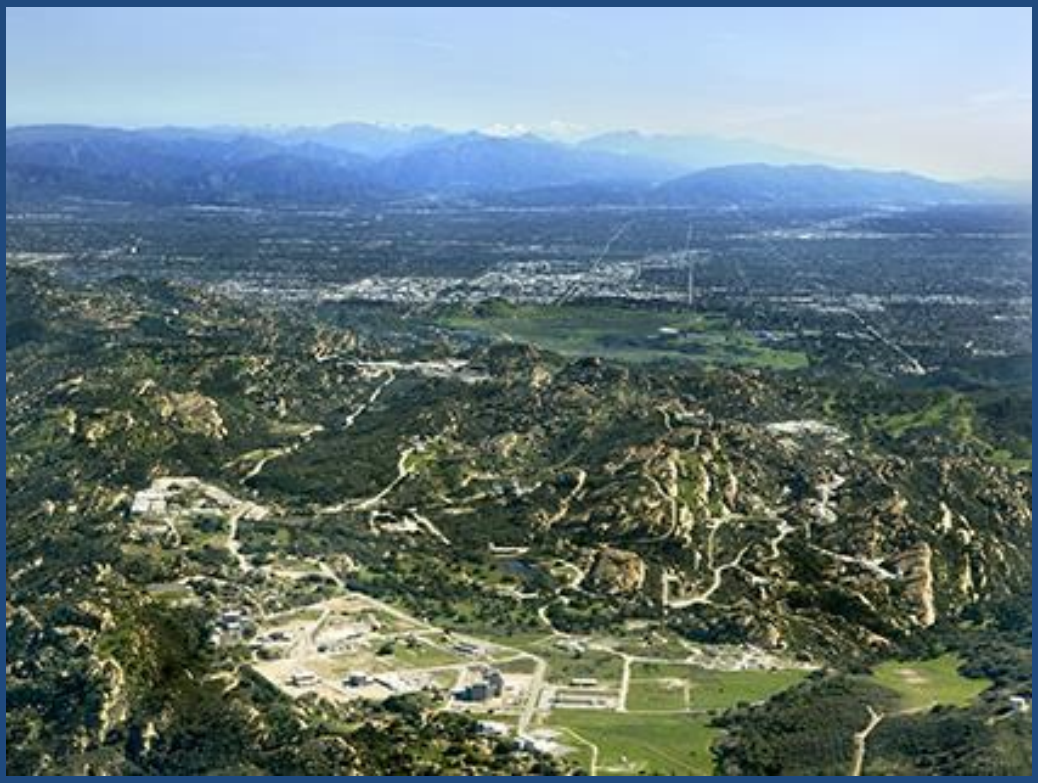

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Acronyms

AI	Atomics International
AOC	Administrative Order of Consent
ASTM	American Society for Testing and Materials
Boeing	The Boeing Company
DOE	U.S. Department of Energy
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
EFH	Extractable fuel hydrocarbons
ETEC	Energy Technology Engineering Center
LUT Value	Look-Up Table Value
NASA	National Aeronautics and Space Administration
PAH	Polyaromatic hydrocarbon
PCB	Polychlorinated biphenyl
QAPP	Quality Assurance Project Plan
RMHF	Radioactive Materials Handling Facility
Sandia	Sandia National Laboratories
SSFL	Santa Susana Field Laboratory
STIG	Soil Treatability Investigation Group
TCDD TEQ	2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalent
TPH	Total petroleum hydrocarbons
UCR	University of California, Riverside

SOIL PARTITIONING STUDY SUMMARY REPORT

May 2015

1 Introduction

1.1. Purpose of Study

The U.S. Department of Energy (DOE) initiated the treatability study process in May 2011 when it contracted Sandia National Laboratories (Sandia). Sandia's role was to evaluate potential soil treatability options and to make recommendations as to what treatment technologies may be applicable to Area IV. DOE concurrently engaged a community working group, the Soil Treatability Investigation Group (STIG), to observe treatability study development during Sandia's evaluation of treatability study options, and the execution of the soil partitioning study. The STIG attended Sandia-led meetings and served in an advisory role to Sandia during this process.

The outcome of this initial set of meetings was the commissioning of five soil treatability studies by the DOE as part of a larger remediation effort for Area IV of the Santa Susana Field Laboratory (SSFL). These five treatability studies investigated methods to reduce the volume of contaminated soils that would typically need to be removed from Area IV by excavation, hauling, and disposal.

The soil partitioning treatability study is one of these five studies, which was developed to determine how site contaminants are partitioned within specific soil grain sizes and how they vary with depth. Results from the soil partitioning study also provide useful information in assessing if follow-up treatability studies are warranted and help guide future Area IV site-wide remediation decisions.

1.2. Authorization for the Study

The soil partitioning treatability study was conducted in compliance with the Administrative Order of Consent (AOC) that DOE signed with the California Environmental Protection Agency Department of Toxic Substances Control (DTSC) in 2010. The AOC specifies the process for completing site characterization and remedy identification for Area IV. Included within the AOC is a requirement for the DOE to conduct soil treatability studies in conjunction with the Area IV soil remediation. The five treatability study plans address the AOC requirement to conduct these studies. DTSC has the regulatory authority for approving and accepting the results of all Area IV treatability studies.

This study was jointly planned and conducted by the University of California, Riverside (UCR) and CDM Smith, and developed under CDM Smith contract no. DE-EM0001128, Task Order DE-DT0003515.

1.3. Summarized Conclusions

Six sample sites were selected for the study based on their locations across Area IV; the analytical results from the 2010/2011 sampling event; and the objectives of the study. Bulk soil samples and partitioned soils at each location were analyzed for contaminants. Based on the soil partitioning analytical results, the following conclusions were developed.

- Soil size fractions at each sample location were found to be comparable. The soils were dominated by sand and gravel. Less than 7 percent of the soil was in the silt/clay fraction.
- Elevated contaminants of concern that exceed DTSC Look-up Table values include metals (mercury, silver, and zinc), polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), limited to Aroclor 1254, Aroclor 1260, and Aroclor 5460); and dioxins and furans as characterized by 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalent (TCDD TEQ).
- There is a general trend for higher contaminant concentrations with decreasing soil size fractions, however, there is some variability. The differences are not sufficient to warrant size separation sieving during *ex situ* processing as a means to reduce treatment and/or disposal volumes.
- Based on the single sample location with multiple soil depths analyzed, contaminant levels decreased with distance below the ground surface. Contamination was found to be highest in the surface layer (0.0 to 0.5 ft bgs).
- Depending on location within Area IV, *ex situ* soil excavation may be limited to the upper soil layers.
- Within the surface soil layer at two of the sampling locations (SL-225-SA5B and SL-311-SA6), the concentrations of PAH, dioxins and furans, and total petroleum hydrocarbons (TPH) decreased from the 2010/2011 sampling event and the 2014 soil partitioning study.
- In the lower soil layer (2 to 3 ft bgs), the concentrations of PAH and dioxins and furans increased.

2 Site Background

North America Aviation established SSFL in 1947 as a facility to test liquid fuel propulsion rocket engines. This testing was first conducted for the Department of Defense and subsequently for the National Aeronautics and Space Administration (NASA) as part of the manned-spaced program. The testing of rocket engines was performed in Areas I, II, and III of SSFL. This testing lasted until about the year 2000.

The Boeing Company (Boeing) currently owns most of SSFL Area I and all of Areas III and IV. The federal government (administered by NASA) owns part of Area I and all of Area II.

SSFL Area IV was used for energy and liquid metals research from the mid-1950s until approximately 2000. A portion of the research in Area IV was conducted under the authority of DOE, who is now responsible for addressing soil and groundwater contamination that resulted from these research activities.

Atomics International (AI), a subsidiary of North America Aviation, began establishing Area IV for energy research in 1954. A 90-acre portion of Area IV (Area IV is 290 acres in size) was first leased to the Atomic Energy Commission and subsequently to DOE for nuclear energy and other research. This 90-acre portion of Area IV was termed the Energy Technology Engineering Center (ETEC) and also served as DOE's Liquid Metals Center of Excellence. Ten small nuclear reactors were tested in Area IV during ETEC operations. The most active period of nuclear research was from 1956 until approximately 1970. The last nuclear reactor was shut down in 1974. Research and handling of nuclear materials in Area IV ceased in 1988.

AI supported commercial clients in conducting nuclear research during the same period of operations. This research included operating one of the first commercially available hot laboratories for the inspection and processing of nuclear fuels. The 1970s marked the beginning of demolition and removal of the nuclear research facilities that continued through about 2005.

The last non-nuclear research in Area IV ended in 2001 with the closure of the Sodium Pump Test Facility. Since then all nuclear materials have been removed from ETEC and only the shells of a few reactor buildings remain. The Radioactive Materials Handling Facility (RMHF), two reactor buildings, and three support buildings remain in Area IV.

DOE was responsible for the construction and ownership of the buildings it used within Area IV, but DOE does not own the land. As previously stated, Boeing is the current land owner of Area IV. However, portions of Area IV were occupied by commercial enterprises also engaged in nuclear and other energy research. That research included nuclear fuels development and conventional energy research such as pressurized steam investigations, component testing, and coal gasification. During the peak years of operation (1956 until the 1970s), there were over 200 numbered structures within Area IV where this research was being conducted. As each study or experiment was completed, the buildings were decontaminated, decommissioned, demolished, and removed. Approximately 22 structures remain, 18 owned by DOE and the remainder owned by Boeing.

A variety of chemicals were used to support the aforementioned research within Area IV. These chemicals included:

- PCBs in electrical components and hydraulic fluids,
- Fuels (measured as extractable fuel hydrocarbons (EFHs) to run auxiliary generators and heat water for steam,
- Chlorinated solvents to clean components between use and testing,
- Metals such as mercury for energy transfer applications, and
- Silver for photograph development.

Burning of wastes onsite produced dioxins and furans, and PAHs, and releases of PCBs, metals, fuels and lubricants, and solvents from transformers, storage tanks, drums in storage areas, and at leach fields contaminated soil within Area IV. Areas where soil contamination exists and will require remediation were identified through a series of soil sampling investigations. The five soil treatability studies focused

on these groups of chemicals and specific locations within Area IV to evaluate the effectiveness of onsite treatment.

3 Roles and Responsibilities of the Study Team

The soil partitioning study team consists of six entities. These entities, and their roles and responsibilities, are briefly described below.

UCR was jointly responsible for preparing the study plan and summary report with CDM Smith; conducting the study with CDM Smith and the contract laboratories; and presenting the study plan and summary report to the STIG. The University team is led by Dr. Mark Matsumoto.

CDM Smith provided overall project management, contracting, and sample collection; was jointly responsible for preparing the study plan and subsequent summary report with the university; conducting the study with the university and contract laboratories; and working with DTSC to gain regulatory acceptance of the study plan.

Contract laboratories performed all geotechnical sieve analyses and analytical analyses of soil samples.

DOE is a responsible party at the site and provided funding for this study.

DTSC is the regulatory agency over Area IV of SSFL and retains ultimate approval authority of the study plan and summary report.

The STIG participated in the progress of the study and was updated on progress and results.

4 Study Basis

Soil contamination generally results from deposition and infiltration of contaminants on the soil surface and/or injection into the subsurface in solution or weak suspension. Transport within the soil matrix depends on binding characteristics of contaminants with soil components and the chemical and biological reactions that occur within the soil matrix. When remediating soil at a contaminated site, two categories of remediation approaches are considered, ex situ and *in situ*. Methods that excavate contaminated soils and subsequently treat and dispose of them are termed e*x situ.* Methods that remediate the soils in place are termed in situ.

Soil partitioning contaminant analyses provide important information regarding:

- The extent of contamination downward into the soil layers and
- Whether higher levels of contamination are associated with specific grain sizes.

These results can be used to assess the extent of soil that must be excavated and treated and/or be ultimately disposed if ex situ remediation methods are employed. Further, depending on the extent of the soil partitioning analyses, the results can also provide valuable insights into the:

- Potential mobility of contaminants within the soil environment,
- Potential applicability of in situ remediation methods such as natural attenuation and phytoremediation, and
- Potential applicability of ex situ soil washing for remediation.

4.1 Study Objectives

Sandia National Laboratories (September 18, 2012), *Investigations Recommended for Resolving Uncertainty About Soil Remediation at ETEC,* posed key uncertainties for the soil partitioning study to resolve:

- What are the grain size distributions for the Area IV soils?
- Do contaminants known to be present within Area IV preferentially reside with the fine grained sediments, or are they uniformly or randomly distributed throughout the soil with the various grain sizes?
- Which contaminant groups are preferentially associated with the fines and which are not?
- Can multiple contaminants be remediated at the same time utilizing this technique and, if so, which contaminant groups?

These uncertainties were addressed using the following phased approach.

- Phase 1: Investigate soil grain size distributions and their associated contaminant concentrations for select study locations and depths.
- Phase 2: Investigate the strength of contaminant-soil particle bonding by surfactant extraction and sequential extraction analyses. This investigation will provide information about the bioavailability of the contaminants.
- Phase 3: Investigate the spatial heterogeneity of soil at the site and the practicality of soil washing as a possible full-scale remediation technology.

The study results summarized in this report are limited to Phase 1.

4.2 Study Phases

4.2.1 Phase 1: Soil Partitioning

Phase 1 of the soil partitioning study evaluated soil grain size distributions at select study sample locations and depths within Area IV to determine how contaminants vary with location, depth, and soil grain size distribution. For Phase 1, soil cores were selected from specific site locations that were:

- Representative of known contaminated locations within Area IV,
- Co-located or in close proximity to sample locations used for the other four soil treatability studies, or sampled previously (two to three years) during earlier sampling events.

Bulk soil from each sample location was analyzed for contaminants. In addition, bulk soil was size fractionated and analyzed for contaminants to determine whether contaminants concentrated in specific size fractions. Only Phase 1 was scoped for this study.

4.2.2 Phase 2: Extraction Analyses

Phase 2 of the soil partitioning study is recommended to determine the relative binding strength of the contaminants to the soil grains. These results will provide greater insights into how amenable the soil may be to treatment by natural attenuation, bioremediation, and/or phytoremediation; and whether mild extractants can be employed to remediate the soil during a process such as soil washing.

4.2.3 Phase 3: Field-scale Tests and Soil Washing

Phase 3 is recommended as a subsequent evaluation to Phase 1 and Phase 2 to test whether the soil samples from the Phase 1 study locations were representative of the soils found throughout the rest of Area IV. Standard excavation equipment would be used to remove soil from the Phase 1 study locations in 6 or 12-inch depth increments. Excavated soil would be partitioned by size using standard soil partitioning practices. Excavated soil would be analyzed by depth and grain size fraction for contaminants. These field-scale results would be compared to those of Phase 1. In addition, a small demonstration trial of soil washing, based on Phase 2 results, would be performed to assess the effectiveness of soil washing as a potential ex situ remediation process within Area IV.

4.3 Limitations of Phase 1 Study

There is significant three dimensional variability in the contamination concentrations at any impacted site, particularly one as large as Area IV. Soil contamination characteristics may vary across the site and with depth. The soil partitioning study is limited in scope but attempted to evaluate representative study locations to provide important information for any future studies or potential remediation approaches. Considering the limited scope of Phase 1, the applicability of the soil partitioning study to the entirety of Area IV is uncertain. The majority of the soil partitioning tests used only very small samples to represent a portion of, or the entire sampled location. If conducted, the Phase 3 tests would provide confirmation of the representativeness of the Phase 1 tests.

Statistical analyses should be performed during the soil partitioning study to access the accuracy and precision of the analytical results. The number of Phase 1 duplicate samples was limited and, therefore, statistical analysis of the analytical results was not possible.

5 Study Methods and Materials

Phase 1 of the soil partitioning study was implemented as follows:

- Identify sample locations,

- Collect soil cores from the identified sample locations,
- Submit samples to a contract laboratory to analyze bulk soils from cores for chemical contaminants and grain size, and then analyze select grain size fractions for chemical contaminants.

5.1 Process for Identification of Study Plot Locations

Area IV is an irregularly shaped polygon that is currently subdivided into ten subareas designated as 3, 5A, 5B, 5C, 5D North, 5D South, 6, 7, 8 North, and 8 South. In addition, there are two buffer zone subareas, designated as BZ-NE and BZ-NW that run along the northern border of Area IV. Area IV is a total of 290 acres in size.

Six sample locations were selected for Phase 1 of this study. These locations spanned the majority of the width of Area IV and coincide with the natural attenuation, bioremediation or phytoremediation treatability study sample locations. The selection of natural attenuation, bioremediation and phytoremediation treatability study plots/sample locations are discussed in the respective treatability study plans.

The six soil partition study sample locations are summarized in Table 5.1 and Figure 5.1. All three of the Subarea 5B samples were taken from the same or nearly the same boring location, but varied by sampling depth.

Table 5.1. Soil Partition Study Sample Locations in Area IV

Sample Identifier	Area IV Subarea	Sample depth (ft bgs)	Sample date
STS-SPT-SO-ASP1-0.5-1.5	5B	0.5-1.5	11/20/2013
STS-SPT-SO-SL225-SA5B-0.0-0.5	5B	0.0-0.5	6/24/2014
STS-SPT-SO-SL225-SA5B-2.0-3.0	5B	2.0-3.0	6/12/2014
STS-SPT-SO-SL115-SA5D-0.5-1.5	5DN	0.5-1.5	2/27/2014
STS-SPT-SO-SL311-SA6-0.0-0.5	6	0.0-0.5	6/12/2014
STS-SPT-SO-SRBS1116-SA6-0.0-0.5	6	0.0-0.5	6/19/2014

Figure 5.1. Soil Partition Study Sample Locations in Area IV

5.2 Soil Sampling Procedures

Soil sampling procedures were developed from the Standard Operating Procedure (SOPs) previously approved by DTSC in the Work Plan for Chemical Data Gap Investigation Phase 3 Soil and Chemical Sampling at Area IV, Santa Susana Field Laboratory, Venture County, CA (CDM Smith, 2012a). Applicable Phase 3 SOPs are included in Appendix D of the Soil Partitioning Study Plan.

The soil partition study was conducted in two stages. In the first stage, one of the six identified sample locations was used for a soil partitioning pilot test. The pilot test was conducted to determine the volume of soil needed to conduct the desired geotechnical and chemical analyses for the remainder of the Phase 1 samples. The remaining five soil partitioning study plots were sampled after the pilot test sample analyses were completed.

Multiple cores were collected from within a 5-foot radius circle of the central sampling point at each of the six study locations. Prior to coring, surface debris and plant matter was removed. Multiple cores were removed to ensure that adequate quantities of soil were collected for grain size and chemical analyses.

