Port of Seattle

Terminal 117 Upland Area

T-117 UPLAND INVESTIGATION QUALITY ASSURANCE PROJECT PLAN

For submittal to:

US Environmental Protection Agency, Region 10
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Seattle, WA 98101

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Terminal 117 Upland Investigation
Quality Assurance Project Plan

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Acronyms

Acronym	Definition
%RSD	percent relative standard deviation
AES	atomic emission spectrometry
ARI	Analytical Resources, Inc.
AOC	administrative order on consent
ASAOC	administrative settlement agreement and order on consent
AST	above-ground storage tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	chain of custody
DCB	decachlorobiphenyl
DL	detection limit
DOF	Dalton, Olmsted & Fuglevand, Inc.
DQI	data quality indicator
DQO	data quality objective
dw	dry weight
EAA	early action area
Ecology	Washington State Department of Ecology
ECD	electron capture detection
EDD	electronic data deliverable
EE/CA	engineering evaluation/cost analysis
EPA	US Environmental Protection Agency
FC	field coordinator
FID	flame ionization detection
FS	feasibility study
GC	gas chromatography
HCID	hydrocarbon identification
HDPE	high-density polyethylene
HSP	health and safety plan
ICP	inductively coupled plasma
ID	identification
LCS	laboratory control sample
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
MDL	method detection limit
Metro	Municipality of Metropolitan Seattle

Acronym	Definition
MLLW	mean lower low water
MS	mass spectrometry
MTCA	Model Toxics Control Act
NTCRA	non-time-critical removal action
NWTPH	Northwest total petroleum hydrocarbons
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Port	Port of Seattle
mg/kg	parts per million
Onsite	Onsite Enterprises, Inc.
OSHA	Occupational Safety and Health Administration
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RI	remedial investigation
RL	reporting limit
RPD	relative percent difference
SARA	Superfund Amendments and Reauthorization Act
SD	standard deviation
SDG	sample delivery group
SECOR	SECOR International, Inc.
SMS	sediment management standard
SOW	statement of work
SPT	standard penetration test
SPU	Seattle Public Utilities
SVOC	semi-volatile organic compound
T-117	Terminal 117
TCLP	toxicity characteristic leaching procedure
TEQ	toxic equivalents
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-Dx	total petroleum hydrocarbons – diesel and oil extractable
TPH-G	total petroleum hydrocarbons – gasoline
TSCA	Toxic Substances Control Act
UST	underground storage tank
VOC	volatile organic compound
Windward	Windward Environmental LLC
WTPH-D	Washington total petroleum hydrocarbons – diesel and oil
ww	wet weight

1.0 Introduction

1.1 PURPOSE

This quality assurance project plan (QAPP) addresses the Upland Investigation at Terminal 117 (T-117) and fulfills Task 2 of the US Environmental Protection Agency (EPA) Administrative Settlement Agreement and Order on Consent (ASAOC) No. CERCLA 10-2006-0072 (EPA 2005). Requirements for the QAPP are further described in the T-117 Upland Area Work Plan for Upland Investigation (Windward et al. 2005d) approved by EPA on November 18, 2005. This QAPP establishes the quality assurance (QA) objectives for the collection of data to support the anticipated Upland Area removal action. The methods and QA procedures described herein will be used by the Port of Seattle (Port) and its contractors during data collection activities beginning in January 2006.

In 2005, elevated concentrations of polychlorinated biphenyls (PCBs) were detected in upland boreholes installed as part of the ongoing design for the T-117 Lower Duwamish Waterway (LDW) Early Action Area (EAA) (to be completed under a separate EPA settlement agreement). The installation of these boreholes was performed under an existing Administrative Order on Consent (Cohen 2003) signed by the City of Seattle, King County, the Port, and The Boeing Company (Boeing) – working together in the LDW as the Lower Duwamish Waterway Group (LDWG). Based on the borehole results (Windward et al. 2005b), EPA and the Port have agreed that a broader investigation of the entire T-117 property is warranted to further evaluate the extent of PCB contamination, examine additional contaminants that may be of concern at the site (i.e., total petroleum hydrocarbons [TPH], polycyclic aromatic hydrocarbons [PAHs], metals [arsenic, copper, cadmium, chromium, lead and zinc], pesticides [previously detected], and phthalates), obtain data necessary to address and control these contaminants, as needed, and make sure that the potential for unacceptable human and/or ecological exposure and sediment recontamination is minimized.

The primary purpose of this investigation is to provide additional characterization of the extent of soil contamination in the upland area of T-117, including the shoreline bank area approximately above elevation +14 mean lower low water (MLLW) to:

- Enable the Port to evaluate the extent of impacted soil onsite and design an anticipated Upland Area removal action that will be protective of human health and the environment.
- Design and implement engineering, maintenance, and institutional control measures for long-term site management.

- Generate sufficient information about the extent of Upland Area contamination to design and implement effective source control measures to effectively reduce any potential for recontamination of the lower bank, mudflat, and sediments. Both the lateral and vertical extent of chemicals of concern that affect soil will be evaluated.

The results of this investigation may also be used to supplement existing data previously collected to develop the engineering evaluation/cost analysis (EE/CA) for the T-117 EAA (Windward et al. 2005a). The methods for and design of the investigation and subsequent anticipated Upland Area removal action will be coordinated with the proposed T-117 EAA non-time-critical remedial action (NTCRA) for the bank and sediment (to be addressed under a separate EPA settlement agreement).

Data generated as a result of the implementation of this QAPP could affect the proposed T-117 EAA removal design in the following ways:

- The additional data could influence the upland extent of the proposed bank and sediment removal.
- Additional data could influence the way in which the construction phase of the NTCRA (i.e., bank removal and replacement) is managed and scheduled to prevent the recontamination of adjacent sediments.
- Additional data could be the basis for recommendations by the Port for any future or additional Upland Area actions consistent with the T-117 Source Control Action Plan (Ecology 2005) and the Source Control Strategy (Ecology 2004) for the LDW.
- Additional data characterization will inform future actions by enabling the Port to establish institutional controls to effectively manage any future surface and subsurface excavation, thereby preventing recontamination of the bank and sediments.

1.2 ORGANIZATION

The purpose of this QAPP is to present a rationale for sample collection and analysis based on existing and historical information and anticipated data needs. It provides a plan for conducting field activities at the T-117 Upland Area to ensure that sample collection and analytical activities are conducted in accordance with technically acceptable protocols and meet data quality objectives. This T-117 Upland Investigation QAPP is organized into the following sections:

- Section 1.0 – Introduction
- Section 2.0 – Background
- Section 3.0 – Sampling design and analytical program development
- Section 4.0 – Data collection and quality control
- Section 5.0 – Project management

- Section 6.0 – Assessment and oversight
- Section 7.0 – Data validation and usability
- Section 8.0 – References

A health and safety plan (HSP) designed to protect onsite personnel and area residents from physical, chemical, and other potential hazards posed by the field sampling effort is included as Appendix A.

The QAPP was prepared following EPA guidance, specifically the *Guidance for Quality Assurance/Project Plans* (EPA 2002a). Analytical quality assurance/quality control (QA/QC) procedures were also developed based on the analytical protocols of the EPA Contract Laboratory Program (EPA 1999, 2002b).

2.0 Background

2.1 SITE BACKGROUND

T-117 is located at 8700 Dallas Avenue S in Seattle, Washington (Figure 2-1). The upland T-117 property covers approximately 3 acres, including a 50-ft-wide section of land adjacent to the shoreline, which is owned by the Port as successor in interest to the King County Commercial Waterway District No. 1. In 1999, the Port acquired the inland parcels between the shoreline parcel and Dallas Avenue S, which was previously owned by the Malarkey Asphalt Company. These properties were consolidated to form the present-day T-117. Adjacent properties include Boeing to the south, the South Park Marina to the north-northwest, and the Basin Oil Company to the west (west of Dallas Avenue S).

2.2 SITE OPERATIONS AND HISTORY

2.2.1 Historical site operations

Figure 2-2 shows the locations of historical site features and operations at T-117. The Duwamish Manufacturing Company reportedly began asphalt manufacturing operations at the site around 1937 and continued until 1978 (URS 1994) at the general location corresponding with the present-day west half of T-117. In 1978, the two parcels were purchased by Michael O. Malarkey, and roofing asphalt manufacturing continued (URS 1994). The business came to be known as the Malarkey Asphalt Company and continued roofing asphalt manufacturing operations at the site until 1993.

The north building, constructed sometime during the 1960s, served as administrative offices for the asphalt company. The south (metal) building was used for a period of time to containerize the roofing asphalt product and as a warehouse for finished product storage. Two of the three abandoned-in-place underground storage tanks (USTs) were reportedly used to store gasoline and then waste oil, and the third stored diesel fuel. The third tank served a diesel fuel dispenser located at the north side of the small office/carport (just inside the north gate). The large-diameter industrial water supply well was reportedly used to obtain makeup cooling water for the asphalt production process.

Structures associated with the asphalt plant but no longer present at the site include above-ground storage tanks (ASTs) and associated piping, removed USTs and associated piping; reaction tanks; the former "ponded" area in the roadway; a diesel fuel dispenser; a hot oil heater and associated shed, transfer pumps and pipes; warehouses at the east side of the plant area, the drum storage shed and a partially buried railroad tank car (Figure 2-2).

The former ASTs at the plant were inventoried prior to plant dismantling activities in late 1996 and 1997, and their contents are indicated on Figure 2-2. An extensive inventory of plant equipment was assembled by Malarkey Asphalt Company and is included in Appendix F of the removal action work plan prepared for the company in 1996 (EMCON 1996).

During the oil embargo in the early 1970s, the facility reportedly received approximately 1,000 gal (3,800 L) per month of waste oil, including PCB-contaminated waste oils. The waste oil was used as fuel for the asphalt manufacturing process (Hart Crowser 1992; URS 1994). This practice apparently continued until the oil embargo was lifted and oil prices stabilized. Oil was reportedly placed in a former railroad tank car located at the site (URS 1994). During Malarkey Asphalt Company operations, flux[1] was received from the Chevron facility at Richmond Beach, Washington (URS 1994). The product was blown to approximately 500 degrees Fahrenheit in the reaction tanks to drive off light-end hydrocarbons. An estimated 500–600 gal (1,900–2,300 L) of these light oils were generated (vaporized) off the blowing stills per month. A fume incinerator/afterburner was operated to burn the vaporized oil, which was routed to the unit via overhead piping. Once the targeted physical properties were achieved, the asphalt was transferred from the blowing stills to various tanks and cooled. A hot oil heater was used to keep the asphalt from hardening in the lines. It was operated 24 hours per day to keep hot oil circulating through jacketed piping (EMCON 1996). Oily runoff from the process area (vicinity of the reaction tanks) reportedly flowed eastward, into the present-day catch basin 2, which still discharges to the roadway area through a small-diameter metal pipe. The nearby large-diameter well has been mislabeled as this "sump" in several reports.

The former roadway ponded area, which was actually a low depression in the shoreline roadway area just inland of the shoreline berm, was reportedly used for some period of time during site operations (URS 1994) for non-contact cooling water from the stills (Hart Crowser 1992). However, EMCON was not able to substantiate the presence of a water storage structure as reported by URS and Hart Crowser.

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[1] Asphalt flux is the residuum of atmospheric and vacuum distillation processes used by petroleum refineries and independent asphalt manufacturers. It is used in the manufacture of some asphalt roofing materials (e.g., saturant asphalts, some modified bitumen products) and is also used as a feedstock in the air-blowing process used to make oxidized roofing asphalt.

According to EMCON, the site owner advised them that the non-contact cooling water was not generated during asphalt processing operations (i.e., the non-contact cooling water evaporated off the blowing stills as steam). Excess water was captured in the containment structure in which the blowing stills and overflow tank were located. A sump pump was then used to pump water from the containment area to a holding tank, where it was then reused for cooling. The area reported as a former "holding pond" was (and continued to be up until 1999) a depressed area of the site where stormwater collected. Periodic overflow to the LDW was noted by EMCON during extended rainy periods. This ponded area was located on the property owned by the Port (EMCON 1996) but was subsequently excavated as part of the PCB-contaminated soil removal action in 1999 and backfilled.

As late as 1995, Basin Oil leased the 10,000-gal heated and insulated horizontal tank referred to as "Tank M" from the Malarkey Asphalt Company under a lease dated February 1, 1989. Basin Oil reportedly used the tank for storing and processing used oil (EPA 1995). As indicated in the Task 1 Report (Windward et al. 2003), Basin Oil also used a portion of the interior of the south building on the T-117 property for a brief period for storage and oil filter processing. It is estimated that Basin Oil occupied the south building from approximately 2003 until late 2004.

