Work Plan/Field Sampling and Analysis Plan
Co-Located Chemical Sampling at Area IV
Santa Susana Field Laboratory
Ventura County, California

Prepared for:

Department of Energy
Energy Technology and Engineering Center
P.O. Box 10300
Canoga Park, California 91309

Prepared by:

CDM Federal Programs Corporation
9444 Farnham Street, Suite 210
San Diego, California 92123

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Prepared by: Shelly Samaritoni
Shelley Samaritoni, P.G.
CDM Geologist

10/14/10
Date

Approved by: John T Wondolleck
John Wondolleck
CDM Project Manager

October 14, 2010
Date

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Acronyms and Abbreviations

°C	degrees Celsius
%	percent
AOC	Area of Concern
bgs	below ground surface
Boeing	The Boeing Company
CAR	corrective action request
CDM	CDM Federal Programs Corporation
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	contaminants of concern
DOE	Department of Energy
DL	detection limit
DPT	direct push technology
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	United States Environmental Protection Agency
ETEC	Energy Technology Engineering Center
FSAP	Field Sampling and Analysis Plan
g	gram
GIS	geographical information system
HAZWOPER	Hazardous Waste Operations and Emergency Response
HGL	HydroGeoLogic, Inc.
IDW	investigative derived waste
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MS	matrix spike
MSD	matrix spike duplicate
NASA	National Aeronautics and Space Administration
NBZ	Northern Buffer Zone
NELAP	National Environmental Laboratory Accreditation Program
oz	ounce
PAH	polycyclic aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	polychlorinated biphenyl
PID	photoionization detector
ppm	parts per million
PRG	preliminary remediation goal

QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
%R	percent recovery
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPD	relative percent difference
SHASP	site health and safety plan
SIM	selective ion monitoring
SSFL	Santa Susana Field Laboratory
SVOC	semi-volatile organic compound
SWMU	solid waste management unit
TPH	total petroleum hydrocarbon
VOC	volatile organic compound

Section 1
Introduction

1.1 Overview of the Work Plan/FSAP

This combined Work Plan/Field Sampling and Analysis Plan (FSAP) addresses the field sampling, analytical, quality control, and data review procedures for the collection and analysis of soil samples within Area IV of the Santa Susana Field Laboratory (SSFL) and the Northern Buffer Zone (NBZ), collectively termed the Area IV study area. As part of a radiological characterization study, the United States Environmental Protection Agency (EPA) will be collecting surface and subsurface soil samples throughout Area IV of SSFL and the NBZ. The California Department of Toxic Substances Control (DTSC) and Department of Energy (DOE) suggested that soil collected by EPA also be analyzed for chemical analytes. EPA's scope is only for radionuclide characterization of soil; therefore, DTSC and DOE agreed that the initial chemical sampling be done by DOE's contractor, CDM Federal Programs Corporation (CDM).

As EPA will be in the field for their first round of radionuclide soil sampling starting on October 18, it was important to move quickly to ensure that chemical samples be obtained at the same time as EPA's initial sampling effort. In the future, this Work Plan/FSAP may be amended to reflect a separate management approach, as directed by DTSC.

EPA will obtain a sufficient volume of soil to allow chemical analyses to be performed at locations consistent with the radiological sampling locations. EPA will collect the soil for placement in sample containers provided by the DOE contractor, CDM. EPA will perform this sampling using the *Field Sampling Plan for Soil Sampling, Area IV Radiological Study* (HydroGeoLogic, Inc [HGL] 2010a) and *Subarea 5C Addendum to Field Sampling Plan for Soil Sampling* (HGL, 2010b). CDM will be responsible for shipment of the soil samples to a DTSC-approved laboratory.

This Work Plan/FSAP addresses the management and quality control procedures for the collection of the co-located samples for chemical analyses for Historical Site Assessment (HSA) Subarea 5-C (HSA 5-C). This work effort adopts the Quality Assurance Project Plan (QAPP) that has been developed for the SSFL RCRA Field Investigation (RFI) program being administered by DTSC (MEC^X 2009). Therefore a separate QAPP will not be developed for the co-located sampling effort.

This Work Plan/FSAP is a bridge document for two reasons. First, EPA plans to initiate soil sampling October 18, 2010. Although DTSC would like to directly hire the contractor and laboratory to perform the chemical analyses, it is not possible given the short time frame. DOE has requested that CDM contract analytical laboratories and conduct the sampling until other arrangements can be made by DTSC.

Second, the chemical cleanup strategy for area investigated under this FSAP is cleanup to background or cleanup to detection limits, whichever is greater. However, the chemical background values for SSFL are currently being developed as well as the chemical one-in-a-million risk-based screening levels (RBSLs) for the rural residential scenario. Detection limits should be based on both considerations. Because background values and rural residential RBSLs are not currently available, analytical detection limits used in this study will be based on reporting limits previously provided by DTSC that approximated the order of magnitude of the suburban RBSLs (MWH Americas, Inc. 2005) lowered by two orders of magnitude. Once the background values and rural residential RBSLs are available, the detection limits stated in this plan may need to be adjusted to reflect the background and rural residential RBSL values.

EPA has subdivided Area IV into at 10 subareas for purposes of its radiological characterization study. EPA proposes to develop separate radionuclide FSAP's for each of the subareas. EPA proposes to initiate sampling within subarea HSA-5C which forms the basis for this FSAP. This FSAP will be amended to reflect the sample locations for each EPA study subarea and any changes that EPA may make in its sampling procedures.

1.2 Site Location and Description

The SSFL is located in southeastern Ventura County, California, and has an area of approximately 1,153 hectares (2,850 acres) near Simi Valley (Figure 1-1). The SSFL is separated into four administrative areas (Figure 1-2). The Boeing Company (Boeing) owns most of Area I, except for 42 acres that are owned by the federal government and administered by the National Aeronautics and Space Administration (NASA). Area II is also owned by the federal government and administered by NASA. The NASA portions are operated by Boeing. Boeing owns and operates Areas III and IV. The SSFL facility includes, within Area IV, a specific operational area that was dedicated to the development and testing of components used in metallic sodium systems that was a part of the federal government's Energy Technology Engineering Center (ETEC). Areas I, II, and III were used by predecessors of Boeing, NASA, and the Department of Defense for rocket engine and laser testing. Environmental contamination resulting from activities in Areas I, II, and III is the responsibility of Boeing and NASA and is not part of the scope of the sampling effort that is guided by this Work Plan/FSAP. Table 2-1 presents the specific RFI areas in Area IV covered by this sampling effort. DOE was and remains responsible for operation of the ETEC located in Area IV.

From the mid-1950s until the mid-1990s, DOE and its predecessor agencies were engaged in or sponsored nuclear operations including the development, fabrication, disassembly, and examination of nuclear reactors, reactor fuel, and other radioactive materials. Associated experiments included large-scale liquid sodium metal testing for fast breeder reactor components. Nuclear operations at ETEC included 10 nuclear research reactors, seven critical facilities, the Hot Laboratory, the Nuclear Materials

Development Facility, the Radioactive Materials Handling Facility, and various test and radioactive material storage areas. In addition to the handling and processing of radioactive materials, these DOE facilities also used non-radioactive chemicals, a variety of specialty metals, and other hazardous materials (e.g., polychlorinated biphenyls [PCBs], solvents, and lead-based paints) in their operations.

All nuclear research in Area IV was terminated in 1988 when DOE shifted its focus at SSFL from research to decontamination and decommissioning activities. Decontamination and decommissioning of the sodium test facilities started in 1996, when DOE determined that the entire ETEC facility was surplus to its mission. At that time, DOE began formal closure of its facilities in Area IV and began cleanup activities in preparation for return of the property to Boeing. DOE discontinued decontamination and demolition of the remaining facilities in 2008, but has continued surveillance, maintenance, monitoring and investigation activities. This includes investigation of soil and groundwater, as required under the DTSC RFI and the EPA radiological investigation.

1.3 Purpose of Co-Located Sampling

The purpose of collecting chemical data co-located with the radionuclide data is to assist decision makers in identifying key chemical and radionuclide contaminants of concern (COCs) that may drive cleanup decisions. This co-located sampling plan presents an efficient and effective means for supporting future cleanup decisions. First, the planned approach is efficient because EPA has already planned and mobilized crews to collect soil samples throughout the Area IV study area(for radionuclide analyses only), the analyses of the samples for chemicals takes advantage of EPA's overall sampling efforts. Second, the planned co-located analyses are effective because it will provide radionuclide and chemical data at the same location and facilitate evaluations of the overlap of radionuclides and chemical presence at the same locations throughout Area IV study area. Evaluating both radionuclides and chemical data supports the purpose or goal of the making informed cleanup decisions. Future chemical sampling may include step-outs and would involve amending this work plan/FSAP or preparation of new planning documents.

1.4 Technical or Regulatory Standards

This FSAP does not establish the final cleanup levels for SSFL. The cleanup levels are being developed through EPA and DTSC background studies, development of RBSLs, and evaluation of laboratory detection limits (DLs), all of which is an ongoing process separate from the collocated chemical sampling effort. In the interim, DOE and DTSC have conceptually agreed to an approach that will be the subject of a legally binding consent order. The consent order will specify the goal for the environmental cleanup of Area IV of SSFL to achieve chemical specific remedial objectives with chemical concentrations equivalent to background or detection limits for chemicals. EPA is currently determining the radionuclide background levels and EPA preliminary remediation goals (PRGs) exist for an agricultural (rural residential) land use scenario.

DTSC has leadership over a study to determine chemical background and is directing development of the rural residential RBSLs.

Background and rural residential RBSLs will form the "regulatory" standards for the co-located soil sampling study. The ability of laboratories to analyze chemicals at a level approximate to the RBSLs is currently being researched through contact with laboratories throughout the United States. The results of that research will be shared with the stakeholders. If the laboratories can analyze samples and report results at background or the RBSL values, then the DL will be the same as the "regulatory" limit. If the laboratories cannot achieve a DL equivalent to the RBSL, then the achievable DL will become a "technical" target for the soil investigation. This process is the same as the process being used by EPA in the demonstration of the ability of laboratories to achieve EPA radionuclide PRGs for the rural residential scenario.

1.5 Work Plan/FSAP Organization

This Work Plan/FSAP includes the following sections:

Section 1	Introduction – Summarizes the basis and objectives of the co-located sampling;
Section 2	Project Background – Provides details regarding the RFI studies of Area IV and EPA's radionuclide characterization study of Area IV;
Section 3	Project Organization – Identifies the individuals responsible for implementing the FSAP, their specific responsibilities, and their organizations;
Section 4	Quality Objectives and Rationale – Provides the data quality objectives and their criteria;
Section 5	Sample Design and Rationale – Describes the rationale for EPA's sample locations, EPA's soil sampling procedures and intervals, the hand-off of sample material to the chemical sampling team, rationale for chemical sample intervals, and volatile organic compound (VOC) sample collection;
Section 6	Project Task Descriptions – Provides the procedures for preparing for sampling hand-off, sample containers, labeling, paperwork, sample management, preservation, custody, and shipment to the analytical laboratories;
Section 7	Quality Control Criteria – Describes the analytical methods, and provides a summary of analytical quality control procedures, analytical detection limits, field quality control limits, and analytical quality control limits;
Section 8	Instrument/Equipment and Supplies – Describes all equipment and materials necessary to collect, preserve, package, record, and ship samples;

Section 9	Special Training and Certification – Describes training requirements for field staff, data reviewers and validators, and certifications of analytical laboratories;
Section 10	Documentation and Records – Describes requirements and procedures for documenting all aspects of sample collection, custody, and analytical reporting;
Section 11	Assessment and Oversight – Describes the field and laboratory assessments/audits that will be performed to ensure that all procedures are adhered to, corrective measures are identified, and corrective actions completed;
Section 12	Data Review – Describes the procedures for reviewing field records for accuracy and completeness, verification of analytical records, data validation, and the overall assessment of data quality relative to project objectives and criteria; and
Section 13	References.

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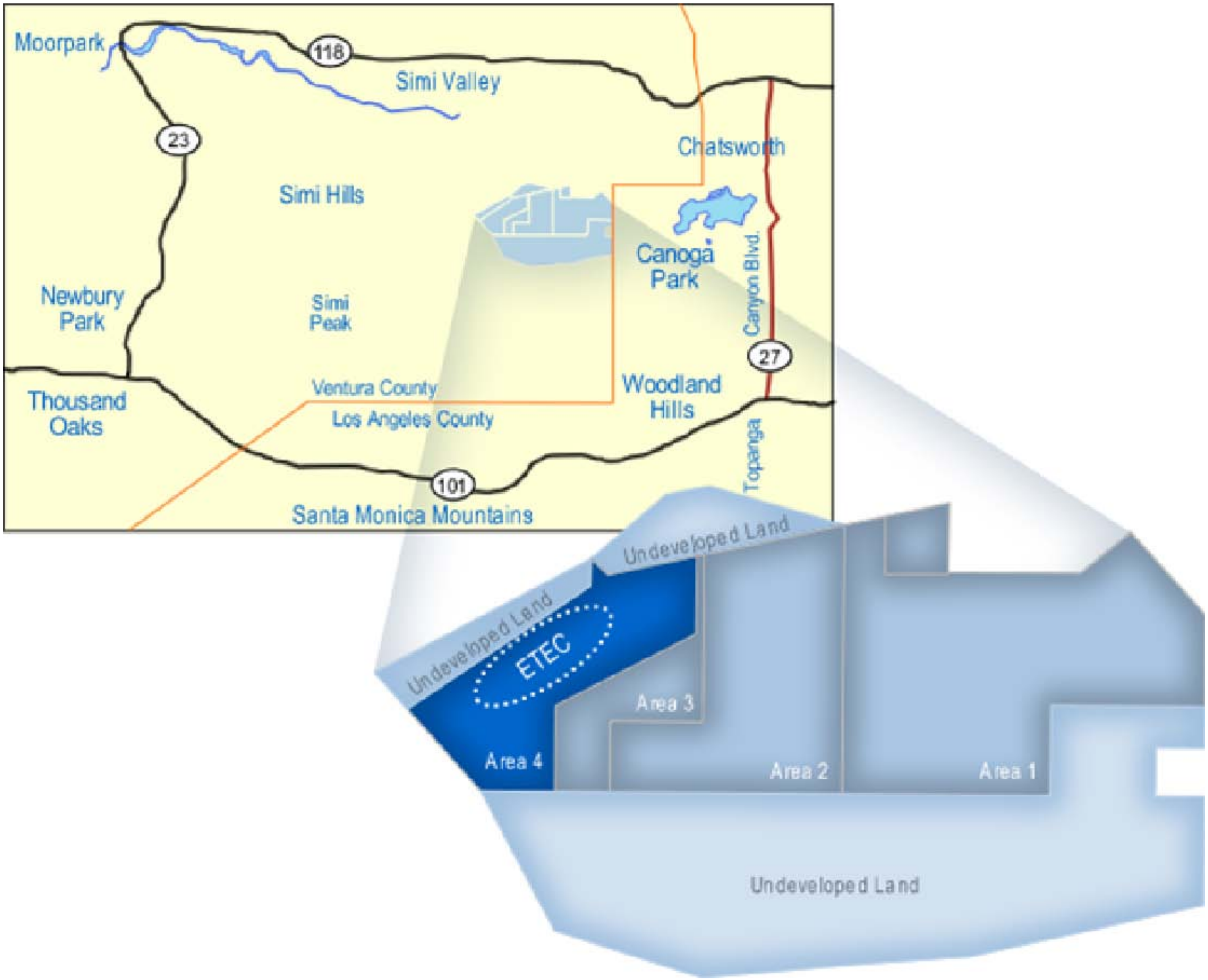
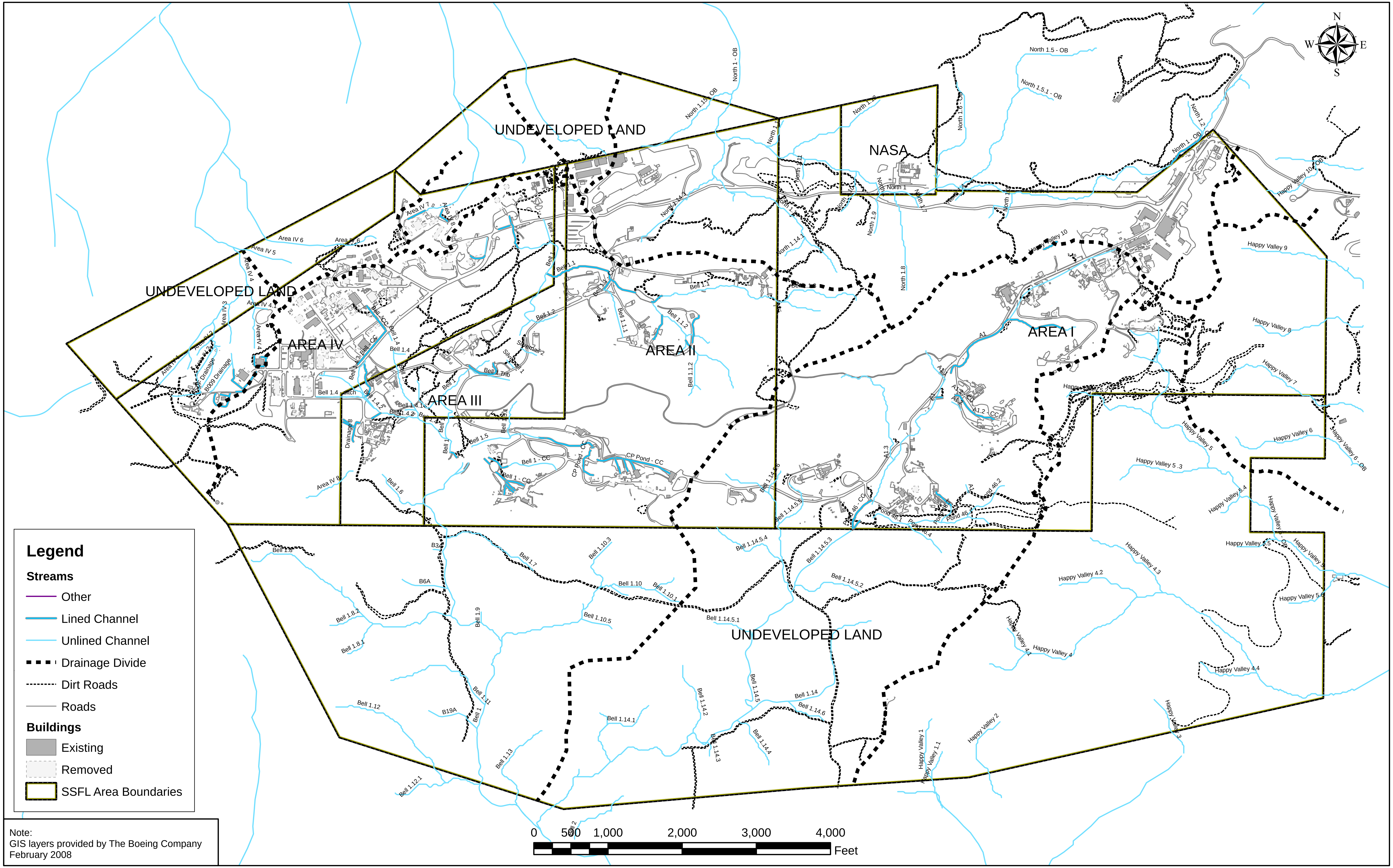