The soil cores were extruded from stainless steel coring sleeves and the targeted interval of the soil core was collected. The 0.0 to 0.5-ft depth interval represents the surface soil. The 0.5 to 1.5-ft depth interval coincides with the expected root growth zone of the majority of plant species being investigated in the phytoremediation treatability study. The 2.0 to 3.0-ft depth represents soil below the root growth zone of the majority of plant species being investigated in the phytoremediation treatability study.

Each of the core depth intervals was placed in individual containers for delivery to the laboratory.

5.3 Soil Homogenization and Sieving Procedures

Following receipt of sample material, the contract lab homogenized the soil per SOP 17, Laboratory Homogenization for Phase 3 Soil Samples (CDM Smith, 2012a). Homogenization was carried out before sieving or chemical analyses.

Subsets of the homogenized soil were then analyzed for bulk soil chemical contaminants and the remainder of the homogenized soil was size fractionated and separated using ASTM Method 2488-09a. The four grain size designations are outlined in Table 5.2.

Table 5.2. Soil Fractions and Their Grain Size Range

Designation	Size Range (mm)	Retained by U.S. Sieve Mesh
Gravel and Coarse sand	>2.00	10
Medium sand	0.425 – 2.00	40
Fine sand	0.075 – 0.425	200
Silts/Clays (Fines)	<0.075	passes 200

5.4 Analytical Procedures/Chemical Analyses

The homogenized soil samples were analyzed for the contaminants of interest (COIs) in Table 5.3 prior to sieving. In addition, each soil size fraction was analyzed for the COIs in Table 5-3.

Table 5.3. Analytical Requirements

Analyte	Soil mass required[a] (g)	Analytical Method	Hold Time
PCBs	30	EPA Method 8082A Gas Chromatograph/Electron Capture Detector (GC/ECD)	14-days to extraction and 40 days to analysis
Dioxins	10	EPA Method 1613B Gas Chromatograph/ High Resolution Mass Spectroscopy (GC/HRMS)	30-days to extraction and 40 days to analysis
PAHs	30	EPA Method 8270C/D SIM Gas Chromatograph/ High Resolution Mass Spectroscopy (GC/HRMS)	14-days to extraction and 40 days to analysis
TPH	15	EPA Method 8015B/C/D Gas Chromatograph/Flame Ionization Detector (GC/FID)	7-days to extraction and 40 days to analysis for EFH. 14 days for GRO
Metals	5	EPA Method 6010C/6020A/7471B Inductively Coupled Plasma (ICP) - Atomic Emission Spectrometry (AES), ICP-Mass Spectrometry (MS), Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)	6-months
Mercury	3	CVAAS: cold vapor atomic absorption spectroscopy EPA Method 7471B	28-days

[a]: These masses are based on estimated soil moisture of 12%

5.5 Process and Data Review

A summary of the overall subdivision, fractionation, and analysis schedule is summarized in Figure 5-2.

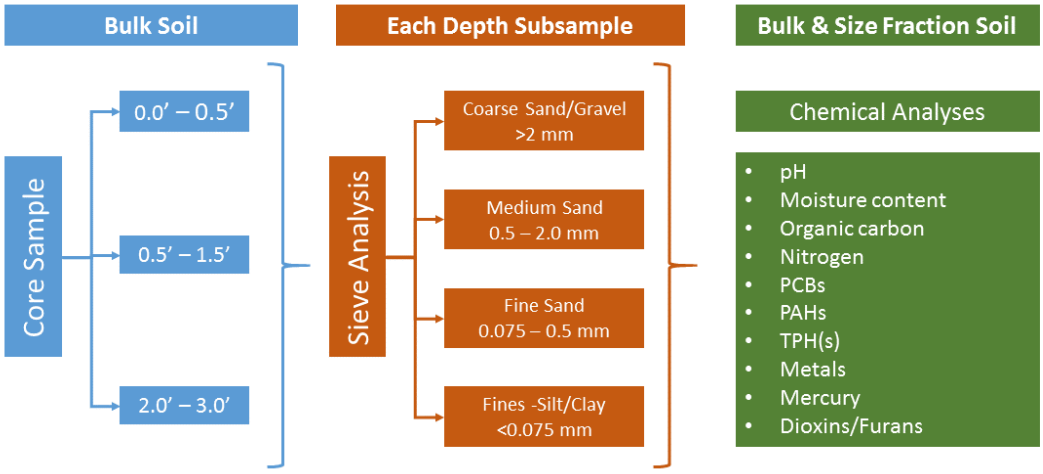


Figure 5.2. Soil Sampling, Subdivision, Fractionation, and Chemical Analysis Overview

5.6 Health and Safety Requirements

Health and safety requirements complied with the Worker Safety and Health Program for Chemical Data Gap Investigation Phase 3 Soil Chemical Sampling at Area IV, Santa Susana Field Laboratory, Ventura County, California (CDM Federal Programs Corporation, March 2012).

5.7 Quality Assurance/Quality Control Requirements

Sampling and analytical methods comply with the Quality Assurance Project Plan (QAPPs) outlined in Quality Assurance Project Plan Chemical Sampling at Area IV, Santa Susana Field Laboratory, Venture County, CA (CDM Federal Programs Corporation, March 2012) that have been previously approved for other studies that have been or will be conducted at SSFL.

6 Study Findings

The Phase 1 results of the soil partitioning study are summarized in this section. The soil size fraction characteristics at each of the six sample locations are presented first, followed by summaries of the contaminant concentrations found in the bulk soil and the individual size fractions at each sample location. Thereafter, a review and discussion of the data results are provided.

6.1 Soil Size Fraction Characteristics

Bulk soil from each sample location was fractionated according to the procedures outlined in Section 5.3. Soil size fractionation results are presented in Table 6.1 and Figure 6.1.

Table 6.1 Soil Mass Distribution by Size Fraction Results

		Percent of total					
Description	Size range (mm)	**SL225-SA5B-0.0-0.5**	**ASP1-0.5-1.5**	**SL225-SA5B-2.0-3.0**	**SL115-SA5D-0.5-1.5**	**SL311-SA6-0.0-0.5**	**SRBS1116-SA6-0.0-0.5**
Coarse sand and gravel	>2.0	31.3%	25.5%	35.0%	45.9%	20.6%	23.7%
Medium sand	0.425 - 2.0	38.0%	33.0%	31.1%	32.0%	36.8%	37.3%
Fines sand	0.075 - 0.425	27.0%	34.8%	29.5%	15.7%	37.1%	33.0%
Silt and clay	<0.075	3.8%	6.6%	4.5%	6.4%	5.5%	6.0%

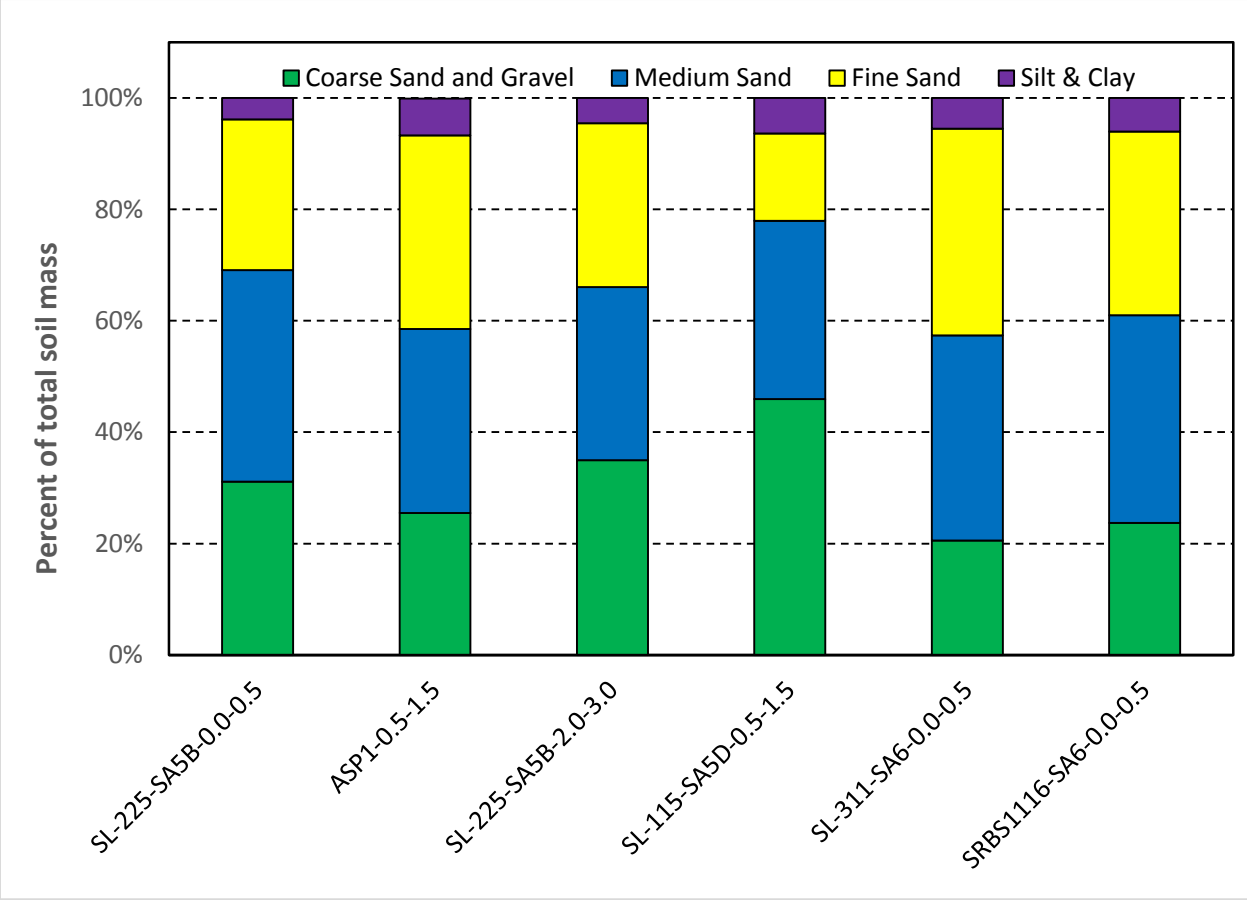


Figure 6.1 Soil Size Fraction Mass Distributions

Soil at all six of the sampling locations were dominated by sand and gravel. Only a small fraction, less than 7 percent, of the soil consisted of silt and clay. Based on soil fractionation and this limited sampling, the upper layer soils within Area IV appear to be relatively uniform.

6.2 Bulk Soil Contamination Characteristics

On June 11, 2013 the DTSC issued the Chemical Look-Up Table Technical Memorandum that outlined the chemical-specific values that will be used to assess whether SSFL cleanup objectives have been achieved. The cleanup objective for each contaminant is referred to as its Look-Up Table Value (LUT Value). The Look-Up Table may be found in Appendix A.

Analytical analyses of the six soils sampled in this study included up to 93 individual chemicals for each bulk soil and soil size fraction. Of these 93 chemical parameters, 77 of them are associated with the LUT Value contaminants.

For each of the bulk soil samples, the concentration for each of the LUT contaminants were compared to the LUT values. Contaminants with concentrations exceeding the LUT values for each soil sample are summarized in Table 6.2.

Despite some variability of contaminants among the sample locations, there are chemical contaminant similarities among the bulk soil analyses conducted at the six locations that can be forwarded with respect to the LUT values.

- Predominant metals of concern are silver and mercury.
- Predominant PAHs include anthracene, benzo(g,h,i)perylene, fluoranthene, phenanthrene, and pyrene.
- Predominant PCBs are Aroclor 1254, Aroclor 1260, and Aroclor 5460.
- Dioxins and furans, summarized by the calculated TCDD TEQ, were elevated at all sample sites.

6.3 Soil Size Fraction Contamination Characteristics

As noted in Section 4, bulk soils at each sample location were fractionated into four size ranges to determine if higher levels of contamination are associated with particular grain sizes.

Contaminants were grouped into specific contaminant groups based on the LUT value categories to simplify the discussion of the results. The contaminant groups and the specific LUT value chemicals in them are summarized in Table 6.3. There are 16 non-LUT value chemicals that were analyzed and categorized into the "Other" category. For the purpose of this report, the metals included in the "Metals" category were limited to cadmium, lead, mercury, and silver, and collectively referred to as "Relevant Metals."

Table 6.2 LUT Value Exceedances at Each Sample Location [a]

Group	Unit	Contaminant	LUT Value	SL225 SA5B 0.0-0.5	SL225 SA5B 0.5-1.5 (ASP1)	SL225 SA5B 2.0-3.0	SL115 SA5D 0.5-1.5	SL311 SA6 0.0-0.5	SRBS1116 SA6 0.0-0.5
Metals	mg/kg	Antimonry	0.85						2.2
		Cadmium	0.7	1.7			0.753	2.04	0.85
		Mercury	0.1	0.4			2.0		0.1
		Molybdenum	3.2						4.5
		Silver	0.2	1.6	0.4			1.5	
		Zinc	214						375
PAHs	µg/kg	Acenaphthene	2.5						12.0
		Acenaphthylene	2.5	17.0					2.7
		Anthracene	2.5	41.3	11.7	4.2	6.7		63
		Benzo(g,h,i)perylene	2.3	2,400	603	147	20.0	70.0	280
		Fluoranthene	5.2	213	55.3	18.3	98.0	25.0	1,050
		Naphthalene	3.6	27.3	5.2				
		Phenanthrene	3.9	177	45.0	13.8	32.0	12.0	390
		Pyrene	5.6	197	47.0	15.6	88.3	23.3	813
		1-Methynaphthalene	2.5	8.4					
		2-Methynaphthalene	2,5	13.3	2.7				
PCBs	µg/kg	Aroclor 1254	1.7	86.3	39.0			2,600	100
		Aroclor 1260	1.7	60.0	23.0			62	45.0
		Aroclor 5460	50						235
Dioxins/Furans	ng/kg	TCDD TEQ	0.912	379	84.0	23.4	11.3	19.1	17.3

[a] Blank values indicate measured values were less than the LUT value, were below detection limits, or were not measured.

Table 6.3 Look-Up Table (LUT) and Non-LUT Contaminants Analyzed in this Study

Contaminant Group	Chemical Type	LUT Value Chemicals	
Metals*	Inorganic	Aluminum	***Mercury***
		Antimony	Molybdenum
		Arsenic	Nickel
		Barium	Potassium
		Beryllium	Selenium
		Boron	***Silver***
		Cadmium	Sodium
		Chromium	Strontium
		Cobalt	Thallium
		Copper	Vanadium
		Lead	Zinc
		Lithium	Zirconium
		Manganese	
Polyaromatic hydrocarbons (PAHs)	Organic	Acenapthene	Dibenzo(a,h)anthracene
		Acenaphthylene	Fluoranthene
		Anthracene	Fluorene
		Benzo(a)anthracene	Indeno(1,2,3-CD)pyrene
		Benzo(a)pyrene	Naphthalene
		Benzo(b)fluoranthene	Phenanthrene
		Benzo(g,h,i)perylene	Pyrene
		Benzo(k)flouroanthene	1-Methylnaphthalene
		Chrysene	2-Methylnappthalene
Polychlorinated biphenyls (PCBs)	Organic	Aroclor 1016	Aroclor 1260
		Aroclor 1221	Aroclor 1262
		Aroclor 1232	Aroclor 1268
		Aroclor 1242	Aroclor 5432
		Aroclor 1248	Aroclor 5442
		Aroclor 1254	Aroclor 5460
Dioxins/Furans	Organic	1,2,3,6,7,8-HpCDD	1,2,3,7,8-PeCDD
		1,2,3,4,6,7,8-HpCDF	1,2,3,7,8-PeCDF
		1,2,3,4,7,8,9-HpCDF	2,3,4,7,8-PeCDF
		1,2,3,4,7,8-HxCDD	2,3,4,6,7,8-HxCDF
		1,2,3,6,7,8-HxCDF	2,3,7,8-TCDD
		1,2,3,6,7,8-HxCDD	2,3,7,8-TCDF
		1,2,3,6,7,8-HxCDF	OCDD
		1,2,3,7,8,9-HxCDD	OCDF
		1,2,3,7,8,9-HxCDF	
Extractable Fuel Hydrocarbons (EFHs)	Organic	EFH (C8-C11)	EFH (C21-C30)
		EFH (C12-C14)	EFH (C30-C40)
		EFH (C15-C20)	
Other	Inorganic	Calcium	Nitrite
		Iron	pH
		Magnesium	Phosphorus
		Moisture	Time
		Nitrate	Titanium
Other	Organic	Azobenzene	NDMA
		Benzo(e)pyrene	TKN
		Biphenyl	TOC

Metals identified in ***bold italics*** are identified as "Relevant Metals" in this study.

The contaminant category concentrations for the bulk soil and the various soil size fractions are tabulated in Table 6.4. Contaminant concentrations for the bulk and various size fractions for the relevant metals, PAHs, PCBs, and TCDD TEQ are graphically summarized in Figure 6.2, Figure 6.3, Figure 6.4, and Figure 6.5, respectively. Note that the sample locations in the upper graphs are different depths from the same borehole. Additionally, the vertical scale range may vary between the upper and lower graphs.

Although there is a moderate degree of variability, contaminant concentrations generally increase with decreasing soil size. Coarse material fractions have lower contaminant concentrations than the silt/clay fraction. However, the variation of contamination by soil size fraction does not warrant soil sieving (fractionation) as part of the overall remediation strategy for Area IV.

6.4 Contaminant Variation by Soil Depth

Understanding the characteristics of soil contamination as a function of soil depth was not an original recommendation in the Sandia report (2012b), however, one of the primary motivations for the soil partitioning study was to assess the extent to which soil within Area IV must be excavated, treated and/or be ultimately disposed if ex situ remediation methods are employed. Therefore, one set of samples collected was a co-located site within Subarea 5B of Area IV. Soil samples were analyzed for contaminants from the surface layer (0.0 to 0.5 ft bgs), the root zone layer for plants being considered for phytoremediation (0.5 to 1.5 ft bgs), and the soil layer below the aforementioned root zone (2.0 to 3.0 ft bgs). These results are also tabulated in Table 6.4. It is important to note that the sample identified as ASP1 is from the same location as the samples designated as SL225-SA5B.

Trends for the contamination variability for relevant metals, PAHs, PCBs, and TCDD TEQ as a function of depth for the bulk soil samples can be seen in Figure 6.6. Soil contaminant concentrations decrease substantially with depth. Contamination was found to be greatest within the surface layer and significantly lower in the underlying soil layers. The drop off of contaminant concentrations with depth is consistent with the assumption that site soil contamination is due to deposition of contaminants over the surface of the site. Contamination in the lower soil layers occurs primarily due soil disturbance (e.g. grading, soil turnover) and transport induced by rainfall percolation. Downward transport via percolation is slow at SSFL, however, due to the low annual rainfall amounts at SSFL.