2.2.2 Current site operations

Figure 2-3 is a recent aerial photograph that shows the present-day configuration of T-117. The only above-ground structures that remain from the time when the asphalt plant was operational are the north and south buildings, the small office/carport inside the north gate, and the truck scale at the west side of the property. The remainder of the site is covered with asphalt or concrete pavement. Additional asphalt plant structures remaining at the site beneath the ground surface include the three abandoned-in-place USTs; the abandoned-in-place large-diameter industrial water supply well; and concrete foundations associated with the former warehouse structures, reaction tanks cooling water sump, tank pads and underground utility corridor. Some small-diameter remnant buried piping associated with the former plant may also be present in the vicinity, although most of this was removed during plant demolition and subsequent cleanout of the utility corridor.

After the asphalt plant closed, portions of the north building were occupied by Evergreen West Wholesale (a lumber wholesaler). A portion of the building is currently occupied by International Inspection, a provider of non-destructive testing services. Second Use Building Materials, Inc., a recycling business that obtains reusable building materials from various demolition projects for resale to the public, uses the south building for inventory storage. Port Construction Services formerly used the outdoor area near the small office/carport for miscellaneous material storage (visible in Figure 2-3). However, these items have since been removed, and Port Construction Services no longer uses the site.

2.2.3 Overview of previous investigation and stabilization activities

Elevated concentrations of PCBs, PAHs, and other constituents in Upland Area soils were noted in early investigations beginning in the mid-1980s. These observations were generally limited to the parcel adjacent to the shoreline and select locations within the former asphalt plant process area. The plant area was dismantled by the owner in the late 1990s, and soil contaminated with PCBs in the shoreline parcel area was removed in an EPA Superfund cleanup action between October 1999 and February 2000 (Onsite 2000a). A detailed summary of the site investigations pre-dating the designation of T-117 as one of seven early action areas (EAAs) (Windward 2003) is included in the summary of existing information and data gaps analysis report (Windward et al. 2003). A discussion of these and subsequent investigations is included below, together with a description of the available information for those previous investigations for which upland soil sampling was performed or where soil removal or site stabilization actions related to the T-117 facility or the former Malarkey Plant area occurred. Some information regarding earlier studies was obtained from summary descriptions provided by subsequent investigators and are referenced as such.

Information from previous investigations was evaluated to determine if it is still relevant to existing conditions. The pertinent information was then further evaluated for reliability and to identify data gaps. The result of this process together with information about historical site operations was used to develop the sampling and analysis program to be implemented at the T-117 Upland Area. Table 2-1 summarizes the previous investigations and other site activities at the property (in chronological order) and also includes an assessment of the usefulness of the data to the proposed sampling and analysis program to be implemented at the T-117 Upland Area.

In addition to previous site sampling and investigation projects, other site activities have included:

- Storage tank removal or closure in place
- Removal of PCB-impacted soil (cleanup level 25 mg/kg) from the former roadway ponded area
- Asphalt paving in select areas to cover exposed soil and provide the terminal with a more continuous and safer working surface
- Cleanout and filling of below-grade concrete-lined utility corridor
- Cleanout and maintenance of catch basins on the site

Table 2-1. Summary of previous T-117 and Malarkey Asphalt site investigations

ACTIVITY	DATE	INVESTIGATOR	SUMMARY	RELEVANCE TO PLANNED INVESTIGATION	SOURCE
Metro inspection – sampling of roadway ponded area and shoreline seep	1984	Municipality of Metropolitan Seattle (Metro)	Water and sediment samples were collected from the LDW, roadway ponded area, catch basin 5 outfall and an apparent groundwater seep at the shoreline. PCBs, PAHs, and metals were detected in one or more of the water and sediment samples. No PCBs in seep. Claims ponded area was used for non-contact cooling water although this was later discounted by subsequent investigators.	Roadway area soil has been removed. Results provide general indication of upland chemicals of concern.	Hart Crowser (1992); URS (1994); EMCON (1996)
Ecology sediment sampling and inspections	1985 and 1986	Ecology	Sediment samples were collected from an onsite drainage ditch. Results showed elevated lead (1,666 mg/kg), arsenic (2,027 mg/kg), and zinc (5,416 mg/kg).	Drainage ditch cleaned and removed from service; currently covered by asphalt pavement.	Hart Crowser (1992); URS (1994)
EPA Toxic Substances Control Act (TSCA) inspection	1989	EPA	Samples were collected from a waste oil tank and another tank containing usable light oils. No PCBs were detected. However, total halogenated hydrocarbons (as total chlorine) were reportedly detected at levels up to 1,160 mg/kg in the sampled product. No materials were noted at this facility to qualify for PCB regulation (URS 1994).	Tanks have since been removed from the property.	Hart Crowser (1992); URS (1994); EMCON (1996)
Ecology site hazard assessment	May 1991	Parametrix, Inc. and SAIC (for Ecology)	Work included review of Ecology and Malarkey Asphalt files, installation of three monitoring wells (MW-01, MW-02, and MW-03), soil sampling and analysis of borehole samples, groundwater sampling, sampling of product in USTs and ASTs. Metals, PCBs, pesticides, and volatile organic compounds (VOCs) were found in soil. Results of toxicity characteristic leaching procedure (TCLP) analyses on soil were below dangerous waste criteria. Metals, PCBs, pesticides, and SVOCs were detected in groundwater. A 1/8-in. (0.3-cm) layer of floating product was reported in MW-03.	Most data no longer relevant. MW-02 and MW-03 were excavated and replaced in 1999. Tanks were subsequently removed. Analytes detected in the 1991 assessment were considered in the selection of analytes proposed for this investigation.	Parametrix (1991)
UST decommissioning and site assessment	1992	Hart Crowser (for site owner)	Four USTs containing diesel and waste oil were decommissioned, including a partially buried railroad tank car. Three USTs were closed in place by filling with concrete slurry. The railroad tank car was removed. Soil samples were taken from the tanks and tested for TPH.	Sampling results in the vicinity of the closed-in-place tanks were considered in selecting sampling location for this investigation effort.	Hart Crowser (1992)

Activity	Date	Investigator	Summary	Relevance to Planned Investigation	Source
Site inspection	1994	URS (for EPA)	Onsite and offsite soil, sediment, groundwater, and surface water were sampled. PCBs and PAHs were detected in soil at former ponded/waste areas. Three monitoring wells and a groundwater seep were also sampled. PCBs were detected in all wells, and PAHs were detected in MW-03. PCBs were not detected in the seep sample.	Analytical results of this investigation were used to identify borehole locations and analyses for additional characterization at the site.	URS (1994)
Soil and water sampling	September 1995	Ecology & Environment (for EPA)	Seven surface soil samples were collected from locations near the ponded area, former railroad tank car, and storm drain ditches. One water sample was collected from inside sump. Samples were analyzed for PCBs and PAHs.	Impacted soil, catch basin sediment, and the former railroad tank car have been removed from the site to date.	EMCON (1996)
Focused site characterization	July 1997	SECOR International, Inc. (for site owner)	Soil was sampled for PCBs, PAHs, TPH, and metals. Groundwater was sampled for PCBs, TPH, and TSS. Floating product was sampled in August 1996. Exploratory borings were made. Much of the sampled soil was removed during the 1999 PCB removal action (Onsite 2000a).	The majority of the soil sampled during this investigation was removed during the subsequent 1999 PCB removal action. Deeper data representing soil from the beneath the removal area is still valid and is considered in this sampling plan.	SECOR (1997)
Removal actions, Malarkey dismantling	1996 to 1997	SECOR International, Inc. (for site owner)	Tank and equipment decommissioning, decontamination, and removal. Hot spot removals (soil from ditch areas, utility corridor). Removal of product from large-diameter well.	Some of these data are historical and no longer represent conditions at the site.	SECOR (1998)
Utility corridor soil sampling	October 1999	Onsite (for Port)	Three borehole locations were sampled along a utility alignment that extended from the former tank area to the south building. PCB concentrations ranged from 0.77 to 15 mg/kg.	The utility corridor contents have been removed, backfilled with concrete, and paved over with asphalt.	Windward and Onsite (2004)
Underground diesel storage tank removal	January 2000	Onsite (for EPA)	A 375-gal (1,420-L) non-leaking diesel tank was removed. Two soil samples from excavation indicated elevated TPH diesel levels (462 and 2780 mg/kg). Other sample concentrations were non-detect.	Elevated TPH concentrations at south side of Areas C and D to be investigated further.	Onsite (2000b)

ACTIVITY	DATE	INVESTIGATOR	SUMMARY	RELEVANCE TO PLANNED INVESTIGATION	SOURCE
PCB soil removal and containment – roadway area	October 1999 to February 2000	Onsite (for EPA)	Actions included the removal and treatment of impounded stormwater, excavation and disposal of over 2,000 tons of PCB-contaminated soil ranging up to 500 mg/kg, backfilling, installation of pavement cap, and storm drain improvements. Abandonment of large-diameter well and replacement of three monitoring wells. PCB cleanup objective in soil was 25 mg/kg.	Data from this program included confirmatory PCB sampling in the removal area for grids where previous data (SECOR 1997) did not indicate a sufficiently low target PCB concentration at depth. These data are still relevant and are considered in this program.	Onsite (2000a)
Soil, catch basin, drainage ditch, and shoreline bank sampling	December 2003	Windward, DOF, and Onsite (for the Port/City under EPA agreement)	This program included advancing soil borings along the T-117 shoreline to: generate chemical and geotechnical data to determine the vertical extent of soil impacted by PCBs along the shoreline for source control evaluation during and after removal, to determine whether PAHs were present in the bank, to assess the potential for contamination to the sediment and to establish the general engineering characteristics of the shoreline soil. Boreholes SB-1 through SB-6 were sampled at depth intervals 0-1.5, 2.5-4.0, 5.0-6.5, 7.5-9.0, 12.5-14 and 17.5-19 ft.	All results of the investigation are relevant to the planned investigation. Results were considered in developing sampling approaches in the vicinity of the boreholes.	Windward et al. (2005b)
Subsurface and surface sediment, soil boring and catch basin sampling	March 2004	Windward, DOF, and Onsite (for the Port/City under EPA agreement)	To better define the removal boundary, additional subsurface and surface sediment samples were collected from the northern portion of the T-117 and shallow soil borings were collected from the northern upland bank. All these samples were analyzed for PCBs and compared to SMS. Soil sampling was also conducted to estimate the concentrations of PCBs in the roadway along the entrance area of the T-117 property and evaluate if these materials are the likely source of elevated PCBs in and around catch basin 5. Roadway soil samples and catch basin samples were analyzed for PCBs. These results were used to delineate the preliminary removal boundary.	The results of these various characterization efforts are being used to support placement of boreholes in this planned investigation as well as providing a basis for the analytical program to be used.	Windward et al. (2005b)
Upland street dust and road right-of-way sampling	July through December 2004	Seattle Public Utilities (SPU)	PCB concentrations exceeding the state Model Toxics Control Act (MTCA) soil cleanup level for unrestricted use (1 mg/kg PCBs) were detected in a number of the street dust, catch basin and roadway samples.	Results of this sampling event are being used to support location of the additional boreholes planned for this characterization effort.	http://www.seattle.gov/util SPU drainage and sewer system data

ACTIVITY	DATE	INVESTIGATOR	SUMMARY	RELEVANCE TO PLANNED INVESTIGATION	SOURCE
South building planter soil sampling	November 2004	Onsite (for the Port/City under EPA agreement)	Four shallow soil grab samples were obtained from the concrete-enclosed soil-filled planter areas at the north side of the south building at T-117. PCB concentrations in the four soil samples ranged from 0.03 to 0.22 mg/kg. Soil in the west planter was subsequently covered over with a layer of clean gravel. Soil in the east planter was covered with asphalt pavement.	Sampling results indicate shallow soil in these planter areas are not a concern (< 1.0 mg/kg) and do not have to be evaluated further.	Onsite (2004)
Upland soil sampling	June 2005	Windward, Onsite, and DOF (for the Port/City under EPA agreement)	Soil borings and direct push probes were used to collect soil samples. All soil and groundwater samples were analyzed for PCBs. Five soil samples from beneath the pavement along the shoreline edge of the site contained the highest PCB concentrations, which ranged from 530 to 1,400 mg/kg.	Results of this sampling event are being used to support location of the additional boreholes planned for this investigation.	Windward et al. (2005c)
Additional upland soil sampling	August 2005	Windward, Onsite, and DOF (for the Port)	Supplemental upland soil sampling was conducted from 26 moderate-depth soil borings (0 to 9 ft) and analyzed for total PCBs. Three soil samples (SB-26, SB-51 and SB-28) along the northern shoreline contained similar PCB concentrations to the previous upland sampling effort in the same area. Two soil samples located in the paved driveway area inboard of the bank extending north of the 1999 PCB removal area revealed two of the highest PCB concentrations, which were 1,200 and 730 mg/kg for soil samples SB-30 and SB-50, respectively. These data identified a new area of elevated PCB contamination on the T-117 site not previously observed in the June 2005 soil sample results.	Results of this sampling event are being used to support location of the additional boreholes planned for this characterization effort.	Windward et al. (2005e)

- Sampling and covering of the planter area on the north side of the south building
- Clearing and placement of temporary gravel cover on shoreline bank adjacent to north driveway area

Figures 2-4 through 2-10 summarize the soil sampling data at the site prior to the implementation of this investigation effort and demonstrate the large amount of existing information already collected.