Santa Susana Field Laboratory Area IV
Ventura County, California

Figure 1-1
SSFL Location

DRAFT - FOR PUBLIC REVIEW AND COMMENT



Note:
GIS layers provided by The Boeing Company
February 2008

CDM

Santa Susana Field Laboratory Area IV
Ventura County, California

Figure 1-2
Santa Susana Field Laboratory Layout

Section 2
Project Background

2.1 Area IV RCRA Field Investigation

The information in this section was taken from the *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report Santa Susana Laboratory, Ventura County, California* (CH2M Hill 2008).

The RCRA-related activities at the SSFL include four major environmental programs being conducted by Boeing under the oversight and jurisdiction of the DTSC. These programs include: (1) RCRA Corrective Action, (2) Closure of inactive RCRA units, (3) Compliance/permitting of RCRA units, and (4) Interim Measures. In some instances these programs overlap (such as closed RCRA units within RFI sites that are investigated as part of Corrective Action). Although related under RCRA, each program has separate process requirements and guidelines. Collectively, these programs represent a comprehensive program for the handling and cleanup of hazardous chemicals. The RCRA Corrective Action Program is described below.

The RCRA Corrective Action process includes four phases to achieve site cleanup and closure. These are the RCRA Facility Assessment (RFA), RFI, Corrective Measures Study (CMS), and Corrective Measures Implementation (CMI) phases. The RFA was completed in 1994 and resulted in the identification of Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs), where various hazardous materials were used, stored, or handled.

The SSFL RCRA Corrective Action program is currently in the RFI phase. During the RFI, additional AOCs (beyond those listed in the RFA) have been identified and investigated. Those identified within Area IV are presented in Table 2-1. The AOCs and SWMUs have been grouped by location for purposes of investigation and are called “RFI sites.” The RFI sites have been divided into 11 Group Reporting Areas across SSFL and four of those groups (Groups 5, 6, 7, and 8) are associated with Area IV.

The RFI includes chemical characterization of all relevant environmental media present at SSFL. Investigations of environmental media (soil, soil gas, sediment, groundwater, and surface water) have been conducted following DTSC-approved work plans. The objectives of the RFI are to characterize the nature and extent of chemical contamination in environmental media, evaluate risks to potential receptors, gather data for the CMS, and identify areas for additional work.

The chemical data collected under this Chemical Co-Location FSAP will be added to the RFI data previously collected to aid in completion of the overall characterization of the RFI groups located within or associated with Area IV.

The CMS phase of the RCRA Corrective Action Program will be an evaluation of remedial alternatives for areas that are identified for cleanup. The CMS may also include further evaluation of cleanup decisions identified through the RFI, such as delineation of chemicals requiring cleanup.

Table 2-1
RFI Groups and Sites Within Area IV of SSFL

GROUP NO.	RFI SITES	AOCs OR SWMUs INCLUDED IN RFI SITE
5	Boeing Area IV Leach Field	Building 4011 Leach Field AOC
		Building 4008 Warehouse AOC
	Environmental Effects Laboratory (EEL)	SWMU 6.9 (located in both Areas III and IV)
	Pond Dredge Area	Pond Dredge Area AOC
	Process Development Unit (PDU)	SWMU 7.10 (Building 4005)
	Southeast Drum Storage Yard (SE Drum Yard)	SE Drum Yard AOC
	Building 65 Metals Laboratory Clarifier	Building 65 Metals Laboratory Clarifier AOC
	Building 100 Trench	SWMU 7.5 (Building 100 Trench Area)
	DOE Leach Field 1 (DOE LF1)	Building 4030 Leach Field AOC
		Building 4093 Leach Field AOC
	DOE Leach Field 2 (DOE LF2)	Building 4010 Leach Field AOC
	DOE Leach Field 3 (DOE LF3)	Building 4373 Leach Field AOC
		Building 4383 Leach Field AOC
		Building 4393 Leach Field AOC
	Hazardous Material Storage Area (HMSA)	SWMU 5.7 (Building 4457)
	Rockwell International Hot Laboratory (RIHL)	SWMU 7.7 (Building 4020)
	Systems for Nuclear Auxiliary Power Facility (SNAP)	Building 4059 AOC

Table 2-1 (continued)
RFI Groups and Sites Within Area IV of SSFL

GROUP NO.	RFI SITES	AOCs OR SMWUs INCLUDED IN RFI SITE
6	Old Conservation Yard	SWMU 7.4
	New Conservation Yard	SWMU 7.8
	Sodium Reactor Experiment	SRE Complex Area AOC
		Building 003 Leach Field AOC
	Building 064 Leachfield	Building 064 Leachfield AOC
7	Building 4029	SWMU 7.11 (Reactive Metals Storage Yard)
	Building 4133	SWMU 7.2 (Sodium Burn Facility)
	Radioactive Materials Handling Facility	SWMU 7.6 (operational area of RMHF & former Catch Basin)
		Building 4021 Leach Field AOC
8	Building 009 Leach Field	Building 009 Leach Field AOC
	Building B056 Landfill	SWMU 7.1
	Empire State Atomic Development Authority (ESADA)	SMWU 7.9 (ESADA Chemical Storage Yard)
	Former Sodium Disposal Facility (FSDF)	SWMU 7.3 (Building 886 FSDF)

Notes:

AOC = area of concern
No. = number
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SSFL = Santa Susana Field Laboratory
SWMU = solid waste management unit

2.2 EPA Radionuclide Characterization Study of Area IV

The primary objective of the EPA soil sampling effort is to evaluate the nature of potential radionuclide contamination in soil within the Area IV Study Area that may have resulted from past nuclear research activities within SSFL Area IV. This objective will be achieved through the collection and analysis of surface and subsurface soil samples. The soil sampling effort is further described in HGL (2010b).

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Section 3
Project Organization

The roles of all entities engaged in this effort are summarized below.

3.1 Department of Energy

DOE is the lead federal agency with ultimate responsibility for the investigation and cleanup of Area IV. DOE is funding the co-located sampling effort.

3.2 Department of Toxic Substances Control

DTSC is the agency with overall responsibility for ensuring that investigation and cleanup is performed to state regulations. DTSC will have responsibility for oversight of field work, analytical laboratory acceptance, review of analytical results, and decisions related to cleanup of all of SSFL, including Area IV.

3.3 United States Environmental Protection Agency

Under an agreement with DOE, EPA is conducting the radiological background and Area IV/NBZ radionuclide characterization studies. Soil samples identified in this Work Plan/FSAP will be collected by EPA at the same locations where EPA will collect soil samples for radionuclide analyses. Portions of EPA's radionuclide FSAP describing sampling procedures and locations are incorporated directly into this co-located sampling Work Plan/FSAP.

3.4 CDM

CDM is the DOE contractor responsible for obtaining soil material collected by EPA, ensuring that the sample labels are correct, chain-of-custody paperwork complete, procurement of analytical services, preparation and shipment of samples to the laboratories, oversight of laboratory performance, review of laboratory data reports for completeness, and independent data validation of the results. CDM will also prepare the data report presenting the finding of the co-located sampling effort.

3.5 Subcontractors

CDM will procure the analytical laboratory and independent data reviewers. The names of both are not known at the time of drafting this version of the co-located sampling Work Plan/FSAP. The Work Plan/FSAP will be amended to include this information.

3.6 Community

The community will have opportunity to review EPA's sampling procedures, EPA's sampling locations, this Work Plan/FSAP, the analytical detection limits stated by the chemical laboratories, and the results of this sampling effort.

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Section 4
Quality Objectives and Rationale

The data quality objective (DQO) process is a series of seven planning steps based on the scientific method, designed to specify the type, quantity, and quality of environmental data needed to support defensible decisions based on current conditions and proposed activities at an environmental site (EPA 2006). The EPA seven-step DQO process was used as general guidance during the development of these DQOs.

DQOs are qualitative and quantitative statements derived from the outputs of each step of the DQO process that:

- Clarify study objectives;
- Define data needs (type, quality, etc.); and
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the decision.

The derived statements are then used to develop scientific, resource-effective, and defensible sampling designs. The DQO summary table is provided in Table 4-1.

Table 4-1
Data Quality Objectives

PROCESS	RESPONSE
STEP 1 State the problem.	Historical operations at SSFL have released chemicals into the soil. Soil chemical concentration data for EPA Subarea HSA 5-C are needed to complete the process of identifying potential COCs and determine if site soil chemical concentrations exceed background values and detection limits. Soil chemical concentrations will be used to determine locations of areas with chemical contamination at the site.
STEP 2 Identify the Goal of the Study.	The COCs (those exceeding background values and detection limit values) and areas of contamination at Area IV need to be determined to allow for cleanup decisions. The specific goal of this soil sampling is to answer the following questions: ▪ Do the soil chemical concentrations exceed background values and detection limit values? ▪ What is the vertical and lateral extent of soil chemical concentrations? ▪ What is the location and volume of contaminated soil that needs to be removed?
STEP 3 Identify Information Inputs.	▪ Field screening of the soil core with a PID will be performed to determine if VOCs or fuels are present in the soil. If the PID indicates the presence of VOCs in the sample core, a sample will be collected and analyzed for VOCs and fuels. ▪ Visual observations of the soil core will be used to look for indicators of contamination (sheen, discoloration, foreign matter, distinct stratigraphic changes, and odor). If these indicators are observed, the subsurface sample will be taken from the depth where potential contamination is observed. ▪ Elevated alpha, beta, or gamma readings. ▪ Soil samples will be analyzed for the chemical analytes stated in Step 7.
STEP 4 Define the Boundaries of the Study.	The lateral boundaries are shown on Figure 1-2 as the boundaries of Area IV and the NBZ. The vertical boundary is to 10 feet bgs or refusal at locations where no prior soil excavation is known; and to the depth of former excavation, or to groundwater, where building excavations have involved replacement of excavated materials. The temporal boundary includes data collected from prior SSFL investigations and to the data collected during this soil sampling and any concurrent or additional investigations at the site (soil vapor sampling, radiological sampling, additional soil sampling, etc.).
STEP 5 Develop the Analytic Approach.	The background values and detection limit values for use at SSFL are currently in development. The target detection limits (Table 7-1) will be used in this WP/FSAP as discussed in Section 7 until the background values and detection limit values have been finalized. The soil chemical concentrations will be compared to the approved background values and detection limit values. Determine whether there has been a release of hazardous substances at Area IV. ▪ **If** chemical concentrations in soils exceed background values and detection limit values, **then** additional sampling may be recommended to further delineate the site and/or a remediation strategy will be developed that will reduce chemical concentrations to below background values and detection limit values. **If** chemical concentrations in soils do not exceed background values and detection limit values, **then** no further action will be recommended at the location where background and detection limits are met.
STEP 6 Specify Performance or Acceptance Criteria.	Analytical data reported by the laboratory will be validated by a third party. Validated data will be assessed for usability as described in Section 12.4 to ensure that the PARCCS data quality indicators are met. Data assessment and validation will determine if collected data can be used for comparison. In general, it will ensure that: ▪ Appropriate field procedures were followed; ▪ Deviations were documented and assessed; ▪ Data met applicable criteria; and ▪ Data are usable for the stated project needs. All samples submitted to the analytical laboratory will be analyzed by an accepted EPA method or DTSC approved method. Laboratory achievable DLs for analytical methods are listed on Table 7-1. Measurement performance criteria for the data are presented in Sections 7.2 and 7.3.

Table 4-1 (continued)
Data Quality Objectives

PROCESS	RESPONSE
STEP 7 Develop the Plan for Obtaining Data.	Soil samples (and appropriate QC samples; see Section 7.2) will be collected at surface soil and Area IV borings locations identified for the radiological study (Figure 5-1). The surface sample will be collected from the 0 to 0.5 feet bgs interval. Samples for VOC analyses will be collected in a TerraCore or En Core sampler, as appropriate. Surface soil samples for SVOC analysis will be collected in a metal sleeve. All other surface soil samples will be a grab sample placed into a glass container. The subsurface soil samples will be collected from a DPT acetate sleeve at intervals as described in the FSAP text. The subsurface chemical samples will be co-located with the radiological sample when elevated alpha/beta/gamma readings are detected or when a specific feature (pipeline, drain, UST, etc.) is targeted by EPA, where there are elevated PID readings (greater than 0 ppm) indicating potential solvents or fuels, or where there is visual evidence of contamination. If the previous conditions are not met (that is there is no elevated gamma reading, no targeted feature, or no evidence of contamination), then the subsurface sample will be collected from 4.5 to 5.5 feet bgs to be consistent with the 5-feet bgs target interval for prior RFI chemical data. The sample interval for subsurface soil samples will be 1 foot to ensure sufficient volume is collected. A second subsurface sample for chemical analyses will be collected below 9 feet (9 to 10 feet bgs, assuming no refusal until 10 feet bgs). Primary samples (meaning samples collected at all locations) will be analyzed by an offsite laboratory as follows: ▪ VOCs using EPA Method 8260B (surface sample exhibiting staining, a positive PID reading, and/or subsurface sample at 5 feet bgs) ▪ 1,4-Dioxane EPA Method 8260B SIM (with any VOC sample) ▪ Metals using EPA Methods 6010/6020B, 7471A (mercury), and 7196A or 7199 (chromium VI); ▪ Fluoride using EPA Method 300.0; ▪ Nitrates using EPA Method 353.2, ▪ SVOCs using EPA Method 8270C; ▪ PAHs using EPA Method 8270 SIM; ▪ PCBs using EPA Method 8082; ▪ Dioxins/Furans using EPA Method 1613B; ▪ Perchlorate using EPA Method 314.0 (6850 for verification of non-detects); ▪ TPH (gas/oil/diesel) using EPA Method 8015B (visual or historic evidence for gasoline/diesel usage). ▪ Pesticides EPA Method 8081A (surface sample only) ▪ Herbicides EPA Method 8151 (surface sample only) Secondary samples (meaning samples of fill, waste, or visually contaminated materials) will be analyzed by an offsite laboratory as follows: ▪ Formaldehyde EPA Method 8315A ▪ Hydrazine EPA Method 8315A ▪ n-Nitrosodimethylamine EPA Method 1625C ▪ Energetics EPA Method 8330A ▪ Cyanide EPA Method 9012B ▪ pH EPA Method 9045C ▪ Alcohols/Terphenyls/Glycols EPA Method 8015B ▪ Methyl Mercury EPA Method 1630 (sediment only) ▪ Organic Tin NOAA Status and Trends (sediment only) ▪ Asbestos 600/R-93/116 (building debris)

Table 4-1 (continued)
Data Quality Objectives

Acronyms and Abbreviations:

bgs = below ground surface
COC = contaminant of concern
DL = detection limit
EPA = United States Environmental Protection Agency
FSAP = field sample and analysis plan
PAH = polycyclic aromatic hydrocarbons
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB = polychlorinated biphenyl
PID = photoionization detector
SIM = selected ion monitoring
SSFL = Santa Susana Field Laboratory
SVOC = semi-volatile organic compound
TPH = total petroleum hydrocarbon
UST = underground storage tank
VOC = volatile organic compound
WP = Work Plan

Section 5
Sample Design and Rationale

This section describes the sampling location rationale and field sampling program to be followed during the performance of the soil sampling for chemicals. Samples will be collected as described in this section and in accordance with the quality control (QC) criteria in Section 12. The field procedures are designed so that:

- Samples collected are consistent with project objectives; and
- Samples are collected in a manner so that data represent actual site conditions.