6.5 Changes in Contaminant Concentrations with Time

Although not an objective of the soil partitioning study, three of the soil partition study sample locations coincided with sample locations and depths during the soil sampling event of Area IV conducted from 2010 to 2011. The three coincidental sample locations and the sample collection dates are summarized in Table 6.5.

Table 6.4 Contaminant Category Concentrations vs. Soil Size Fraction

Sample Location	Soil Depth (ft)	Contaminant Category	Units	Concentration					
				LUT Value	Bulk	Coarse Sand & Gravel	Medium Sand	Fine Sand	Silt & Clay
SL225-SA5B	0.0-0.5	PAHs	µg/kg	37	6,654	8,634	7,001	7,229	11,607
		PCBs	µg/kg	170	195	217	193	215	253
		Relevant Metals	mg/kg	50	40.7	49.9	38.6	44.5	55.2
		TCDD TEQ	ng/kg	0.912	384.6	445.7	333.4	389.1	533.7
ASP1 (SL225-SA5B)	0.5-1.5	PAHs	µg/kg	37	1,731	647	1,291	2,070	2,963
		PCBs	µg/kg	170	62.0	39.0	54.0	73.0	86.0
		Relevant Metals	mg/kg	50	14.2	14.9	12.2	15.8	20.5
		TCDD TEQ	ng/kg	0.912	84.0	55.7	65.0	99.5	134
SL225-SA5B	2.0-3.0	PAHs	µg/kg	36.9	419	107	275	586	1,169
		PCBs	µg/kg	170	0.0	0.0	0.0	0.0	0.0
		Relevant Metals	mg/kg	50	7.1	7.8	7.3	8.9	14.9
		TCDD TEQ	ng/kg	0.912	23.4	11.8	19.4	36.0	24.5
SL115-SA5D	0.5-1.5	PAHs	µg/kg	37	508	1,146	193	533	320
		PCBs	µg/kg	170	ND	ND	ND	ND	ND
		Relevant Metals	mg/kg	50	19.5	19.4	18.8	22.00	24.8
		TCDD TEQ	ng/kg	0.912	536	375	450	693	1,087
SL311-SA6	0.0-0.5	PAHs	µg/kg	37	263	133	150	303	549
		PCBs	µg/kg	170	2,662	2,639	1,731	3,359	6,782
		Relevant Metals	mg/kg	50	37.5	86.1	25.6	41.8	79.0
		TCDD TEQ	ng/kg	0.912	305	385	132	290	207
SRBS1116-SA6	0.0-0.5	PAHs	µg/kg	36.9	5,040	172	1,983	2,268	579
		PCBs	µg/kg	170	380	101	189	637	526
		Relevant Metals	mg/kg	50	33.0	7.8	12.7	40.9	33.1
		TCDD TEQ	ng/kg	0.912	690	164	560	1,002	1,459

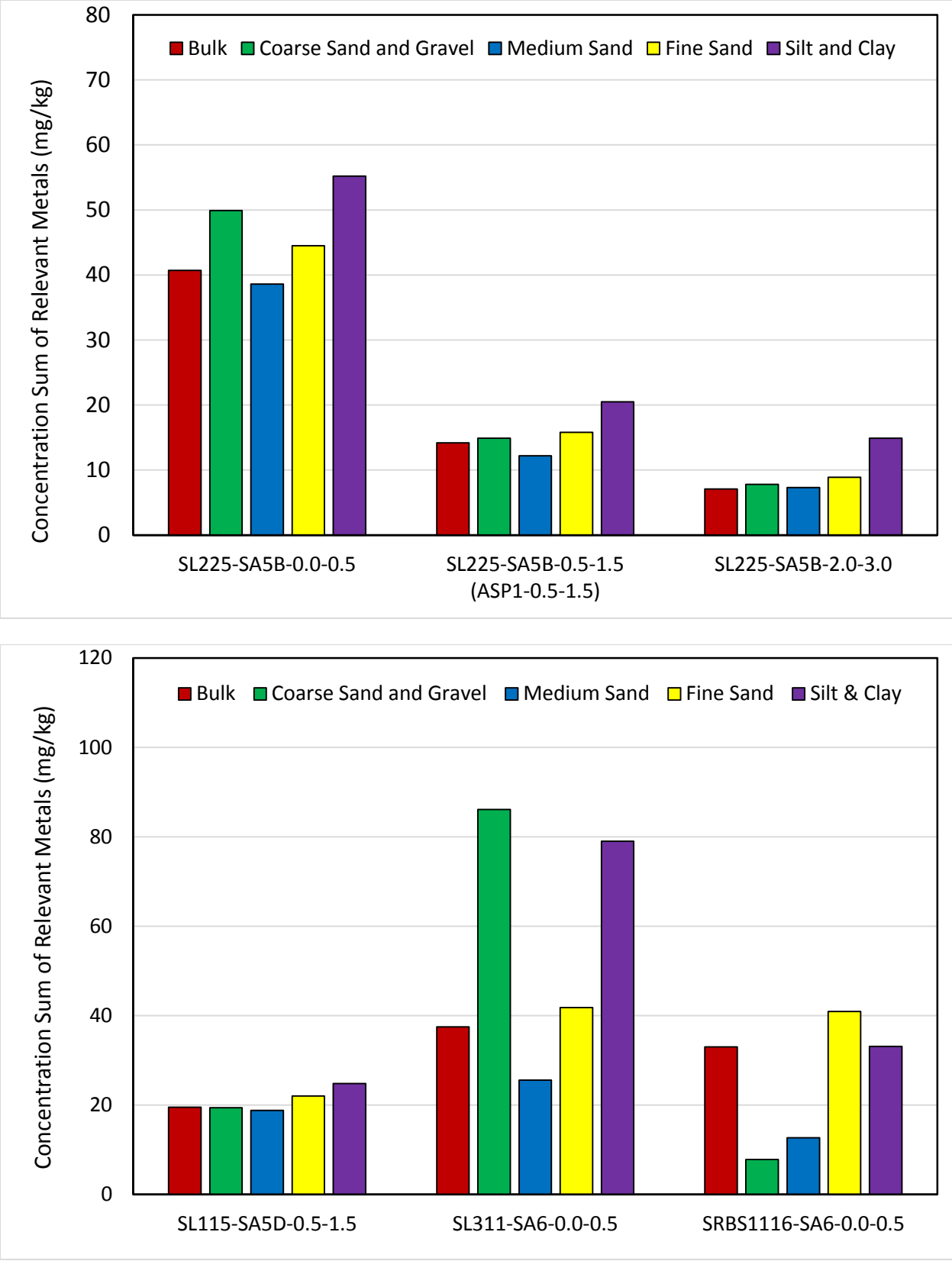


Figure 6.2 Relevant Metals Concentration for the Bulk Soil and the Various Soil Size Fractions

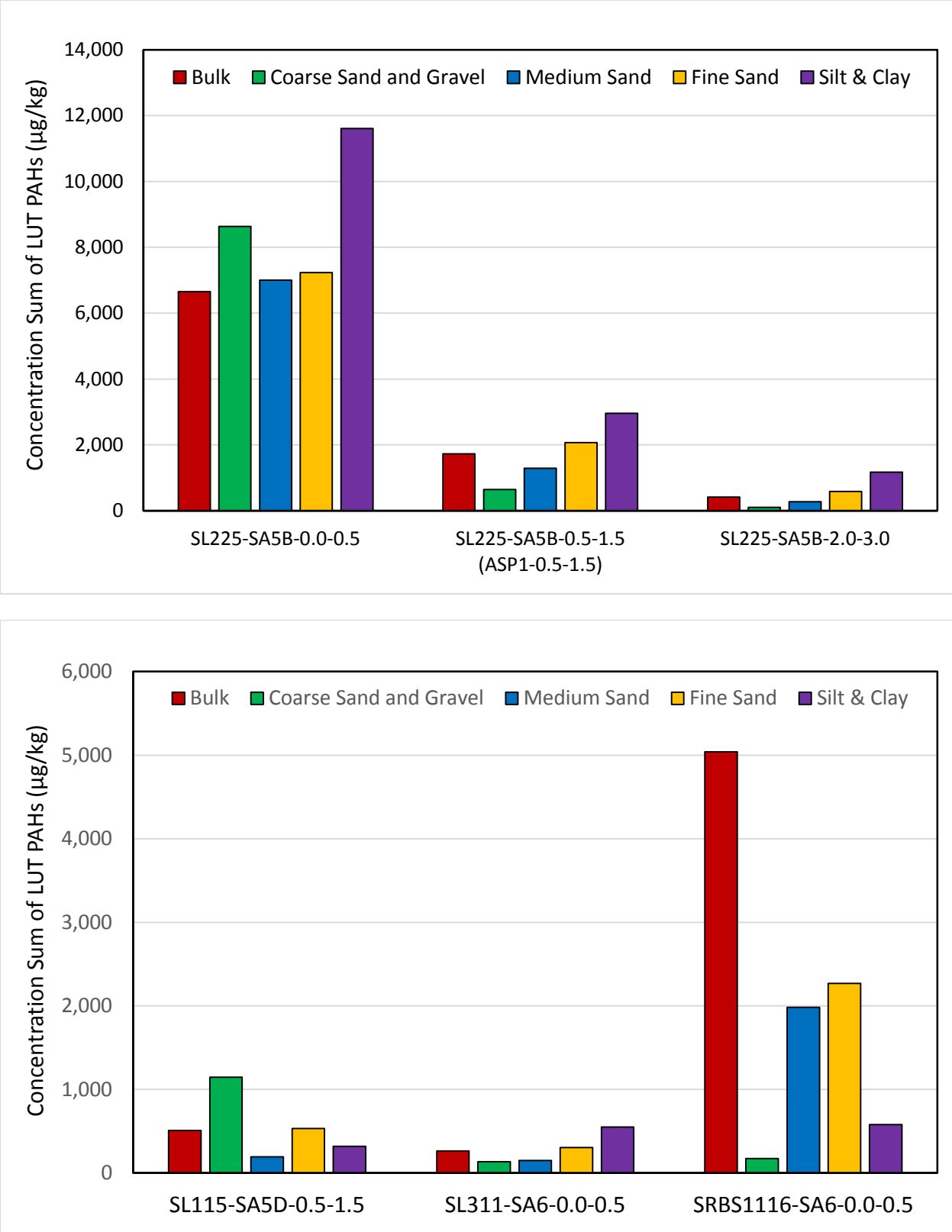
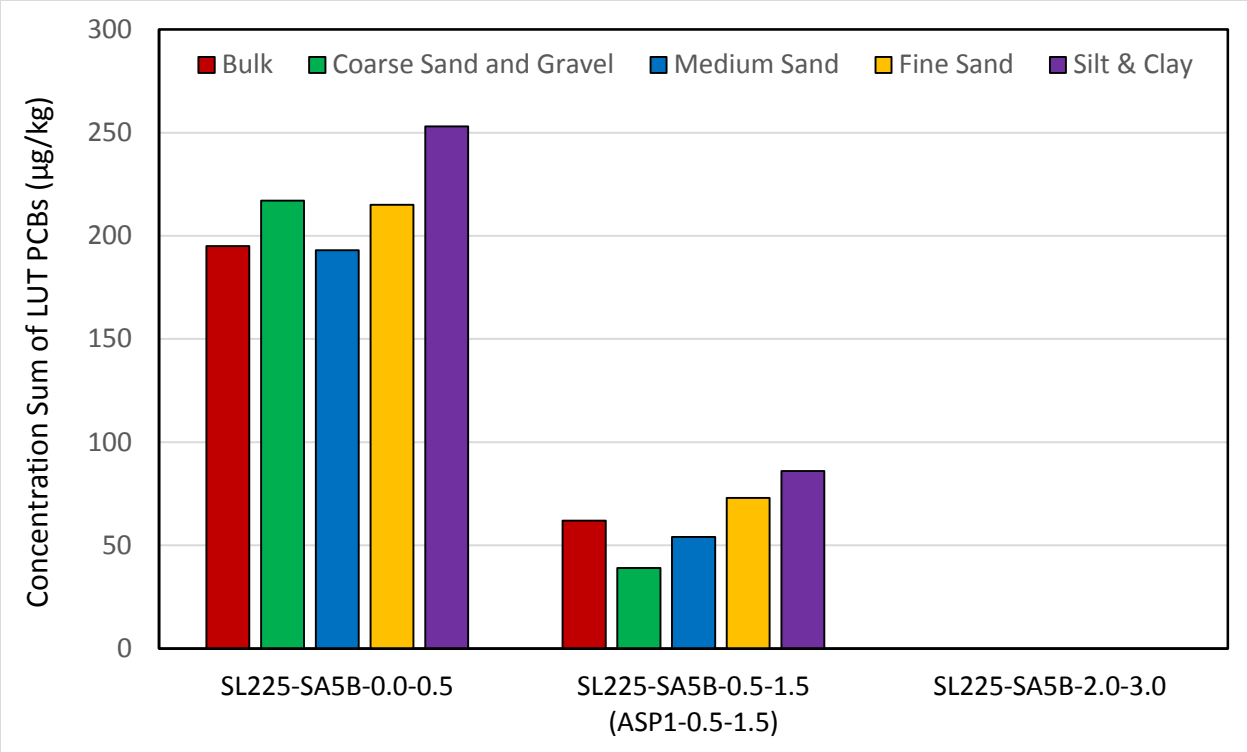


Figure 6.3 Concentration Sum of LUT PAHs for the Bulk Soil and the Various Soil Size Fractions



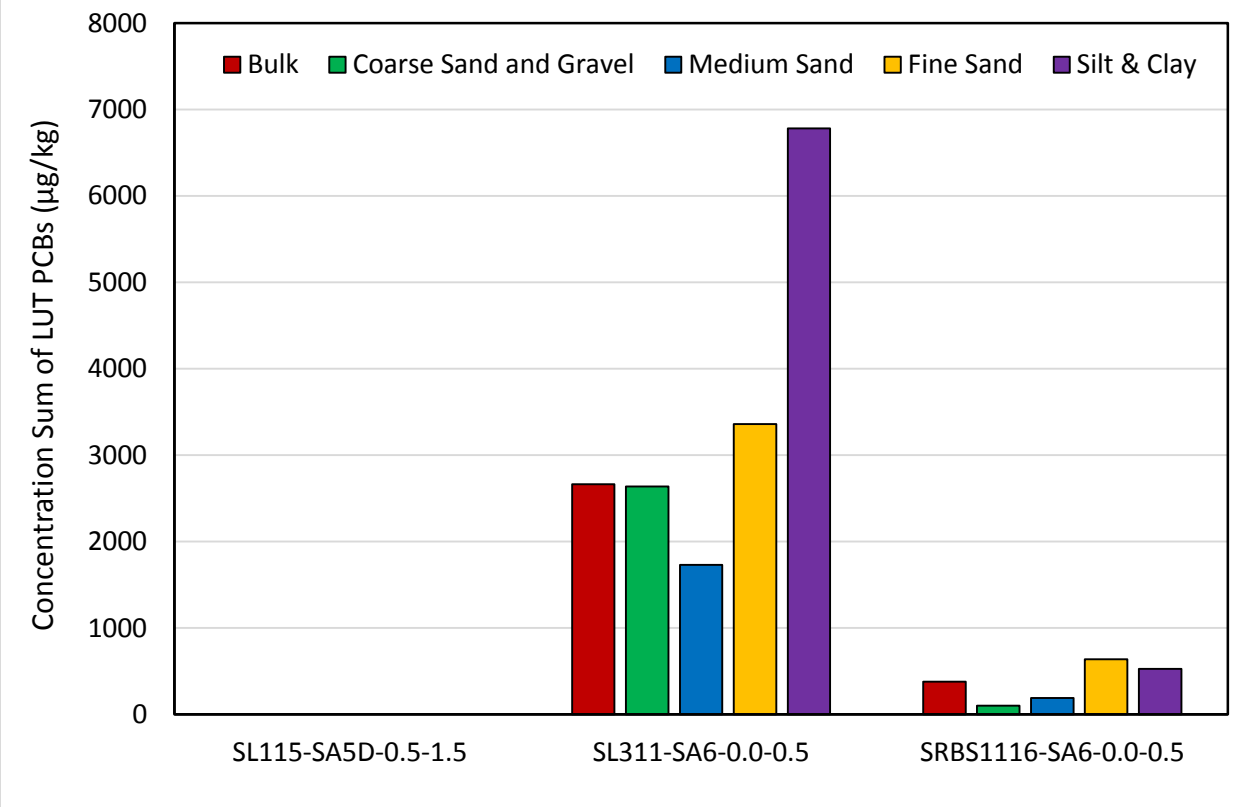
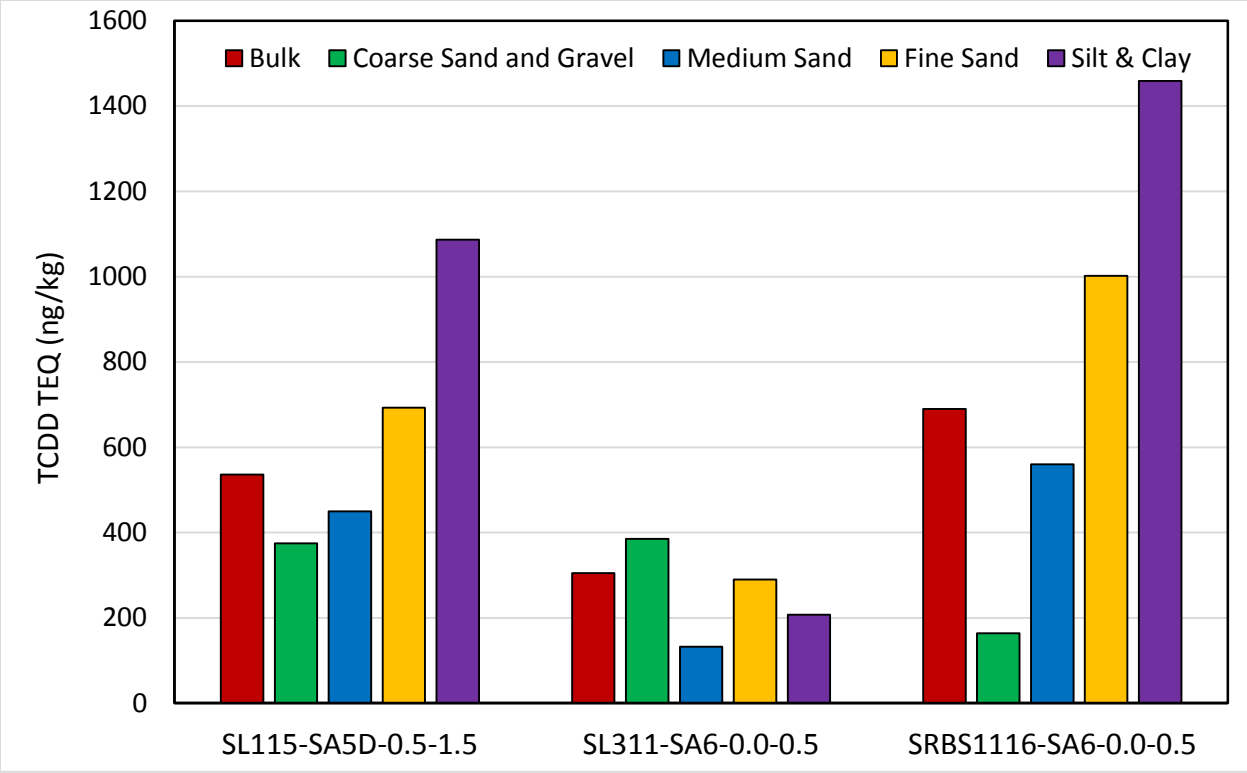