1984 Metro inspection

In 1984, the Municipality of Metropolitan Seattle (Metro) conducted an inspection of the LDW, which included portions of the T-117 site (URS 1994). Metro collected sediment and surface water samples from the waterway upstream and downstream of the site. Sediment and surface water samples were also collected from an "on-site holding pond," from the storm drain outfall, and from observed groundwater seeps that were discharging into the waterway. PCBs were detected in "sediment and water" (presumably a turbid grab sample) collected from the onsite roadway ponded area at 23 mg/L. The water sample collected from the storm outfall contained PCBs at 6.8 mg/L. Zinc was detected in onsite surface water up to 206 mg/L. It was concluded that the discharges from the site exceeded Washington State water quality standards for PCBs and zinc. Additional investigation was recommended to determine the source of PCBs and zinc at the site (EMCON 1996).

Relevance of data to proposed investigation – The results of this early investigation do not address potential data gaps because the roadway ponded area soil has been removed. However, the results do provide an indication of the potential types of contaminants that were present in the Upland Area at the time that the sediment and water samples were obtained.

1985 and 1986 Ecology inspections

Ecology conducted inspections at the site in 1985 and 1986 (URS 1994). During these inspections, Ecology identified "partially buried" USTs and ASTs and associated piping at the site. Areas of visibly stained surface soil were also noted. Ecology collected sediment samples from an onsite drainage ditch, believed to be the ditch that historically drained toward catch basin CB-5, at the south end of the roadway ponded area. The laboratory results of the sediment samples indicated that metals, including lead (1,666 mg/kg), arsenic (2,027 mg/kg), zinc (5,416 mg/kg), and cadmium (11 mg/kg), were detected. The results of the investigation prompted Ecology to mandate additional investigation at the site through an enforcement action; however, the Malarkey Asphalt Company appealed based on economic hardship, and the investigation was never conducted (EMCON 1996; Parametrix 1991).

Relevance of data to proposed investigation – The impacted sediment noted in this investigation from the onsite drainage ditch was removed from the site, and the ditch was filled and covered with asphalt. Based on this historic data, a borehole will be installed in the vicinity of the former drainage ditch during this investigation for additional characterization.

1989 EPA TSCA inspection

EPA conducted a Toxic Substances Control Act (TSCA) inspection in 1989. Samples were collected from a waste oil tank and another tank containing usable light oils. One of the sampled tanks was the tank that was formerly located at the north side of the south building (believed to be used for a time to store asphalt and later used for waste oil storage by Basin Oil). It is unclear from available reports which of the additional tanks at the facility were sampled at this time. No PCBs were detected, although total halogens were detected in samples at levels up to 1,160 mg/L total chlorine in one tank (Hart Crowser 1992). Halogens are not unexpected because the recycling activities associated with Basin Oil at the time included the handling of saline bilge waters. The contents of the partially buried railroad tank car were not sampled during the TSCA inspection. No PCB-related activities were identified in the TSCA report (EMCON 1996; URS 1994).

Relevance of data to proposed investigation – These tanks and the partially buried railroad tank car were subsequently removed. The tank contents that were sampled are no longer present, so the data are no longer applicable. Boreholes are planned upgradient and downgradient of the former tank locations to further characterize the immediate vicinity.

1991 Ecology site hazard assessment

A site hazard assessment was performed in May 1991 under the Model Toxics Control Act (MTCA) by Parametrix and SAIC (Parametrix 1991). The project site was given a ranking of 1 on a scale of 1 (for highest risk) to 5 (for lowest risk). The site assessment included a review of Ecology’s files, Malarkey Asphalt’s files, and fieldwork. The scope of the fieldwork included the drilling and installation of three monitoring wells (MW-01, original MW-02, and original MW-03), soil sampling and analysis during the drilling activities, and groundwater sampling and analysis. The fieldwork also included sampling product in the USTs and ASTs.

The laboratory results of the samples indicated that metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including PAHs, and PCBs were present beneath the site at depths ranging from 1 to 6 ft (0.3 to 1.8 m) below ground surface (bgs). VOCs, heavy metals, PCBs, pesticides, and SVOCs reportedly were detected in all matrices analyzed. The toxicity characteristic leaching procedure (TCLP) results for metals indicated that all sample results were below the Washington State Dangerous Waste Criteria (EMCON 1996; URS 1994).

Relevance of data to proposed investigation – A large volume of the impacted soil identified during the 1991 investigation was subsequently removed during the 1999 PCB removal action. The locations and results of the 1991 sampling investigation are being taken into consideration for borehole placement and sample analysis for this investigation. Phthalates and pesticides were detected in the vicinity of original monitoring wells MW-02 and MW-03 during the 1991 sampling event. These constituents will be included in the analyses for soil samples obtained from the former roadway area (vicinity of MW-02 and MW-03) to further characterize the site.

1992 UST decommissioning

Hart Crowser decommissioned three USTs at the site in 1992 (Hart Crowser 1992; URS 1994). The decommissioned tanks included two 4,000-gal (15,000-L) waste oil USTs and one 10,000-gal (38,000-L) diesel UST. One 12,000-gal (45,000-L) partially buried railroad tank car was also decommissioned by removal. The three USTs, which are located under the small office/carport inside the north gate, were closed in place by filling with concrete slurry. The contents of the railroad tank car (waste oil) were also pumped out and placed into 55-gal (208-L) drums.

Hart Crowser collected three soil samples from beneath each of the three closed-in-place USTs before abandoning the tanks. Soil samples were also collected from the former diesel pump and product line area (located off the northwest corner of the building that is north of the former tank farm). The laboratory results indicated that diesel- and bunker C-range petroleum hydrocarbons were detected in one sample collected from beneath one of the 4,000-gal (15,000-L) USTs and in one sample collected from the pump/product line area. The UST samples and the pump/product line area sample also contained TPH at concentrations of 240 and 790 mg/kg, respectively (Figure 2-4). Hart Crowser also collected a soil sample from beneath the railroad tank car excavation. This sample contained TPH at 580 mg/kg. Although PCBs were detected in the sludge removed from the railroad tank car (66 mg/kg), the soil sample collected from beneath the railroad tank car was not analyzed for PCBs (EMCON 1996).

Relevance of data to proposed investigation – Except for the sample from beneath the excavated railroad tank car (soil was likely removed in 1999), all other confirmatory soil sampling results for tank closure/removal are still considered relevant to the planned program and are shown on Figure 2-4. During this investigation, additional soil borings will be advanced in the area immediately adjacent to the closed-in-place USTs and upgradient and downgradient of the former location of the buried railroad tank car. PCB, PAH, and TPH analyses will be performed to further characterize the soil within these areas. Soil from the vicinity of the closed-in-place tanks and other former tanks that at one time reportedly contained waste oil will also be analyzed for metals and checked for gas-range petroleum hydrocarbons.

1994 URS site inspection

In 1994, URS conducted an inspection of the site, which included onsite and offsite soil, sediment, groundwater, and surface sampling. This work was conducted for EPA as a result of concerns regarding potential surface water and groundwater contamination and onsite exposure identified in the preliminary assessment (Ecology & Environment 1990). URS collected three surface soil samples at depths ranging from 0 to 0.5 ft (0.15 m) bgs at locations where wastes were suspected (mainly near the former railroad tank car location and around the ponded area). Three additional samples were collected at the same locations at depths ranging from 1.5 to 2 ft (0.5 to 0.6 m) bgs. PCBs were detected in all three surface soil samples at concentrations ranging from 18 to 120 mg/kg. Subsurface soil samples also contained PCBs up to 180 mg/kg. PAHs were also detected in all three surface soil samples at concentrations up to 0.884 mg/kg chrysene. PAHs were only detected at depth in two of the three sampling locations (EMCON 1996).

Relevance of data to proposed investigation – Much of the impacted soil identified above was subsequently removed from the former roadway ponded area during the 1999 PCB removal action. However, boreholes will be advanced in the vicinity of the former railroad tank car and into the soil beneath the 1999 PCB removal area to further characterize the current conditions at the site.

1996/1997 Malarkey Asphalt Plant decommissioning

In 1996, EMCON prepared a removal action work plan for additional work in response to the Administrative Order on Consent (AOC) for Removal Action between EPA Region 10 and the Malarkey Asphalt Company (April 26, 1996). Activities addressed in the work plan included additional asbestos survey and abatement for the asphalt plant, interim stormwater controls, plant tank and equipment decommissioning, and hot spot soil removal. The plan also described proposed additional investigations of the former roadway ponded area and the former tank farm.

Approximately 20 ASTs were reportedly cleaned and removed from the site. Tanks and contents were inventoried, contents were sampled, and procedures for cleaning were developed. Two tanks that served as blowing stills were cleaned and retained for future use. All other tanks were demolished and shipped offsite for recycling. Extensive disassembly and cleaning of plant piping and equipment was also conducted. Approximately 1.2-in. of floating product were observed on the surface of the water in the large-diameter well and were removed during the plant decommissioning (EMCON 1996; SECOR 1998).

Relevance of data to proposed investigation – Although the tanks have been removed from the T-117 property, several boreholes will be installed upgradient and downgradient, as applicable, to the location of the former tank farm. One borehole will also be installed through the tank farm concrete pad (still in place beneath the asphalt pavement) to examine the soil quality beneath the slab in the vicinity of tanks known to have contained oil. Although the pad appeared to be in good condition prior to being paved over by the Port in 2000, the possibility exists that plant operations prior to the construction of the pad may have resulted in releases to this area. For example, one early report of a spill (Washington State Pollution Control Commission 1946) refers to a release of 5,000 gal of oil from an unspecified tank at the Duwamish Manufacturing Company facility. Samples will be analyzed for PCBs, PAHs, and TPH, along with metals that are commonly found in waste oil in certain locations since used or waste oil was stored in ASTs within the former tank farm, as shown in Figure 2-2.

1997 SECOR focused site characterization

In further response to the 1996 AOC, SECOR International, Inc. (SECOR) conducted a focused site characterization at the Malarkey site for the Malarkey Asphalt Company's legal counsel (SECOR 1997). The work was based on the draft removal action work plan (EMCON 1996) and subsequent refinements agreed to with EPA. The scope of work included subsurface (core) soil sampling from grid locations in the former roadway ponded area (Port property), soil sampling from the former drainage ditch area, subsurface soil sampling from five locations in the vicinity of a former waste oil UST and associated piping, and the collection of subsurface soil samples. Soil samples were analyzed for PCBs, PAHs, TPH, and six metals (arsenic, copper, cadmium, chromium, lead, and zinc). Results indicated that PCBs were present in shallow soil throughout the former roadway ponded area on the Port property (Figure 2-5). PCB concentrations ranged up to 531 mg/kg. PAHs were not detected above the then-established Method C industrial cleanup levels and were not considered to be chemicals of concern. Results for soil sampling near the waste oil UST (sample locations SB-UA, SB-UB, and SB-UC in Area D [Figure 2-5]) found PCBs at less than 20 mg/kg, and investigators concluded that soil removal was not necessary.

Relevance of data to proposed investigation – Impacted soil identified in the roadway area (Figure 2-5) estimated to be at concentrations above the then-established target cleanup level of 25 mg/kg was subsequently removed as part of the 1999 PCB removal action. Results of the SECOR investigation analyses from soil beneath the removal area that remained in place are still relevant to this investigation and are presented in Appendix B and shown on Figure 2-6 (for PCBs) and Figures 2-4 and 2-7 (for TPH and PAHs, respectively).

1999 Port of Seattle PCB soil removal/containment action

The Port, under EPA oversight, implemented the removal and containment of PCB-contaminated soil in the upland portion of the T-117 and Malarkey Asphalt site in the fall of 1999 (Onsite 2000a), hereafter referred to as the 1999 removal action. The work included the removal and treatment of impounded stormwater in the roadway ponded area, excavation and disposal of over 2,000 tons of PCB-contaminated soil, backfilling, installation of storm drain improvements, and site paving. The soil removal criterion for the project was 25 mg/kg. A grid was developed to delineate excavation cells, with the excavation depth of each cell being determined by the PCB sampling results for the borehole installed as part of the 1997 SECOR focused site characterization. Verification testing was performed in portions of the 1999 removal area where PCB concentrations previously detected in the deepest borings sampled in

1997 (SECOR 1997) still exceeded the removal criterion. Soil was tested until the removal criterion was met. These results, together with the useable data from the 1997 SECOR investigation, serve as the confirmatory data set for soil in the 1999 removal area as shown in Figure 2-6. Table 2-2 presents the excavation depths, the remaining SECOR samples, and the verification samples associated in each grid cell. Soil beneath the concrete pad located in grid A-1 (southwest corner of Area C) was never excavated, and a confirmatory sample was not obtained from grid B-1. Remaining soil in the vicinity of B-1 will be re-examined through samples obtained as part of this investigation.