5.1 Sampling Location Rationale

The sample location design is based on the EPA's radiological study sampling protocols. The soil sampling for chemicals is being conducted concurrently with the radiological soil sampling in order to expedite sampling and provide co-located chemical and radiological data. The soil samples for chemical analysis will be co-located, as described in Sections 5.2.2 and radiological sampling in Section 5.2.3. The boring locations proposed for HSA-5C study area are shown in Figure 5-1. EPA is currently planning on collecting samples from approximately 100 locations throughout the HSA-5C study unit.

Per the EPA field sampling plan (HGL 2010a) the selection of targeted sampling locations are based on a combination of review of existing data, historical records sources, and current gamma and geophysical surveys.

5.2 Field Sampling Program

The field sampling activities will include surface soil sampling and subsurface soil sampling from a direct push technology (DPT) borehole drilled by HGL and soil sampling by HGL (HGL 2010a,b). Once the soil samples are collected and placed in appropriate containers, HGL will transfer the samples to CDM. Land surveying of all borehole locations will be conducted by HGL upon completion of all drilling activities (HGL 2010a). Investigative derived waste (IDW) disposal activities will be performed by HGL and CDM (see Section 6.9).

5.2.1 EPA Soil Sampling Procedure

Approximately 100 borings (see Figure 5-1) will be advanced by HGL using DPT to delineate the vertical and horizontal extent of radiological contamination in soil within Subarea HSA 5C. HGL will advance the drill tip to the targeted depth or to refusal. Gamma readings will be taken by HGL along the length of the boring.

Surface soil samples will be collected from the 0 to 6-inch bgs interval. The surface of the sample area will be prepared by HGL's sampler by removing leaves, grass, and surface debris. For radionuclide sampling, the soil will be collected from a circle approximately 12-inches in diameter to a depth of 6 inches bgs ensuring the edges are vertical to provide a representative sample. The removed soil will be placed in a stainless steel bowl for homogenization removing any debris, wood, or materials greater than 0.25 inches in size.

For chemical sampling, any stained surface soil will be sampled first using an En Core or TerraCore sampler, as appropriate. Soil collected for SVOC analyses will be collected from undisturbed surface soil using a 6-inch brass or stainless steel sleeve. The metal sleeve will be capped and sealed to reduce loss of semi-volatile compounds. Soil for the remaining chemical analyses will be collected as grab samples using a stainless steel trowel, and placed directed into the appropriate glass sample containers consistent with current RFI sampling practice.

Subsurface soil sampling activities will be performed by HGL using DPT after surface soil sampling is complete. The DPT operations will be conducted by a California-licensed DPT subcontractor with HGL oversight. In most cases, DPT borings will be advanced to a targeted depth of approximately 10 feet bgs or refusal. The definition of refusal for this study will be when the DPT soil sampler cannot be advanced any further below the ground surface.

Soil cores will be collected using the Geoprobe dual-tube sampling method, which consists of a 3.25 inch outer drive casing and an inner soil sampling barrel. A Geoprobe Macro-Core sampler will be used as the inner soil sampling barrel to collect continuous 4-foot soil cores from inside the outer drive casing. After the system is advanced the length of the Macro-Core sampler, the sampler will be retrieved while the drive casing is left in place to prevent the borehole from collapsing. The Macro-Core sampler provides a 2.5-inch diameter, 4-foot long soil core contained in an acetate sleeve.

The general sampling procedure is as follows:

- Drive the 3.25 inch outer drive casing and Macro-Core sampler into the sample material the length of the sampler.
- Retract and disassemble the Macro-Core sampler.
- Remove the acetate liner.
- Open the acetate liner with a cutting tool.
- Screen the soil core using Micro R (gamma) and Pancake (alpha, beta) probes.
- Screen the soil core using a photoionization detector (PID).
- Determine the depth interval to be sampled (based on instrument readings, visual evidence, or default depths).
- Collect the sample using a clean utensil.

- Place the sample in an appropriate container.
- Decontaminate sampler and inner rods.
- Insert new acetate liner.
- Insert the Macro-Core sampler back inside the outer drive casing.
- Drive the 3.25 outer drive casing and Macro-Core sampler into the sample material the length of the sampler.
- Repeat until the desired depth is reached.

HGL will screen the length of the core using alpha/beta detectors to look for evidence of non gamma emitting radionuclides. HGL will also use a PID to take measurements for VOCs as the sleeve is cut open along the length of the sleeve. The PID readings will be used to determine the subsurface sample location for volatile compound (solvents and fuels) analyses (see Sections 5.2.2 and 5.2.3).

Once the sample depth intervals have been determined following the borehole gamma logging and PID measurements, and second boring will be pushed by HGL. The soil sleeve from this second boring will be used for chemical analyses. The soil from the selected interval will be cut into smaller segments of tubing for appropriate distribution to the project laboratories for analysis. Soil samples for VOC/TPH analyses will be collected in an EnCore or TerraCore Sampler directly from the polyethylene sleeve first before the sleeve is divided any further. If additional sample material is required, a second borehole will be advanced and additional soil will be collected from the same depth interval. Soil for Semi-Volatile analyses will be extruded with minimal soil disturbance directly into glass containers. Soil for all other analyses will be retained within the acetate sleeves. The sleeves will be capped, sealed and labeled for shipment to the lab.

After the borehole has been properly abandoned, a survey nail will be placed to mark the sampling location. In addition to the survey nail, geographic coordinates for each sampling location will be recorded using a GPS unit.

If a sample location is inaccessible for any reason, such as the location being obscured by a rock outcropping, building, or tree; or the presence of a protected precludes sampling at the location, the sample location will be moved up to 30 feet in any direction to allow access. If a sample location is moved, the new coordinates will be recorded in the field logbook, and the rationale for moving the sample location will be documented. If no accessible locations are found within 30 feet of the planned location, the sampler will notify the Field Supervisor. When practical a photograph of the inaccessible location will be taken.

The reader of this FSAP is referred to the EPA's field sampling plan (HGL 2010a,b) for additional details on the DPT drilling, gamma reading equipment and procedures, radiological soil sampling procedures, as well as standard operating procedures that will be followed.

5.2.2 Chemical Sample Interval Selection

The surface chemical sample interval is 0 to 0.5 feet bgs. With the exception of soil to be analyzed for SVOCs, HGL will place the soil in the required sample containers and pass the filled sample containers to CDM for shipment to the appropriate analytical laboratory. SVOC samples will be collected in either a 6- inch stainless steel or brass sleeve using an impact hammer. Surface samples will be analyzed for all primary analytes as described in Table 4-1, Step 7.

The subsurface chemical sample intervals will be determined in the field based on field observations. The protocol for making this determination is detailed in Figures 5-2A and 5-2B. It is assumed that based on prior investigations that subsurface refusal will be encountered between 5 and 10 feet bgs except areas of former excavations.

5.2.3 Volatile Organic Compound Sampling

Surface soil samples will not be collected for VOCs and gasoline range analysis. Subsurface soil samples will be collected for VOCs analysis where PID readings indicate the presence of fuels or solvents or at the 5-ft bgs interval when there is no indication of fuels or solvents.

5.2.3.1 Identification of Sample Interval

As the sleeve holding the core is cut open, PID readings will be taken. If there are elevated PID readings (above 0 parts per million [ppm]), a subsurface soil sample will be taken at the midpoint of the elevated PID reading. For those borings where no PID readings are encountered, a subsurface soil sample will be collected at the 5 foot bgs interval.

5.2.3.2 VOC/Petroleum Hydrocarbon Sampling Procedure

CDM will provide HGL with an En Core® Sampler or TerraCore Sampler, as appropriate. HGL will use the sample to collect the subsurface soil samples to be analyzed for VOCs. Three 5 gram (g) samplers are required for each sample for sufficient soil volume. HGL will also place soil in a one 4-ounce (oz) wide-mouth glass jar for moisture analysis of the VOC sample. An En Core® Sampler T-handle, supplied to HGL by CDM, will be used to collect samples. Soil samples collected for TPH gasoline range hydrocarbon analysis will also be collected using En Core® Samplers.

The requirements for collecting soil for analysis by the En Core® Sampler Method are as follows:

1. Wear clean gloves during handling of all sample containers and sampling devices.

2. Remove sampler and cap from package and attach T-handle to sampler body.

3. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full. The O-ring will be visible within the hole on the side of the T-handle. If the O-ring is not visible within this window, then the sampler is not full.
4. Extract sampler and wipe the sampler head with a new, clean paper towel so that the cap can be tightly attached.
5. Push cap on with a twisting motion to secure to the sampler body.
6. Rotate the sampler stem counterclockwise until stem locks in place to retain sample within the sampler body.
7. Fill out sample label and attach to sampler.
8. Repeat procedure for the remaining two samplers.
9. Collect moisture sample in 4-oz wide-mouth jar using a clean stainless steel spoon or trowel.
10. Store samplers at 4 degrees Celsius (°C) ±2°C. Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

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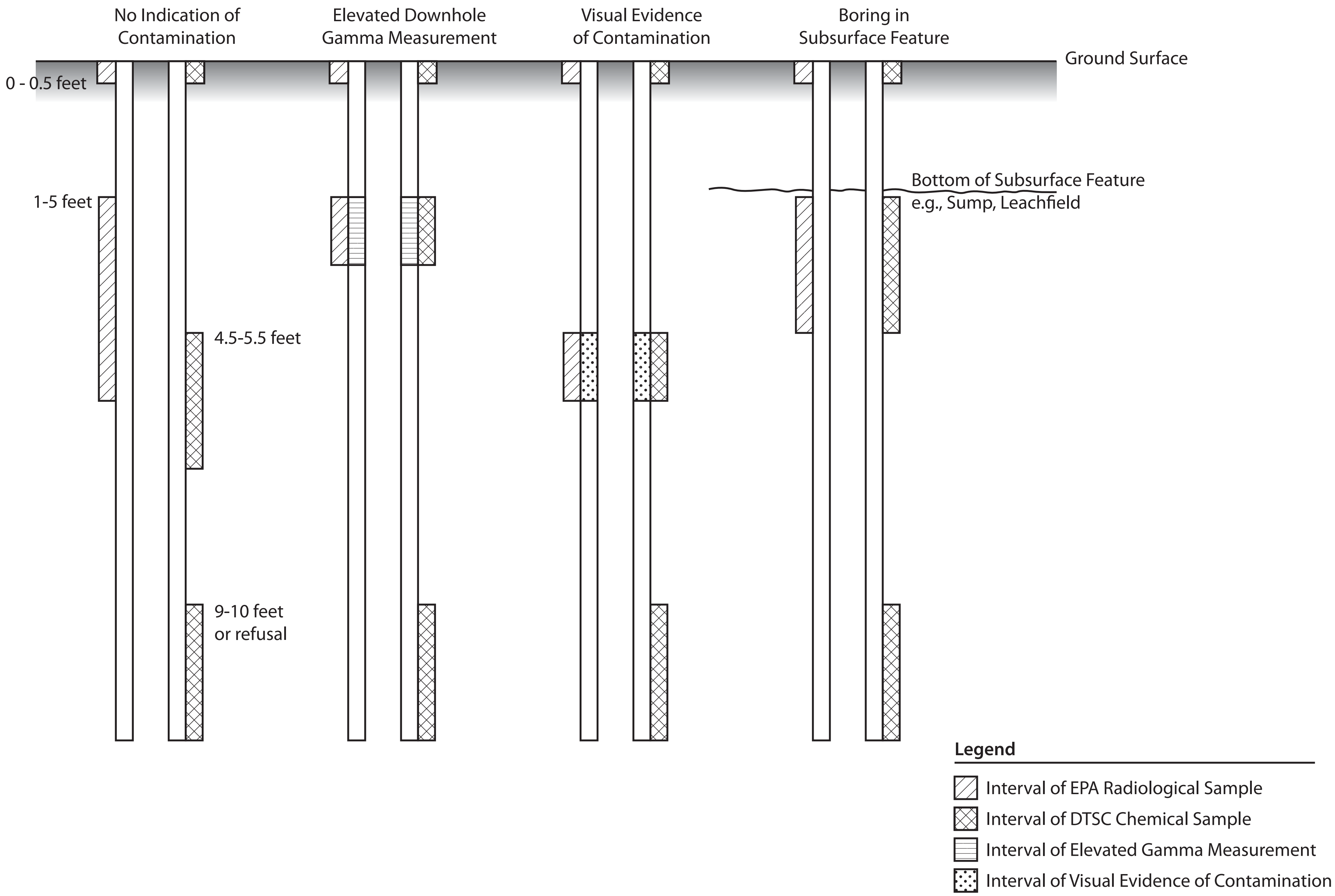
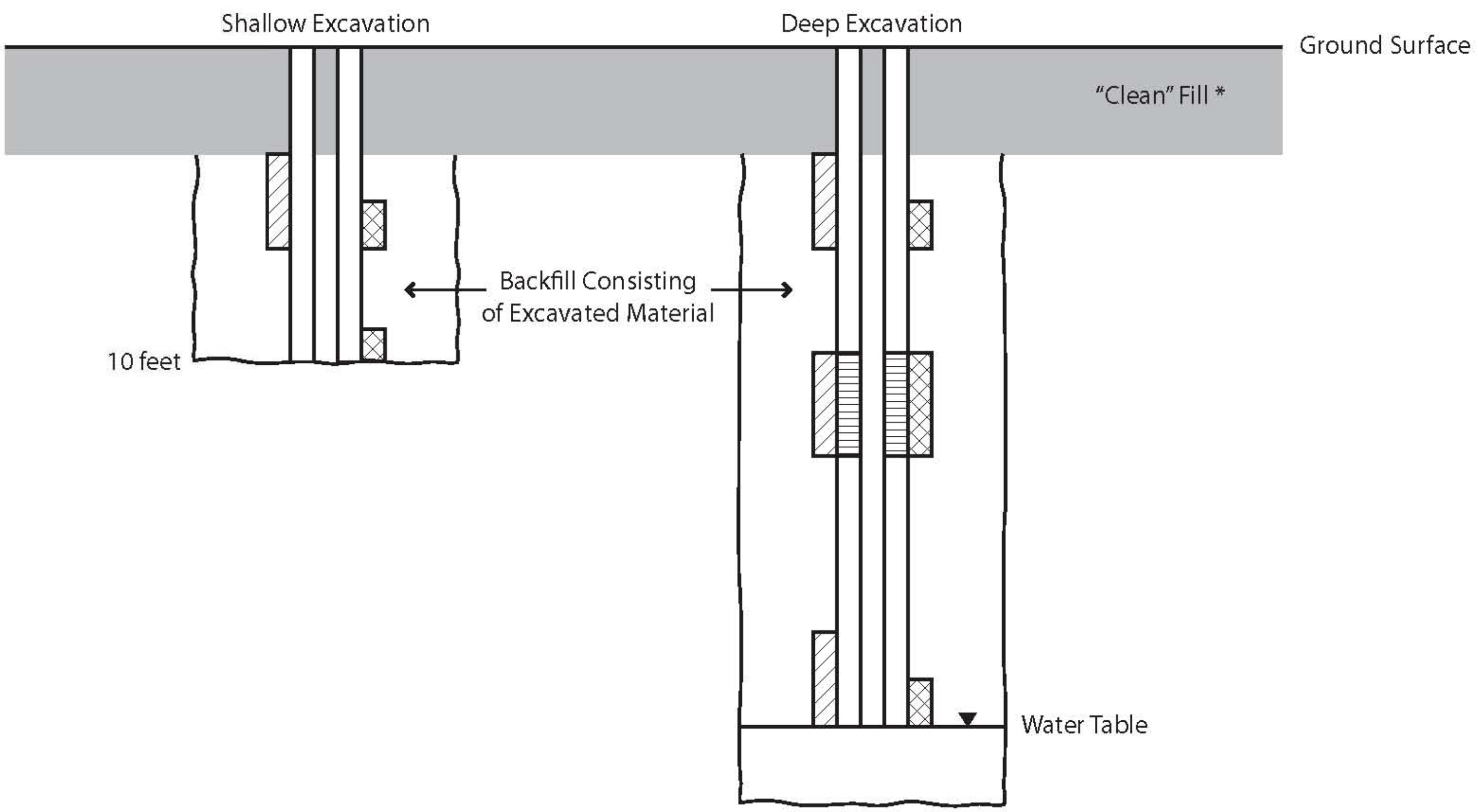
Figure 5-1
Proposed Sample Locations - Subarea 5C
Santa Susana Field Laboratory



W:\REPORTS\Santa Susana Field Laboratory_May10\Graphics\Figure5-2A_Sampling Strategy for EPA DTSC.ai 10/11/10 JJT

Figure 5-2A

Sampling Strategy for EPA/DTSC Co-Located Borings
Borings Not Located in Areas Previously Excavated



* The need for sampling of the clean fill for chemicals and radionuclides will be assessed on a case-by-case basis.