Figure 6.4 Concentration Sum of LUT PCBs for the Bulk Soil and the Various Soil Size Fractions



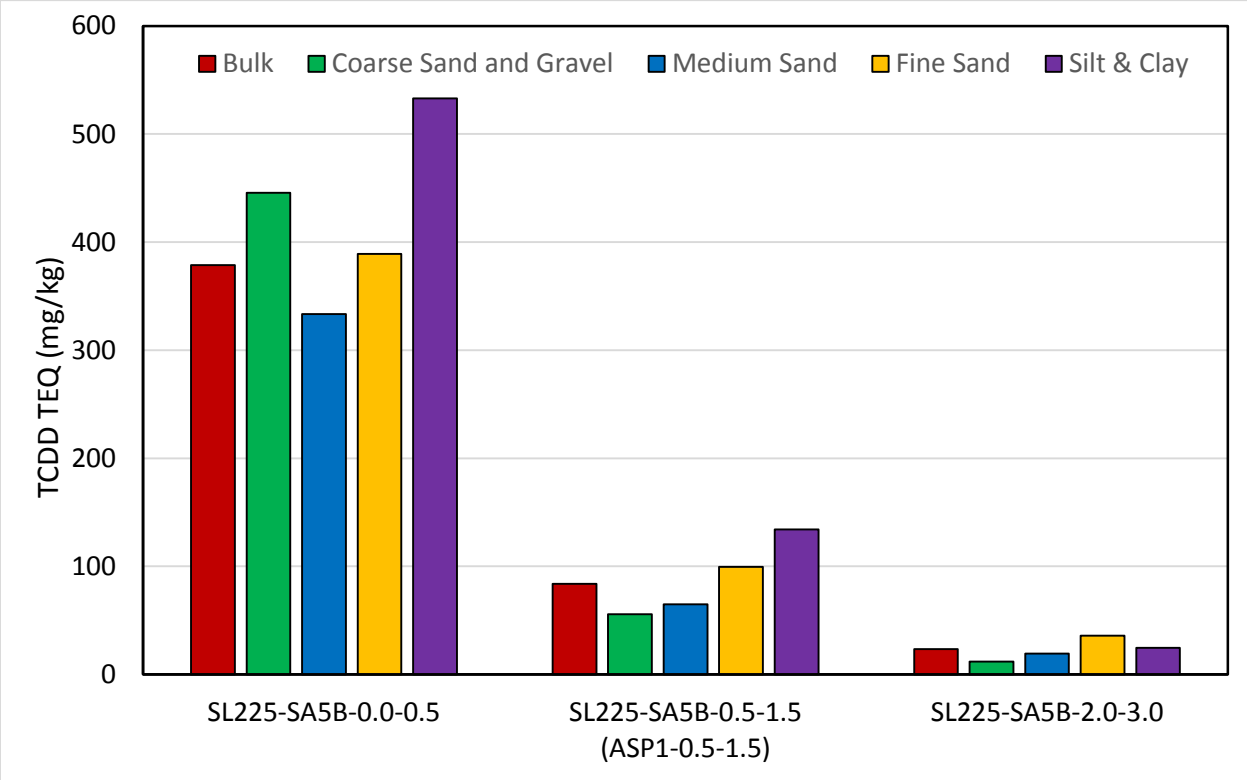


Figure 6.5 TCDD TEQ Values for the Bulk Soil and the Various Soil Size Fractions

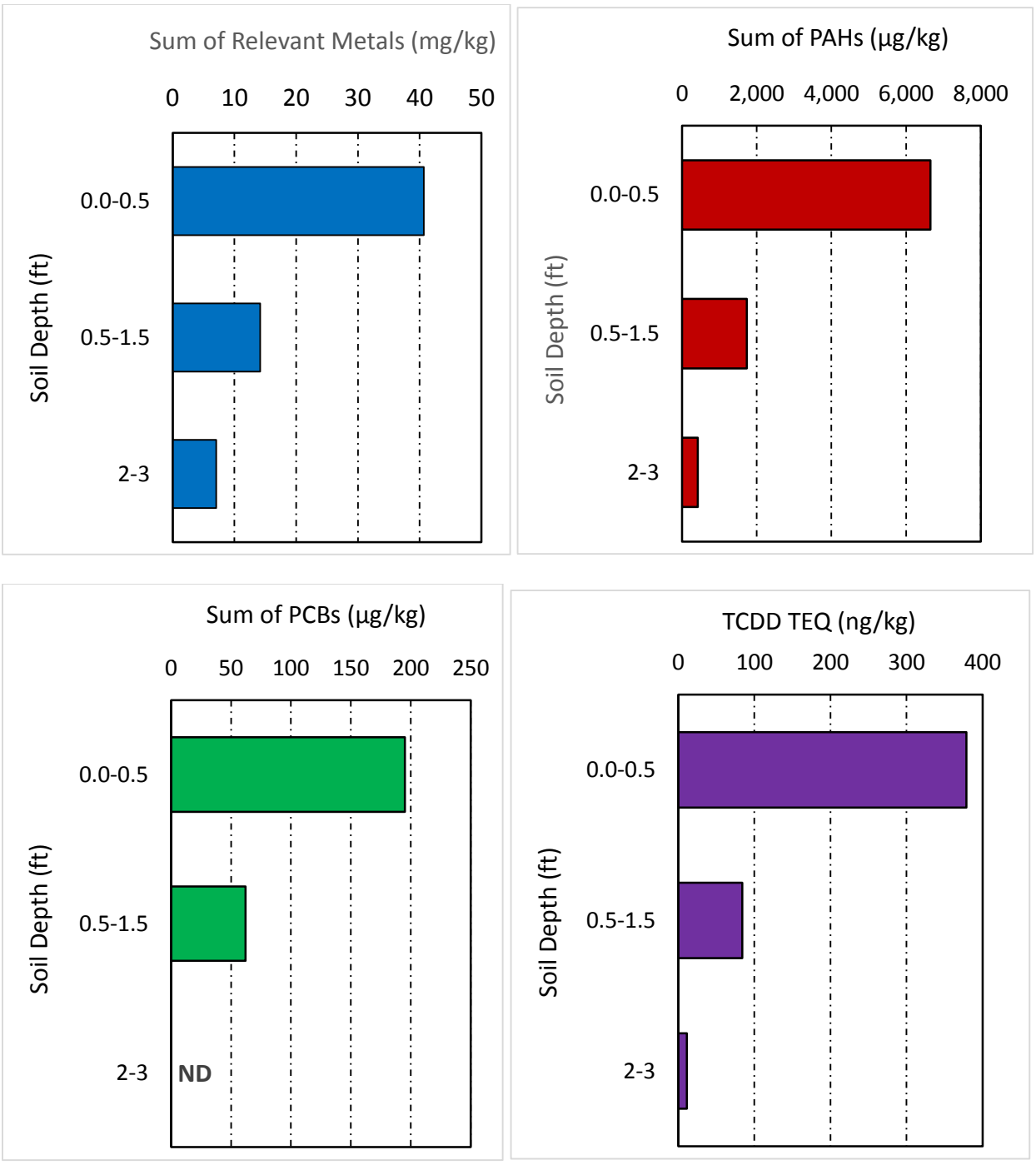


Figure 6.6 Contaminant Concentrations as a Function of Depth at SL225-SA5B

Table 6.5 Common Sample Locations for the 2010/11 Area IV Soil Chemical Survey and the 2014 Soil Partitioning Study

Location Identifier	Sample Depth	Chemical Survey Sample Date	Soil Partitioning Study Sample Date
SL225-SA5B	0.0 – 0.5	21 Dec 2010	12 Jun 2014
SL225-SA5B	2.0 – 3.0	9 Mar 2011	12 Jun 2014
SL311-SA6	0.0 – 0.5	26 Jul 2011	12 Jun 2014

Changes in relevant metals, PAHs, PCBs, TCDD TEQ, and TPH are presented for each of the three sample locations in Figure 6.7 through Figure 6.11. TPH changes are included as an additional category of organic contaminants.

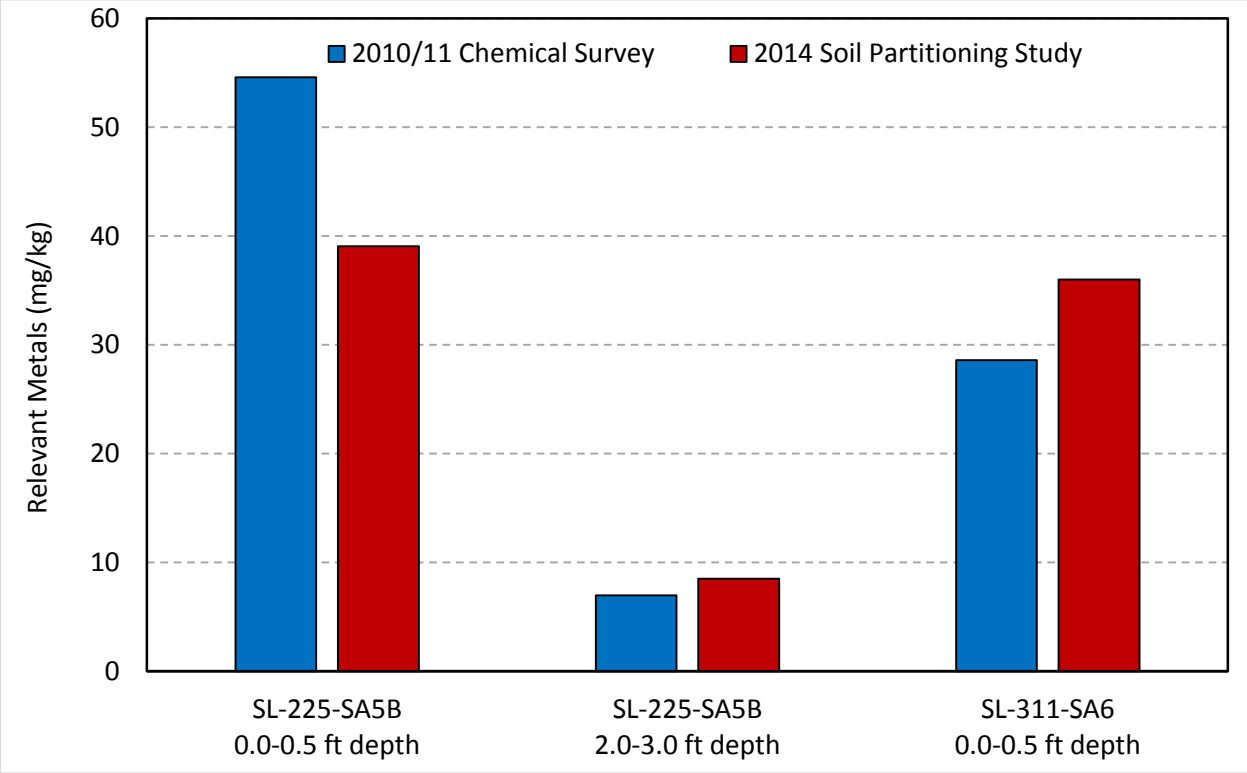


Figure 6.7 Change in Relevant Metals Concentration from 2010/2011 Soil Sampling Event to 2014 Soil Partition Study

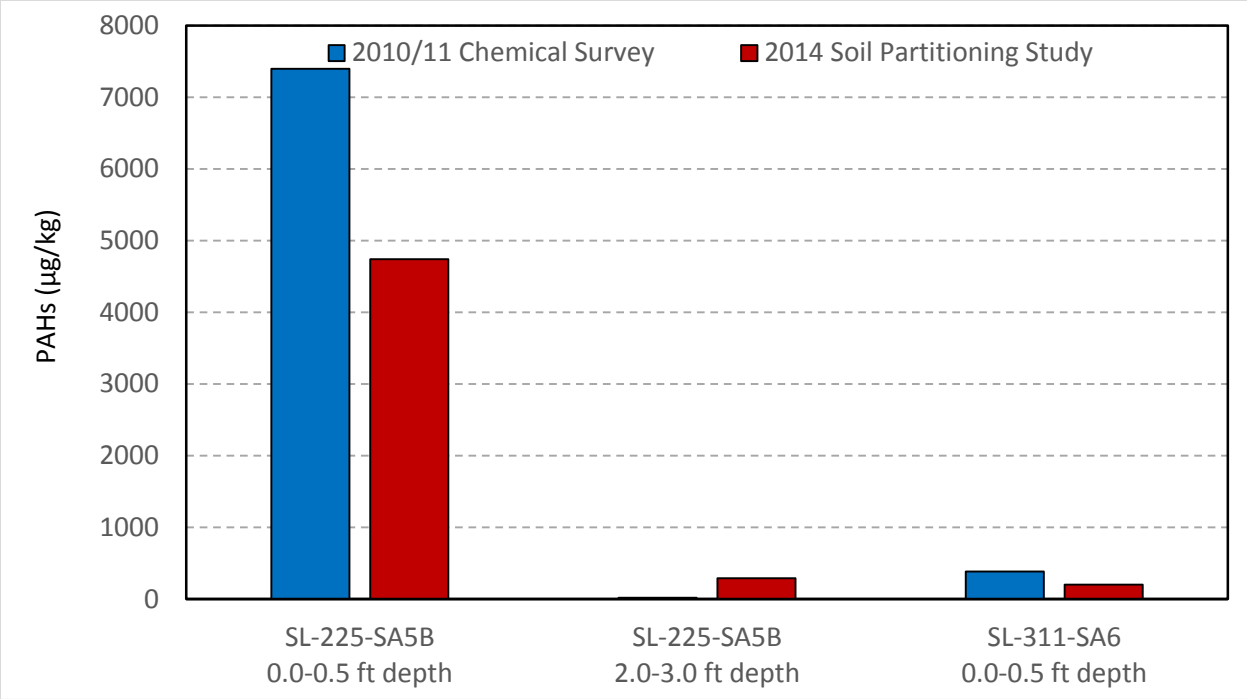


Figure 6.8 Change in PAHs Concentration from 2010/2011 Soil Sampling Event to 2014 Soil Partition Study

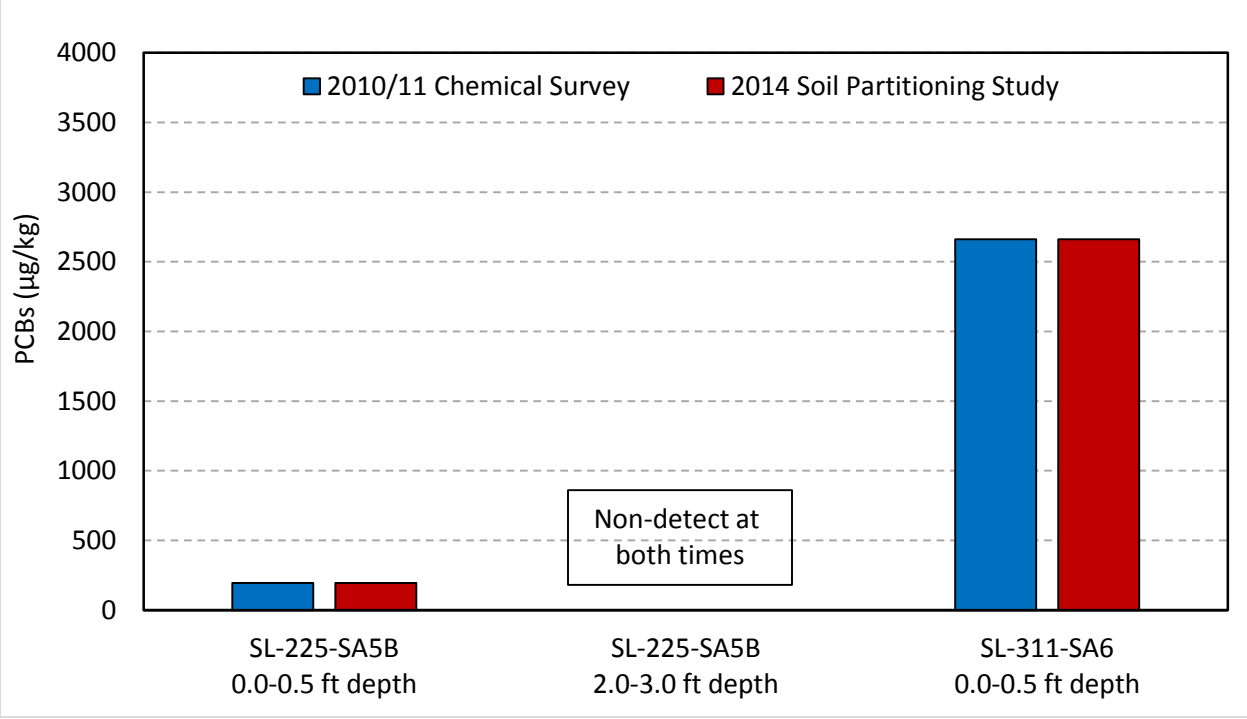


Figure 6.9 Change in PCBs Concentration from 2010/2011 Soil Sampling Event to 2014 Soil Partition Study