Table 2-2. 1999 PCB removal grid excavation depths and relevant samples

Grid Cell	Excavation Depth (ft)	Relevant 1997 SECOR Samples and 1999 Verification Grab Samples		
		Location ID	Sample Depth (ft)	PCB Result (mg/kg)
A-1	0.3	SB-A1	**0.5**	**31.5**
			2.0	**33.7**
A-2	3.5	SB-A2	2.0	0.385
			4.8	**2.9**
		SG-A2[a]	**5.0**	**0.50 U**
A-3	0.5	SB-A3	**2.0**	**0.619**
			4.8	**0.268**
A-4	5.0	SB-A4	2.0	51.4
			3.5	0.726
B-1	6.0	SB-B1	2.0	1.49
			4.5	0.344
B-2	0.5	SB-B2	**2.0**	**0.433**
			3.5	**0.221**
B-3	0.5	SB-B3	**2.0**	**0.0792**
			3.5	**6.8**
B-4	5.3	SB-B4	2.0	85.1
			4.8	0.360
		SG-B4 (SE)[a]	**4.0**	**7.18**
		SG-B4 (SW)[a]	**4.0**	**50.0**
C-1	0.5	SB-C1	**2.0**	**2.42**
			3.5	**0.77**
C-2	4.0	SB-C2	2.0	70.5
			3.5	0.0942
C-3	0.5	SB-C3	**2.0**	**5.64**
			3.5	**0.050 U**
C-4	4.0	SB-C4	2.0	109
			3.5	18.5
D-1	2.5	SB-D1	0.5	41.2
			3.5	0.162
D-2	2.5	SB-D2	0.5	29.5
			3.5	**0.050 U**

Grid Cell	Excavation Depth (ft)	Relevant 1997 SECOR Samples and 1999 Verification Grab Samples		
		Location ID	Sample Depth (ft)	PCB Result (mg/kg)
D-3	5.5	SB-D3	0.5	18.3
			3.5	531
		SG-D3[a]	**4.0**	**0.71**
D-4	0.5	SB-D4	0.5	15.3
			3.5	**0.107**
E-1	2.5	SB-E1	0.5	268
			3.5	**1.66**
E-2	2.5	SB-E2	0.5	64.1
			3.5	**0.137**
E-3	2.5	SB-E3	0.5	110
			3.5	**0.0565**
E-4	0.5	SB-E4	**2.0**	**0.252**
			3.5	**0.149**
F-1[b]	0.5	na	na	na
F-2	2.5	MW4	1.0	183
		SG-F2[a]	**2.5**	**19.3**[c]
MW-2	5.5	SB-MW2[d]	1.5	370
			3.0	600
			4.5	2.7
MW-3	3.5	SB-MW3[d]	1.5	170
			3.0	50
			4.0	**6.2**
			4.5	**1.8**
MASS03	4.0	SG-MASS03[a]	**4.0**	**0.50 U**
MASS04	4.0	SG-MASS04[a]	**4.0**	**0.50 U**

[a] Post-excavation verification samples. Analyses by TEG Mobile Laboratory as reported in the final soil removal report (Onsite 2000a).

[b] Surface grading removal only; no verification sample required.

[c] Averaged with field duplicate or replicate.

[d] Samples collected as part of the site hazard assessment (Parametrix 1991).

Bold values indicate relevant and current soil conditions; non-bold values indicate excavated soils.

na – not applicable

U – undetected

Three shallow monitoring wells (MW-02, MW-03, and MW-04) were abandoned to allow for excavation and replaced once the project work was completed. A large-diameter industrial water supply well located at the site (referred to in some reports as a sump) was also abandoned after it was inspected and determined not to contain product. The completion of this work resulted in the present-day configuration of the site.

The presence of an underground diesel fuel storage tank filling port was detected at the site near the southeast corner of Area D (Figure 2-2) during the 1999 removal action, and the tank was removed. The tank was located west of the south end of the removal area and was a 375-gal, single-walled metal UST that was determined to be non-leaking by direct observation of the condition of all surfaces of the removed tank while suspended by a hoist. No holes were observed in the tank walls, other than those installed in the top of the tank for accessing contents. As indicated on the drawings, the tank was present in Area D. Two soil samples taken from the excavation detected elevated TPH-diesel concentrations (462 and 2,780 mg/kg). Other samples did not contain detectable concentrations of TPH (Onsite 2000b). These data are still applicable and are presented on Figure 2-4.

Relevance of data to proposed investigation – PCB testing data from this project, together with the previous data developed by SECOR for soil remaining beneath the soil removal area (Figure 2-6) is still relevant to current conditions at the site and was considered in developing sampling program rationale. Boreholes will be advanced within the footprint of the 1999 removal action area to further characterize the underlying soil. Samples will include analysis for PCBs, PAHs, TPH, and pesticides, DDT, DDD, aldrin, and dieldrin. Boreholes will also be advanced in the vicinity of the location of the former diesel fuel tank (removed during the 1999 removal action) to provide additional analytical information regarding TPH and other contaminants in the vicinity.

South building planter soil sampling

Surface soil sampling in the two long, narrow planter-shaped areas at the north side of the south building located on T-117 occurred on November 23, 2004. Four locations (stations PL-1 through PL-4 [Figure 2-8]) were sampled to a depth of 3 in. to determine PCB concentrations in the soil for the purpose of evaluating disposal requirements. All samples were analyzed for PCBs. Only Aroclor 1260 was detected at concentrations ranging from 0.03 to 0.26 mg/kg.

Relevance of data to proposed investigation – The results of this limited investigation indicate that soil inside the small planter areas does not require further investigation.

2003 catch basin, drainage ditch, and shoreline bank sampling

Samples were collected from catch basins 1 and 5 at T-117 in early December 2003 to evaluate the potential for PCB contamination from the catch basins to the sediment. Sediment samples were collected from the bottom of catch basin 1; from the catch basin and surrounding soil at catch basin 5; and from the drainage ditches located on the extreme southern end of the site. Catch basin soil and sediment samples and drainage ditch soil samples were analyzed for total PCBs, metals, and SVOCs. These results are summarized in Appendix B.

In early March 2004, roadway and catch basin sediment samples were collected from catch basins 4 and 6. Soil sampling was also conducted to estimate the concentrations of PCBs in the roadway along the south gate entrance to the T-117 property and to evaluate if these materials were the likely source of elevated PCBs in and around catch basin 5. Roadway soil samples and catch basin samples were analyzed for PCBs. These results are summarized in Appendix B.

Relevance of data to proposed investigation – Catch basins are routinely cleaned out as part of the Port's ongoing source control program at T-117, so the data for historical materials are not directly pertinent to the proposed investigation. The PCB, TPH, and PAH data for the samples obtained from the drainage ditch area at the extreme south end of the site (near the shoreline) are still relevant, and the results are shown on Figures 2-4, 2-7, and 2-8.

Upland soil sampling – December 2003 and March 2004

Soil borings were installed in December 2003 to a depth of 15 to 20 ft bgs using a drill rig, and eight more shallow borings were completed along the northern bank of the T-117 property in March 2004. The March soil borings were advanced using a hand-held auger, which has a practical depth limit of approximately 1.5 to 2 ft. Soil borings were advanced along the shoreline to generate chemical and geotechnical data in order to determine the vertical extent of soil impacted by PCBs along the shoreline. These data were then used to conduct a source control evaluation to determine whether PAHs were present in the bank, assess the potential for sediment contamination, and establish the general engineering characteristics of the shoreline soil in order to assess the constructability of potential removal actions.

Soil boring samples from the initial effort were analyzed for total PCBs, PAHs, total solids, and TOC. Elevated PCB concentrations were detected in all six areas but dominated in the northern end of the site. Thirty-three soil boring samples were analyzed for PAHs. Two samples, SB-4 (at the 5- to 6.5-ft depth interval) and SB-3 (at the 2.5- to 4-ft depth interval) had elevated PAH concentrations of 53 and 20.8 mg/kg, respectively.

Relevance of data to proposed investigation – The highest PCB concentration was detected at the northernmost end of the T-117 upland property boundary. These results are summarized in Appendix B and are shown on Figures 2-9 and 2-10. PCB data collected during the above investigation were used to support the locations of additional boreholes to be installed during this investigation.

Seattle Public Utilities upland street dust and road right-of-way sampling

Surface soil and street dust samples were collected by Seattle Public Utilities (SPU) from July through December 2004 (City of Seattle 2005), as shown on Figures 2-6, 2-8, and 2-9. Results indicate that concentrations of PCBs exceeding the state MTCA soil cleanup level for unrestricted use (1 mg/kg PCBs) were detected in a number of the street dust, catch basin, and roadway samples (see the SPU Web site: www.seattle.gov/util/southpark). In December 2004, the City implemented extensive interim source control measures and is now working with EPA and Ecology to develop longer-term solutions. Interim measures included removing contaminated soil from roadway shoulders and replacing it with clean gravel along Dallas Avenue S;

grading and paving the 17th Avenue S, S Donovan Street, and Dallas Avenue S roadways; and installing a temporary stormwater collection and treatment system to control stormwater runoff from the newly paved roadways.

Relevance of data to proposed investigation – Although this investigation will not include the area analyzed by SPU, boreholes (including borehole B-8 near the north entrance to T-117) will be installed near the property line to help assess the potential impact of soil contaminants in areas adjacent to T-117. Results will be compared to the SPU findings.

Upland soil sampling – June 2005

Upland soil sampling was conducted in June 2005, and subsurface soil samples were collected from three upland regions of T-117: the unpaved upland area along the northern shoreline; beneath the pavement along the shoreline edge of the site; and the ditch along the southern boundary of the site (adjacent to the Boeing property) (Windward et al. 2005c). The program included sampling from push probe stations PD-1 through PD-8 and PS-1 through PS-12 and soil borehole stations SB-15 through SB-18 (Figures 2- through 26, and 2-8 through 2-10 and Exhibit A). Two new groundwater monitoring wells were also installed to extend the existing network northward and facilitate sampling from wells along the entire shoreline. All shoreline monitoring wells and upgradient MW-03 were also monitored for the presence of free product.

A geophysical survey was conducted along the eastern portion of the shoreline paved area to delineate the fill placed as part of the 1999 removal action. The primary focus of this investigation was to field-locate and re-verify the limits of the 1999 removal area in order to properly position borehole stations in the vicinity. All soil and groundwater samples were analyzed for PCBs. Five soil samples from beneath the pavement along the shoreline edge of the site contained the highest PCB concentrations, which ranged from 530 to 1,400 mg/kg at PS-5 and PS-7, respectively (see Figure 2-10).

Relevance of data to proposed investigation – Results from this sampling event reflect current conditions at the site and have been used to support the positioning of planned boreholes and the selection of analytes for this investigation. Samples from these boreholes will be used to further characterize the PCB-impacted soil, examine the presence and concentration of other contaminants, and provide more information to support the anticipated future upland removal action.

Additional upland soil sampling – August 2005

Additional upland soil sampling was conducted independently by the Port in August 2005 to collect supplementary subsurface soil data to delineate the lateral and vertical extent of elevated PCB contamination (Windward et al. 2005e). Samples were collected from the bank and the paved driveway area inboard of the bank extending north of the 1999 removal area. Soil samples were collected from 26 moderate-depth soil borings (0 to 9 ft) and analyzed for total PCBs only. This series encompassed boreholes SB-19 through SB-41 and SB-50 through SB-52 (Figures 2-9 and 2-10 and Exhibit A).

Three soil samples (SB-26, SB-51, and SB-28) along the eastern shoreline contained PCB concentrations similar to those from the previous upland sampling effort in the same area (June 2005). Two soil samples located in the paved driveway area inboard of the bank north of the 1999 removal area revealed two of the highest PCB concentrations (1,200 and 730 mg/kg for soil samples SB-39 and SB-50, respectively).

Relevance of data to proposed investigation – These data are relevant to the proposed investigation because they presented a new area of elevated PCB contamination on the T-117 site not previously observed in the June 2005 soil sample results. Planned boring locations have been identified using the analytical information gathered during this August 2005 effort.

Septic tank sampling

A grab sample from the floating solids layer present in the underground septic tank at the side of the north building (Figure 2-2) was obtained in December 2005 and submitted for PCB and silver analysis. Results indicated elevated PCBs (11 mg/kg as Aroclor 1260) and a silver concentration of 2.3 mg/kg. The presence of PCBs indicates that the tank contents will need to be addressed as part of the eventual upland remedial action. The silver concentration is at the lower end of the range of silver typically found in sanitary septage (Ecology 2001) and is therefore not believed to be a concern for soil in the drain field area.

Relevance of data to proposed investigation – Silver is not retained as an upland soil analyte.

3.0 Sampling Design and Analytical Program Development

This section presents a detailed discussion of the sampling program design scheduled to be implemented at the uplands portion of T-117. This section also discusses the technical rationale for the analytical program developed for use during this investigation effort.

For purposes of planning and organizing this investigation, the upland portion of T-117 has been divided into six distinct areas based on site operation history, physical location, and previous investigations (see Figure 2-2 and Exhibit A). The six areas are:

- Area A – North lot
- Area B – North driveway
- Area C – 1999 PCB removal area
- Area D – Former asphalt plant operations area
- Area E – South driveway

- Area F – South building

In addition to the area-specific discussion, this section also provides a list of the potential chemicals of concern at T-117 and the general assumptions and rationale for their inclusion in this investigation program.