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Figure 5-2B
Sampling Strategy for EPA/DTSC Co-Located Borings
Borings Located in Former Excavation and Fill Areas

Section 6
Project Task Descriptions

The following project tasks will be performed during the soil sampling for chemical analyses.

6.1 Field Work Preparation

The CDM field team leader will coordinate with the subcontracted analytical laboratory in advance of field work to obtain sample containers (pre-preserved as required), chain-of-custody forms, and coolers. The number and type of containers needed for samples are presented in Table 6-1. This table also lists preservatives and holding times for each analytical method. Holding time is the maximum time allowed between sample collection and extraction (if applicable) and sample analysis, during which the designated preservation and storage techniques are employed. The method of shipment will be chosen to meet required holding times.

The field team leader will coordinate with HGL in advance of field work to verify mobilization and drilling start dates. The logistics of coordinating the subsurface soil sampling protocol and sample hand-off will be discussed in a conference call one week prior to the start of sampling.

Once in the field, HGL will perform the initial site setup which consists of determining access to each of the sites for field vehicles, personnel, and equipment, and determining an appropriate staging area for items and equipment generated from proposed field activities.

6.2 Sample Container Labeling

Field crews managing the chemical samples will use identical sample identification as EPA to allow for direct correlation with the radiological samples. To distinguish chemical soil samples collected from discrete depths from radiological soil samples homogenized over a 4 feet interval in the same soil boring, the sample identification will identify a common boring location, but distinguish between the depth intervals.

A unique number code to indicate the sampling location will identify each sample using the numbering logic developed by HGL. The sample identification will include:

- Subarea: SA5C
- Sample Location: SL001 to SL999
- Sample Type: SS for surface soil; SB for subsurface soil
- Beginning depth-End Depth: listed in feet

- QA/QC samples: EB for equipment rinsate; FB for source water blank; DUP for field duplicate; and MS for matrix spike

An example surface soil sample identification is:

SL004-SA5C-SS-0.0-0.5 (surface soil sample collected in subarea 5C at sample location 4 at a depth of 0 to 0.5 feet)

An example subsurface soil sample identification is:

SL056-SA5C -SB-4.0-6.0 (subsurface soil sample collected in subarea 5C at sample location 56 at a depth of 4 to 6 feet)

An example aqueous QC sample identification is:

EB03-SA5C-112510 (third equipment rinsate QC blank collected in subarea 5C on November 25, 2010)

An example field duplicate sample identification is:

DUP25-SA5C-QC-112510 (25th field duplicate QC sample collected in subarea 5C on November 25, 2010)

Sample labels will be used for all samples collected for this project. One label will be completed with the following information for each sample container collected.

- project code
- sample number
- date to indicate the month, day, and year of sample collection
- time (military) of sample collection
- indicate composite or grab sample
- sample location
- sampler’s initial
- preservative (other than ice)
- list of analyses for which the sample is to be analyzed
- any additional relevant information

The adhesive sample labels will be placed directly on the sample containers and secured with clear tape over the label to protect from moisture. CDM will verify that the information recorded on the sample label is consistent with the information recorded on the chain-of-custody record.

6.3 Sample Container Filling

Soil collected for VOCs and TPH gasoline range hydrocarbons analyses will be collected in either En Core or TerraCore samplers (see Section 5.2.3.2 for VOC sample handling procedures) in all instances. Surface soil collected for SVOC analyses will be collected in metal sleeves. Surface soil for all other analyses will be collected with a stainless steel trowel and placed discretely in appropriate containers (Table 6-1).

All subsurface soil will be initially collected in stainless steel sleeves. Soil for VOC analyses will be collected from a sleeve using either an En Core or TerraCore sampler, as appropriate. Subsurface soil for SVOC analysis will be extruded from the acetate sleeve in a manner causing minimal soil disturbance and placed in an appropriate glass container. Soil for all other analyses will be retained in the acetate sleeve, capped and sealed on each end. All sample volumes will be based on the analytical laboratories requirements to address the detection limit requirements of this investigation. The number and type of containers needed for samples are presented in Table 6-1. The containers will be labeled immediately after filling (see Section 6.2 for sample labeling procedures). The exteriors of sample containers will be wiped with a new, clean paper towel to remove residual soil from the exterior of the containers prior to labeling. The labeled container will be placed in zip-top plastic bags. After each zip-top plastic bag is sealed, it will be placed in a cooler containing ice.

6.4 Sample Handling

After a sample has been collected it will be immediately prepared for shipment. The following steps will be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of “environmental sample” and are not a hazardous material defined by the Department of Transportation. During the collection of soil samples, a Geiger-Mueller (Pancake) probe will be used to screen each soil core to identify potential radiological activity. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager shall be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly.

4. Place all bottles and jars in separate and appropriately sized plastic zip-top bags and close the bags. Up to three volatile organic analysis vials (collected as QC samples) may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap.

5. Place 2 to 4 inches of packing material into a cooler that has been lined with a garbage bag, and then place the sample containers in the bag with sufficient space to allow for the addition of packing material between any glass containers. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler shall reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4°C. Fill all remaining space between the bottles or jars with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Make and retain an electronic copy of the chain-of-custody form. Place the completed chain-of-custody record for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed custody seal across the opening of the cooler on opposite sides. The custody seals shall be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked **"THIS END UP"** and arrow labels that indicate the proper upward position of the container shall be affixed to the cooler. A label containing the name and address of the shipper (CDM) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

6.5 Sample Preservation

6.5.1 Soil

Soil samples will be maintained at a temperature of 4°C ±2°C. If VOC samples are collected using a Terra Core sampler, the samples will be preserved in the field using methanol and sodium bisulfate. Soil samples for volatiles analyses collected using an EnCore sampler are required to be preserved by the laboratory within 48 hours of collection.

6.5.2 Water

Aqueous samples will be collected for QC purposes (see Section 7.2). The analytical laboratory will provide pre-preserved sample containers. The preservative required for each method is included in Table 6-1. Aqueous samples will also be maintained at a temperature of 4°C ±2°C.

6.6 Sample Documentation

Sample documentation will be tracked on chain-of-custody forms and shipping documents. Copies of these documents will be maintained in the project files, as well as annotated in the field logbook. The field logbook provides a means of recording all data collection activities performed at the site. As such, entries should be as descriptive and detailed as possible so that a sample's history can be reconstructed without relying on the collector’s memory. The field logbook will be completed, tracked, and maintained in accordance with Section 10.1. Any deviations from these procedures will be noted in the field logbook.

6.7 Sample Custody

This section establishes a method for maintaining custody of samples through use of a chain-of-custody record. These procedures will be followed for all samples collected or split samples accepted.

The following steps describe the procedures required to maintain field custody:

1. As few people as possible shall handle samples.

2. Complete sample labels or tags for each sample using waterproof ink.

3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

A chain-of-custody record will be completed in for all samples. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory. The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures.

Common carriers are not required to sign the chain-of-custody record. In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian. If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record. If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher.

The samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, a chain-of-custody record shall be filled out for each cooler documenting only samples contained in that particular cooler.

The original chain-of-custody record will accompany the shipment, and the copies will be retained by CDM and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by CDM as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of custody record and field logbook.

The following procedure is to be used to fill out the chain-of-custody record. The chain-of-custody record shall be filled out in its entirety.

1. Record project number.
2. Record the field team leader for the project (if a field sample custodian has been designated, also record this name in the “Remarks” or “Notes” box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier’s airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample (or pre-preserved in the sample container).
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time.

13. Enter the initials of the samplers next to the sample location number of the sample they collected.

14. List parameters for analysis and the number of containers submitted for each analysis.

15. Enter appropriate designation for laboratory quality control (e.g., matrix spike [MS]/matrix spike duplicate [MSD], or other remarks (e.g., sample depth).

16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.

17. The originator checks information entered on the chain-of-custody and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).

18. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file.

19. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" or "Notes" on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy. The white copy is returned to CDM.

6.8 Equipment Decontamination

Equipment decontamination minimizes the risk of cross-contamination of samples and ensures the collection of representative samples. All equipment decontamination will be conducted by HGL. Any deviations will be noted in the CDM and HGL field logbooks.

6.9 Investigative Derived Waste Management

HGL will generate and dispose of the IDW during the field activities, except CDM's personal protective equipment IDW. CDM will dispose of personal protective equipment as solid waste off site.

Table 6-1
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	EPA Preparation/Analytical Method (unless otherwise shown)	Matrix	Sample Container Size[(a)]/Minimum Sample Volume	Preservation	Maximum Holding Times[(b)]	
					Extraction	**Analysis**
Fluoride	EPA 300.0	Soil	Acetate sleeve[(c)] or 4 oz/5 grams (g)	Ice to 2 to 6ºC	--	28 days
Nitrate as Ammonia	EPA 350.3	Soil	Acetate sleeve[(c)] or 4 oz/5 grams (g)	Ice to 2 to 6ºC	--	28 days
Dioxins/Furans	EPA 1613B/8290	Soil	Acetate sleeve[(c)] or 4 oz/10 g	Ice to 2 to 6ºC	30 days	45 days
Total Petroleum Hydrocarbons	EPA 8015M	Soil	3 x 5 g En Core Sampler or Terracore Sampler/5 g for gasoline	Methanol and Sodium Bisulfate (as appropriate), Ice to 2 to 6ºC	48 hours	7 days
			Acetate sleeve[(c)] or 4 oz/50 g for oil and diesel	Ice to 2 to 6ºC	14 days	40 days
SVOCs	EPA 8270C	Soil	Stainless steel or brass sleeve for surface soil, acetate sleeve or 4 oz/30 g for subsurface soil	Ice to 2 to 6ºC	14 days	40 days
PAHs	EPA 8270SIM	Soil	Acetate sleeve[(c)] or 4 oz	Ice to 2 to 6ºC	14 days	40 days
Hexavalent Chrome	EPA 7196A/7199	Soil	Acetate sleeve[(c)] or 4 oz/40 g	Ice to 2 to 6ºC	28 days	29 days
Metals	EPA 6010B/6020A/7471	Soil	Acetate sleeve[(c)] or 4 oz/5 g	Ice to 2 to 6ºC	--	6 months (28 days for Hg)

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	**EPA Preparation/Analytical Method (unless otherwise shown)**	**Matrix**	**Sample Container Size[(a)]/Minimum Sample Volume**	**Preservation**	**Maximum Holding Times[(b)]**	
					Extraction	**Analysis**
VOCs	EPA 8260B	Soil	3 x 5 g En Core Sampler or Terracore Sampler/5 g	Methanol and Sodium Bisulfate (as appropriate), Ice to 2 to 6ºC	48 hours	7 days
PCBs	EPA 8082	Soil	Acetate sleeve[(c)] or 4 oz/30 g	Ice to 2 to 6ºC	14 days	40 days
1,4-Dioxane	8260B SIM	Soil	3 x 5 g En Core Sampler or Terracore Sampler/5 g	Methanol and Sodium Bisulfate (as appropriate), Ice to 2 to 6ºC	14 days	40 days
Perchlorate	314.0	Soil	Acetate sleeve[(c)] or 4 oz/ 10 g	Ice to 2 to 6ºC	--	7 days
Formaldehyde	8315A	Soil	Acetate sleeve[(c)] or 4 oz/ 10 g	Ice to 2 to 6ºC	--	7 days
Hydrazine	8315A	Soil	Acetate sleeve[(c)] or 4 oz/ 10 g	Ice to 2 to 6ºC	--	28 days
n-Nitrosodimethylamine	1625C	Soil	Acetate sleeve[(c)] or 4 oz/ 10 g	Ice to 2 to 6ºC	14 days	40 days
Energetics	8330A	Soil	Acetate sleeve[(c)] or 4 oz/ 10 g	Ice to 2 to 6ºC	14 days	40 days
Cyanide	9012B	Soil	Acetate sleeve[(c)] or 4 oz/ 5 g	Ice to 2 to 6ºC	--	14 days

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	EPA Preparation/Analytical Method (unless otherwise shown)	Matrix	Sample Container Size[(a)]/Minimum Sample Volume	Preservation	Maximum Holding Times[(b)]	
					Extraction	Analysis
pH	9045C	Soil	Acetate sleeve(c) or 4 oz/ 5g	Ice to 2 to 6ºC	--	24 hours
Alcohols	8015B	Soil	3 x 5 g En Core Sampler or Terracore Sampler/5 g	Methanol and Sodium Bisulfate (as appropriate), Ice to 2 to 6ºC	48 hours	7 days
Terphenyls	8015B	Soil	Acetate sleeve(c) or 4 oz/10 g	Ice to 2 to 6ºC	14 days	40 days
Glycols	8015B	Soil	3 x 5 g En Core Sampler or Terracore Sampler/5 g	Methanol and Sodium Bisulfate (as appropriate), Ice to 2 to 6ºC	48 hours	7 days
Total Solids	160.3	Soil	Acetate sleeve(c) or 4 oz/ 10 g	Ice to 2 to 6ºC	--	--
Methyl Mercury	1630	Soil	Acetate sleeve(c) or 4 oz/ 10 g	Ice to 2 to 6ºC	--	28 days
Organic Tin	NOAA Status and Trends	Soil	Acetate sleeve(c) or 4 oz/ 10 g	Ice to 2 to 6ºC	--	--

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	**EPA Preparation/Analytical Method (unless otherwise shown)**	**Matrix**	**Sample Container Size[(a)]/Minimum Sample Volume**	**Preservation**	**Maximum Holding Times[(b)]**	
					Extraction	**Analysis**
Asbestos	600/R-93/116	Soil	Acetate sleeve[(c)] or 4 oz/ 50 g	Ice to 2 to 6ºC	--	--
Pesticides	8081A	Soil	Acetate sleeve[(c)] or 4 oz/ 30 g	Ice to 2 to 6ºC	14 days	40 days
Herbicides	8151	Soil	Acetate sleeve[(c)] or 4 oz/ 30 g	Ice to 2 to 6ºC	14 days	40 days
Fluoride	EPA 300.0	Water (source blank & equipment blank)	1 x 250 ml polyethylene/100 ml	Ice to 2 to 6ºC	--	28 days
Nitrate as Ammonia	EPA 350.3	Water (source blank & equipment blank)	1 x 250 ml polyethylene/100 ml	Ice to 2 to 6ºC	--	28 days
Dioxins/Furans	EPA 1613B	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2-6ºC	30 days	45 days
Total Petroleum Hydrocarbons	EPA 8015M	Water (source blank & equipment blank)	3 x 40 ml VOA vials/40 ml for gas	Ice to 2-6ºC, HCl	--	14 days
			1 x 1 L amber glass/ 1 L for oil and diesel	Ice to 2-6ºC	14 days	40 days
SVOCs	EPA 8270C	Water (source blank & equipment blank)	1 x 1 L amber glass/ 1 L	Ice to 2-6ºC	7 days	40 days