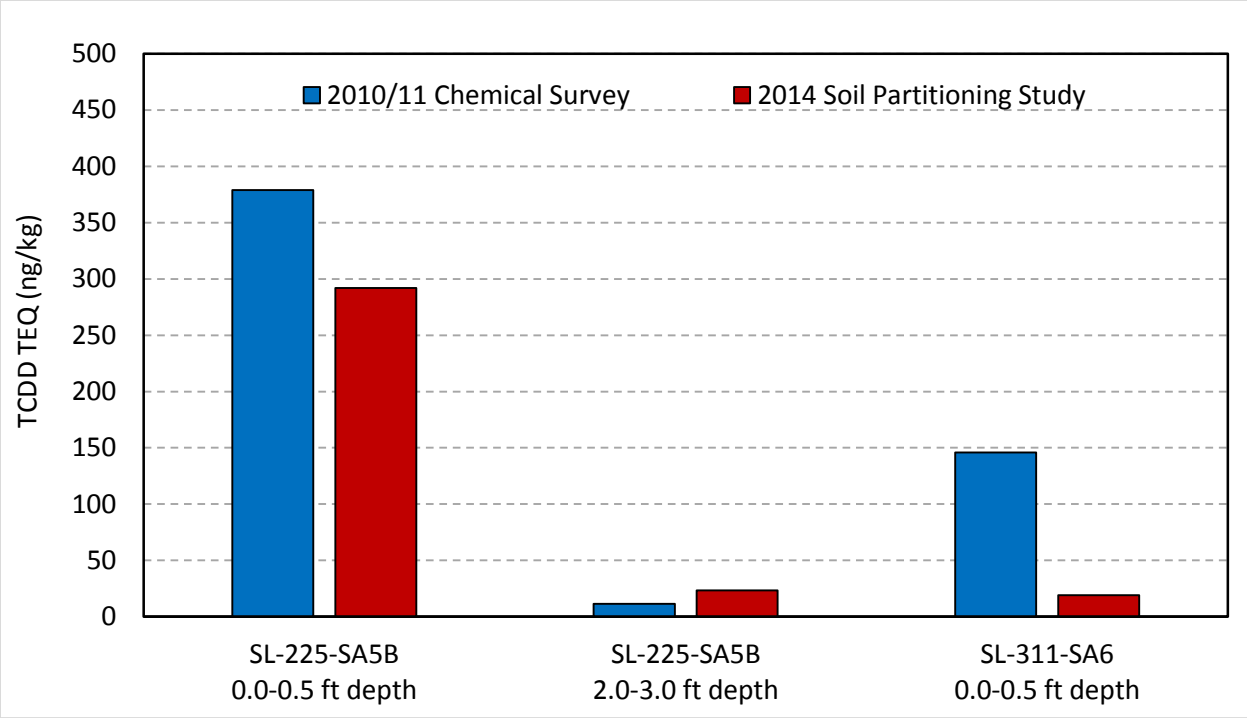


Figure 6.10 Change in TCDD TEQ from
2010/2011 Soil Sampling Event to 2014 Soil Partition Study

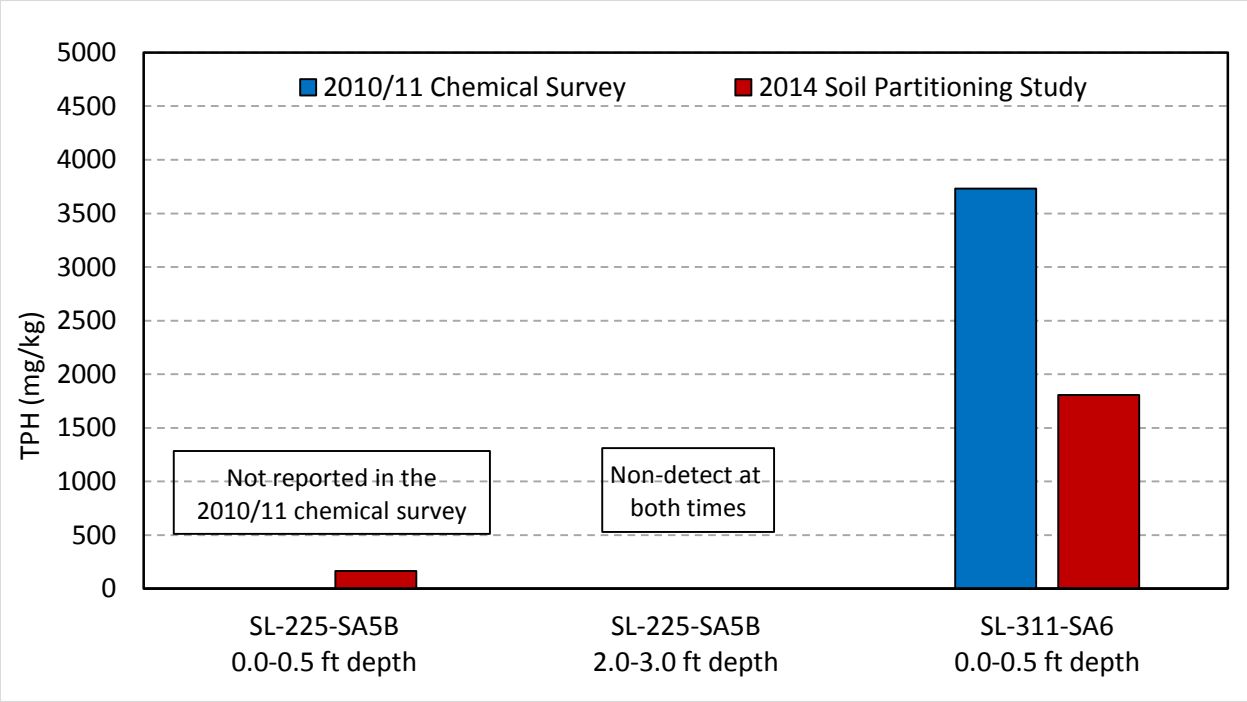


Figure 6.11 Change in TPH from
2010/2011 Soil Sampling Event to 2014 Soil Partition Study

In the two surface soil layer samples, the levels of PAHs, TCDD, and TPH have decreased. PCB levels, however, have remained steady. Changes in the relevant metals differed at the two surface layer locations.

In contrast, in the single subsurface sample SL225-SA5B-2.0-3.0 the levels of PAHs and TCDD TEQ increased. PCB levels were below the detection limit for both sampling dates and the relevant metals increased slightly.

With respect to the organic components, PAHs, TCDD TEQ, and TPH, the decrease in levels may be due to a combination of natural attenuation and transport of contaminants downward into the lower soil layers. This latter possibility would be consistent with the small, but observable increase of contaminants in the subsurface sample, SL225-SA5B-2.0-3.0.

More definitive observations may be included in the natural attenuation treatability study.

7 Conclusions and Recommendations

Conclusions from the soil partitioning study will be presented first, followed by recommendations for additional consideration.

7.1 Conclusions

Six sample sites were selected to study based on the location across Area IV, the previous results from the 2010/2011 soil sampling event, and the objectives of this study. Bulk soil samples along with size fractionated soils at each location were analyzed for contaminant concentrations. Based on the soil partitioning and analytical results, the following conclusions were developed.

- Soil size fractions at each sample location were found to be comparable. The soils were dominated by sand and gravel. Less than 7 percent of the soil was in the silt/clay fraction.
- Elevated contaminants of concern that exceed LUT values include metals (mercury, silver, and zinc), PAHs, PCBs (limited to Aroclor 1254, Aroclor 1260, and Aroclor 5460), and dioxins and furans (as characterized by TCDD TEQ).
- There is a general trend for higher contaminant concentrations with decreasing soil size fraction. However, there is some variability. The differences are not sufficient to warrant size separation sieving during ex situ processing as a means to reduce treatment and/or disposal volumes.
- Based on the single sample location with multiple soil depths analyzed, contaminant levels decreased with distance below the ground surface. Contamination was found to be highest in the surface layer (0.0 to 0.5 ft bgs).
- Depending on location within Area IV, ex situ soil excavation may be minimized to the upper soil layers.
- Within the surface soil layer at two of the sampling locations, the concentrations of PAH, TCDD TEQ, and TPH decreased over the period from 2010/2011 (soil sampling event) and 2014 (soil partitioning study).

- In the lower soil layer (2.0 to 3.0 ft bgs), the concentrations of PAH and TCDD TEQ increased.

7.2 Recommendations

Based on the soil partitioning analytical results and conclusions, the following recommendations are proposed.

- Further soil contaminant characterization based on soil size fraction is not warranted.
- Assess the depth of excavation that is needed for ex situ remediation processes with additional contaminant characterization as a function of soil depth.
- Due to the predominance of sand and gravel, soil washing may be applicable. Conduct Phase 2 (see Section 4.2.2) of the soil partitioning study to evaluate potential effectiveness of soil washing/contaminant extraction as a remedial soil treatment process. These tests may be limited to bulk soils only.
- Phase 3 (see Section 4.2.3) would be a follow-up to Phase 2 if satisfactory results are found.
- Depending on the conclusions developed in the natural attenuation soil treatability study, additional studies may be warranted to assess the mechanisms responsible for the decrease in contaminant concentration over time. This investigation should include possible biotic and abiotic degradation mechanisms, as well as contaminant leaching/transport.

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9 Appendixes

9.1 Appendix A – DTSC Look-Up Table Values (LUT Values)

DTSC Chemical Look-Up Table for DOE NASA at SSFL

June 2013

Chemical Constituent	Units	Look-Up Table Value	Basis
Alcohols - EPA Method 8015B			
Ethanol	mg/kg	0.7	BG MRL
Methanol	mg/kg	0.7	BG MRL
Anions - EPA Methods 300.0 / 9056A			
Fluoride	mg/kg	10.2	BTV
Nitrate	mg/kg	22.3	BTV
Cyanide - EPA Method 9012A			
Cyanide	mg/kg	0.6	BG MRL
Dioxin-Furans - EPA Method 1613B			
1,2,3,4,6,7,8-HpCDD	pg/g	see note[1]	---
1,2,3,4,6,7,8-HpCDF	pg/g	see note[1]	---
1,2,3,4,7,8,9-HpCDF	pg/g	see note[1]	---
1,2,3,4,7,8-HxCDD	pg/g	see note[1]	---
1,2,3,4,7,8-HxCDF	pg/g	see note[1]	---
1,2,3,6,7,8-HxCDD	pg/g	see note[1]	---
1,2,3,6,7,8-HxCDF	pg/g	see note[1]	---
1,2,3,7,8,9-HxCDD	pg/g	see note[1]	---
1,2,3,7,8,9-HxCDF	pg/g	see note[1]	---
1,2,3,7,8-PeCDD	pg/g	see note[1]	---
1,2,3,7,8-PeCDF	pg/g	see note[1]	---
2,3,4,6,7,8-HxCDF	pg/g	see note[1]	---
2,3,4,7,8-PeCDF	pg/g	see note[1]	---
2,3,7,8-TCDD	pg/g	see note[1]	---
2,3,7,8-TCDF	pg/g	see note[1]	---
OCDD	pg/g	see note[1]	---
OCDF	pg/g	see note[1]	---
2,3,7,8-TCDD TEQ			
2,3,7,8-TCDD TEQ[1]	pg/g	0.912 (see note[1])	BTV-TEQ
Energetics - EPA Method 8330			
RDX	µg/kg	300	M-L MRL
Formaldehyde - EPA Method 8315A			
Formaldehyde	µg/kg	1,870	BG MRL

Chemical Constituent	Units	Look-Up Table Value	Basis
Herbicides - EPA Method 8151A			
2,4,5-T	µg/kg	1.2	BTV
2,4,5-TP	µg/kg	0.63	BTV
2,4-D	µg/kg	5.8	BTV
2,4-DB	µg/kg	2.4	BG MRL
2,4-DP (Dichloroprop)	µg/kg	2.4	BTV
Dalapon	µg/kg	12.5	BG MRL
Dicamba	µg/kg	1.3	BTV
Dinoseb	µg/kg	3.3	BG MRL
MCPA	µg/kg	761	BTV
MCPP (Mecoprop)	µg/kg	377	BTV
Pentachlorophenol	µg/kg	170	M-L MRL
Metals - EPA Methods 6010B/6020A			
Aluminum	mg/kg	58,600	BTV
Antimony	mg/kg	0.86	BTV
Arsenic	mg/kg	46	BTV
Barium	mg/kg	371	BTV
Beryllium	mg/kg	2.2	BTV
Boron	mg/kg	34	BTV
Cadmium	mg/kg	0.7	BTV
Chromium	mg/kg	94	BTV
Cobalt	mg/kg	44	BTV
Copper	mg/kg	119	BTV
Lead	mg/kg	49	BTV
Lithium	mg/kg	91	BTV
Manganese	mg/kg	1,120	BTV
Molybdenum	mg/kg	3.2	BTV
Nickel	mg/kg	132	BTV
Potassium	mg/kg	14,400	BTV
Selenium	mg/kg	1	BTV
Silver	mg/kg	0.2	BTV
Sodium	mg/kg	1,780	BTV
Strontium	mg/kg	163	BTV
Thallium	mg/kg	1.2	BTV
Vanadium	mg/kg	175	BTV
Zinc	mg/kg	215	BTV
Zirconium	mg/kg	19	BTV
Hexavalent Chromium - EPA Methods 7199/7196A			
Hexavalent Chromium	mg/kg	2	BTV
Mercury - EPA Methods 7471A/7470A			
Mercury	mg/kg	0.13	BG MRL
Methyl Mercury - EPA Method 1630 (Mod)			
Methyl Mercury	µg/kg	0.05	M-L MRL

Chemical Constituent	Units	Look-Up Table Value	Basis
PCBs / PCTs - EPA Method 8082			
Aroclor 1016	µg/kg	17	M-L MRL
Aroclor 1221	µg/kg	33	M-L MRL
Aroclor 1232	µg/kg	17	M-L MRL
Aroclor 1262	µg/kg	33	M-L MRL
Aroclor 1254	µg/kg	17	M-L MRL
Aroclor 1260	µg/kg	17	M-L MRL
Aroclor 1268	µg/kg	33	M-L MRL
Aroclor 1242	µg/kg	17	M-L MRL
Aroclor 1248	µg/kg	17	M-L MRL
Aroclor 5432	µg/kg	50	M-L MRL
Aroclor 5442	µg/kg	50	M-L MRL
Aroclor 5460	µg/kg	50	M-L MRL
Perchlorate - EPA Methods 6850/6860			
Perchlorate	µg/kg	1.63	BTV
Pesticides - EPA Method 8081A			
Aldrin	µg/kg	0.24	BG MRL
Alpha-BHC	µg/kg	0.24	BG MRL
Beta-BHC	µg/kg	0.23	BTV
Chlordane	µg/kg	7	BTV
Delta-BHC	µg/kg	0.22	BTV
Dieldrin	µg/kg	0.48	BG MRL
Endosulfan I	µg/kg	0.24	BG MRL
Endosulfan II	µg/kg	0.48	BG MRL
Endosulfan Sulfate	µg/kg	0.48	BG MRL
Endrin	µg/kg	0.48	BG MRL
Endrin Aldehyde	µg/kg	0.7	BTV
Endrin Ketone	µg/kg	0.7	BTV
Gamma-BHC - Lindane	µg/kg	0.24	BG MRL
Heptachlor	µg/kg	0.24	BG MRL
Heptachlor Epoxide	µg/kg	0.24	BG MRL
Methoxychlor	µg/kg	2.4	BG MRL
Mirex	µg/kg	0.5	BTV
p,p-DDD	µg/kg	0.48	BG MRL
p,p-DDE	µg/kg	8.6	BTV
p,p-DDT	µg/kg	13	BTV
Toxaphene	µg/kg	8.8	BG MRL

Chemical Constituent	Units	Look-Up Table Value	Basis
Semi-Volatiles (SVOCs)/PAHs - EPA Method 8270C(SIM)			
Acenaphthylene	µg/kg	2.5	BG MRL
Anthracene	µg/kg	2.5	BG MRL
Benzo(a)anthracene	µg/kg	see note [2]	---
Benzo(a)pyrene	µg/kg	see note [2]	---
Benzo(b)fluoranthene	µg/kg	see note [2]	---
Benzo(g,h,i)perylene	µg/kg	2.5	BG MRL
Benzo(k)fluoranthene	µg/kg	see note [2]	---
Bis(2-Ethylhexyl)phthalate	µg/kg	61	BTV
Butylbenzylphthalate	µg/kg	100	BTV
Chrysene	µg/kg	see note [2]	---
Dibenz(a,h)anthracene	µg/kg	see note [2]	---
Diethyl phthalate	µg/kg	27	BG MRL
Dimethyl phthalate	µg/kg	27	BG MRL
Di-n-butylphthalate	µg/kg	27	BG MRL
Di-n-octylphthalate	µg/kg	27	BG MRL
Fluoranthene	µg/kg	5.2	BTV
Fluorene	µg/kg	3.8	BTV
Indeno(1,2,3-cd)pyrene	µg/kg	see note [2]	---
Naphthalene	µg/kg	3.6	BTV
Phenanthrene	µg/kg	3.9	BTV
Pyrene	µg/kg	5.6	BTV
1-Methyl naphthalene	µg/kg	2.5	BG MRL
2-Methylnaphthalene	µg/kg	2.5	BG MRL
Acenaphthene	µg/kg	2.5	BG MRL
Benzo(a)pyrene Equivalent			
Benzo(a)pyrene TEQ [2]	µg/kg	4.47 (see note [2])	BTV-TEQ
Other SVOCs			
Benzoic Acid - EPA 8270	µg/kg	660	M-L MRL
N-Nitrosodimethylamine - 8270C(SIM)	µg/kg	10	M-L MRL
Phenol - EPA 8270	µg/kg	170	M-L MRL
TPH - EPA Method 8015			
TPH EFH (C15-C20) [3]	mg/kg	5 (see note [3])	M-L MRL
Terphenyls - EPA Method 8015			
o-Terphenyl	mg/kg	7	M-L MRL

Chemical Constituent	Units	Look-Up Table Value	Basis
VOCs - EPA Method 8260			
1,1-Dichloroethene	µg/kg	5	M-L MRL
1,4-Dioxane - EPA 8260 (SIM)	µg/kg	10	M-L MRL
2-Hexanone	µg/kg	10	M-L MRL
Acetone	µg/kg	20	M-L MRL
Benzene	µg/kg	5	M-L MRL
cis-1,2-Dichloroethene	µg/kg	5	M-L MRL
Ethylbenzene	µg/kg	5	M-L MRL
Hexachlorobutadiene	µg/kg	5	M-L MRL
Methylene chloride	µg/kg	10	M-L MRL
Tetrachloroethene	µg/kg	5	M-L MRL
Toluene	µg/kg	5	M-L MRL
Trichloroethene	µg/kg	5	M-L MRL
Vinyl chloride	µg/kg	5	M-L MRL

Notes:
mg/kg: milligrams per kilogram (parts per million)
µg/kg: micrograms per kilogram (parts per billion)
pg/g: picograms per gram (parts per trillion)
BTV: Background threshold value
BG-MRL: Background method reporting limit
M-L MRL: Multi-Lab method reporting limit
PAH: Polyaromatic hydrocarbon
PCB: Polychlorinated biphenyl
PCT: Polychlorinated terphenyl
RDX: Research Department Explosive
SIM: Selective ion monitoring
SVOC: Semi-volatile organic compound
TEQ: Toxicity equivalency
TPH EFH: Total petroleum hydrocarbon - extractable fuel hydrocarbon
VOC: Volatile organic compound

[1] DTSC applied the World Health Organization's 2,3,7,8-TCDD toxicity equivalence approach for dixoin-furans. To evaluate 2,3,7,8-TCDD equivalence, dixoin-furans need to meet respective background study MRLs.