3.1 T-117 AREA DESCRIPTIONS AND SAMPLING RATIONALE

Table 3-1 summarizes the six study areas within T-117 providing the approximate square footage of each area, the number of existing borehole stations and samples from previous investigations, and the number of boreholes and samples for this soil investigation. Table 3-2 identifies each borehole location to be installed within the study areas and includes the list of analytes to be assessed and highlights the rationale for each borehole placement. Additional details on analyte selection are provided in Section 3.3.

Table 3-1. Summary of investigation areas and sampling history

Study Area	Expected Subsurface Conditions	Area (sq ft)	Number of Previous Boreholes/ Samples[a]	Number of Proposed Boreholes/ Samples[b]	Number of Proposed Analytes							
					PCBs	PAHs	TPH-Dx	HCID/ TPH-G[c]	Metals Analyses		Phthalates	Pesticides
									Select[d]	Metals[e]		
Area A – North lot	asphalt pavement, fill	19,833	13 / 50	10 / 28[f]	28	28	28	0	6	0	0	0
Area B – North driveway	asphalt pavement, fill, debris, possible septic drain field	26,348	35 / 118	8 / 34	34	34	21	13 / 13	16	0	0	0
Area C – 1999 PCB removal area	asphalt pavement, crushed rock, quarry spalls, fill, debris	20,855	21 / 31	8 / 46	46	46	46	0	18	16	6	10
Area D – Former asphalt plant Operations area	asphalt pavement, concrete foundations, fill, debris	31,947	3 / 6	11 / 58	58	58	52	6 / 6	29	16	3	0
Area E – South driveway	asphalt overlay, concrete driveway, fill	8,695	2 / 10	3 / 19	19	19	19	0	10	6	10	0
Area F – South building	concrete foundation, fill	23,376	1 / 5	9 / 32	32	32	32	0	0	6	0	0
Total		**131,054**	**75 / 220**	**49 / 217**	**217**	**217**	**198**	**19 / 19**	**79**	**44**	**19**	**10**

[a] Includes only borehole samples collected after 1998 that have not been excavated.

[b] Proposed sample number does not include duplicates and/or rinsate blanks.

[c] HCID analyses will be completed first; TPH-G (or TPH-Dx) analyses, as appropriate, will be performed pending results of HCID screen.

[d] Select metals includes arsenic, lead, chromium and zinc.

[e] Metals includes the four select metals (arsenic, lead, chromium, and zinc) plus cadmium and copper.

[f] Total includes one soil grab sample (A-10).

Table 3-2. Borehole locations and sampling program rationale

LOCATION ID	EASTING	NORTHING	SAMPLING METHOD[a]	DEPTH (ft)[b]	ANALYTES[c]	SAMPLING RATIONALE
Area A – North Lot						
A-1	1275105	195734	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the north lot and adjacent to the property boundary with the South Park Marina.
A-2	1275132	195701	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the central portion of the north lot.
A-3	1275175	195698	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the north lot adjacent to the north building foundation.
A-4	1275240	195697	HSA	6.5	PCBs, PAHs, TPH, select metals	Evaluate concentrations of contaminants in addition to PCBs (previously characterized by other boreholes in vicinity). Re-evaluate PCB concentrations.
A-5	1275087	195702	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the north lot and adjacent to the property boundary with the South Park Marina.
A-6	1275107	195656	HSA	6.5	PCBs, PAHs, TPH, select metals	Evaluate potential presence and concentration of contaminants in soil beneath the central portion of the north lot.
A-7	1275160	195666	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the north lot adjacent to the north building foundation.
A-8	1275062	195663	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the north lot and adjacent to the property boundary with the South Park Marina.
A-9	1275142	195623	HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the north lot adjacent to the north building foundation.
A-10	1275122	195777	hand auger	1.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in shallow soil in South Park Marina bank area on opposite side of facility boundary from SB-14.
Area B – North Driveway						
B-1	1275284	195664	HSA	6.5	PCBs, PAHs, TPH, select metals	Delineate elevated concentrations of PCBs in shallow soil observed in surrounding boreholes. Evaluate potential presence and concentration of additional contaminants in soil.
B-2[d]	1275339	195631	HSA	14.0[d]	PCBs, PAHs, TPH	Delineate elevated concentrations of PCBs in shallow soil observed in surrounding boreholes including observations in PS-7. Evaluate potential presence and concentration of additional contaminants in soil.
B-3	1275336	195600	HSA	6.5	PCBs, PAHs, TPH	Delineate elevated concentrations of PCBs in shallow soil observed in surrounding boreholes. Evaluate potential presence and concentration of additional contaminants in soil.

LOCATION ID	EASTING	NORTHING	SAMPLING METHOD[a]	DEPTH (ft)[b]	ANALYTES[c]	SAMPLING RATIONALE
B-4	1275345	195570	HSA	6.5	PCBs, PAHs, TPH	Delineate elevated concentrations of PCBs in shallow soil observed in boreholes to the west. Evaluate potential presence and concentration of additional contaminants in soil.
B-5	1275313	195557	HSA	6.5	PCBs, PAHs, TPH	Delineate elevated concentrations of PCBs in shallow soil observed in nearby boreholes. Evaluate potential presence and concentration of additional contaminants in soil.
B-6	1275236	195582	HSA	6.5	PCBs, PAHs, TPH	Evaluate concentrations of contaminants of concern in soil in vicinity of septic tank.
B-7[d]	1275265	195541	HSA	14.0[d]	PCBs, PAHs, HCID, TPH-G, select metals	Check for elevated PCB concentrations at depth similar to those observed in borehole to the north and at elevation near estimated bottom of USTs. Evaluate TPH, PAH, and select metals in soil near the facility entrance and septic tank and adjacent to closed-in-place USTs. Borehole location will be advanced to the groundwater table or bottom of contamination, as appropriate.
B-8	1275214	195542	HSA	6.5	PCBs, PAHs, select metals, HCID, TPH-G	Check for contaminants near facility's north entrance in the vicinity of the previous SPU sampling locations in Dallas Ave S and adjacent to the closed-in-place USTs.
Area C – 1999 PCB Removal Area[e]						
C-1[d]	1275453	195502	HSA	14.0[d]	PCBs, PAHs, TPH	Delineate elevated PCB concentrations observed at depth in nearby borehole PS-10. Evaluate concentrations of other contaminants. Borehole will be extended to 14.0 feet to provide additional geology/hydrogeology information to support the in-water design effort.
C-2[d]	1275475	195468	HSA	14.0[d]	PCBs, PAHs, TPH	Delineate elevated PCB concentrations observed at depth in nearby borehole PS-10. Evaluate concentrations of other contaminants. Borehole will be extended to 14.0 feet to provide additional geology/hydrogeology information to support the in-water design effort.
C-3[e]	1275409	195520	HSA	9.0[e]	PCBs, PAHs, TPH, pesticides, metals	Evaluate residual PCB concentration beneath 1999 removal area. Check for concentrations of other contaminants. Pesticides will be included at this location to confirm results from prior sampling.
C-4[d,e]	1275484	195394	HSA	14.0[d,e]	PCBs, PAHs, TPH, pesticides, metals	Delineate depth and confirm nature of TPH contamination observed at this location. Evaluate concentrations of other contaminants. Pesticides will be included at this location to confirm results from prior sampling. Borehole location will be advanced to the groundwater table or bottom of contamination, as appropriate.

Location ID	Easting	Northing	Sampling Method[a]	Depth (ft)[b]	Analytes[c]	Sampling Rationale
C-5[d,e]	1275487	195358	HSA	14.0[d]	PCBs, PAHs, phthalates, TPH, select metals	Evaluate residual PCB concentration beneath 1999 removal area and ditch alignment (boundary between Areas D and E). Check for concentrations of other contaminants. Borehole location will be advanced to the groundwater table or bottom of contamination, as appropriate.
C-6[d,e]	1275438	195424	HSA	14.0[d,e]	PCBs, PAHs, TPH, select metals	Evaluate residual PCB concentration beneath 1999 removal area. Check for concentrations of other contaminants. Pesticides will be included at this location to confirm results from prior sampling. Borehole location will be advanced to the groundwater table or bottom of contamination, as appropriate.
C-7[d,e]	1275460	195391	HSA	14.0[d,e]	PCBs, PAHs, TPH, select metals	Evaluate soil conditions in the vicinity of the former railroad tank car location. Borehole location will be advanced to the groundwater table or bottom of contamination, as appropriate.
C-8[d]	1275473	195354	HSA	6.5 (option to 14.0)[d,e]	PCBs, PAHs, TPH, metals	Delineate contamination in area not previously excavated due to presence of concrete pad and ditch alignment (boundary between Areas D and E). Boring may be advanced to greater depth based on the observations at boring C-5.
Area D – Former Asphalt Plant Operations Area						
D-1	1275344	195508	CC and HSA	6.5	PCBs, PAHs, TPH	Evaluate contaminants in soil beneath the former warehouse foundation.
D-2	1275389	195440	CC and HSA	16.5	PCBs, PAHs, TPH	Evaluate contaminants in soil adjacent to abandoned large-diameter well. Evaluate stratigraphy and potential contaminants in deeper strata (to 16.5 ft).
D-3[d]	1275435	195383	CC and HSA	14.0[d]	PCBs, PAHs, TPH, select metals	Evaluate contaminants in soil beneath the former warehouse foundation and upgradient of former buried tank location in Area C. Location will also help support delineation the boundary of the 1999 soil removal area.
D-4	1275301	195518	HSA	6.5	PCBs, PAHs, HCID, TPH-G, select metals, phthalates	Evaluate contaminants in soil in north portion of former plant roadway area and in proximity to closed-in-place USTs. In addition to PCBs and PAHs, the samples will be analyzed for TPH-HCID and potentially TPH-G because of the former UST. Phthalates and select metals will also be evaluated at this location because it is a former storm drainage pathway.
D-5	1275374	195411	HSA	6.5	PCBs, PAHs, TPH	Evaluate contaminants in soil in central portion of former plant roadway area and near the former location of the hot oil heater.
D-6[d]	1275391	195367	HSA	14.0[d]	PCBs, PAHs, TPH, metals	Determine vertical extent of TPH and other contaminants near former UST sample location SB-UA at an elevation near the bottom of the UST.
D-7[d]	1275417	195329	HSA	14.0[d]	PCBs, PAHs, TPH, select metals	Evaluate contaminants in soil in south portion of former plant roadway area and in vicinity of former UST location (near former sample location SG-2 and ditch alignment (boundary between Areas D and E).

LOCATION ID	EASTING	NORTHING	SAMPLING METHOD[a]	DEPTH (ft)[b]	ANALYTES[c]	SAMPLING RATIONALE
D-8	1275278	195476	HSA	6.5	PCBs, PAHs, HCID, TPH-G, select metals	Evaluate contaminants vicinity of truck scale, closed-in-place USTs and former asphalt plant process areas. In addition to PCBs and PAHs, the samples will be analyzed for metals, TPH-HCID and potentially TPH-G because of the former UST.
D-9	1275293	195423	CC and HSA	6.5	PCBs, PAHs, TPH, select metals	Evaluate contaminants in soil immediately west of the former tank containment area.
D-10	1275319	195371	CC and HSA	6.5	PCBs, PAHs, TPH, metals	Evaluate contaminants in soil adjacent to the central portion of former tank farm.
D-11	1275364	195331	CC and HSA	6.5	PCBs, PAHs, TPH, metals	Evaluate contaminants in soil beneath tank slab in south portion of former tank farm in the vicinity of the former oil storage tanks.
Area E – South Driveway						
E-1[d]	1275496	195332	CC and HSA	14.0[d]	PCBs, PAHs, TPH, metals, phthalates	Evaluate concentration of contaminants beneath east end of the south driveway. Evaluate elevated TPH concentrations suspected to be in this location. Phthalates and metals will be analyzed in boring E-1 because it has historically been the low point at the site where runoff typically converged.
E-2[d]	1275455	195312	CC and HSA	6.5 (option to 14.0)[d]	PCBs, PAHs, TPH, select metals	Evaluate concentration of contaminants beneath the south driveway. Evaluate limit of elevated TPH concentrations suspected east of this location. Option for deeper sampling based on observations at E-1.
E-3	1275386	195285	CC and HSA	6.5	PCBs, PAHs, TPH, select metals	Evaluate concentration of contaminants beneath the south driveway adjacent to the former tank farm and asphalt tank locations. This borehole is also in the path of historic run-on to the facility from offsite.
Area F – South Building						
F-1	1275538	195312	HSA	9.0	PCBs, PAHs, TPH	Evaluate concentration of contaminants along bank slope. Additional boring depth to gather information to support NTCRA design effort.
F-2	1275560	195262	HSA	9.0	PCBs, PAHs, TPH	Evaluate concentration of contaminants along bank slope. Additional boring depth to gather information to support NTCRA design effort.
F-3[d]	1275510	195310	CC and HSA	6.5 (option to 14.0)[d]	PCBs, PAHs, TPH, metals	Evaluate potential presence and concentration of contaminants in soil beneath the concrete parking area. Evaluate limits of elevated TPH in vicinity of MW-02. Option for deeper sampling based on observations at E-1.
F-4	1275535	195266	CC and HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath outdoor concrete pad at east side of south building.
F-5	1275560	195210	CC and HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath outdoor concrete pad at east side of south building. Evaluate limits of elevated PCB concentrations observed in south ditch area.
F-6	1275486	195245	CC and	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath

LOCATION ID	EASTING	NORTHING	SAMPLING METHOD[a]	DEPTH (ft)[b]	ANALYTES[c]	SAMPLING RATIONALE
			HSA			the concrete parking area.
F-7	1275487	195185	CC and HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the south building's concrete floor slab near the south side (former building locations).
F-8	1275420	195237	CC and HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the south building's concrete floor slab.
F-9	1275442	195189	CC and HSA	6.5	PCBs, PAHs, TPH	Evaluate potential presence and concentration of contaminants in soil beneath the south building's concrete floor slab near the south side (former building locations).