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	EPA Preparation/Analytical Method (unless otherwise shown)	Matrix	Sample Container Size(a)/Minimum Sample Volume	Preservation	Maximum Holding Times(b)	
					Extraction	Analysis
PAHs	EPA 8270SIM	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2-6ºC	7 days	40 days
Hexavalent Chrome	EPA 7196A/7199	Water (source blank & equipment blank)	1 X 500 ml polyethylene/100 ml	Ice to 2-6ºC	--	24 hours
Metals	EPA 6010B/6020A/7471	Water (source blank & equipment blank)	1 X 500 ml polyethylene/100 ml	Ice to 2-6ºC, HNO_3	--	6 months (28 days for Hg)
VOCs	EPA 8260B	Water (source blank, equipment blank, & trip blank)	3 x 40 ml VOA vials/40 ml	Ice to 2-6ºC, HCl	--	14 days
PCBs	EPA 8082	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2-6ºC	7 days	40 days
1,4-Dioxane	8260B SIM	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	14 days	40 days
Perchlorate	314.0	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	--	7 days

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	**EPA Preparation/Analytical Method (unless otherwise shown)**	**Matrix**	**Sample Container Size[(a)]/Minimum Sample Volume**	**Preservation**	**Maximum Holding Times[(b)]**	
					Extraction	**Analysis**
Formaldehyde	8315A	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	3 days	72 hours after extraction
Hydrazine	8315A	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	--	28 days
n-Nitrosodimethylamine	1625C	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC,H_2SO_4	7 days	40 days
Energetics	8330A	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	7 days	40 days
Cyanide	9012B	Water (source blank & equipment blank)	1 x 1 L poly/1 L	Ice to 2 to 6ºC, NaOH to pH >12	--	14 days
pH	9040C	Water (source blank & equipment blank)	1 x 250 ml poly/ 40 ml	Ice to 2 to 6ºC	--	24 hours

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	EPA Preparation/Analytical Method (unless otherwise shown)	Matrix	Sample Container Size(a)/Minimum Sample Volume	Preservation	Maximum Holding Times(b)	
					Extraction	**Analysis**
Alcohols	8015B	Water (source blank & equipment blank)	3 x 40 ml VOA vials/40 ml	Ice to 2 to 6ºC	--	7 days
Terphenyls	8015B	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	7 days	40 days
Glycols	8015B	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	--	7 days
Methyl Mercury	1630	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC, HCl	--	28 days
Organic Tin	NOAA Status and Trends	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	7 days	40 days
Asbestos	600/R-93/116	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	--	--
Pesticides	8081A	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	7 days	40 days

Table 6-1 (continued)
Analytical Methods, Containers, Preservatives, and Holding Times

Parameter	EPA Preparation/Analytical Method (unless otherwise shown)	Matrix	Sample Container Size[(a)]/Minimum Sample Volume	Preservation	Maximum Holding Times[(b)]	
					Extraction	Analysis
Herbicides	8151	Water (source blank & equipment blank)	1 x 1 L amber glass/1 L	Ice to 2 to 6ºC	7 days	40 days

(a) Multiple analyses for soil samples (other than VOCs and total petroleum hydrocarbons gasoline range) can be performed from one soil container from either a 4 oz jar or soil collected in a larger 8 oz jar. This depends on how many different laboratories will be receiving a sample. Surface soil samples will be mostly glass bottles while the subsurface samples will be acetate sleeved (other than volatile analysis).

(b) Source is from MEC^x, 2009.

(c) The acetate sleeve is 2.5 inches in diameter.

Acronyms and Abbreviations:

ºC = degrees Celsius
EPA = United States Environmental Protection Agency
g = gram
HCl = hydrochloric acid
HNO_3 = nitric acid
L = liter
ml = milliliter
NOAA = National Oceanic and Atmospheric Association
oz = ounce
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SIM = selected ion monitoring
SVOCs = semi-volatile organic compounds
VOA = volatile organic analyte
VOCs = volatile organic compounds
-- = extraction not performed

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Section 7
Quality Control Criteria

The field quality assurance (QA) program has been designed in accordance with CDM's *Quality Assurance Manual, Revision 11* (CDM 2007), *Guidance for the Data Quality Objectives Process* (EPA 2006), and *EPA Requirements for Quality Assurance Project Plans* (EPA 2001).

All project deliverables will receive technical and QA reviews prior to being issued to the client; completed review forms will be maintained in the project file. Corrective action of any deficiencies will be the responsibility of the project manager, with assistance from the QA staff.

This section describes the QC criteria used to ensure that the data collected during this sampling effort will be used appropriately to meet the project objectives.

7.1 Analytical Methods and Detection limits

All samples will be submitted to a fixed-base laboratory certified by the California Department of Health Services through Environmental Laboratory Accreditation Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP). The samples collected during this investigation will be analyzed using the methods provided below. These methods are described in detail in *Test Methods For Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition* as updated by revisions I, II, IIA, IIB, III, IIIA, IIIB, IVA, and IVB (EPA 1997).

The background values for SSFL are currently being developed as well as the one-in-a-million RBSLs for the rural residential scenario. These two values will be used as decision criteria for Area IV as described in Section 1.4. Analytical DLs should also be based on both considerations. Because these values are not currently available, analytical protocols used in this study will be based on reporting limits previously provided by DTSC that approximated the suburban RBSLs lowered by two orders of magnitude for soil (Table 7-1). Once the background values and RBSLs are available, the DL goals stated in this plan may need to be adjusted to reflect the background and RBSL values.

When a positive detection is greater than the laboratory DL, but less than the method reporting limit, the value will be reported and qualified (J flagged) as an estimated concentration. DLs are attained contingent upon instrument sensitivity and sample matrix effects. It is important to monitor the sensitivity of data-gathering instruments to ensure data quality through constant checks of instrument performance.

7.1.1 Volatile Organic Compounds

Soil samples will be analyzed for VOCs using EPA Method 8260B.

7.1.2 Metals

Soil samples will be analyzed for metals, including chromium VI, using EPA Methods 6010/6020B, 7471A (mercury), and 7196A or 7199 (chromium VI).

7.1.3 Fluoride

Soil samples will be analyzed for fluoride using EPA Method 300.0.

7.1.4 Nitrate as Ammonia

Soil samples will be analyzed for nitrate as ammonia using EPA Method 350.3.

7.1.5 Semi-Volatile Organic Compounds

Soil samples will be analyzed for semi-volatile organic compounds (SVOCs) using EPA Method 8270C.

7.1.6 Polycyclic Aromatic Hydrocarbons

Soil samples will be analyzed for polycyclic aromatic hydrocarbons (PAHs) using EPA Method 8270 modified for selected ion monitoring (SIM).

7.1.7 Polychlorinated Biphenyls and Terphenyls

Soil samples will be analyzed for PCBs and TCBs using EPA Method 8082.

7.1.8 Dioxins/Furans

Soil samples will be analyzed for dioxins/furans using EPA Method 1613B.

7.1.9 Perchlorate

Soil samples will be analyzed for perchlorate using EPA Method 314.0 with verification by either 8321/331.0/6850/6860.

7.1.10 Total Petroleum Hydrocarbons

Soil samples will be analyzed for total petroleum hydrocarbons (TPH) (gas/oil/diesel) using EPA Method 8015B.

7.2 Field QC Samples and Frequencies

The following types of field QC samples will be required during sampling. All QC samples will be analyzed for the same parameters as the primary samples except trip blanks which will only be analyzed for VOCs. Table 7-2 presents the measurement performance criteria for the required field QC samples.

7.2.1 Field Duplicate

Soil duplicates will be collected in separate containers, but from the same location of the original primary samples. The duplicate samples will be analyzed as a separate sample from the primary samples. This type of field duplicate measures the total system variability (field and laboratory variance), including the variability component resulting from the inherent heterogeneity of the soil. Field duplicates will be collected at a frequency of one per twenty primary soil samples.

7.2.2 Equipment Rinsate Blank

An equipment rinsate blank will be prepared and submitted for analysis at a minimum frequency of one per sampling technique per day and additionally whenever there are changes in the sample collection procedures, sampling decontamination procedures, or sampling equipment. The equipment rinsate blank will consist of analyte-free water used to rinse sampling equipment as the last step in the decontamination process. This QC sample serves as a check for effectiveness of the decontamination process.

7.2.3 Trip Blank

A trip blank consists of target analyte-free water provided by the laboratory. The trip blank is a sealed container that accompanies the samples from collection at the site through shipment. This QC sample serves as a check for cross-contamination of VOCs. Trip blanks will be submitted to the laboratory at a frequency of one per cooler (for VOC and gasoline range petroleum hydrocarbons analyses only) for those coolers containing samples to be analyzed for VOCs.

7.2.4 Source Blank

A source blank consists of target analyte-free water provided by the laboratory or deionized water used by sampling personnel for equipment decontamination. The sample is used to represent chemical characteristics of the decontamination water. The analyte-free water is placed into the sampling container, preserved as shown on Table 6-1, and analyzed for the same parameters as the soil samples. This QC sample serves as a check on reagents (preservatives) and the cleanliness of the water used for decontamination. One source blank will be prepared and submitted for each lot number of deionized (or American Society for Testing and Materials Type II) water used during the sampling event.

7.2.5 Temperature Blank

A temperature blank will be used to notify the receiving laboratory if samples exceeded the acceptable temperature (4°C ± 2°C) during transport. This QC measure serves as a check of adequate cooling of samples to be analyzed. The temperature blank will show the current temperature of the cooler. Temperature blanks will be submitted to the laboratory at a frequency of one per cooler.

7.3 Laboratory QC Samples

Laboratory QC data are necessary to determine precision and accuracy and to demonstrate the absence of interference by and/or contamination of laboratory glassware and reagents. Table 7-2 presents a summary of the laboratory QC samples for this project, their frequency, and the measurement performance criteria. Laboratory QC results will be included in the data package.

The types of QC spike samples the laboratory will use include laboratory control samples (LCSs) (or method blank spikes), matrix spike (MS) matrix spike duplicate (MS/D, and surrogates. An LCS is a clean matrix (i.e., the same used for a method blank) spiked with known concentration(s) of target analyte(s). The LCS will be carried through the entire analytical procedure to assess the overall accuracy of the method. An MS is an aliquot of a parent sample spiked with target analyte(s) of known concentration(s) prior to sample preparation. The impact of the sample matrix on target analyte recovery (i.e., accuracy) and precision will be assessed by QC sampling MSs and MSDs. A surrogate is a non-target analyte spiked at a known concentration prior to sample preparation. Surrogate analytes will be used to monitor method performance on a matrix-specific/sample-specific basis.

For this project, acceptance limits for precision and accuracy for MSs and surrogate percent recovery are presented in Table 7-2. Each analytical preparation batch must contain an MS/MSD pair.

Matrix QC samples will be analyzed with each batch of 20 samples or fewer analyzed by the laboratory.

A calibration standard is prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix or dilution of commercially obtained solution. The final concentration calculated from the known quantities is the true value of the standard. Where applicable, reference standard solutions will be traceable to National Institute of Standards and Technology or another nationally recognized reference standard source. The analytical results obtained for these standards are used to prepare a standard curve and thereby quantify the compounds found in the environmental samples. The number of calibration standards is prescribed by each analytical method procedure.

Table 7-1
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
Volatile Organics by EPA 8260B	**ng/kg**	**µg/L**
1,3-Dichlorobenzene	20	2
1,3-Dichloropropane	20	2
1,4-Dichlorobenzene	20	2
2-Chloroethyl vinyl ether	50	5
2-Chloro-1,1,1-trifluoroethane	50	5
2-Chlorotoluene	50	5
2-Butanone (MEK)	100	10
2-Hexanone	100	10
2,2-Dichloropropane	10	1
4-Chlorotoluene	50	5
4-Methyl-2-pentanone (MIBK)	50	5
Acetone	100	10
Benzene	20	2
Bromobenzene	50	5
Bromochloromethane	50	5
Bromodichloromethane	20	2
Bromoform	50	5
Bromomethane	50	5
n-Propylbenzene	20	2
p-Isopropyltoluene	20	2
sec-Butylbenzene	50	5
tert—Butylbenzene	50	5
Styrene	20	2
Tetrachloroethene	20	2
Toluene	20	2
trans-1,2-Dichloroethene	20	2
trans-1,3-Dichloropropene	20	2
Trichloroethene	20	2
Trichlorofluoromethane	50	5
o-Xylene	20	2
m, p-Xylene	50	2
Vinyl chloride	20	2
1,1,2-Trichloro-1,2,2-trifluoroethane	50	5

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
1,1,1-Trichloroethane	20	2
1,1,2,2-Tetrachloroethane	20	2
1,1,2-Trichloroethane	20	2
1,1-Dichloroethane	20	2
1,1-Dichloroethene	50	5
1,1-Dichloropropene	20	1
1,2,3-Trichlorobenzene	50	2
1,2,3-Trichloropropane	10	5
1,2,4-Trichlorobenzene	50	1
1,2,4-Trimethylbenzene	20	5
1,2-Dibromo-3-chloropropane	50	2
1,2-Dibromoethane (EDB)	20	5
1,2-Dichlorobenzene	20	2
1,2-Dichloroethane	10	2
1,2-Dichloropropane	20	1
1,3,5-Trimethylbenzene	20	2
Carbon tetrachloride	10	1
Chlorobenzene	20	2
Chloroethane	50	5
Chloroform	20	5
Chloromethane	50	2
Chlorotrifluoroethylene	50	5
cis-1,2-Dichloroethene	20	2
cis-1,3-Dichloropropene	20	2
Dibromochloromethane	20	2
Dibromomethane	10	1
Dichlorodifluoromethane	50	5
Ethylbenzene	20	2
Hexachlorobutadiene	50	5
Isopropylbenzene	20	2
Methyl-tert-butyl- Ether (MTBE)	50	5
Methylene chloride	50	5
n-butylbenzene	50	5

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
1,4-Dioxane by EPA 8260B SIM	**ng/kg**	**µg/L**
1,4-Dioxane	50	5
Metals by EPA 6010/6020B	**µg/kg**	**µg/L**
Aluminum	100	200
Antimony	10	10
Arsenic	5	5
Barium	5	2
Beryllium	3	0.5
Boron	50	50
Cadmium	2	1
Calcium	100	50
Chromium	10	3
Cobalt	5	1
Copper	2	1
Iron	50	20
Lead	4	2
Lithium	63	5
Magnesium	1000	10
Manganese	10	1
Molybdenum	1	0.5
Nickel	4	2
Phosphorus	500	50
Potassium	500	50
Selenium	10	5
Silver	2	1
Sodium	500	50
Strontium	50	5
Thallium	2	1
Tin	100	10
Titanium	20	2
Vanadium	10	10
Zinc	50	10
Zirconium	250	50

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
Mercury by EPA 7471A	**µg/kg**	**µg/L**
Mercury	0.1	0.2
Chromium VI by EPA 7196A or 7199	**µg/kg**	**µg/L**
Chromium VI	2	10
Select SVOC (PAHs) by EPA Method 8270C(SIM)*	**ng/kg**	**µg/L**
1-Methyl naphthalene	200	10
2-Methylnaphthalene	200	10
Acenaphthene	200	10
Acenaphthylene	200	10
Anthracene	200	10
Benzo(a)anthracene	200	10
Benzo(a)pyrene	200	10
Benzo(b)fluoranthene	200	10
Benzo(ghi)perylene	200	10
Benzo(k)fluoranthene	200	10
bis(2-Ethylhexyl) phthalate	200	10
Butyl benzyl phthalate	200	10
Chrysene	200	10
Dibenzo(a,h)anthracene	200	10
Diethyl phthalate	200	10
Dimethyl phthalate	200	10
Di-n-butyl phthalate	200	10
Di-n-octyl phthalate	200	10
Fluoranthene	200	10
Fluorene	200	10
Indeno(1,2,3-cd)pyrene	200	10
Naphthalene	200	10
n-Nitrosodimethylamine	200	10
Phenanthrene	200	10
Pyrene	200	10