[2] Benzo(a)pyrene equivalence developed based on sum of carcinogenic PAHs. In order to evaluate Benzo(a)pyrene equivalence, carcinogenic PAHs need to meet respective background study MRLs.

[3] For locations where TPH is the sole contaminant, a cleanup strategy will be considered based on the findings of soil treatability study.

9.2 Appendix B – Soil Partition Study Chemical Analysis – ASP1-0.5-1.5

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Metals												
Aluminum	mg/kg	10766.7	58,272	11900	9680	10700	16000	No	No	No	No	No
Antimony	mg/kg	0.3	0.85	0.342	0.281	0.342	0.453	No	No	No	No	No
Arsenic	mg/kg	3.9	46	4.35	3.48	3.75	5.57	No	No	No	No	No
Barium	mg/kg	106.0	369	104	89.3	111	172	No	No	No	No	No
Beryllium	mg/kg	0.6	2.2	0.729	0.493	0.584	0.826	No	No	No	No	No
Boron	mg/kg	4.1	34	4.65	3.84	4.5	5.7	No	No	No	No	No
Cadmium	mg/kg	0.6	0.7	0.639	0.494	0.645	0.863	No	No	No	No	Yes
Chromium	mg/kg	19.2	94	21.8	17.7	20.3	30.4	No	No	No	No	No
Cobalt	mg/kg	5.8	44	6.12	5.1	5.96	8.1	No	No	No	No	No
Copper	mg/kg	13.7	118	14.5	12	15.3	20.5	No	No	No	No	No
Lead	mg/kg	13.1	49	13.9	11.3	14.6	18.9	No	No	No	No	No
Lithium	mg/kg	20.3	91	23	18.5	20.9	31.3	No	No	No	No	No
Magnesium	mg/kg	3426.7	NA	3700	3100	3460	4810	No	No	No	No	No
Mercury	mg/kg	0.1	0.1	0.0744	0.0842	0.109	0.156	No	No	No	Yes	Yes
Molybdenum	mg/kg	0.7	3.2	0.848	0.638	0.742	1.11	No	No	No	No	No
Nickel	mg/kg	12.7	131	13.3	11.3	13.6	20.2	No	No	No	No	No
Potassium	mg/kg	2433.3	14317	2680	2220	2510	3500	No	No	No	No	No
Selenium	mg/kg	0.3	1	0.296	0.276	0.307	0.435	No	No	No	No	No
Silver	mg/kg	0.4	0.2	0.313	0.312	0.494	0.617	Yes	Yes	Yes	Yes	Yes
Sodium	mg/kg	197.0	1773	222	182	207	292	No	No	No	No	No
Strontium	mg/kg	29.5	162	31.4	25.5	30.5	45.1	No	No	No	No	No
Thallium	mg/kg	0.3	1.2	0.3	0.243	0.288	0.404	No	No	No	No	No
Vanadium	mg/kg	30.1	174	36	27.3	30.1	43.2	No	No	No	No	No
Zinc	mg/kg	197.7	214	217	178	231	301	No	Yes	No	Yes	Yes
Zirconium	mg/kg	ND	19	ND	ND	ND	ND	No	No	No	No	No
PAHs												
Acenaphthene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Acenaphthylene	µg/kg	4.7	2.5	ND	3.9	5.6	7.4	Yes	No	Yes	Yes	Yes
Anthracene	mg/kg	11.7	2.5	4.5	9.1	16	21	Yes	Yes	Yes	Yes	Yes
Benzo(a)anthracene	µg/kg	26.0	NA	8.8	18	33	48	No	No	No	No	No
Benzo(a)pyrene	µg/kg	120.0	NA	44	86	140	210	No	No	No	No	No
Benzo(b)fluoranthene	µg/kg	183.3	NA	67	130	210	330	No	No	No	No	No
Benzo(g,h,i)perylene	µg/kg	603.3	2.3	230	460	710	1000	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene	µg/kg	28.0	NA	11	23	36	39	No	No	No	No	No
Chrysene	µg/kg	46.0	NA	14	29	53	79	No	No	No	No	No
Dibenzo(a,h)anthracene	µg/kg	49.0	NA	18	37	58	85	No	No	No	No	No
Fluoranthene	µg/kg	55.3	5.2	21	40	70	98	Yes	Yes	Yes	Yes	Yes

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Fluorene	µg/kg	ND	3.8	ND	ND	ND	ND	No	No	No	No	No
Indeno(1,2,3-CD)Pyrene	µg/kg	503.3	NA	190	380	600	860	No	No	No	No	No
Naphthalene	µg/kg	5.2	3.6	3.9	5.4	9.9	9.8	Yes	Yes	Yes	Yes	Yes
Phenanthrene	µg/kg	45.0	3.9	17	33	62	82	Yes	Yes	Yes	Yes	Yes
Pyrene	µg/kg	47.0	5.6	18	34	58	84	Yes	Yes	Yes	Yes	Yes
1-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	3.4	4	No	No	No	Yes	Yes
2-Methylnaphthalene	µg/kg	2.7	2.5	ND	2.6	5.1	5.7	Yes	No	Yes	Yes	Yes
PCBs												
Aroclor 1016	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1221	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1232	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1242	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1248	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1254	µg/kg	39.0	1.7	25	33	47	53	Yes	Yes	Yes	Yes	Yes
Aroclor 1260	µg/kg	23.0	1.7	14	21	26	33	Yes	Yes	Yes	Yes	Yes
Aroclor 1262	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1268	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5432	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5442	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5460	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Dioxins-Furans												
1,2,3,4,6,7,8-HpCDD	ng/kg	3075.0	NA	2020	2410	3540	4940	No	No	No	No	No
1,2,3,4,6,7,8-HpCDF	ng/kg	424.5	NA	273	329	525	647	No	No	No	No	No
1,2,3,4,7,8,9-HpCDF	ng/kg	31.8	NA	23	26.7	37.2	48.9	No	No	No	No	No
1,2,3,4,7,8-HxCDD	ng/kg	26.9	NA	19.2	20.4	32.2	41.7	No	No	No	No	No
1,2,3,4,7,8-HxCDF	ng/kg	11.0	NA	7.86	8.83	13.1	16.3	No	No	No	No	No
1,2,3,6,7,8-HxCDD	ng/kg	137.5	NA	87.5	108	160	218	No	No	No	No	No
1,2,3,6,7,8-HxCDF	ng/kg	16.9	NA	10.4	12.1	21.8	21.6	No	No	No	No	No
1,2,3,7,8,9-HxCDD	ng/kg	58.8	NA	40	46.5	69.9	93.5	No	No	No	No	No
1,2,3,7,8,9-HxCDF	ng/kg	3.9	NA	2.69	2.9	4.31	5.29	No	No	No	No	No
1,2,3,7,8-PeCDD	ng/kg	10.2	NA	6.78	7.37	12.1	15.9	No	No	No	No	No
1,2,3,7,8-PeCDF	ng/kg	2.2	NA	1.41	1.4	2.45	2.85	No	No	No	No	No
2,3,4,7,8-PeCDF	ng/kg	4.0	NA	2.72	2.85	4.24	5.9	No	No	No	No	No
2,3,6,7,8-HxCDF	ng/kg	26.6	NA	18	20.9	31.8	40.8	No	No	No	No	No
2,3,7,8-TCDD	ng/kg	0.7	NA	0.522	0.422	0.821	0.92	No	No	No	No	No
2,3,7,8-TCDF	ng/kg	1.1	NA	0.714	0.612	0.985	1.28	No	No	No	No	No
OCDD	ng/kg	28950.0	NA	18600	22600	34700	52500	No	No	No	No	No
OCDF	ng/kg	1055.0	NA	678	862	1270	1720	No	No	No	No	No
TCDD TEQ	ng/kg	84.0	0.912	55.7	65.0	99.5	134.2	Yes	Yes	Yes	Yes	Yes
TPHs												
EFH (C8-C11)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
EFH (C30-C40)	mg/kg	11.3	NA	11	14	14	17	No	No	No	No	No

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
EFH (C21-C30)	mg/kg	7.3	NA	5.7	6.9	9.3	14	No	No	No	No	No
EFH (C15-C20)	mg/kg	ND	5.7	ND	ND	ND	ND	No	No	No	No	No
EFH (C12-C14)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Other												
Azobenzene	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Benzo(e)pyrene	µg/kg	143.3	NA	54	110	170	250	No	No	No	No	No
Biphenyl	µg/kg	ND	NA	ND	ND	2.7	ND	No	No	No	No	No
Calcium	mg/kg	2446.7	NA	2640	2200	2560	3670	No	No	No	No	No
Iron	mg/kg	16566.7	NA	19300	14900	16500	23400	No	No	No	No	No
Manganese	mg/kg	186.3	1110	177	162	186	250	No	No	No	No	No
Moisture	mg/kg	16.8	None	1.3	1.2	9.7	11.3	No	No	No	No	No
NDMA	µg/kg	ND	20	ND	ND	ND	ND	No	No	No	No	No
Nitrate	mg/kg	1.3	22.3	1.3	1.5	2	3.2	No	No	No	No	No
Nitrite	mg/kg	0.6	None	0.5	0.51	0.55	0.56	No	No	No	No	No
pH	mg/kg	7.3	None	7.37	7.36	7.3	7.25	No	No	No	No	No
Phosphorus	mg/kg	247.0	None	283	225	256	382	No	No	No	No	No
Tin	mg/kg	ND	None	ND	ND	ND	ND	No	No	No	No	No
Titanium	mg/kg	654.0	None	718	605	672	927	No	No	No	No	No
TKN	mg/kg	734.0	None	628	621	770	1000	No	No	No	No	No
TOC	mg/kg	10650.0	None	7970	8330	9680	8050	No	No	No	No	No

9.3 Appendix C – Soil Partition Study Chemical Analysis – SL115-SA5D-0.5-1.5

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Metals												
Aluminum	mg/kg	10766.7	58,272	11900	9680	10700	16000	No	No	No	No	No
Antimony	mg/kg	0.3	0.85	0.342	0.281	0.342	0.453	No	No	No	No	No
Arsenic	mg/kg	3.9	46	4.35	3.48	3.75	5.57	No	No	No	No	No
Barium	mg/kg	106.0	369	104	89.3	111	172	No	No	No	No	No
Beryllium	mg/kg	0.6	2.2	0.729	0.493	0.584	0.826	No	No	No	No	No
Boron	mg/kg	4.1	34	4.65	3.84	4.5	5.7	No	No	No	No	No
Cadmium	mg/kg	0.6	0.7	0.639	0.494	0.645	0.863	No	No	No	No	Yes
Chromium	mg/kg	19.2	94	21.8	17.7	20.3	30.4	No	No	No	No	No
Cobalt	mg/kg	5.8	44	6.12	5.1	5.96	8.1	No	No	No	No	No
Copper	mg/kg	13.7	118	14.5	12	15.3	20.5	No	No	No	No	No
Lead	mg/kg	13.1	49	13.9	11.3	14.6	18.9	No	No	No	No	No
Lithium	mg/kg	20.3	91	23	18.5	20.9	31.3	No	No	No	No	No
Magnesium	mg/kg	3426.7	NA	3700	3100	3460	4810	No	No	No	No	No
Mercury	mg/kg	0.1	0.1	0.0744	0.0842	0.109	0.156	No	No	No	Yes	Yes
Molybdenum	mg/kg	0.7	3.2	0.848	0.638	0.742	1.11	No	No	No	No	No
Nickel	mg/kg	12.7	131	13.3	11.3	13.6	20.2	No	No	No	No	No
Potassium	mg/kg	2433.3	14317	2680	2220	2510	3500	No	No	No	No	No
Selenium	mg/kg	0.3	1	0.296	0.276	0.307	0.435	No	No	No	No	No
Silver	mg/kg	0.4	0.2	0.313	0.312	0.494	0.617	Yes	Yes	Yes	Yes	Yes
Sodium	mg/kg	197.0	1773	222	182	207	292	No	No	No	No	No
Strontium	mg/kg	29.5	162	31.4	25.5	30.5	45.1	No	No	No	No	No
Thallium	mg/kg	0.3	1.2	0.3	0.243	0.288	0.404	No	No	No	No	No
Vanadium	mg/kg	30.1	174	36	27.3	30.1	43.2	No	No	No	No	No
Zinc	mg/kg	197.7	214	217	178	231	301	No	Yes	No	Yes	Yes
Zirconium	mg/kg	ND	19	ND	ND	ND	ND	No	No	No	No	No
PAHs												
Acenaphthene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Acenaphthylene	µg/kg	4.7	2.5	ND	3.9	5.6	7.4	Yes	No	Yes	Yes	Yes
Anthracene	mg/kg	11.7	2.5	4.5	9.1	16	21	Yes	Yes	Yes	Yes	Yes
Benzo(a)anthracene	µg/kg	26.0	NA	8.8	18	33	48	No	No	No	No	No
Benzo(a)pyrene	µg/kg	120.0	NA	44	86	140	210	No	No	No	No	No
Benzo(b)fluoranthene	µg/kg	183.3	NA	67	130	210	330	No	No	No	No	No
Benzo(g,h,i)perylene	µg/kg	603.3	2.3	230	460	710	1000	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene	µg/kg	28.0	NA	11	23	36	39	No	No	No	No	No
Chrysene	µg/kg	46.0	NA	14	29	53	79	No	No	No	No	No
Dibenzo(a,h)anthracene	µg/kg	49.0	NA	18	37	58	85	No	No	No	No	No
Fluoranthene	µg/kg	55.3	5.2	21	40	70	98	Yes	Yes	Yes	Yes	Yes

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Fluorene	µg/kg	ND	3.8	ND	ND	ND	ND	No	No	No	No	No
Indeno(1,2,3-CD)Pyrene	µg/kg	503.3	NA	190	380	600	860	No	No	No	No	No
Naphthalene	µg/kg	5.2	3.6	3.9	5.4	9.9	9.8	Yes	Yes	Yes	Yes	Yes
Phenanthrene	µg/kg	45.0	3.9	17	33	62	82	Yes	Yes	Yes	Yes	Yes
Pyrene	µg/kg	47.0	5.6	18	34	58	84	Yes	Yes	Yes	Yes	Yes
1-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	3.4	4	No	No	No	Yes	Yes
2-Methylnaphthalene	µg/kg	2.7	2.5	ND	2.6	5.1	5.7	Yes	No	Yes	Yes	Yes
PCBs												
Aroclor 1016	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1221	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1232	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1242	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1248	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1254	µg/kg	39.0	1.7	25	33	47	53	Yes	Yes	Yes	Yes	Yes
Aroclor 1260	µg/kg	23.0	1.7	14	21	26	33	Yes	Yes	Yes	Yes	Yes
Aroclor 1262	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1268	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5432	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5442	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5460	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Dioxins-Furans												
1,2,3,4,6,7,8-HpCDD	ng/kg	3075.0	NA	2020	2410	3540	4940	No	No	No	No	No
1,2,3,4,6,7,8-HpCDF	ng/kg	424.5	NA	273	329	525	647	No	No	No	No	No
1,2,3,4,7,8,9-HpCDF	ng/kg	31.8	NA	23	26.7	37.2	48.9	No	No	No	No	No
1,2,3,4,7,8-HxCDD	ng/kg	26.9	NA	19.2	20.4	32.2	41.7	No	No	No	No	No
1,2,3,4,7,8-HxCDF	ng/kg	11.0	NA	7.86	8.83	13.1	16.3	No	No	No	No	No
1,2,3,6,7,8-HxCDD	ng/kg	137.5	NA	87.5	108	160	218	No	No	No	No	No
1,2,3,6,7,8-HxCDF	ng/kg	16.9	NA	10.4	12.1	21.8	21.6	No	No	No	No	No
1,2,3,7,8,9-HxCDD	ng/kg	58.8	NA	40	46.5	69.9	93.5	No	No	No	No	No
1,2,3,7,8,9-HxCDF	ng/kg	3.9	NA	2.69	2.9	4.31	5.29	No	No	No	No	No
1,2,3,7,8-PeCDD	ng/kg	10.2	NA	6.78	7.37	12.1	15.9	No	No	No	No	No
1,2,3,7,8-PeCDF	ng/kg	2.2	NA	1.41	1.4	2.45	2.85	No	No	No	No	No
2,3,4,7,8-PeCDF	ng/kg	4.0	NA	2.72	2.85	4.24	5.9	No	No	No	No	No
2,3,6,7,8-HxCDF	ng/kg	26.6	NA	18	20.9	31.8	40.8	No	No	No	No	No
2,3,7,8-TCDD	ng/kg	0.7	NA	0.522	0.422	0.821	0.92	No	No	No	No	No
2,3,7,8-TCDF	ng/kg	1.1	NA	0.714	0.612	0.985	1.28	No	No	No	No	No
OCDD	ng/kg	28950.0	NA	18600	22600	34700	52500	No	No	No	No	No
OCDF	ng/kg	1055.0	NA	678	862	1270	1720	No	No	No	No	No
TCDD TEQ	ng/kg	84.0	0.912	55.7	65.0	99.5	134.2	Yes	Yes	Yes	Yes	Yes
TPHs												
EFH (C8-C11)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
EFH (C30-C40)	mg/kg	11.3	NA	11	14	14	17	No	No	No	No	No

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
EFH (C21-C30)	mg/kg	7.3	NA	5.7	6.9	9.3	14	No	No	No	No	No
EFH (C15-C20)	mg/kg	ND	5.7	ND	ND	ND	ND	No	No	No	No	No
EFH (C12-C14)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Other												
Azobenzene	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Benzo(e)pyrene	µg/kg	143.3	NA	54	110	170	250	No	No	No	No	No
Biphenyl	µg/kg	ND	NA	ND	ND	2.7	ND	No	No	No	No	No
Calcium	mg/kg	2446.7	NA	2640	2200	2560	3670	No	No	No	No	No
Iron	mg/kg	16566.7	NA	19300	14900	16500	23400	No	No	No	No	No
Manganese	mg/kg	186.3	1110	177	162	186	250	No	No	No	No	No
Moisture	mg/kg	16.8	None	1.3	1.2	9.7	11.3	No	No	No	No	No
NDMA	µg/kg	ND	20	ND	ND	ND	ND	No	No	No	No	No
Nitrate	mg/kg	1.3	22.3	1.3	1.5	2	3.2	No	No	No	No	No
Nitrite	mg/kg	0.6	None	0.5	0.51	0.55	0.56	No	No	No	No	No
pH	mg/kg	7.3	None	7.37	7.36	7.3	7.25	No	No	No	No	No
Phosphorus	mg/kg	247.0	None	283	225	256	382	No	No	No	No	No
Tin	mg/kg	ND	None	ND	ND	ND	ND	No	No	No	No	No
Titanium	mg/kg	654.0	None	718	605	672	927	No	No	No	No	No
TKN	mg/kg	734.0	None	628	621	770	1000	No	No	No	No	No
TOC	mg/kg	10650.0	None	7970	8330	9680	8050	No	No	No	No	No