[a] Drilling method – CC = concrete coring to penetrate concrete slabs/pavement; HSA = hollow stem auger. Sonic drilling will only be used as a method of last resort to access sample locations not achievable by other means.

[b] Most boreholes will extend to a depth of 6.5 ft. Selection of the 6.5-ft depth is supported by the depths of elevated PCB concentrations detected in numerous boreholes previously installed to date. FCs have the prerogative to obtain deeper samples if observations in a particular location warrant further analyses. Boreholes advanced to 9 ft are proposed for location in Areas C and F in order to sample material beneath former removal locations or to provide additional information for the future NTCRA. Boreholes to 14 ft and 16.5 ft are proposed for some locations in Areas B, C, D, E, and F. These deep boreholes will provide additional information on soil that remains in place after the 1999 removal action, soil located at depth in the vicinity of former or closed-in-place USTs, and soil at the groundwater interface.

[c] Select Metals = arsenic, chromium, lead, and zinc because these metals are potentially found in waste oil or in runoff areas. Metals = Select Metals (arsenic, chromium, lead, and zinc) and additionally copper and cadmium to provide information about the nature and extent of additional metals at the site. TPH = TPH-Dx (extended), except as otherwise indicated for additional analysis (i.e., HCID and TPH-G). TOC will be analyzed for the shallowest soil sample only from each borehole.

[d] Boreholes will extend to identified depth or groundwater, whichever is encountered first.

[e] Samples will not be obtained from shallower intervals determined to be within the backfill of the 1999 removal area.

Rows outlined with dark border indicate boreholes are scheduled for continuous sampling (B-7, D-3, D-6, D-7, and E-1).

3.1.1 Area A – North Lot

Description – Area A includes the open paved areas on the north and east sides of the north building. It is separated from Area B by a chain-link fence and gate. Area A is bounded on the north by the South Park Marina, on the west by Dallas Avenue S, and on the east by the bank of the Duwamish River. Aerial photographs from 1969 and 1974 show that the area was used for storage and parking.

Historical information – Relatively little activity related to the asphalt plant is apparent in Area A. The area appears to have been used for storage over the years.

Applicable existing data – A number of investigative soil borings have been sampled in the paved area between the building and the river bank. Analysis of these samples indicates that while PCBs are present at detectable levels in soil, the highest concentrations (2.9 to 760 mg/kg) are limited to the shallowest depths (0 to 1.5 ft) (Windward et al. 2005c, e).

Proposed sampling location – The potential presence of soil contamination beneath the open paved area immediately north of the building has not been investigated. Nine boreholes (A-1 through A-9) will be installed in a grid-like pattern (see Figure 3-1). The boreholes at the northernmost edge of the area will be installed as close as possible to the boundary with the South Park Marina and will be used to assess the areas of disturbed soil observed in the 1969 aerial photograph. The boreholes will extend to a depth of 6.5 ft bgs, which should be sufficient to penetrate the historical fill layer. Standard penetration test (SPT) samples will be collected in 1.5-ft lengths on 2.5-ft centers.

Sampling is not included for the concrete-paved area immediately west of the north building (adjacent to Dallas Avenue S) for several reasons: 1) the soil in this area is located beneath concrete pavement and does not represent an ongoing exposure or erosion hazard; 2) drilling in this area would be extremely disruptive for the current tenant in the north building; and 3) there is a buried gas utility in the vicinity, which serves the adjacent building.

One hand-grab soil sample (A-10) will be collected from surficial soil on the adjacent South Park Marina property immediately to the north of study Area A and the previous sampling location SB-14. The sampling location will be accessed through the Marina property.

Proposed analytes – Table 3-2 lists the analytes proposed for soil samples from each sampling location in Area A. Soil samples, including the grab sample from location A-10, will be analyzed for PCBs, PAHs, and TPH-Dx. Soil samples from A-4 and A-6 will also be analyzed for select metals (arsenic, chromium, lead, and zinc). PCBs, PAHs, and TPH will be analyzed because they are chemicals potentially found in site soils as a result of historical site operations (i.e., former asphalt plant with used oil storage).

The inclusion of metals serves as a spot-check for these contaminants, although no historical or operational sources would indicate their potential presence in the area.

3.1.2 Area B – North Driveway

Description – Area B, the North Driveway, encompasses the triangle-shaped open paved area south of the north building and Area A. Area B is bounded on the south by Areas C and D, on the west by the north gate and Dallas Avenue S, and on the east by the bank of the Duwamish River (see Figure 2-2).

Historical information – Historical aerial photographs indicate that portions of this area were used for material storage, particularly along the boundary with Area C and inboard of the shoreline bank. This area received truck traffic as vehicles entered and exited from Dallas Avenue S in order to access the former roadway area in Area C and the roadway that traversed the former asphalt plant area between the tank farm and warehouses (Area D). Area B is currently paved, although this was not always the case. The date of paving is unknown.

Additional features in Area B include a septic tank, which is located on the south side of the north building. It is believed that the drain field for this tank is located somewhere under the North Driveway. The south side of the driveway immediately inside the north gate is in the proximity of several closed-in-place USTs located in Area D.

Applicable existing data – Soil sampling throughout much of this area has occurred in several phases and has focused primarily on determining the extent and depth of PCB contamination detected during previous investigations, beginning near the river bank. Boreholes SB-1 and SB-2 (Figure 2-10) were initially installed at the top of the river bank as part of the upland source identification sampling program in early December 2003 (Windward et al. 2005b). Elevated PCBs were observed in the near-surface soils (85 and 150 mg/kg for SB-1 and SB-2, respectively, in the 0- to 1.5-ft sample depth interval) and decreased with depth to less than 1.0 mg/kg. Samples from these boreholes were also analyzed for PAHs (Figure 2-7); SB-1 contained total PAH concentrations ranging from 0.039 to 2.07 mg/kg and SB-2 contained total PAH concentrations ranging from nondetected at 0.019 to 12.3 mg/kg.

Shallow boreholes SB-7, SB-8, and SB-9 (Figure 2-10) were sampled in Area B from the 0- to 1.5-ft sample depth interval in March 2004 to further delineate PCBs in the bank area (PAHs were not analyzed). Concentrations of PCBs in these borehole were 200, 15, and 100 mg/kg, respectively. In order to further delineate the extent of shallow PCB soil contamination inboard of the shoreline bank area (inboard of the edge of the pavement), samples from push probe stations PS-4 through PS-8 were obtained in June 2005 (Windward et al. 2005c). These results indicated the same general pattern: PCB concentrations in the shallow depth interval (0 to 1.5 ft) ranged from 290 to 1,400 mg/kg, with concentrations decreasing markedly with depth. Soil analysis was limited to PCBs.

The presence of these relatively high PCB concentrations prompted additional investigation into the interior of the area in order to determine the limit of the shallow lens of contaminated soil. In August 2005, an additional network of boreholes (SB-19 through SB-41 and SB-50, SB-51, and SB-52 were sampled for PCBs (Windward et al. 2005e). All but three of these were located in Area B (SB-19, SB-20, and SB-29 were located in adjoining Area A). As shown in Figure 2-10, PCB concentrations at these three locations were markedly lower (5.7, 1.5, and 2.9 mg/kg, respectively, in the 0-1.5-ft depth interval). Exceptions were the elevated PCBs observed in samples from boreholes SB-39, SB-40, and SB-50 (1,200, 460, and 730 mg/kg, respectively) in the shallowest depth interval (0 to 1.5 ft) and the elevated concentration (79 mg/kg) observed in the sample at the 5- to 6.5-ft depth interval in borehole SB-37.

Proposed sampling locations – The proposed borehole locations for Area B are shown on Figure 3-1. The specific rationale for each borehole location and depth is presented in Table 3-2. The general rationale for additional soil sampling in Area B includes:

- Provide additional spatial coverage for PCB concentrations and information on soil contaminants other than PCBs (i.e., PAHs, TPH, and select metals).
- Provide additional information on PCB concentrations and other contaminants in soil in the central portion of the area near the shoreline bank (borehole B-2).
- Better define the extent of elevated PCB concentrations observed in the shallow soil near the south central portion of the area (and possibly extending into the former asphalt plant area) and at depth near borehole SB-37.
- Evaluate TPH, PAHs, and select metals in the vicinity of the closed-in-place USTs located in the north end of Area D. Borehole B-7 will be used to check for layers of soil in the vicinity that may be contaminated with historically released hydrocarbons from USTs. It will therefore be extended to a depth of 14.0 ft or to groundwater, as appropriate, and will be continuously sampled (see Section 4.1.2 for details).
- Measure pavement thicknesses, observe physical characteristics of the penetrated soil column, and note the presence of any large debris or waste masses encountered in the boreholes.

Six boreholes extending to a depth of 6.5 ft and two borehole to 14 ft are proposed to address these objectives. Their locations are shown on Figure 3-1.

Proposed analytes – Table 3-2 lists the analytes proposed for soil samples from each borehole location in Area B. All soil samples will be analyzed for PCBs, PAHs, and TPH. Select metals will be analyzed for borehole B-1 as a spot check and for B-7 and B-8 because they are in proximity to the closed-in-place USTs that formerly contained waste oil. Samples from boreholes B-7 and B-8 will also be analyzed for gas-range hydrocarbons because these same tanks may have once contained gasoline.

3.1.3 Area C – 1999 PCB Removal Area

Description – Area C is the location of the 1999 removal action (see Figure 2-6). The area is bounded on the north by Area B, on the south by Area E, on the west by Area D (the former asphalt plant operations area), and on the east by the bank of the Duwamish River. Area C, also known as the former roadway ponded area or the shoreline roadway area, is located on the parcel of land owned by the Port as successor in interest to the Duwamish Commercial Waterway District No. 1.

Historical information – Area C was acquired by the Port as successor in interest to the King County Commercial Waterway District No. 1. During the time when the asphalt plant was in operation, the property was the location of several buried and partially buried oil and waste-oil storage tanks (Figure 2-2). In addition, oily water from the plant operations and periodic oil spills routinely flowed to the roadway, either through catch basin 2 or around to the south (down the south driveway) where water was known to collect (or pond) when catch basin 5 became filled with dirt. At the time, water from this ponded area flowed over the shoreline bank into the Duwamish River. The roadway area was also used for equipment/truck storage and as a truck thoroughfare for vehicles entering and leaving the plant area.

Applicable existing data – PCBs were sampled extensively by SECOR in the roadway area. SECOR analyzed approximately 40 soil samples in the late 1990s using boreholes to evaluate the concentrations of PCBs at various depth intervals (SECOR 1997). The results of this work are shown in Figure 2-5. Detected PCB concentrations ranged from non-detect to 531 mg/kg (SB-D3). Based on these data, a soil removal plan was developed and implemented by the Port with EPA oversight in 1999 (Onsite 2000a). Soil was removed from rectangular grid areas to a target cleanup level of 25 mg/kg, extending to various depths within each grid. Residual PCB concentrations estimated to be present in remaining soil beneath the removal area were assessed through the collection and analyses of 28 soil samples, the results of which are shown in Figure 2-6. Although earlier sampling events also documented the presence of PCBs and other contaminants in Area C soil (Parametrix 1991; URS 1994), these soils were, for the most part, subsequently removed in 1999.

The shoreline bank immediately east of the removal area above an elevation of +14 ft is included in Area C. Previous boreholes in this area include SB-3 and SB-4 (completed as monitoring wells MW-05 and MW-06 in early December 2004, respectively) and PS-10, installed in June 2005 to a depth of 9 ft. PCB concentrations in SB-3 were 29 and 28 mg/kg in the upper two samples and decreased to undetectable concentrations at depth. The highest PCB concentration in SB-4 was 4.0 mg/kg at the 5- to 6.5-ft depth; other samples were below detection limits. Soil from PS-10 at the depth interval of 5 to 6.5 ft contained 200 mg/kg PCB, with the underlying sample (7.5- to 9.0-ft interval) containing less than 1 mg/kg.