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
Semivolatiles by EPA 8270C	**µg/kg**	**µg/L**
1-Methylnaphthalene	3.3	10
1,2-Dichlorobenzene	3.3	10
1,2-Diphenylhydrazine/Azobenzene	3.3	20
1,3-Dichlorobenzene	3.3	10
1,4-Dichlorobenzene	3.3	10
1,2,4-Trichlorobenzene	3.3	10
2,4,5-Trichlorophenol	3.3	20
2,4,6-Trichlorophenol	3.3	20
2,4-Dichlorophenol	3.3	10
2,4-Dimethylphenol	3.3	20
2,4-Dinitrophenol	6.6	20
2,4-Dinitrotoluene	3.3	10
2,6-Dinitrotoluene	3.3	10
3,3-Dichlorobenzidine	8.3	20
2-Chloronaphthalene	3.3	20
2-Chlorophenol	3.3	10
2-Methylnaphthalene	3.3	10
2-Methylphenol	3.3	10
2-Nitroaniline	3.3	10
2-Nitrophenol	3.3	10
3-Nitroaniline	3.3	20
3,5-Dimethylphenol	3.3	20
4,6-Dinitro-2-methylphenol	4.2	20
4-Bromophenyl-phenylether	3.3	10
4-Chloroaniline	3.3	10
4-Chloro-3-methylphenol	3.3	20
4-Chlorophenyl-phenylether	3.3	10
4-Methylphenol	3.3	10
4-Nitroaniline	8.3	20
4-Nitrophenol	8.3	20
Acenaphthene	3.3	10
Acenaphthylene	3.3	10
Aniline	4.2	10

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
Anthracene	3.3	10
Benzidine	16	20
Benzoic acid	8.3	20
Benzo(a)anthracene	3.3	10
Benzo(a)pyrene	3.3	10
Benzo(b)fluoranthene	3.3	10
Benzo(g,h,i)perylene	3.3	10
Benzo(k)fluoranthene	3.3	10
Benzyl alcohol	3.3	20
bis(2-Chloroethoxy)methane	3.3	10
Bis(2-chloroethyl)ether	3.3	10
Bis(2-chloroisopropyl)ether	3.3	10
Bis(2-ethylhexyl)phthalate	3.3	50
Butylbenzylphthalate	3.3	20
Carbazole	3.3	20
Chrysene	3.3	10
Dibenzo(a,h)anthracene	3.3	20
Dibenzofuran	3.3	10
Diethylphthalate	3.3	10
Dimethylphthalate	3.3	10
Di-n-butylphthalate	3.3	20
Di-n-octyl-phthalate	3.3	20
Fluoranthene	3.3	10
Fluorene	3.3	10
Hexachlorobenzene	3.3	10
Hexachlorobutadiene	3.3	10
Hexachlorocyclopentadiene	8.3	20
Hexachloroethane	3.3	10
Indeno(1,2,3-cd)pyrene	3.3	20
Isophorone	3.3	10
Naphthalene	3.3	10
Nitrobenzene	3.3	20
n-Nitroso-di-n-propylamine	3.3	10
n-Nitrosodimethylamine	3.3	20

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
n-Nitrosodiphenylamine	3.3	10
Phenanthrene	3.3	10
Pentachlorophenol	8.3	20
Phenol	3.3	10
Pyrene	3.3	10
Formaldehyde by EPA 8315A	**µg/kg**	**µg/L**
Formaldehyde	10	50
Hydrazine by EPA 8315A	**ng/kg**	**µg/L**
Hydrazine	50	5
Monomethyl Hydrazine	250	25
Unsymetrical Dimethyl Hydrazine	250	25
Perchlorate	**ng/kg**	**µg/L**
EPA 8321/331.0/6850/6860	20	2
EPA 314.0	40	4
PCB and PCT by EPA 8082	**ng/kg**	**µg/L**
Aroclor 1016	150	0.1
Aroclor 1221	150	0.2
Aroclor 1232	150	0.1
Aroclor 1242	150	0.1
Aroclor 1248	150	0.1
Aroclor 1254	150	0.1
Aroclor 1260	150	0.1
Aroclor 1262	500	0.5
Aroclor 1268	500	0.5
Aroclor 5432	500	0.5
Aroclor 5442	500	0.5
Aroclor 5460	500	0.5
NDMA by EPA 1625C	**ng/kg**	**µg/L**
n-Nitrosodimethylamine	30	0.01

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
Energetics by EPA 8330A	**µg/kg**	**µg/L**
HMX	2.5	0.5
Nitrobenzene	2.5	0.5
Nitroglycerin	50	2
PETN	40	2
RDX	2.5	0.5
Tetryl	5	1.5
1,3-Dinitrobenzene	2.5	0.5
1,3,5-Trinitrobenzene	2.5	0.5
2-Amino-4,6-dinitrotoluene	2.5	0.5
2-Nitrotoluene	2.5	0.5
2,4-diamino-6-nitrotoluene	10	5
2,4-Dinitrotoluene	2.5	0.5
2,4,6-Trinitrotoluene	2.5	0.5
2,6-diamino-4-nitrotoluene	10	5
2,6-Dinitrotoluene	2.5	0.5
3-Nitrotoluene	2.5	0.5
4-Amino-2,6-dinitrotoluene	2.5	0.5
4-Nitrotoluene	4	0.5
Anions by EPA 300.0	**µg/kg**	**mg/L**
Bromide	50	0.2
Chloride	50	0.2
Fluoride	50	0.1
Nitrate-NO3	50	0.1
Nitrite-NO2	50	0.1
Orthophosphate – PO4	50	0.2
Sulfate	50	0.4
Cyanide by EPA 9012B	**µg/kg**	**µg/L**
Cyanide	5	5

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
pH by EPA 9045C	**pH**	**pH**
pH	0.1 pH units	0.1 pH units
Ammonia-N by EPA 350.3	**µg/kg**	**mg/L**
Ammonia-N	50	0.25
TKN by SM4500-NORG,C	**µg/kg**	**mg/L**
Total Kjeldahl Nitrogen	50	0.5
TPH by EPA 8015B	**µg/kg**	**µg/L**
Total Petroleum Hydrocarbons as Gasoline (C4-C12)	50	50
Total Petroleum Hydrocarbons as Diesel – Specific Carbon Ranges		
EFH(C8-C11)	50	100
EFH(C12-C14)	50	100
EFH(C15-C20)	50	100
EFH(C21-C30)	50	100
Total Petroleum Hydrocarbons as Oil (C30-C40)	250	100
Alcohols by EPA 8015B	**mg/kg**	**mg/L**
Ethanol	1	20
Isopropanol	1	20
Methanol	1	20
Terphenyls by EPA 8015B	**µg/kg**	**mg/L**
o-Terphenyl	1.7	0.005
m-Terphenyl	1.7	0.005
p-Terphenyl	1.7	0.005
Glycols by EPA 8015B	**µg/kg**	**µg/L**
Diethylene Glycol	500	10
Ethylene Glycol	500	10
Propylene Glycol	500	10

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
% Solids by D2216	**Percent**	
Percent Solids	0.1	None
Total Solids by 160.3	**Percent**	
Total Solids	0.1	None
Methyl Mercury by 1630 (Mod)	**pg/g**	**ng/L**
Methyl mercury	0.5	0.06
Organic Tin by NOAA Status and Trends	**ng/kg**	**µg/L**
Monobutyl tin	50	0.5
Tetrabutyl tin	17	0.05
Tributyl tin	18	0.045
Dibutyl tin	13	0.039
Asbestos by EPA 600/R-93/116	**Percent**	**Percent**
Chrysotile	1	1
Amosite	1	1
Crocidolite	1	1
Anthophyllite	1	1
Tremolite	1	1
Actinolite	1	1
Pesticides by 8081A	**ng/kg**	**µg/L**
4,4'-DDD	50	0.04
4,4'-DDE	50	0.04
4,4'-DDT	50	0.04
Aldrin	50	0.02
alpha-BHC	50	0.02
beta-BHC	50	0.02
Chlordane (Technical)	100	0.25
delta-BHC	100	0.02
Dieldrin	50	0.04
Endosulfan I	50	0.02
Endosulfan II	50	0.04

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
Endosulfan sulfate	100	0.04
Endrin	50	0.04
Endrin aldehyde	50	0.04
Endrin ketone	50	0.04
gamma-BHC	50	0.02
Heptachlor	50	0.02
Heptachlor epoxide	50	0.02
Mirex	50	0.05
p,p'-Methoxychlor	50	0.2
Toxaphene	500	2
Herbicides by EPA Method 8151	**ng/kg**	**µg/L**
2,4,5-T	200	1.0
2,4,5-Trichlorophenoxypropionic acid	800	1.0
2,4-Dichlorophenoxyacetic Acid (2,4-D)	200	4.0
2,4-Dichlorophenoxybutyric acid	800	4.0
Dalapon	500	2
Dicamba	400	2.0
Dichlorprop	800	4.0
Dinoseb	120	1.0
MCPA	80000	500
MCPP	80000	500
Dioxin/Furan by EPA Method 1613B	**pg/g**	**ng/L**
1,2,3,4,6,7,8-HpCDF	0.05	0.01
1,2,3,4,6,7,8-HpCDD	0.05	0.01
1,2,3,4,7,8,9-HpCDF	0.05	0.01
1,2,3,4,7,8-HxCDF	0.05	0.01
1,2,3,4,7,8-HxCDD	0.05	0.01
1,2,3,6,7,8-HxCDF	0.05	0.01
1,2,3,6,7,8-HxCDD	0.05	0.01
1,2,3,7,8,9-HxCDF	0.05	0.01
1,2,3,7,8,9-HxCDD	0.05	0.01
1,2,3,7,8-PeCDF	0.05	0.01
1,2,3,7,8-PeCDD	0.05	0.01

Table 7-1 (continued)
Subarea HSA 5C Target Detection Limits

Method/Analyte	Targeted Method Detection limits Soil	Method Detection limit Aqueous
2,3,4,6,7,8-HxCDF	0.05	0.01
2,3,4,7,8-PeCDF	0.05	0.01
2,3,7,8-TCDD	0.01	0.005
2,3,7,8-TCDF	0.01	0.005
OCDF	0.1	0.05
OCDD	0.1	0.05

Notes:

EPA = United States Environmental Protection Agency
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
ng/L = nanograms per liter
PAH = polycyclic aromatic hydrocarbons
pg/g = picograms per gram
SIM = selected ion monitoring
µg/kg = micrograms per kilogram
µg/L = micrograms per liter

Table 7-2
Quality Control Objectives for Analytical Methods

Analytical Category	Method Number and Reference	MS/MSD or Surrogate Accuracy Criterion (% Recovery)	BS/LCS Accuracy Criterion (% Recovery)	Precision Criterion (Maximum RPD)
		Soil/Water	Soil/Water	Soil/Water
Volatile Organic Compounds	**EPA Method 8260B**			
Spike				
1,3-Dichlorobenzene				
1,4-Dichlorobenzene		--	--	--
2-Butanone (MEK)		--	--	--
2-Hexanone		--	--	--
4-Methyl-2-pentanone (MIBK)		--	--	--
Acetone		--	--	--
Benzene		--	--	--
Bromodichloromethane		--	--	--
Bromoform		--	--	--
Bromomethane		--	--	--
Carbon Tetrachloride		--	--	--
Cyclohexane		--	--	--
Methyl acetate		--	--	--
Methylcyclohexane		--	--	--
Styrene		--	--	--
Tetrachloroethene		--	--	--
Toluene		--	--	--
Trans-1,2-Dichloroethene		--	--	--
Trans-1,3-Dichloropropene		--	--	--
Trichloroethene		--	--	--
Trichlorofluoromethane		--	--	--
Vinyl chloride		--	--	--
1,1,2-Trichloro-1,2,2-trifluorethane		--	--	--
1,1,1-Trichloroethane		--	--	--
1,1,2,2-Tetrachloroethane		--	--	--
1,1,2-Trichloroethane		--	--	--
1,1-Dichloroethane		--	--	--
1,1-Dichloroethene		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	**Method Number and Reference**	**MS/MSD or Surrogate Accuracy Criterion (% Recovery)**	**BS/LCS Accuracy Criterion (% Recovery)**	**Precision Criterion (Maximum RPD)**
		Soil/Water	**Soil/Water**	**Soil/Water**
1,2-Dichlorobenzene		--	--	--
1,2-Dichloropropane		--	--	--
Chlorobenzene		--	--	--
Chloroethane		--	--	--
Chloroform		--	--	--
Chloromethane		--	--	--
Cis-1,2-Dichloroethene		--	--	--
Cis-1,3-Dichloropropene		--	--	--
Dibromochloromethane		--	--	--
Dichlorodifluoromethane		--	--	--
Ethylbenzene		--	--	--
Isopropylbenzene		--	--	--
Methylene chloride		--	--	--
o-Xylene		--	--	--
m,p-Xylenes		--	--	--
1,2-Dichlorobenzene		--	--	--
1,2-Dichloropropane		--	--	--
Chlorobenzene		--	--	--
<u>Surrogate</u>				
4-Bromofluorobenzene		74-121/86-115	74-121/86-115	NA
Dibromofluoromethane		80-120/86-118	80-120/86-118	NA
1,2-Dichloroethane- d_4		80-120/80-120	80-120/80-120	NA
Toluene-d_8		81-117/88-110	81-117/88-110	NA
1,4-Dioxane	**EPA Method 8260B SIM**			
<u>Spike</u>				
1,4-Dioxane		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	Method Number and Reference	MS/MSD or Surrogate Accuracy Criterion (% Recovery)	BS/LCS Accuracy Criterion (% Recovery)	Precision Criterion (Maximum RPD)
		Soil/Water	Soil/Water	Soil/Water
Total Solids	**EPA Method 160.3**			
<u>Spike</u>				
Total solids		NA/NA	80-120/NA	20/NA
Ammonia - N	**EPA Method 350.3**			
<u>Spike</u>				
Ammonia		75-125/75-125	90-110/85-115	15
Total Kjeldahl Nitrogen	**SM4500-NORG,C**			
<u>Spike</u>				
Total kjeldahl nitrogen		65-135/85-120	80-120/85-120	35/15
pH	**EPA Method 9045C**			
<u>Spike</u>				
pH		NA/NA	95-105/90-110	5
Total Petroleum Hydrocarbons (TPH)	**EPA Method 8015B**			
<u>Spike</u>				
TPH as gasoline		--	--	--
TPH as diesel		--	--	--
TPH as oil		--	--	--
Semivolatile Organic Compounds	**EPA Method 8270C**			
<u>Spike</u>				
Acenaphthene		--	--	--
Acenaphthylene		--	--	--
Acetophenone		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	**Method Number and Reference**	**MS/MSD or Surrogate Accuracy Criterion (% Recovery)**	**BS/LCS Accuracy Criterion (% Recovery)**	**Precision Criterion (Maximum RPD)**
		Soil/Water	**Soil/Water**	**Soil/Water**
Anthracene		--	--	--
Benzo(a)anthracene		--	--	--
Benzo(b)fluoranthene		--	--	--
Benzo(k)fluoranthene		--	--	--
Benzo(g,h,i)perylene		--	--	--
Benzo(a)pyrene		--	--	--
Benzylaldehyde		--	--	--
Bis(2-ethylhexyl)methane		--	--	--
Bis(2-chloroethyl)phthalate		--	--	--
4-Bromophenyl phenyl ether		--	--	--
Butyl benzyl phthalate		--	--	--
4-Chloraniline		--	--	--
2-Chloronaphthalene		--	--	--
4-Chloro-3-methylphenol		--	--	--
2-Chlorophenol		--	--	--
4-Chlorophenyl phenyl ether		--	--	--
Chrysene		--	--	--
Dibenz(a,h)anthracene		--	--	--
Dibenzofuran		--	--	--
Di-n-butyl phthalate		--	--	--
Carbazole		--	--	--
3,3-Dichlorobenzidine		--	--	--
2,4-Dichlorophenol		--	--	--
Diethyl phthalate		--	--	--
2,4-Dimethylphenol		--	--	--
Dimethyl phthalate		--	--	--
4,6-Dinitro-2-methylphenol		--	--	--
2,4-Dinitrophenol		--	--	--
2,4-Dinitrotoluene		--	--	--
2,6-Dinitrotoluene		--	--	--
Di-n-octyl phthalate		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	**Method Number and Reference**	**MS/MSD or Surrogate Accuracy Criterion (% Recovery)**	**BS/LCS Accuracy Criterion (% Recovery)**	**Precision Criterion (Maximum RPD)**
		Soil/Water	**Soil/Water**	**Soil/Water**
Fluoranthene		--	--	--
Fluorene		--	--	--
Hexachlorobenzene		--	--	--
Hexachlorobutadiene		--	--	--
Hexachlorocyclopentadiene		--	--	--
Hexachloroethane		--	--	--
Indeno(1,2,3-cd)pyrene		--	--	--
Isophorone		--	--	--
2-Methylnaphthalene		--	--	--
2-Methylphenol		--	--	--
4-Methylphenol		--	--	--
Naphthalene		--	--	--
2-Nitroaniline		--	--	--
3-Nitroaniline		--	--	--
4-Nitroaniline		--	--	--
Nitrobenzene		--	--	--
2-Nitrophenol		--	--	--
4-Nitrophenol		--	--	--
N-Nitrosodiphenylamine		--	--	--
N-Nitroso-di-n-propylamine		--	--	--
Pentachlorophenol		--	--	--
Phenanthrene		--	--	--
Phenol		--	--	--
Pyrene		--	--	--
2,4,5-Trichlorophenol		--	--	--
2,4,6-Trichlorophenol		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	**Method Number and Reference**	**MS/MSD or Surrogate Accuracy Criterion (% Recovery)**	**BS/LCS Accuracy Criterion (% Recovery)**	**Precision Criterion (Maximum RPD)**
		Soil/Water	**Soil/Water**	**Soil/Water**
<u>Surrogate</u>				
2-Fluorobiphenyl		45-130/45-130	45-130/45-130	NA
2-Fluorophenol		25-130/20-130	25-130/20-110	NA
Nitrobenzene-d_5		40-130/40-130	40-130/40-130	NA
Phenol-d_5		25-120/20-120	25-120/20-110	NA
Terphenyl- d_{14}		45-135/45-135	45-130/45-130	NA
2,4,6-Tribromophenol		35-130/30-130	35-130/30-110	NA
Polychlorinated biphenyl	**EPA Method 8082**			
<u>Spike</u>				
Aroclor-1016		--	--	--
Arochlor-1260		--	--	--
Arochlor-5432		--	--	--
Arochlor-5442		--	--	--
Arochlor-5460		--	--	--
<u>Surrogate</u>				
Decachlorobiphenyl		45-120/45-120	45-120/45-120	NA
Anions	**EPA Method 300**			
<u>Spike</u>				
Bromide		80-120/80-120	90-110/90-110	20
Chloride		80-120/80-120	90-110/90-110	20
Fluoride		80-120/80-120	90-110/90-110	20
Nitrate		80-120/80-120	90-110/90-110	20
Nitrite		80-120/80-120	90-110/90-110	20
Orthophosphate		80-120/80-120	90-110/90-110	20
Sulfate		80-120/80-120	90-110/90-110	20