9.4 Appendix D – Soil Partition Study Chemical Analysis – SL225-SA5B-0.0-0.5

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Metals												
Aluminum	mg/kg	11633.3	58,272	13100	11000	10400	13400	No	No	No	No	No
Antimony	mg/kg	0.6	0.85	0.628	0.583	0.649	0.633	No	No	No	No	No
Arsenic	mg/kg	3.8	46	4.05	3.63	3.68	4.47	No	No	No	No	No
Barium	mg/kg	98.0	369	110	90.8	96.6	121	No	No	No	No	No
Beryllium	mg/kg	0.5	2.2	0.601	0.463	0.559	0.681	No	No	No	No	No
Boron	mg/kg	4.3	34	4.89	4.13	4.69	5.46	No	No	No	No	No
Cadmium	mg/kg	1.650	0.7	1.88	1.62	1.68	1.99	Yes	Yes	Yes	Yes	Yes
Chromium	mg/kg	31.5	94	37	30.3	31.3	39.3	No	No	No	No	No
Cobalt	mg/kg	7.0	44	7.85	6.58	7.27	8.43	No	No	No	No	No
Copper	mg/kg	33.5	118	41.9	33	35.4	40.2	No	No	No	No	No
Lead	mg/kg	37.1	49	45.4	35.1	40.8	50.7	No	No	No	No	Yes
Lithium	mg/kg	21.2	91	23.3	18.9	20.2	24.8	No	No	No	No	No
Manganese	mg/kg	247.7	1110	250	240	256	287	No	No	No	No	No
Mercury	mg/kg	0.4	0.1	0.407	0.301	0.345	0.434	Yes	Yes	Yes	Yes	Yes
Molybdenum	mg/kg	0.8	3.2	0.808	0.776	0.771	0.913	No	No	No	No	No
Nickel	mg/kg	24.0	131	30.7	23	24.1	30	No	No	No	No	No
Potassium	mg/kg	2530.0	14317	2700	2310	2410	2920	No	No	No	No	No
Selenium	mg/kg	0.4	1	0.458	0.414	0.447	0.462	No	No	No	No	No
Silver	mg/kg	1.6	0.2	2.21	1.53	1.72	2.05	Yes	Yes	Yes	Yes	Yes
Sodium	mg/kg	161.3	1773	192	151	146	195	No	No	No	No	No
Strontium	mg/kg	33.4	162	37.7	32.4	33.5	40.9	No	No	No	No	No
Thallium	mg/kg	0.3	1.2	0.319	0.241	0.289	0.369	No	No	No	No	No
Vanadium	mg/kg	28.9	174	31.5	26.9	27.4	34.1	No	No	No	No	No
Zinc	mg/kg	829.7	214	1110	800	831	1030	Yes	Yes	Yes	Yes	Yes
Zirconium	mg/kg	ND	19	ND	ND	ND	ND	No	No	No	No	No
PAHs												
Acenaphthene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Acenaphthylene	µg/kg	17.0	2.5	22	19	19	27	Yes	Yes	Yes	Yes	Yes
Anthracene	mg/kg	41.3	2.5	52	44	49	69	Yes	Yes	Yes	Yes	Yes
Benzo(a)anthracene	µg/kg	120.0	NA	140	120	130	200	No	No	No	No	No
Benzo(a)pyrene	µg/kg	476.7	NA	590	490	510	760	No	No	No	No	No
Benzo(b)fluoranthene	µg/kg	770.0	NA	960	770	810	1200	No	No	No	No	No
Benzo(g,h,i)perylene	µg/kg	2400.0	2.3	3100	2400	2500	4300	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene	µg/kg	126.7	NA	170	160	150	250	No	No	No	No	No
Chrysene	µg/kg	210.0	NA	230	220	230	340	No	No	No	No	No
Dibenzo(a,h)anthracene	µg/kg	153.3	NA	220	190	190	270	No	No	No	No	No
Fluoranthene	µg/kg	213.3	5.2	250	230	240	340	Yes	Yes	Yes	Yes	Yes

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Fluorene	µg/kg	2.9	3.8	3.2	3.1	3.1	ND	No	No	No	No	No
Indeno(1,2,3-CD)Pyrene	µg/kg	1700.0	NA	2400	1900	1900	3100	No	No	No	No	No
Naphthalene	µg/kg	27.3	3.6	33	30	35	56	Yes	Yes	Yes	Yes	Yes
Phenanthrene	µg/kg	176.7	3.9	210	190	210	310	Yes	Yes	Yes	Yes	Yes
Pyrene	µg/kg	196.7	5.6	230	210	220	320	Yes	Yes	Yes	Yes	Yes
1-Methylnaphthalene	µg/kg	8.4	2.5	9.3	9.6	13	27	Yes	Yes	Yes	Yes	Yes
2-Methylnaphthalene	µg/kg	13.3	2.5	14	15	20	38	Yes	Yes	Yes	Yes	Yes
PCBs												
Aroclor 1016	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1221	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1232	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1242	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1248	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1254	µg/kg	86.3	1.7	100	89	88	110	Yes	Yes	Yes	Yes	Yes
Aroclor 1260	µg/kg	60.0	1.7	69	60	62	80	Yes	Yes	Yes	Yes	Yes
Aroclor 1262	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1268	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5432	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5442	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5460	µg/kg	48.7	50	48	44	65	63	No	No	No	Yes	Yes
Dioxins-Furans												
1,2,3,4,6,7,8-HpCDD	ng/kg	14700	NA	17100	12700	15000	20533	No	No	No	No	No
1,2,3,4,6,7,8-HpCDF	ng/kg	1860	NA	2140	1560	1880	2453	No	No	No	No	No
1,2,3,4,7,8,9-HpCDF	ng/kg	144.7	NA	163	117	138	187	No	No	No	No	No
1,2,3,4,7,8-HxCDD	ng/kg	120.5	NA	144	103	124	163	No	No	No	No	No
1,2,3,4,7,8-HxCDF	ng/kg	45.9	NA	49.8	38.2	46.3	59	No	No	No	No	No
1,2,3,6,7,8-HxCDD	ng/kg	650.3	NA	716	559	623	861	No	No	No	No	No
1,2,3,6,7,8-HxCDF	ng/kg	54.3	NA	59.8	44.4	53	70	No	No	No	No	No
1,2,3,7,8,9-HxCDD	ng/kg	267.8	NA	300	224	273	371	No	No	No	No	No
1,2,3,7,8,9-HxCDF	ng/kg	10.4	NA	14.5	10.3	5.01	18	No	No	No	No	No
1,2,3,7,8-PeCDD	ng/kg	43.7	NA	48.1	37.9	44	63	No	No	No	No	No
1,2,3,7,8-PeCDF	ng/kg	6.3	NA	9.01	7	8.13	11	No	No	No	No	No
2,3,4,7,8-PeCDF	ng/kg	14.8	NA	16.3	12.9	15.7	21	No	No	No	No	No
2,3,6,7,8-HxCDF	ng/kg	118.0	NA	129	95.3	111	148	No	No	No	No	No
2,3,7,8-TCDD	ng/kg	2.7	NA	2.81	2.55	3.28	4	No	No	No	No	No
2,3,7,8-TCDF	ng/kg	3.6	NA	4.03	3.27	3.81	5	No	No	No	No	No
OCDD	ng/kg	126500	NA	173000	121000	139000	190667	No	No	No	No	No
OCDF	ng/kg	5655	NA	6510	4600	5380	7260	No	No	No	No	No
TCDD TEQ	ng/kg	384.6	0.912	446	333	389	534	Yes	Yes	Yes	Yes	Yes
TPHs												
EFH (C8-C11)	mg/kg	ND	NA	ND	ND	ND	3.7	No	No	No	No	No
EFH (C30-C40)	mg/kg	52.0	NA	35.5	57.5	36.5	48.5	No	No	No	No	No

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
EFH (C21-C30)	mg/kg	30.7	NA	28	37	26.5	41	No	No	No	No	No
EFH (C15-C20)	mg/kg	ND	5.7	ND	3.2	ND	3	No	No	No	No	No
EFH (C12-C14)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Other												
Azobenzene	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Benzo(e)pyrene	µg/kg	597	NA	730	610	640	940	No	No	No	No	No
Biphenyl	µg/kg	6.6	NA	7.7	6.6	7.9	12	No	No	No	No	No
Calcium	mg/kg	3593	NA	3910	3580	3660	4300	No	No	No	No	No
Iron	mg/kg	16333	NA	18300	15300	15400	18900	No	No	No	No	No
Magnesium	mg/kg	3737	NA	4290	3510	3320	4020	No	No	No	No	No
Moisture	mg/kg	1.4	None	1.7	1.5	1.55	1.7	No	No	No	No	No
NDMA	µg/kg	ND	20	ND	ND	ND	ND	No	No	No	No	No
Nitrate	mg/kg	16.4	22.3	11.2	12.4	14.4	17.3	No	No	No	No	No
Nitrite	mg/kg	1.0	None	1	1	1	2.93	No	No	No	No	No
pH	mg/kg	6.9	None	7.01	6.94	7.07	7.46	No	No	No	No	No
Phosphorus	mg/kg	438	None	456	435	429	550	No	No	No	No	No
Tin	mg/kg	ND	None	ND	ND	ND	ND	No	No	No	No	No
Titanium	mg/kg	795	None	832	708	742	908	No	No	No	No	No
TKN	mg/kg	1506	None	ND	ND	ND	ND	No	No	No	No	No
TOC	mg/kg	19933	None	11300	10100	9280	10930	No	No	No	No	No

9.5 Appendix E – Soil Partition Study Chemical Analysis – SL225-SA5B-2.0-3.0

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Metals												
Aluminum	mg/kg	15333.3	58,272	16200	14000	13700	21800	No	No	No	No	No
Antimony	mg/kg	0.2	0.85	0.234	0.204	0.215	0.274	No	No	No	No	No
Arsenic	mg/kg	4.6	46	4.65	4.25	4.27	6.89	No	No	No	No	No
Barium	mg/kg	123.0	369	119	106	140	250	No	No	No	No	No
Beryllium	mg/kg	0.8	2.2	0.741	0.638	0.666	1.1	No	No	No	No	No
Boron	mg/kg	2.9	34	ND	2.98	ND	4.81	No	No	No	No	No
Cadmium	mg/kg	0.344	0.7	0.336	0.319	0.385	0.647	No	No	No	No	No
Chromium	mg/kg	21.8	94	22.6	19.7	21	33.2	No	No	No	No	No
Cobalt	mg/kg	6.5	44	7	5.64	6.02	9.33	No	No	No	No	No
Copper	mg/kg	10.6	118	11.1	10.1	11.9	18.9	No	No	No	No	No
Lead	mg/kg	6.6	49	7.41	6.85	8.33	13.9	No	No	No	No	No
Lithium	mg/kg	35.1	91	35.4	30.2	29.7	46.7	No	No	No	No	No
Manganese	mg/kg	204.7	1110	209	178	195	301	No	No	No	No	No
Mercury	mg/kg	ND	0.1	ND	ND	ND	0.0561	No	No	No	No	No
Molybdenum	mg/kg	0.7	3.2	0.84	0.67	0.709	1.15	No	No	No	No	No
Nickel	mg/kg	13.2	131	14	12	13.1	20.8	No	No	No	No	No
Potassium	mg/kg	2153.3	14317	2370	2020	2190	3420	No	No	No	No	No
Selenium	mg/kg	ND	1	ND	ND	0.204	0.333	No	No	No	No	No
Silver	mg/kg	0.1	0.2	0.0853	0.0971	0.158	0.3	No	No	No	No	Yes
Sodium	mg/kg	343.0	1773	330	303	326	473	No	No	No	No	No
Strontium	mg/kg	32.6	162	33.8	28.8	32.9	53.9	No	No	No	No	No
Thallium	mg/kg	0.2	1.2	0.289	0.224	0.246	0.376	No	No	No	No	No
Vanadium	mg/kg	40.3	174	40.3	35.4	36.2	55.6	No	No	No	No	No
Zinc	mg/kg	69.3	214	97.4	249	123	194	No	No	Yes	No	No
Zirconium	mg/kg	ND	19	ND	ND	ND	ND	No	No	No	No	No
PAHs												
Acenaphthene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Acenaphthylene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Anthracene	mg/kg	4.2	2.5	ND	ND	3.2	6.5	Yes	No	No	Yes	Yes
Benzo(a)anthracene	µg/kg	8.6	NA	2.8	5.8	12	22	No	No	No	No	No
Benzo(a)pyrene	µg/kg	26.3	NA	6.6	17	37	80	No	No	No	No	No
Benzo(b)fluoranthene	µg/kg	41.3	NA	11	28	58	110	No	No	No	No	No
Benzo(g,h,i)perylene	µg/kg	146.7	2.3	41	100	210	400	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene	µg/kg	8.7	NA	ND	5.2	9.1	25	No	No	No	No	No
Chrysene	µg/kg	12.6	NA	ND	6.8	20	45	No	No	No	No	No
Dibenzo(a,h)anthracene	µg/kg	9.1	NA	2.8	6.9	13	27	No	No	No	No	No
Fluoranthene	µg/kg	18.3	5.2	3.4	9	20	40	Yes	No	Yes	Yes	Yes

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Fluorene	µg/kg	ND	3.8	ND	ND	ND	ND	No	No	No	No	No
Indeno(1,2,3-CD)Pyrene	µg/kg	113.3	NA	33	81	170	330	No	No	No	No	No
Naphthalene	µg/kg	ND	3.6	ND	ND	ND	6	No	No	No	No	Yes
Phenanthrene	µg/kg	13.8	3.9	3.1	7	16	32	Yes	No	Yes	Yes	Yes
Pyrene	µg/kg	15.6	5.6	3.1	8.4	18	38	Yes	No	Yes	Yes	Yes
1-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	ND	3.3	No	No	No	No	Yes
2-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	ND	4.6	No	No	No	No	Yes
PCBs												
Aroclor 1016	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1221	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1232	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1242	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1248	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1254	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1260	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1262	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1268	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5432	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5442	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5460	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Dioxins-Furans												
1,2,3,4,6,7,8-HpCDD	ng/kg	897.7	NA	524	850	1490	1180	No	No	No	No	No
1,2,3,4,6,7,8-HpCDF	ng/kg	122.7	NA	73.4	114	207	129	No	No	No	No	No
1,2,3,4,7,8,9-HpCDF	ng/kg	11.0	NA	7.18	10.8	20.2	22.6	No	No	No	No	No
1,2,3,4,7,8-HxCDD	ng/kg	7.5	NA	4.28	5.99	12	7.3	No	No	No	No	No
1,2,3,4,7,8-HxCDF	ng/kg	3.4	NA	2.57	3.21	5.91	8.85	No	No	No	No	No
1,2,3,6,7,8-HxCDD	ng/kg	37.9	NA	22.7	35.8	58.8	31	No	No	No	No	No
1,2,3,6,7,8-HxCDF	ng/kg	5.4	NA	3.07	4.53	7.85	7.91	No	No	No	No	No
1,2,3,7,8,9-HxCDD	ng/kg	16.4	NA	10.1	15.3	28.3	14.6	No	No	No	No	No
1,2,3,7,8,9-HxCDF	ng/kg	1.6	NA	2.21	5	2.22	2.3	No	No	No	No	No
1,2,3,7,8-PeCDD	ng/kg	2.7	NA	1.33	1.79	3.9	3.29	No	No	No	No	No
1,2,3,7,8-PeCDF	ng/kg	0.4	NA	0.238	0.428	0.375	3.02	No	No	No	No	No
2,3,4,7,8-PeCDF	ng/kg	0.8	NA	0.713	5	0.649	2.52	No	No	No	No	No
2,3,6,7,8-HxCDF	ng/kg	8.3	NA	5.63	7.21	13.2	12.3	No	No	No	No	No
2,3,7,8-TCDD	ng/kg	1.0	NA	1.01	0.999	0.261	0.475	No	No	No	No	No
2,3,7,8-TCDF	ng/kg	0.3	NA	0.148	0.227	0.395	2.21	No	No	No	No	No
OCDD	ng/kg	7720.0	NA	4730	7700	13100	20800	No	No	No	No	No
OCDF	ng/kg	347.0	NA	206	325	589	282	No	No	No	No	No
TCDD TEQ	ng/kg	23.4	0.912	11.8	19.4	36	24.5	Yes	Yes	Yes	Yes	Yes
TPHs												
EFH (C8-C11)	mg/kg	ND	NA	ND	ND	ND	3.7	No	No	No	No	No
EFH (C30-C40)	mg/kg	52.0	NA	35.5	57.5	36.5	48.5	No	No	No	No	No

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
EFH (C21-C30)	mg/kg	30.7	NA	28	37	26.5	41	No	No	No	No	No
EFH (C15-C20)	mg/kg	ND	5.7	ND	3.2	ND	3	No	No	No	No	No
EFH (C12-C14)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Other												
Azobenzene	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Benzo(e)pyrene	µg/kg	33.3	NA	9.3	23	48	100	No	No	No	No	No
Biphenyl	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Calcium	mg/kg	2733	NA	2810	2500	2710	4170	No	No	No	No	No
Iron	mg/kg	19800	NA	20400	17800	18400	27400	No	No	No	No	No
Magnesium	mg/kg	3933	NA	4100	3690	3920	5810	No	No	No	No	No
Moisture	mg/kg	1.7	None	2.2	1.8	2.1	2.3	No	No	No	No	No
NDMA	µg/kg	ND	20	ND	ND	ND	ND	No	No	No	No	No
Nitrate	mg/kg	1.0	22.3	1.00	1.00	1.00	12.50	No	No	No	No	No
Nitrite	mg/kg	1.0	None	1.00	1.00	1.00	1.00	No	No	No	No	No
pH	mg/kg	7.4	None	7.49	7.55	7.43	7.33	No	No	No	No	No
Phosphorus	mg/kg	229.3	None	263	235	248	415	No	No	No	No	No
Tin	mg/kg	ND	None	ND	ND	ND	ND	No	No	No	No	No
Titanium	mg/kg	864.7	None	951	808	818	1220	No	No	No	No	No
TKN	mg/kg	443.3	None	446	452	522	1020	No	No	No	No	No
TOC	mg/kg	3120.0	None	2200	4070	3890	11800	No	No	No	No	No