PAHs and TPH were also analyzed by SECOR for soil samples in this area, and concentrations for those soils that are still in place are shown on Figures 2-4 and 2-7.

TPH concentrations historically detected at the south end of the removal area (SECOR 1997) are elevated (as high as 55,100 mg/kg at 4.8-ft depth) and indicate the potential for concentrated oily residues at this location. PAH concentrations in the same samples from this location were comparatively low.

Pesticides have also been historically detected in Area C, although some data may be qualified due to data validation issues (i.e., exceeded holding times). Soil from the former monitoring well MW-02 and MW-03 locations (replaced after the 1999 removal action) contained detectable quantities of DDT and DDD, although this quantification is likely to have been overestimated due to the enrichment of the samples with Aroclors (the concentrations of DDT, DDD, and Aroclor 1260 exhibit covariance in the data set). Heptachlor-epoxide was also detected in material sampled from a tank that was subsequently removed in the early 1990s (Parametrix 1991). Aldrin, dieldrin, and endrin were also detected in soil from the same vicinity (URS 1994).

Phthalates have also been detected in soil likely to have been routinely exposed to stormwater drainage that generally collected in Area C. One sample from the location of original monitoring well MW-03 reportedly contained bis(2-ethylhexyl)phthalate at a concentration of 37 mg/kg, although the data were qualified due to exceeded holding times. Subsequent sampling also detected a trace of butyl benzyl phthalate (26.2 J mg/kg) in a soil sample from the drainage ditch that formerly conveyed stormwater from the vicinity of Dallas Avenue S along the south ends of Areas C and D toward the vicinity of catch basin 5 (URS 1994).

Arsenic has been detected in soil samples collected from the former drainage ditch, former roadway area, site catch basins, and the south drainage ditch area (URS 1994; Windward et al. 2005b). The recent (2003) sampling of the catch basins and south ditch area detected arsenic concentrations ranging from undetected to 24 mg/kg, which are within the range of low-to-moderate arsenic levels typical of soils impacted by area-wide sources, such as the Tacoma-Asarco smelter according to the Area-Wide Soil Contamination Task Force (2003). During this investigation, arsenic will be analyzed in samples from select boreholes in the proximity of elevated levels of petroleum hydrocarbons are suspected or known to exist (the southern border of Area C) and in areas where surface water runoff was known to accumulate.

Proposed sampling locations – Eight boreholes are proposed for Area C: six (C-3 through C-8) will be used to examine residual contaminant levels beneath the 1999 removal area, and two (C-1 and C-2) will be used to further evaluate elevated PCB concentrations detected in the vicinity of PS-10 at depth. The six boreholes will supplement the existing data from over 20 locations within the 1999 removal area (Figure 2-6). Boreholes C-1, C-2 and C-4 through C-7 will extend to a depth of 14.0 ft, borehole C-3 will extend to a depth of 14 ft, and borehole C-8 will extend to a depth of 6.5 ft. The general rationale for additional boreholes in Area C includes:

- Examine residual PCB concentrations and concentrations of TPH PAHs, and metals (including arsenic) at six locations beneath the 1999 removal area backfill.
- Evaluate the potential presence of pesticides and phthalates in samples from boreholes where these contaminants might be encountered based on historical data and former site conditions (i.e., former roadway ponded area). Phthalate analyses will be completed for soil samples collected from boreholes C-5, and pesticide analyses will be conducted for soil samples from boreholes C-3 and C-4.
- Provide information on the lateral extent of the 200-mg/kg PCB concentration detected in soil at depth in PS-10.
- Measure pavement thicknesses, observe physical characteristics of the penetrated soil column, and note the presence of any large debris or waste masses encountered in the boreholes.

Proposed analytes – Table 3-2 lists the proposed analytes for each borehole in Area C. All samples will be analyzed for PCBs, PAHs, and TPH because these contaminants are associated with upgradient plant operations and have been previously detected in the roadway soil. Samples from boreholes C-5 through C-7 will be analyzed for select metals (arsenic, chromium, lead, and zinc) because these are potentially associated with waste oils, known to have been present in oily water that accumulated in the south portion of the area or with runoff. Samples from boreholes C-3, C-4 and C-8 will also be analyzed for the four select metals as well as for copper and cadmium. Soil from boreholes C-3 and C-4 will be examined for pesticides, inasmuch as these were historically detected in waste oil tanks in the area. In addition, phthalates will also be analyzed for in the soil sample from borehole C-5.

3.1.4 Area D – Former Asphalt Plant Operations Area

Description – Area D, the former asphalt plant operations area, was the primary location of facilities associated with the manufacturing process, including storage tanks, warehouses, a roadway, and truck scale (Figure 2-2). Area D is bordered on the north, east, and south by Areas B, C, and E, respectively, and on the west by Dallas Avenue S. Except for the small wood-framed office/carport and the truck scale on the west side, all of the above-ground structures associated with the plant were removed prior to purchase by the Port in 1999. Remaining known below-grade features include the concrete pads for the former tank farm, the concrete floor slabs for the two warehouses and miscellaneous small sheds and buildings, the former utility corridor to the east of the tank farm, and the abandoned large-diameter well (Figure 2-2). Both the utility corridor and the large-diameter well were abandoned in place by filling with concrete. The surface of all of these structures is covered by asphalt pavement.

Historical information – Figure 2-2 shows the locations and inventoried contents of the ASTs formerly located in Area D. Three of these tanks, at the south end of the former tank farm, were known to contain oil. The area was also the site of a number of USTs. All of these have been removed, with the exception of the three tanks abandoned in place beneath the office/carport. These tanks consisted of two 4,000-gal tanks that possibly contained gasoline (Parametrix 1991) and subsequently waste oil and a third 10,000-gal tank that contained diesel fuel (Hart Crowser 1992). The former UST in the center of the south portion of the plant roadway contained waste oil (SECOR 1997); a 500-gal UST at the extreme south edge of the area that was used to store diesel fuel was discovered and removed in 1999 (Onsite 2000b).

The truck scale (located on the east side of Area D) was examined during the preparation of this QAPP. Observations beneath the wooden scale platform were limited to what could be seen from the small lever pit at the side of the scale pit. The lever pit is concrete lined and has a concrete bottom, which is evident beneath a thin (half-in.) layer of dry soil. The larger scale chamber also has concrete walls and appears to also have a concrete bottom (detected by probing), although this might be a concrete floor for the lever fulcrum to rest on and may not extend throughout the pit. Where observable, the bottom of the pit appeared to be covered by a 6-in.-thick layer of soil, with intermixed pieces of roofing asphalt. Due to the limited ability to view inside the pit, it could not be determined if there was a concrete floor throughout, if water was accumulating anywhere beneath the scale planks, or if there was evidence of a drain. No drain was visible in the lever pit, and there are no drain holes opposite the pit at the side of the elevated ramp.

Applicable existing data – Except for historical TPH analyses related to the UST removals and closures, few analytical data are available on potential chemicals of concern in this area. Although EMCON analyzed soil samples from the area, most of these were taken from the vicinity of the foundation of the former shed structure that housed the former hot oil heater (Figure 2-2). The sampling locations (HB-UD and SB-UE) are shown on Figure 2-6. Historic PCB sampling results for the two locations indicated concentrations of 433 and 11.1 mg/kg, respectively. Exposed shallow soil around the foundation was subsequently removed by hand during the 1999 PCB removal action. These shallow/surface soils were subsequently removed as part of the 1998 plant decommissioning by Malarkey Asphalt and the 1999 removal action. Historical TPH results indicate that residual contamination may still be present in soils in the vicinity of the two removed USTs and the three closed-in-place USTs.

Proposed sampling locations – Table 3-2 presents the rationale for each borehole proposed for this area. The overall objective of the proposed boreholes is to fill in data gaps regarding subsurface soil quality. Rationale for the selection and placement of boreholes include:

- Evaluate contaminants in soil beneath the foundations of the former warehouses (boreholes D-1 and D-3).
- Evaluate contaminants in soil adjacent to the abandoned large-diameter well. Borehole D-2 will be extended to depth of 16.5 ft to provide for an improved

understanding of the deeper soil strata and check for potential contaminants at depth.

- Evaluate soil contaminants in the vicinity of the closed-in-place and removed USTs (boreholes D-4, D-6, D-7, and D-8).
- Evaluate soil contaminants beneath the former plant roadway and downgradient from the former utility corridor and tank farm (boreholes D-4, D-5, D-6, and D-7).
- Evaluate soil contaminants adjacent to, and downgradient from, the truck scale location (borehole D-8).
- Evaluate soil contaminants on the west side of the site along the boundary with Dallas Avenue S (boreholes D-8, D-9, D-10, and D-11).
- Evaluate soil contaminants adjacent to the former hot oil heater shed (borehole D-5).
- Evaluate conditions in soil beneath the south end of the former tank farm in the vicinity of former ASTs known to have contained oil (borehole D-11).
- Measure pavement thicknesses, observe physical characteristics of the penetrated soil column, and note the presence of any large debris or waste masses encountered in the boreholes.

Boreholes D-3, D-6, and D-7 are in the vicinity of former tank locations and will be used to check for layers of soil that may be contaminated with historically released hydrocarbons. They will therefore be extended to a depth of 14.0 ft or to groundwater, as appropriate and will be continuously sampled (see Section 4.1.2 for details).

Proposed analytes – In addition to PCBs, TPH, and PAHs (to be analyzed for all soil samples from Area D), samples from boreholes D-3, D-4, and D-7 through D-9 will be analyzed for select metals (arsenic, chromium, lead, and zinc). These boreholes were selected for metals analysis because they are in the vicinity of former waste oil handling and storage areas, areas where oil could have been released to the soil, or areas of known surface drainage. The list of select metals plus copper and cadmium will also be analyzed for samples from boreholes D-6, D-10, and D-11 to provide additional information about the nature and extent of these metals. Samples from boreholes D-4 and D-8 will also be analyzed for gasoline-range TPH because they bracket the abandoned-in-place USTs. Phthalates will be analyzed for samples from borehole D-4 because this borehole is near the vicinity of a former storm drainage pathway.

3.1.5 Area E – South Driveway

Description – Area E is bounded on the north by Areas C and D and on the south by Area F. The south driveway extends from the south gate at Dallas Avenue S eastward to the river bank. Prior to 1999, the driveway consisted of concrete pavement. This pavement is still in place but was swept clean and overlain with a thin layer of asphalt pavement by Port Construction Services in early 2000.

Historical information – Area E was used primarily as a thoroughfare for vehicles entering and exiting the roadways in Areas C and D and loading and unloading materials at the north and east sides of the south building. Historical aerial photographs indicate that the area was occupied by small structures or sheds, storage areas, and vegetation before becoming a driveway in the late 1960s. The driveway is crossed by the former utility corridor, which contained insulated asphalt and hot oil pipes for asphalt transfer. These pipes served an above-ground insulated asphalt tank, which was located on a concrete slab in the southwest corner of Area E, just north of the south building. The tank was removed by the asphalt plant owner, and the utility corridor was recently cleaned out and abandoned-in-place in 2004 (Windward and Onsite 2004).

Prior to improvements made to the drainage on Dallas Avenue S by SPU in 2005, uncontrolled drainage from the upland areas including the Basin Oil property flowed onto T-117 and eastward toward the shoreline (toward catch basin 5). A former drainage ditch along the north side of the south driveway also conveyed drainage from the asphalt plant operations area to the east and was a likely drainage path for oil spills known to have occurred during the long history of plant operations (major upland spills were documented as early as the 1940s). Catch basin 6, now essentially isolated by the SPU improvements, also received drainage from Dallas Avenue S near the west corner of the south building and discharged through a buried culvert onto the driveway surface upstream of catch basin 5.

Applicable existing information – Previous boreholes (SB-5 and PS-12) in the area are limited to the east end of the driveway. Although no evidence of oily contamination was observed in SB-5, soil samples from PS-12 (further inland from SB-5) exhibited oily odors in shallow samples and oily sheens in the deeper soil. The potential presence of TPH in the vicinity is also supported by historical data indicating elevated TPH in soil along the nearby boundary with Area C. Monitoring for NAPL in monitoring well MW-02 detected a trace sheen on the groundwater surface during rising water levels (potentially influenced by the nearby river), further confirming the likely presence of TPH in the surrounding smear zone. In contrast, analytical results for the two boreholes indicate PCBs are mostly limited to the shallower soils. The presence of oil in the soil in this vicinity is expected because this portion of Area C was historically where stormwater and plant runoff collected in a ponded area of the former roadway. Historical spill reports describe oil from the asphalt plant operations area pooling in this vicinity and on the nearby Area C roadway area.

The two shallow samples from SB-5 (0 to 1.5 ft and 2.5 to 4 ft) contained PCBs at 15 and 6.8 mg/kg, respectively. Concentrations were less than 1.0 mg/kg beneath these depths. Samples from station PS-12 were very similar, with PCB concentrations ranging from 17 to 11 mg/kg in the upper samples and 0.034 to 0.091 mg/kg in the deeper strata. Although most of the samples from PS-12 were oily, no corresponding elevated concentrations of PCBs were detected in these same samples.