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	Method Number and Reference	MS/MSD or Surrogate Accuracy Criterion (% Recovery)	BS/LCS Accuracy Criterion (% Recovery)	Precision Criterion (Maximum RPD)
		Soil/Water	Soil/Water	Soil/Water
Title 22 metals	**EPA Method 6010B**			
Spikes				
Aluminum		75-125/75-125	80-120/80-120	20
Antimony		75-125/75-125	80-120/80-120	20
Arsenic		75-125 /75-125	80-120/80-120	20
Barium		75-125/75-125	80-120/80-120	20
Beryllium		75-125 /75-125	80-120/80-120	20
Cadmium		75-125/75-125	80-120/80-120	20
Calcium		75-125/75-125	80-120/80-120	20
Chromium		75-125/75-125	80-120/80-120	20
Cobalt		75-125/75-125	80-120/80-120	20
Copper		75-125/75-125	80-120/80-120	20
Iron		75-125/75-125	80-120/80-120	20
Lead		75-125/75-125	80-120/80-120	20
Magnesium		75-125/75-125	80-120/80-120	20
Manganese		75-125/75-125	80-120/80-120	20
Nickel		75-125/75-125	80-120/80-120	20
Potassium		75-125/75-125	80-120/80-120	20
Selenium		75-125/75-125	80-120/80-120	20
Silver		75-125/75-125	80-120/80-120	20
Sodium		75-125/75-125	80-120/80-120	20
Thallium		75-125/75-125	80-120/80-120	20
Vanadium		75-125/75-125	80-120/80-120	20
Zinc		75-125/75-125	80-120/80-120	20
Dioxins/Furans	**EPA Method 1613B**			
Spikes				
2,3,7,8-TCDD		40-135/40-125	67-158/60-150	20
1,2,3,7,8-PeCDD		40-135/40-125	70-142/60-150	20
1,2,3,4,7,8-HxCDD		40-135/40-125	70-142/60-150	20

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	Method Number and Reference	MS/MSD or Surrogate Accuracy Criterion (% Recovery)	BS/LCS Accuracy Criterion (% Recovery)	Precision Criterion (Maximum RPD)
		Soil/Water	**Soil/Water**	**Soil/Water**
1,2,3,6,7,8-HxCDD		40-135/40-125	76-134/60-150	20
1,2,3,7,8,9-HxCDD		40-135/40-125	64-162/60-150	20
1,2,3,4,6,7,8-HpCDD		40-135/40-125	70-140/60-150	20
OCDD		40-135/40-125	78-144/60-150	20
2,3,7,8-TCDF		40-135/40-125	75-158/60-150	20
1,2,3,7,8-PeCDF		40-135/40-125	80-134/60-150	20
2,3,4,7,8-PeCDF		40-135/40-125	68-160/60-150	20
1,2,3,4,7,8-HxCDF		40-135/40-125	72-134/60-150	20
1,2,3,6,7,8-HxCDF		40-135/40-125	84-130/60-150	20
2,3,4,6,7,8-HxCDF		40-135/40-125	70-156/60-150	20
1,2,3,7,8,9-HxCDF		40-135/40-125	78-130/60-150	20
1,2,3,4,6,7,8-HpCDF		40-135/40-125	82-122/60-150	20
1,2,3,4,7,8,9-HpCDF		40-135/40-125	78-138/60-150	20
OCDF		40-135/40-125	63-170/60-150	20
Mercury	**EPA Method 7471A**			
Spike				
Mercury		65-135/75-120	85-120/90-115	20
Methyl Mercury	**EPA Method 1630**			
Spike				
Methyl mercury		70-130/75-125	70-130/77-123	30/25
Chromium VI	**EPA Method 7196A/7199**			
Spike				
Chromium VI		75-125/85-115	80-120/90-110	20
Cyanide	**EPA Method 9012B**			
Spike				
Cyanide		75-125/70-115	80-120/90-110	20/15

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	Method Number and Reference	MS/MSD or Surrogate Accuracy Criterion (% Recovery)	BS/LCS Accuracy Criterion (% Recovery)	Precision Criterion (Maximum RPD)
		Soil/Water	Soil/Water	Soil/Water
Perchlorate	**EPA Method 314/331/ 6850/6860/8321**			
<u>Spike</u>				
Perchlorate		80-120/80-120	85-115/85-115	20
N-Nitrosodimethylamine	**EPA Method 1625C**			
<u>Spike</u>				
n-Nitrosodimethylamine		--	--	--
Organotin	**NOAA Status and Trends**			
Monbutyltin		--	--	--
Tetrabutyltin		--	--	--
Tributyltin		--	--	--
Dibutyltin		--	--	--
Pesticides	**EPA METHOD 8081A**			
<u>Spikes</u>				
4,4’-DDD		--	--	--
4,4’-DDE		--	--	--
4,4’DDT		--	--	--
Aldrin		--	--	--
Alpha-BHC		--	--	--
Alpha-Chlordane		NA	NA	NA
beta-BHC		--	--	--
delta-BHC		--	--	--
Dieldrin		--	--	--
Endosulfan I		--	--	--
Endosulfan II		--	--	--
Endosulfan Sulfate		--	--	--
Endosulfan II		--	--	--
Endosulfan Sulfate		--	--	--
Endrin		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	**Method Number and Reference**	**MS/MSD or Surrogate Accuracy Criterion (% Recovery)**	**BS/LCS Accuracy Criterion (% Recovery)**	**Precision Criterion (Maximum RPD)**
		Soil/Water	**Soil/Water**	**Soil/Water**
Endrin Aldehyde		--	--	--
Endrin Ketone		--	--	--
gamma-BHC		--	--	--
Heptachlor		--	--	--
Heptachlor Epoxide		--	--	--
Methoxychlor		--	--	--
Mirex		--	--	--
<u>Surrogate</u>				
Decachlorobiphenyl		20-120/40-150	20-120/40-150	NA
Tetrachloro-m-xylene		50-130/30-140	50-130/30-140	NA
Energetics	**EPA Method 8330A**			
<u>Spike</u>				
HMX		--	--	--
Nitrobenzene		--	--	--
Nitroglycerin		--	--	--
PETN		--	--	--
RDX		--	--	--
Tetryl		--	--	--
1,3-Dinitrobenzene		--	--	--
1,3,5-Trinitrobenzene		--	--	--
2-Amino-4,6-dinitrotoluene		--	--	--
2-Nitrotoluene		--	--	--
2,4-diamino-6-nitrotoluene		--	--	--
2,4-Dintrotoluene		--	--	--
2,4,6-Trinitrotoluene		--	--	--
2,6-diamino-4-nitrotoluene		--	--	--
2,6-Dinitrotoluene		--	--	--
3-Nitrotoluene		--	--	--
4-Amino-2,6-dinitrotoluene		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	Method Number and Reference	MS/MSD or Surrogate Accuracy Criterion (% Recovery)	BS/LCS Accuracy Criterion (% Recovery)	Precision Criterion (Maximum RPD)
		Soil/Water	**Soil/Water**	**Soil/Water**
4-Nitrotoluene		--	--	--
<u>Surrogate</u>				
1,2-Dintrobenzene		65-135/75-120	70-130/75-120	NA
Herbicides	**EPA Method 8151A**			
<u>Spikes</u>				
2,4-D		--	--	--
2,4-DB		--	--	--
2,4,5-T		--	--	--
Silvex		--	--	--
Dalapon		--	--	--
Dicambra		--	--	--
Dichloroprop		--	--	--
Dinoseb		--	--	--
MCPA		--	--	--
MCPP		--	--	--
PAH	**EPA METHOD 8270SIM**			
<u>Spikes</u>				
Acenaphthene		--	--	--
Acenaphthylene		--	--	--
Anthracene		--	--	--
Benzo(a)anthracene		--	--	--
Benzo(a)pyrene		--	--	--
Benzo(b)fluoranthene		--	--	--
Benzo(g,h,i)perylene		--	--	--
Benzo(k)fluoranthene		--	--	--
Bis(2-ethylhexyl)phthalate		--	--	--
Chrysene		--	--	--
Di-n-butyl phthalate		--	--	--
Di-n-octyl phthalate		--	--	--
Dibenzo(a,h)anthracene		--	--	--

Table 7-2 (continued)
Quality Control Objectives for Analytical Methods

Analytical Category	**Method Number and Reference**	**MS/MSD or Surrogate Accuracy Criterion (% Recovery)**	**BS/LCS Accuracy Criterion (% Recovery)**	**Precision Criterion (Maximum RPD)**
		Soil/Water	**Soil/Water**	**Soil/Water**
Diethyl phthalate		--	--	--
Dimethyl phthalate		--	--	--
Fluoranthene		--	--	--
Fluorene		--	--	--
Indeno(1,2,3-cd)pyrene		--	--	--
n-Nitrosodiphenylamine		--	--	--
Naphthalene		--	--	--
Phenanthrene		--	--	--
Pyrene		--	--	--
1-Methylnaphthalene		--	--	--
2-Methylnaphthalene		--	--	--
<u>Surrogate</u>		--	--	NA
Phenol-d5		25-120/20-120	25-120/20-110	NA
2-Fluorophenol		25-130/20-130	25-130/20-110	NA
2,4,6-Tribromophenol		35-130/30-130	35-130/30-110	NA
Nitrobenzene-d5		40-130/40-130	40-130/40-130	NA
2-Fluorbiphenyl		45-130/45-130	45-130/45-130	NA
Terphenyl-d14		45-135/45-135	45-130/45-130	NA

Source of information in Table 7-2 is from MEC^{x}, 2009.

Acronyms and Abbreviations:

BFB = Bromofluorobenzene
BS/LCS = Blank Spike/Laboratory Control Sample
EPA = U.S. Environmental Protection Agency
MS/MSD = Matrix Spike/Matrix Spike Duplicate
NA = not applicable
RPD = Relative Percent Difference
“—“ = Laboratory specific lower control limit-upper control limit or laboratory specific maximum RPD

Section 8
Instruments/Equipment and Supplies

8.1 Field Instruments/Equipment

All field instruments/equipment will be calibrated and tested in accordance with laboratory standard operating procedures or manufacturer's specifications, as applicable. HGL will maintain all field instruments and equipment on site and specific details can be found in EPA's field sampling plan (HGL 2010a). HGL will maintain documentation of its calibration and maintenance activities.

8.2 Laboratory Instruments/Equipment

Calibration of laboratory equipment will be based on written procedures approved by laboratory management. Instruments and equipment will be initially and continuously calibrated at approved intervals as specified by either the manufacturer or other requirements (e.g., methodology requirements). The laboratory will provide their respective SOPs.

8.3 Inspection/Acceptance of Supplies and Consumables

Prior to acceptance, supplies and consumables will be inspected to ensure that they are in satisfactory condition and free of defects.

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Section 9
Special Training and Certification

All CDM field personnel will be required to demonstrate successful completion of health and safety training prescribed by 29 Code of Federal Regulations 1910.120 also known as Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations. All employees and subcontractor personnel will have completed 40-hours of HAZWOPER instruction in addition to receiving 8-hours of refresher training on a yearly basis. Minimum course requirements included in the HAZWOPER training is described in the Site Health and Safety Plan (SHASP).

All field personnel will be required to read and understand the procedures described in this Work Plan/FSAP and HGL's field sampling plan (HGL 2010a,b) before beginning field work. The CDM QA Coordinator, Matt Brookshire, will conduct a field planning meeting with CDM field personnel prior to commencement of field work to discuss the understanding of the Work Plan/FSAP.

All samples will be submitted to a laboratory that has been certified by the state of California through the ELAP or NELAP, for the methods that California certifies.

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Section 10
Documentation and Records

Table 10-1 provides a summary of the documents to be maintained for this project. CDM's local administrative staff has the responsibility for maintenance of the document control system for the project. This system includes a document inventory procedure and a filing system. Project personnel will be responsible for project documents in their possession while working on a particular task.

Electronic copies of project deliverables, including graphics, will be routinely backed up and archived. Final reports will be submitted to DOE on compact disks in Microsoft Word, Microsoft Excel for certain tables, and geographical information system (GIS) for figures.

10.1 Field Logbook and Records

A permanently bound and consecutively paginated field logbook will be maintained daily by the CDM field team in accordance with the procedures below. Documentation modification requirements are also described below. In general, a single strikeout, initialed and dated, is required for each documentation change. HGL will maintain a separate field logbook in accordance with the HGL field sampling plan (HGL 2010).

The CDM field team leader is responsible for ensuring that the format and content of data entries are in accordance with this procedure. The field team leader will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

All markings and notes will be made with indelible black or blue ink pen. All pages must be numbered before initial use of the logbook. Before use in the field, each logbook will be marked with a specific document control number issued by the CDM project manager. The following information shall be recorded on the cover of the logbook:

- Field logbook document control number.
- Start date of entries.
- Activity, site name, and location.
- Name of CDM contact and phone number(s) (typically the project manager).
- End date of entries.

The first few (approximately five) pages of the logbook will be reserved for a table of contents. Mark the first page with the heading (Table of Contents) and enter the following:

- Date/Description Pages
- (Start Date)/Reserved for Table of Contents 1-5

The remaining pages of the table of contents will be designated as such with "Table of Contents" written on the top center of each page. The table of contents should be completed as activities are completed and before placing the logbook in the records file.

The requirements that must be followed when using a logbook are:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information does not need to be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:

  Above notes authored by:

  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.

- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
    - Date and time
    - Name of individual making entry
    - Names of field team and other persons onsite
    - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
    - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
    - Level of personal protection used
    - Serial numbers of instruments
    - Equipment calibration information
    - Serial/tracking numbers on documentation (e.g., carrier air bills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded. At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.
- Visitors to the site.

To guard against loss of data as a result of damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the project office.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

The onsite HGL geologist will prepare detailed boring logs in accordance with the HGL field sampling plan (HGL 2010).

10.2 Photographs

Photographs will be taken at the site to visually document field activities and site features before, during, and after fieldwork occurs. Digital photographs will be submitted to the electronic project files.