9.6 Appendix F – Soil Partition Study Chemical Analysis – SL311-SA6-0.0-0.5

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Metals												
Aluminum	mg/kg	7826.7	58,272	11200	6280	9440	16600	No	No	No	No	No
Antimony	mg/kg	0.6	0.85	4.03	0.632	0.58	0.912	No	Yes	No	No	Yes
Arsenic	mg/kg	2.9	46	23.8	2.18	3.07	5.65	No	No	No	No	No
Barium	mg/kg	86.4	369	110	68.9	93.2	146	No	No	No	No	No
Beryllium	mg/kg	0.3	2.2	0.399	0.23	0.345	0.64	No	No	No	No	No
Boron	mg/kg	6.6	34	8.29	2.82	4.93	6.86	No	No	No	No	No
Cadmium	mg/kg	2.037	0.7	4.45	1.41	2.63	4.82	Yes	Yes	Yes	Yes	Yes
Chromium	mg/kg	14.7	94	53.5	11.3	18.3	29.5	No	No	No	No	No
Cobalt	mg/kg	4.2	44	17.3	3.36	4.58	7.82	No	No	No	No	No
Copper	mg/kg	19.8	118	94.7	13.6	20.5	39.9	No	No	No	No	No
Lead	mg/kg	33.9	49	79.9	23.4	36.3	67.9	No	Yes	No	No	Yes
Lithium	mg/kg	13.0	91	15.3	9.31	14.3	23.9	No	No	No	No	No
Manganese	mg/kg	177.3	1110	478	143	189	318	No	No	No	No	No
Mercury	mg/kg	0.1	0.1	0.102	0.0656	0.0944	0.197	No	Yes	No	No	Yes
Molybdenum	mg/kg	0.9	3.2	2.53	0.633	1.11	2.27	No	No	No	No	No
Nickel	mg/kg	22.3	131	59.7	15.1	18.4	40.4	No	No	No	No	No
Potassium	mg/kg	2243.3	14317	2570	1730	2600	4120	No	No	No	No	No
Selenium	mg/kg	ND	1	ND	ND	ND	ND	No	No	No	No	No
Silver	mg/kg	1.5	0.2	1.69	0.719	2.76	6.07	Yes	Yes	Yes	Yes	Yes
Sodium	mg/kg	151.0	1773	149	113	160	299	No	No	No	No	No
Strontium	mg/kg	18.2	162	15.6	11.2	17.2	33.6	No	No	No	No	No
Thallium	mg/kg	0.1	1.2	0.182	0.118	0.176	0.276	No	No	No	No	No
Vanadium	mg/kg	22.1	174	91	16.5	25.1	42.1	No	No	No	No	No
Zinc	mg/kg	81.0	214	207	54	88.1	157	No	No	No	No	No
Zirconium	mg/kg	ND	19	ND	ND	ND	ND	No	No	No	No	No
PAHs												
Acenaphthene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Acenaphthylene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Anthracene	mg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
Benzo(a)anthracene	µg/kg	9.2	NA	ND	7.9	14	84	No	No	No	No	No
Benzo(a)pyrene	µg/kg	19.0	NA	ND	13	21	55	No	No	No	No	No
Benzo(b)fluoranthene	µg/kg	33.0	NA	17	24	41	99	No	No	No	No	No
Benzo(g,h,i)perylene	µg/kg	70.0	2.3	57	26	34	76	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene	µg/kg	11.0	NA	ND	ND	13	ND	No	No	No	No	No
Chrysene	µg/kg	26.3	NA	14	22	41	44	No	No	No	No	No
Dibenzo(a,h)anthracene	µg/kg	ND	NA	ND	ND	9	ND	No	No	No	No	No
Fluoranthene	µg/kg	25.0	5.2	9.4	18	48	73	Yes	Yes	Yes	Yes	Yes

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Fluorene	µg/kg	ND	3.8	ND	ND	ND	ND	No	No	No	No	No
Indeno(1,2,3-CD)Pyrene	µg/kg	34.0	NA	26	15	20	49	No	No	No	No	No
Naphthalene	µg/kg	ND	3.6	ND	ND	ND	ND	No	No	No	No	No
Phenanthrene	µg/kg	12.0	3.9	ND	7.8	21	ND	Yes	No	Yes	Yes	No
Pyrene	µg/kg	23.3	5.6	9.5	16	41	69	Yes	Yes	Yes	Yes	Yes
1-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
2-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
PCBs												
Aroclor 1016	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1221	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1232	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1242	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1248	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1254	µg/kg	2600.0	1.7	2600	1700	3300	6700	Yes	Yes	Yes	Yes	Yes
Aroclor 1260	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1262	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1268	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5432	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5442	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5460	µg/kg	62.0	50	39	31	59	82	Yes	No	No	Yes	Yes
Dioxins-Furans												
1,2,3,4,6,7,8-HpCDD	ng/kg	137.8	NA	115	55.3	130	281.3	No	No	No	No	No
1,2,3,4,6,7,8-HpCDF	ng/kg	55.7	NA	68.8	24.1	54.5	111.0	No	No	No	No	No
1,2,3,4,7,8,9-HpCDF	ng/kg	5.7	NA	4.93	2.11	4.91	9.8	No	No	No	No	No
1,2,3,4,7,8-HxCDD	ng/kg	2.5	NA	2.3	0.971	2.54	5.3	No	No	No	No	No
1,2,3,4,7,8-HxCDF	ng/kg	13.6	NA	12.5	5.89	12.9	26.7	No	No	No	No	No
1,2,3,6,7,8-HxCDD	ng/kg	8.0	NA	9.07	3.68	6.92	14.8	No	No	No	No	No
1,2,3,6,7,8-HxCDF	ng/kg	8.7	NA	8.72	3.72	8.18	17.2	No	No	No	No	No
1,2,3,7,8,9-HxCDD	ng/kg	5.2	NA	4.67	2.72	5.15	10.6	No	No	No	No	No
1,2,3,7,8,9-HxCDF	ng/kg	3.9	NA	5	5	5	5.9	No	No	No	No	No
1,2,3,7,8-PeCDD	ng/kg	2.2	NA	1.84	1.07	1.27	3.3	No	No	No	No	No
1,2,3,7,8-PeCDF	ng/kg	12.5	NA	9.39	5.46	11.6	24.5	No	No	No	No	No
2,3,4,7,8-PeCDF	ng/kg	17.1	NA	15.2	7.74	16.4	34.7	No	No	No	No	No
2,3,6,7,8-HxCDF	ng/kg	7.5	NA	6.88	3.19	7.24	14.0	No	No	No	No	No
2,3,7,8-TCDD	ng/kg	0.5	NA	1	0.999	0.236	0.6	No	No	No	No	No
2,3,7,8-TCDF	ng/kg	24.3	NA	19.4	10.5	23.1	47.4	No	No	No	No	No
OCDD	ng/kg	936.5	NA	597	336	830	1930	No	No	No	No	No
OCDF	ng/kg	75.2	NA	66.6	30.6	76.5	168.7	No	No	No	No	No
TCDD TEQ	ng/kg	19.1	0.912	13.3	6	14.3	30	Yes	Yes	Yes	Yes	Yes
TPHs												
EFH (C8-C11)	mg/kg	ND	NA	ND	ND	ND	3.7	No	No	No	No	No
EFH (C30-C40)	mg/kg	52.0	NA	35.5	57.5	36.5	48.5	No	No	No	No	No

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
EFH (C21-C30)	mg/kg	30.7	NA	28	37	26.5	41	No	No	No	No	No
EFH (C15-C20)	mg/kg	ND	5.7	ND	3.2	ND	3	No	No	No	No	No
EFH (C12-C14)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Other												
Azobenzene	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Benzo(e)pyrene	µg/kg	41.0	NA	34	28	47	110	No	No	No	No	No
Biphenyl	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Calcium	mg/kg	2280	NA	2300	1320	1930	3820	No	No	No	No	No
Iron	mg/kg	13633	NA	70100	11000	15600	24200	No	No	No	No	No
Magnesium	mg/kg	2630	NA	3140	2170	3210	5290	No	No	No	No	No
Moisture	mg/kg	0.5	None	0.69	0.44	0.52	1.1	No	No	No	No	No
NDMA	µg/kg	ND	20	ND	ND	ND	ND	No	No	No	No	No
Nitrate	mg/kg	3.1	22.3	2.50	2.00	3.50	7.30	No	No	No	No	No
Nitrite	mg/kg	1.0	None	1.00	1.00	1.00	3.40	No	No	No	No	No
pH	mg/kg	6.2	None	6.48	6.23	6.16	6.19	No	No	No	No	No
Phosphorus	mg/kg	267.7	None	971	216	324	659	No	No	No	No	No
Tin	mg/kg	ND	None	14.2	ND	ND	5.75	No	No	No	No	No
Titanium	mg/kg	627.3	None	719	484	722	1130	No	No	No	No	No
TKN	mg/kg	608.6	None	ND	ND	ND	ND	No	No	No	No	No
TOC	mg/kg	11188.3	None	11300	10100	9290	10700	No	No	No	No	No

9.7 Appendix G – Soil Partition Study Chemical Analysis – SL1116-SA6-0.0-0.5

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Metals												
Aluminum	mg/kg	10833.3	58,272	10600	9530	12700	18300	No	No	No	No	No
Antimony	mg/kg	2.2	0.85	0.488	0.805	1.25	1.28	Yes	No	No	Yes	Yes
Arsenic	mg/kg	5.4	46	4.8	4.1	5.46	7.22	No	No	No	No	No
Barium	mg/kg	99.4	369	83.4	112	107	143	No	No	No	No	No
Beryllium	mg/kg	0.5	2.2	0.616	0.381	0.534	0.764	No	No	No	No	No
Boron	mg/kg	3.9	34	4.79	2.99	3.78	6.18	No	No	No	No	No
Cadmium	mg/kg	0.853	0.7	0.521	0.667	1.01	1.26	Yes	No	No	Yes	Yes
Chromium	mg/kg	29.6	94	18.9	22.6	32.9	44.4	No	No	No	No	No
Cobalt	mg/kg	6.8	44	8.51	5.15	7.53	8.9	No	No	No	No	No
Copper	mg/kg	22.5	118	11	13.5	17.5	20	No	No	No	No	No
Lead	mg/kg	31.9	49	7.19	11.9	39.4	31.4	No	No	No	No	No
Lithium	mg/kg	17.9	91	16.7	13.3	19.3	27.6	No	No	No	No	No
Manganese	mg/kg	254.3	1110	257	194	263	323	No	No	No	No	No
Mercury	mg/kg	0.1	0.1	0.138	0.154	0.368	0.285	Yes	Yes	Yes	Yes	Yes
Molybdenum	mg/kg	4.5	3.2	0.982	3.82	4.17	4.2	Yes	No	Yes	Yes	Yes
Nickel	mg/kg	11.8	131	11.2	8.92	13	16.4	No	No	No	No	No
Potassium	mg/kg	2726.7	14317	2930	2180	3090	3950	No	No	No	No	No
Selenium	mg/kg	0.9	1	0.215	0.693	0.722	0.768	No	No	No	No	No
Silver	mg/kg	0.1	0.2	ND	ND	0.0866	0.14	No	No	No	No	No
Sodium	mg/kg	109.7	1773	84.6	97	112	144	No	No	No	No	No
Strontium	mg/kg	35.7	162	37.4	29.9	36.6	52.2	No	No	No	No	No
Thallium	mg/kg	0.2	1.2	0.174	0.129	0.197	0.251	No	No	No	No	No
Vanadium	mg/kg	38.8	174	38.8	30.1	42.3	54.9	No	No	No	No	No
Zinc	mg/kg	375.3	214	128	235	417	522	Yes	No	Yes	Yes	Yes
Zirconium	mg/kg	ND	19	ND	ND	ND	ND	No	No	No	No	No
PAHs												
Acenaphthene	µg/kg	12.0	2.5	ND	ND	ND	ND	Yes	No	No	No	No
Acenaphthylene	µg/kg	2.7	2.5	ND	ND	ND	ND	Yes	No	No	No	No
Anthracene	mg/kg	63.0	2.5	ND	18	15	ND	Yes	No	Yes	Yes	No
Benzo(a)anthracene	µg/kg	383	NA	10	130	150	30	No	No	No	No	No
Benzo(a)pyrene	µg/kg	430	NA	ND	170	210	57	No	No	No	No	No
Benzo(b)fluoranthene	µg/kg	680	NA	42	280	360	100	No	No	No	No	No
Benzo(g,h,i)perylene	µg/kg	280	2.3	30	140	180	68	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthene	µg/kg	182	NA	ND	72	84	27	No	No	No	No	No
Chrysene	µg/kg	437	NA	19	170	190	51	No	No	No	No	No
Dibenzo(a,h)anthracene	µg/kg	66.7	NA	10	33	39	13	No	No	No	No	No
Fluoranthene	µg/kg	1050	5.2	23	390	420	88	Yes	Yes	Yes	Yes	Yes

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
Fluorene	µg/kg	ND	3.8	ND	ND	ND	ND	No	No	No	No	No
Indeno(1,2,3-CD)Pyrene	µg/kg	250	NA	17	110	150	51	No	No	No	No	No
Naphthalene	µg/kg	ND	3.6	ND	ND	ND	ND	No	No	No	No	No
Phenanthrene	µg/kg	390	3.9	ND	150	120	19	Yes	No	Yes	Yes	Yes
Pyrene	µg/kg	813	5.6	21	320	350	75	Yes	Yes	Yes	Yes	Yes
1-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
2-Methylnaphthalene	µg/kg	ND	2.5	ND	ND	ND	ND	No	No	No	No	No
PCBs												
Aroclor 1016	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1221	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1232	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1242	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1248	µg/kg	ND	1.7	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1254	µg/kg	100	1.7	44	39	130	100	Yes	Yes	Yes	Yes	Yes
Aroclor 1260	µg/kg	45.0	1.7	20	30	77	76	Yes	Yes	Yes	Yes	Yes
Aroclor 1262	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 1268	µg/kg	ND	3.3	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5432	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5442	µg/kg	ND	50	ND	ND	ND	ND	No	No	No	No	No
Aroclor 5460	µg/kg	235	50	37	120	430	350	Yes	No	Yes	Yes	Yes
Dioxins-Furans												
1,2,3,4,6,7,8-HpCDD	ng/kg	573.0	NA	125	488	837	1220	No	No	No	No	No
1,2,3,4,6,7,8-HpCDF	ng/kg	58.3	NA	16.1	36.9	86.1	120	No	No	No	No	No
1,2,3,4,7,8,9-HpCDF	ng/kg	9.4	NA	1.96	5.77	13.6	20.3	No	No	No	No	No
1,2,3,4,7,8-HxCDD	ng/kg	3.1	NA	0.923	1.67	4.9	7.55	No	No	No	No	No
1,2,3,4,7,8-HxCDF	ng/kg	4.6	NA	0.976	2.81	6.17	8.78	No	No	No	No	No
1,2,3,6,7,8-HxCDD	ng/kg	14.6	NA	3.74	9.3	21	31.5	No	No	No	No	No
1,2,3,6,7,8-HxCDF	ng/kg	3.9	NA	0.963	2.27	5.27	7.43	No	No	No	No	No
1,2,3,7,8,9-HxCDD	ng/kg	6.9	NA	1.91	4.42	9.71	14.4	No	No	No	No	No
1,2,3,7,8,9-HxCDF	ng/kg	3.6	NA	5.01	0.506	1.4	4.97	No	No	No	No	No
1,2,3,7,8-PeCDD	ng/kg	1.7	NA	5.01	0.844	2.43	5.21	No	No	No	No	No
1,2,3,7,8-PeCDF	ng/kg	2.6	NA	0.332	1.27	2.28	2.35	No	No	No	No	No
2,3,4,7,8-PeCDF	ng/kg	1.6	NA	0.337	1.14	2.26	3.1	No	No	No	No	No
2,3,6,7,8-HxCDF	ng/kg	5.4	NA	1.43	3.13	8.03	11.6	No	No	No	No	No
2,3,7,8-TCDD	ng/kg	0.5	NA	0.121	0.983	0.48	0.751	No	No	No	No	No
2,3,7,8-TCDF	ng/kg	1.0	NA	0.313	0.87	1.39	0.994	No	No	No	No	No
OCDD	ng/kg	9630.0	NA	1770	8220	14000	19700	No	No	No	No	No
OCDF	ng/kg	123.3	NA	30.2	80	173	249	No	No	No	No	No
TCDD TEQ	ng/kg	17.3	0.912	4.2	12.9	22.9	32.5	Yes	Yes	Yes	Yes	Yes
TPHs												
EFH (C8-C11)	mg/kg	ND	NA	2.6	ND	ND	ND	No	No	No	No	No
EFH (C30-C40)	mg/kg	66.3	NA	125	83	53	54.5	No	No	No	No	No

COI	Units	Concentration						Exceeds LUT Value?				
		Bulk	LUT Value	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays	Bulk	Coarse Materials	Medium Sands	Fine Sands	Silts & Clays
EFH (C21-C30)	mg/kg	61.8	NA	85	59	43.5	51.5	No	No	No	No	No
EFH (C15-C20)	mg/kg	4.5	5.7	ND	ND	ND	ND	No	No	No	No	No
EFH (C12-C14)	mg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Other												
Azobenzene	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Benzo(e)pyrene	µg/kg	306.7	NA	31	130	160	58	No	No	No	No	No
Biphenyl	µg/kg	ND	NA	ND	ND	ND	ND	No	No	No	No	No
Calcium	mg/kg	10533	NA	14000	9890	10900	17900	No	No	No	No	No
Iron	mg/kg	21233	NA	20500	16500	22700	26900	No	No	No	No	No
Magnesium	mg/kg	4067	NA	3990	3620	4930	6480	No	No	No	No	No
Moisture	mg/kg	1.9	None	1.6	1.5	1.9	2.9	No	No	No	No	No
NDMA	µg/kg	ND	20	ND	ND	ND	ND	No	No	No	No	No
Nitrate	mg/kg	7.1	22.3	4.40	6.00	9.50	11.50	No	No	No	No	No
Nitrite	mg/kg	1.0	None	1.00	1.00	1.00	1.00	No	No	No	No	No
pH	mg/kg	7.6	None	7.82	7.56	7.58	7.8	No	No	No	No	No
Phosphorus	mg/kg	556.0	None	431	434	626	828	No	No	No	No	No
Tin	mg/kg	ND	None	ND	ND	ND	ND	No	No	No	No	No
Titanium	mg/kg	767.0	None	643	606	859	967	No	No	No	No	No
TKN	mg/kg											
TOC	mg/kg	10110.0	None	5630	5670	9260	11800	No	No	No	No	No