All digital photographs should have a caption added after the photographs are downloaded. This information should also be recorded in the field logbook as the photographs are taken. The caption should contain the following information:

- Photograph sequence number
- Description of activity/item shown (e.g., name of facility/site, specific project name, project number)
- Date and time
- Direction (if applicable)
- Photographer

10.3 Laboratory Data

The laboratory will submit an analytical data report to CDM. The data report will contain a case narrative that briefly describes the numbers of samples, the analyses, and noteworthy analytical difficulties or QA/QC issues associated with the submitted samples. The data report will include signed COC forms, cooler receipt forms, analytical data, a QC package, raw data, and an electronic copy of the data in a format compatible with the established SSFL data management system. The data package will also include all QC sample results and associated calculations (i.e., percent recovery [%R] and relative percent difference [RPD]).

Hard copies and electronic copies of the data report on compact disks will be archived by CDM at offsite storage for a minimum of five years and will be made available to the regulatory agencies upon request by DOE. DOE will maintain hard copies and electronic files per federal requirements. The analytical results and environmental data will be submitted to the established SSFL data management system using the semi-colon delimited text file submittal requirements specified in the extended electronic data deliverable (EDD) specification within 30 days of receiving all data validation reports.

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Section 11
Assessment and Oversight

11.1 Planned Project Assessments

Prior to initiating field work, a Field Planning Meeting will be held with HGL to assess the readiness for field work start up. The Field Planning Meeting will be documented using the form presented in Figure 11-1. The project manager is responsible for holding the Field Planning Meeting and is responsible for responding to or correcting any deficiencies identified during the meeting prior to the initiation of field work.

System assessments are qualitative reviews of different aspects of project work (e.g., field audits and office audits) to check on the use of appropriate QC measures and the functioning of the QA system. Determinations for project assessments will be performed under the direction of the CDM QA director, who reports directly to the CDM president. Quality Procedure 6.2, as defined in the CDM Quality Assurance Manual, Part Two (CDM 2007), defines CDM's corporate assessments procedures and requirements.

11.1.1 Field Assessments

At the start of field work, the project manager or field team leader will conduct a Field Sampling Technical Systems Assessment. This qualitative audit will assess the equipment, facilities, personnel, training, procedures, record-keeping, and data management aspects of the field work to ensure conformance with the Work Plan/FSAP. The project manager or field team leader is responsible for conducting the Field Sampling Technical Systems Assessment, reporting the results of the assessment in the field logbook, and responding to or correcting any deficiencies identified during the assessment prior to the start of field work.

A minimum of one field audit will be conducted on CDM work and subcontractor work activities by an authorized CDM technical staff independent of the activities audited. Auditors for field activities and laboratory operations require technical expertise specific to the activity audited and must be authorized by the CDM QA Director. The project manager and/or field team leader are responsible for responding to and correcting any identified field audit findings. The QA coordinator is responsible for monitoring the effectiveness of the implemented corrective action. The responsibilities and procedures for planning, conducting, and closing-out audits are further specified in CDM's QA Manual (CDM 2007).

DOE and EPA staff will have the opportunity to review site activities and verify that the procedures described in planning documents such as the Work Plan/FSAP are being followed.

11.1.2 Laboratory Assessments

Performance assessments are quantitative checks on the quality of a measurement system (e.g., proficiency testing) and will be scheduled for this project.

CDM chemists will perform an formal review of laboratory activities sample logging, recording, handling, preparation, and analysis procedures the first week of sampling to verify that the procedures described in planning documents such as the Work Plan/FSAP are being followed. If the CDM chemist(s) observe deviations from the planning documents, a formal performance assessment will be performed within one week.

11.2 Assessments Findings and Response Actions

Any conditions or problems identified during routine activities or through assessments that may impair the quality of work will be addressed through either rapid corrective response actions or formal corrective action processes. All response actions will be implemented on a case by case basis to correct quality problems.

Field audit findings are provided by the auditor to the project manager and/or field team leader on the day of the audit through a post-audit debrief. Field audits are further documented via an audit report. Within 15 working days of the audit, the auditor will prepare a draft audit report for review by the QA Director. The QA Director will approve and distribute the audit report within 30 working days of the audit. If there are any unresolved deficiencies, the auditor, through a corrective action request (Figure 11-2), will request the audited party to take corrective action. Specific procedures for issuing and following up on corrective actions are presented in CDM's QA Manual (CDM 2007). The timeframe for response to the corrective action request is typically 15 to 30 days from the date of the corrective action notice. The QA Director is the individual responsible for receiving and approving the corrective action response.

Minor rapid response actions taken in the field immediately (within 24 hours) to correct a quality problem will be documented in the field logbook and verbally reported to the CDM project manager.

Major rapid response actions taken in the field will require notification (within 24 hours) and approval by the DOE project manager, EPA project manager, CDM QA Coordinator, and CDM project manager prior to implementation. Such actions may include revising procedures in the field or retesting.

Minor or major quality problems that cannot be corrected quickly through rapid routine procedures require implementation of a corrective action request (CAR) form (see Figure 11-2). The CAR will be initiated by the person identifying the problem and forwarded to the CDM QA Coordinator within 48 hours of identifying the problem. In consultation with the CDM QA Director, the CDM QA Coordinator will be responsible for investigating and following up on the quality problem; the timeframe for response will be determined by the CDM QA Coordinator based on the specific quality problem.

The DOE project manager will approve any major response actions in writing.

11.3 Reports to Management

During active months of the project, CDM will schedule, at a minimum, monthly phone calls with the DOE and EPA project managers to provide a verbal status report identifying activities performed, significant conversations, planned activities, and an updated schedule.

QA reports will be provided to management when significant quality problems are encountered. Field staff will note quality problems on field data sheets. The CDM project manager will inform the CDM QA coordinator upon encountering quality issues that cannot be immediately corrected. Monthly QA reports will be submitted to CDM's QA director by the CDM QA coordinator. These reports will be provided upon request of the DOE project manager.

The measurement report (to be prepared by CDM) will contain a QA section that will discuss adherence to governing documents, extent to which DQOs were met, deviations from the Work Plan/FSAP, data precision and accuracy goals met, and changes, if any, to the governing documents. It will also provide a summary of QA activities performed as well as a description of quality problems encountered and corrective actions implemented. QA reports and CARs will be included in the measurement report as appropriate.

Figure 11-1
Field Planning Meeting Form

CDM FIELD PLANNING MEETING FORM

Assignment No./Name:______________________________

Date of Meeting:____________________________________

ATTENDEES

Project Manager:____

Field Team Leader: ____

Site Health and Safety Officer: _____________________________________

Additional Sampling Personnel:_____________________________________

QA Coordinator:____

AGENDA

I. PERSONNEL, FIELD SCHEDULES, TASKS

A. Who is doing the sample collection? List personnel and responsibilities.

B. What media are being sampled? List here.

C. Identify sample locations and requested analytical parameters here. Attach map if needed.

D. How long will personnel be in the field?

Figure 11-1 (continued)
Field Planning Meeting Form

II. PRE-PLANNING

A. Are site-specific Work Plan, SAP and H&SP ready?

B. Have other necessary documents been assembled (Client SOPs, CDM SOPs, other applicable client documents)?

C. Review status of procurement of field supplies, equipment and subcontracts

D. Reservation of Laboratory Space

E. Arrangement for QC Samples (Spikes, trip blanks, rinsates, temperature blank, duplicates, MS/MSD, others if necessary)

F. Coordination with client project manager and subcontractors

G. Have chain-of-custody forms and sample labels been prepared?

H. Are field equipment calibration logs prepared/available for all the field equipment to be used?

III. TRAINING

A. Are sampling personnel familiar with sample collection procedures and requirements, CDM SOP requirements, or other applicable client requirements?

B. Review sampling procedures as needed (logbook entries, non-CLP tracking form, spike submittal, etc)

Figure 11-1 (continued)
Field Planning Meeting Form

IV. CHAIN-OF-COMMAND

A. Who will talk to client project manager?

B. Have back-ups been established for the client project manager and the CDM project manager?

C. If applicable, has a client contract specialist or client technical/field procedure contact been established?

Figure 11-2
Corrective Action Request Form

CAR No. ____________

CDM CORRECTIVE ACTION REQUEST

Project: ____

Contract/Project No: ____________ Project Manager: ____________

Description of problem and date identified: ____________________

Requested by: ________________ Date: ____________________

Submit this form to the QA Director promptly.

Significant Condition Adverse to Quality? Yes / No

Responsible for Action: __________ Response Due: ______________

Submit completed response to: ____________________________

[To be completed by the responsible person. Attach additional pages as required. **Include evidence that corrective action has been implemented.**]

State cause of problem (if known or suspected): ____________________

____

____

Corrective Action(s) Taken to Correct Problem and Prevent Recurrence: ______

____

____

Signature: ____________________ Date: ____________________

Corrective Action Plan Accepted: __________________ Date: __________

Corrective Action Verified By: ____________________ Date: __________

Corrective Action Accepted: ______________________ Date: __________

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Section 12
Data Review

The data review process includes four distinctive steps to evaluate and ensure that project data quality will meet the project needs and requirements. The data review process is comprised of verification, validation and usability assessments. Each of these is conducted to ensure that project data are of known and documented quality. The following sections provide details associated with each step in the data review process.

12.1 Field Record Verification

Data verification consists of a completeness review that is performed in order to ensure that required information is available. This step provides examination of objective evidence to ensure that sampling and analytical requirements have been completed. Several inputs will be examined. Table 12-1 provides a summary of the verification steps for this project.

12.2 Laboratory Data Verification

Data verification consists of a completeness review that is performed in order to ensure that required information is available. This step provides examination of objective evidence to ensure that sampling and analytical requirements have been completed. Several inputs will be examined. Table 12-1 provides a summary of the verification steps for this project.

12.3 Data Validation

The data validation process consists of two steps to be completed. The first step consists of determining compliance with methods, procedures, and contracts for sampling and analysis. The second step of the data validation process consists of comparing information collected with measurement performance criteria presented in the Work Plan/FSAP and data validation guidance. Several validation inputs will be examined.

All data validation will be conducted in accordance with *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 2004), *EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA 2008), and *EPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review* (EPA 2005).

The data validation strategy to be employed during the field sampling is to validate 10% of the data according to EPA Level IV protocols and the remaining 90% according to EPA Level III protocols. Data validation will be conducted by an independent data validation subcontractor.

12.4 Data Usability Assessment

The data usability assessment will be performed on the validated data by a team of personnel at CDM under the responsibility of the project manager. The results of the data usability assessment will be presented in the measurement report and data deemed appropriate for use will be used in the project decision making process. Data qualified as rejected are considered unusable. All other data are considered to be valid and acceptable including those analytes that have been qualified as estimated or non-detect.

The following sections describe the precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) goals for this project and describe how they will be used to conduct the data usability assessment.

12.4.1 Precision

The precision of a measurement is an expression of mutual agreement among individual measurements of the same property taken under prescribed similar conditions. Precision is quantitative and most often expressed in terms of RPD. Precision of reported results is a function of inherent field-related variability plus laboratory analytical variability. Various measures of precision exist, depending upon "prescribed similar conditions." Field duplicate samples will be collected to provide a measure of the contribution to overall variability of field-related sources. Contribution of laboratory-related sources to overall variability is measured through various laboratory QC samples. The acceptable RPD limits for field duplicates are less than 50% for soil. Chemical analytical data will be validated for precision using field duplicates, laboratory duplicates, MS/MSDs, and LCS/laboratory control sample duplicates (LCSDs), as applicable.

Precision of the laboratory analysis will be assessed by comparing the analytical results and the laboratory duplicate results. The RPD will be calculated for each pair of duplicate analyses using the following equation:

$$RPD = \left(|S - D| / (S + D) / 2\right) \times 100$$

Where S = First sample value (original value); and
D = Second sample value (duplicate value).

A discussion summarizing the results of laboratory and field precision and any limitations on the use of the data will be described in the measurement report.

12.4.2 Accuracy

Accuracy is the degree of agreement of a measurement with an accepted reference or true value, and is a measure of the bias in a system. Accuracy is quantitative and usually expressed as the %R of a sample result. Ideally, it is desirable that the reported concentration equals the actual concentration present in the sample. Acceptable QC limits for %R are 70% to 130% for water and soil LCS/LCSDs; 70% to

130% for soil LCS/LCSDs; 70% to 130% for surrogates; and 70% to 130% for MS/MSDs. Chemical analytical data will be validated for accuracy using surrogates, MS/MSDs, and LCS/LCSDs, as applicable.

The %R of spiked samples will be calculated using the following equation:

$$\%R = \left(\left(A - B\right) / C\right) \times 100$$

Where A = Analyte concentration determined experimentally from the spiked sample;
B = Background level determined by a separate analysis of the unspiked sample; and
C = Amount of the spike added.

A discussion summarizing the results of laboratory accuracy and any limitation on the use of the data will be described.

12.4.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent: (a) a characteristic of a population, (b) parameter variations at a sampling point, and/or (c) an environmental condition. Representativeness is a qualitative and quantitative parameter that is most concerned with the proper design of the sampling plan and the absence of cross-contamination. Good representativeness will be achieved through:

- Careful, informed selection of sampling sites;
- Selection of testing parameters and methods that adequately define and characterize the extent of possible contamination and meet the required parameter DLs;
- Proper gathering and handling of samples to avoid interference and prevent contamination and loss; and
- Collection of a sufficient number of samples to allow characterization.

Representativeness is a consideration that will be employed during sample location and collection efforts and will be assessed qualitatively by reviewing field procedures and reviewing actual sampling locations versus planned locations. Representativeness will be reviewed quantitatively using blank samples. If a concentration in a sample is less than five times the concentration in an associated blank, the sample concentration is considered non-detect. Conclusions drawn based on these reviews will be presented and any impacts discussed in the measurement report.

12.4.4 Completeness

Completeness is a measure of the amount of usable data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Usability will be assessed by evaluating the PARCCS parameters. Those data that are validated and need no qualification, or are qualified as estimated data, are considered usable. Rejected data are not considered usable. Completeness will be calculated following data evaluation. For this work, a completeness goal of 90% is projected for each analytical test. If this goal is not met, additional sampling may be necessary to adequately achieve project objectives. An evaluation of the impact of missing information and any project limitations with respect to completeness will be discussed in the measurement report.

12.4.5 Comparability

Consistency in the acquisition, handling, and analysis of samples is necessary for comparing results. Where appropriate, the results of analyses obtained will be compared with the results obtained in previous studies. Standard EPA analytical and QC methods will be used to ensure comparability of results with other analyses performed in a similar manner. Comparability is a qualitative parameter and cannot be assessed using QC samples. Any comparability limitations will be presented and discussed in the measurement report.

12.4.6 Sensitivity

Sensitivity is the ability of the method or instrument to detect target analytes at the level of interest. Examples of QC measures for determining sensitivity include method detection limit studies, and low initial calibration standards at the quantitation/detection limit. A review of initial calibration data (specifically low standards at the detection limit) will be completed to determine if project required sensitivities (detection limits) were achieved. The measurement report will discuss sensitivity and any impacts and limitations on the use of project data.

Table 12-1
Verification Process

Verification Input	Description	Internal/ External	Responsible for Verification
Chain-of-custody forms	Chain-of-custody forms will be reviewed internally upon their completion and verified against the packed sample coolers prior to shipment to the laboratory. Copies of the chain-of-custody forms will be reviewed again and verified against field logs, analytical laboratory reports, and the Work Plan/Field Sampling and Analysis Plan (FSAP) prior to completion of the measurement report.	Internal	Field team leader
Audit reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. Project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the project manager will be notified to ensure action is taken.	Internal	Project manager
Field logbooks and field forms	Field logbooks and field forms will be reviewed to ensure accuracy and completeness. The field logbook will be maintained in the project file and field forms will be included in the measurement report.	Internal	Field team leader
Laboratory Data Reports	Data validation reports will be reviewed to ensure they represent the data collected during the project. The laboratory data will be evaluated against the project data quality objectives and measurement performance criteria established in the Work Plan/FSAP.	Internal	Project manager and/or database coordinator
Sampling Procedures	The implementation of sampling procedures will be reviewed and evaluated through the use of audit reports, sampling reports, field change request forms, the Work Plan/FSAP, and/or field logbooks to determine proper equipment use and sampling processes.	Internal	Field team leader
Electronic Data Deliverables (EDD)	The electronic data deliverable will be compared to the EDD guidance for compliance with required fields and format. The results will be reviewed to ensure that they have been transferred correctly from laboratory data printouts to the laboratory report and to the EDD.	Internal	Database coordinator
Work Plan/FSAP	All planning documents (including the Work Plan/FSAP) will be reviewed to evaluate whether planned activities and objectives were actually implemented and to document deviations to the plans as necessary.	Internal and External	All data users
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work and by the data validators for completeness and technical accuracy prior to submittal to CDM.	Internal and External	Subcontracted analytical laboratory and data validators

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Section 13
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