Proposed sampling locations – Rationale for additional boreholes in Area E includes: Evaluate the concentration of contaminants (PCBs, PAHs, TPH, phthalates and metals) beneath the east end of the south driveway (borehole E-1). Evaluate elevated TPH concentrations suspected to be in the smear zone at this location by extending borehole E-1 to a depth of 14.0 ft or to groundwater, as appropriate, and employing continuous sampling (see Section 4.1.2 for details).

- Evaluate the concentration of contaminants beneath the south driveway immediately downgradient of the former utility corridor alignment (borehole E-2).
- Evaluate concentrations of contaminants beneath the south driveway adjacent to the former tank farm and asphalt tank locations (borehole E-3). This borehole is also in the path of historical runon to the facility from offsite.
- Measure pavement thicknesses, observe physical characteristics of the penetrated soil column, and note the presence of any oils, debris or waste masses encountered in the boreholes.

Proposed analytes – Except for the above-described boreholes, no information on the quality of the soil from beneath the driveway is available. PCBs, PAHs, and TPH will be analyzed for all soil samples from Area E because these contaminants are historically associated with the former plant operations and have been typically detected elsewhere on the site. Select metals will also be analyzed for all samples because the potential exists for the presence of waste oils in the area from various historical sources (i.e., oil circulating pipes in the utility corridor, historical spills from the upgradient plant area, and elevated TPH detected in previous boreholes near the east end of the driveway in the vicinity of catch basin 5). Copper and cadmium will also be analyzed for samples from boreholes E-1. Phthalates will be analyzed in boring E-1 because it has historically been the low point at the site where runoff has typically converged.

3.1.6 Area F – South Building

Description – Area F includes the south building as well as the concrete loading dock, landings, ramps, and the shoreline bank (above +14-ft elevation) east of the building (see Figure 2-8). The south building has a concrete floor that does not have any drains. The building perimeter has a concrete foundation and footings. Area F is bordered on the north by Area E, on the east by the Duwamish River, on the south by the Boeing facility and on the west by the intersection of Dallas Avenue S and S Donovan Street.

Historical information – The history of Area F is highlighted by the construction of the metal-frame south building and its concrete landing structures sometime in the late 1970s or early 1980s. The 1974 aerial photograph indicates that prior to that time, the area's surface was disturbed and used for miscellaneous storage. Several small buildings were also present along the south property line, in the location that is now occupied by the south side of the south building. Portions of the south building were leased to Basin Oil for a period of time (Windward et al. 2003), and when the asphalt plant was operational, the building was also used as a staging area for filling cardboard containers with finished asphalt product and for finished asphalt product storage.

Applicable existing data – Soil samples previously obtained in this area are from soil borehole SB-6, which is located in the southeast corner of the area in the shoreline bank soil immediately east of the concrete loading dock. Similar to boreholes in Area E, samples from this borehole contained relatively low levels of detectable PCBs in the upper depth intervals (5.1 and 0.099 mg/kg) and undetectable PCB concentrations in the deeper strata. Samples were not analyzed for other contaminants.

Proposed sampling locations – The primary purpose of additional sampling in the area is to fill in data gaps and check for potential chemicals of concern that might still be present beneath the building's concrete floor, the outdoor concrete pavement, or in the adjacent shoreline bank. Rationale for the proposed boreholes includes:

- Fill in data gaps regarding contaminant concentrations in upland shoreline bank soils in this area (boreholes F-1 and F-2).
- Evaluate the limits of elevated TPH in the smear zone in the vicinity of MW-02 in nearby Area E (borehole F-3). Examine soil samples from this borehole for select metals (arsenic, chromium, lead, and zinc) inasmuch as those metals may be associated with oily contamination or runoff.
- Evaluate soil conditions beneath the concrete loading dock at the east side of the building (borehole F-4).
- Evaluate the northern limits of elevated PCB concentrations observed in the south ditch area (borehole F-5).
- Evaluate soil conditions beneath the central portions of the south building's concrete floor (boreholes F-6 and F-8).
- Evaluate the potential presence and concentration of contaminants in soil beneath the south building's concrete floor near the south property border and in the vicinity of the former locations of several smaller buildings (boreholes F-7 and F-9).
- Measure concrete foundation thicknesses, observe physical characteristics of the penetrated soil column, and note the presence of any large debris or waste masses encountered in the borehole.

Proposed analytes – All soil samples from the boreholes in Area F will be analyzed for PCBs, PAHs, and TPH because these contaminants are known to be associated with asphalt plant waste materials and therefore potentially found in site soils. Samples from borehole F-3 will also be analyzed for metals (arsenic, copper, cadmium, chromium, lead, and zinc) previously detected at the site or potentially associated with waste oil (the borehole is in the proximity of oily contamination previously detected to the north).

3.2 CONTINGENT SAMPLING

The FCs, in consultation with the project coordinator and project manager, may elect to install a limited number of additional boreholes and/or extend certain boreholes deeper for additional sampling if field observations indicate such actions are warranted and would be beneficial to the overall program. For the purpose of providing a definable scope for the program, it is anticipated that such discretionary sampling would be limited to an additional 5% of the total sample volume.

FCs will have the discretion of relocating or adjusting the position of boreholes if refusal is encountered to such a degree as to prohibit the effective collection of samples. Offsetting station locations more than 10 ft from the original planned location must be approved by EPA or its designated oversight entity. FCs will have the option of extending boreholes E-2 and F-3 to a 14.0-ft depth if warranted by observations in deep borehole E-1. All changes or additions to the planned program must be thoroughly documented using the appropriate field forms included in this QAPP. It is anticipated that the EPA project manager or the EPA project manager's designated oversight person will be available to make decisions during business hours while the field work is ongoing.

3.3 PROGRAM ANALYTES

All borehole samples will be analyzed for PCBs, PAHs and TPH. Certain samples will be analyzed for arsenic, copper, cadmium, chromium, lead, and zinc at locations where elevated concentrations of waste oil are known or suspected to exist based on historical operations, site surface drainage areas, and prior investigation results. In addition, samples will be collected from the base of the 1999 removal action area at D-3 and D-4 to be analyzed for select pesticides, and soil samples from boring locations (C-5, D-4, and E-1) will be analyzed for phthalates. The following subsections present the rationale for the inclusion of selected analytes.

3.3.1 Polychlorinated biphenyls

All proposed borehole soil sample locations will be analyzed for PCBs. PCBs are the primary chemicals of concern at T-117 and have also been detected in the adjacent roadway areas (City of Seattle 2005) and adjacent Duwamish sediments (Windward et al. 2005b). Potential historical sources of PCBs in upland soil include spillage and chronic leakage of PCB-contaminated oils and waste oils used during the asphalt manufacturing process. The site has a documented history of receiving and using PCB-contaminated oil in its operations.

Analytical method GC/ECD (EPA 8082) was used during previous investigations and is appropriate for quantifying both individual Aroclors and total PCBs in each sample. Section 4.4 discusses the quality objectives and criteria for chemical measurement, including PCBs.

3.3.2 Polycyclic aromatic hydrocarbons

PAHs will be analyzed in all borehole soil samples and are included in the analytical suite for the following reasons:

- PAHs are commonly associated with heavy-end waste oils. PAH concentrations will be evaluated together with those measured for TPH to provide an improved understanding of TPH-related contaminants in soil at the site. Waste oils are known to have been both used at the site and released into the environment.
- PAH compounds were contained in waste products from asphalt manufacturing.
- PAHs can occur as degradation products of asphalt.
- Information on PAH distribution is necessary to determine how effective a removal action focusing on PCBs will be in co-addressing PAH impacts.

Analytical method GC/MS (EPA 8270D) will be used to quantify PAHs at the site. This method is the same as that used during previous site investigations and is appropriate for quantifying PAH compounds. Section 4.4 discusses the quality objectives and criteria for chemical measurement, including PAHs.

Ecology's site hazard assessment (Parametrix 1991) reported the presence of limited dioxin and furan compounds in a shallow soil sample from the vicinity of the original monitoring well MW-02. However, no tetra isomers were reported, and the location where the sample was obtained was subsequently removed during the 1999 PCB removal action (Onsite 2000a).

Dioxins and furans have been analyzed in one sediment sample (location 772) collected from the LDW adjacent to T-117. The concentration of dioxins in this sample was expressed as 2,3,7,8-tetrachlorodibenzo-*p*-dioxin toxic equivalents (TEQs). The TEQ was calculated using mammalian toxic equivalency factors from Van den Berg et al. (1998) and was estimated to be 2.6 ng/kg dw (Windward 2005). In comparison to data collected from other areas of the LDW and the Puget Sound region, the TEQ concentration in the T-117 sample is relatively low. The range of TEQ concentrations in 29 surface samples collected from throughout the LDW as part of the 1998 EPA site inspection (Weston 1999) was 1.17 to 224 ng/kg dw, with a mean of 19.5 ng/kg dw (Windward 2005). Existing Puget Sound regional background dioxin/furan sediment data were evaluated as part of the Phase 2 LDW remedial investigation (RI). Mean background TEQ concentrations at four locations in Puget Sound were found to range from 0.72 to 11.3 ng/kg dw (Windward 2005). As an additional comparison, EPA summarized national dioxin data collected from 11 lakes and reservoirs throughout the United States that had no known dioxin or furan sources, and calculated a mean TEQ concentration of 5.3 ng/kg dw (EPA 2000). These data were evaluated by EPA in their draft human health reassessment of dioxin (EPA 2000) to distinguish between areas impacted by industrial point sources and areas considered to be urban and rural backgrounds for dioxins and furans.

The Washington State Department of Health prepared a health consultation for the Malarkey Asphalt Upland Area under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (WSDOH 2001). The health consultation concluded that the past combustion of fuel oils contaminated with PCBs likely emitted dioxin to the air as a byproduct but that exposure of humans to contaminants in air became less significant when asphalt production ceased. Typically, dioxins are present at waste sites where the ash of burned PCB-contaminated solids is deposited. To date, none of the investigations at the site have detected ash, nor is it expected that historical burning of liquid oil would result in any significant production of ash.

In summary, dioxin/furan analyses have not been included in the upland T-117 sampling because: 1) dioxin was detected in only one sediment sample and below a level of concern, and 2) potential sources of dioxin (i.e., ash) have not been found at the site.

3.3.3 Total petroleum hydrocarbons

All borehole samples will be analyzed for TPH. Heavier-end (diesel- and waste oil-range) hydrocarbons are the predominant types of TPH expected in soils based on the historical petroleum uses at the site (diesel fuel and waste oils). Soil samples collected from all borings, with the exception of four locations, will be analyzed using the NWTPH-D extended analytical method. Soil samples obtained from the vicinity of the three closed-in-place USTs in Area D, two of which were reportedly used at one time to store gasoline, will be screened using NWTPH-HCID analyses for broader-range TPH, including gasoline-range organics. These include soil samples from borings B-7, B-8, D-4, and D-8. Depending on the results of the HCID analysis, samples from these four locations may be subsequently analyzed using method TPH-G or TPH-Dx, as appropriate.

Waste oils are known to have been used at the site and released into the environment. Materials stored in USTs and ASTs include diesel fuel, oils, and gasoline. Elevated TPH concentrations have been observed previously at locations associated with former USTs and in the vicinity of the east end of the south driveway (near catch basin 5 and monitoring well MW-02).

An improved understanding of the distribution of TPH at the site is necessary to address questions regarding the potential co-occurrence of TPH and PCBs and the possibility that PCBs may be associated with higher concentrations of oil. It is important to understand how anticipated upland remedial actions focusing on PCBs would also co-address TPH and if those measures need to be expanded to address areas where elevated TPH levels are detected.

As recently as the early 1990s, gasoline was reportedly stored at the site in two 4,000-gal gasoline USTs near the north gate entrance. This is tenuously indicated by a single label ("gas") shown in Figure 2 of the Site Hazard Assessment Report prepared for Ecology in 1991 (Parametrix 1991). If indeed these tanks ever contained gasoline, then sometime during 1991 or 1992, the tanks were apparently converted to waste oil storage and soon thereafter, the two tanks were abandoned in place (Hart Crowser 1992). Surrounding soil was tested for TPH compounds as part of the abandonment process and only diesel- and bunker-range hydrocarbons were detected (this will be re-verified by analyzing soil samples from the vicinity using HCID and TPH-G methodologies).

Approximately 1 year prior to the abandonment of the three USTs, soil samples obtained from boreholes completed as MW-01 and original wells MW-02 and MW-03 (the latter two wells are downgradient from the USTs) were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX). BTEX compounds were not detected in any of the soil or groundwater samples from the subsequently constructed wells (Parametrix 1991). Benzene, toluene, xylenes, and m-xylene compounds were detected in one surface soil sample taken from the drainage ditch along the south driveway in 1994 (URS 1994) at concentrations of 5.4 (J), 57, 107, and 68.3 µg/kg, respectively. This ditch received runoff from the offsite street areas and the vicinity of the Basin Oil operations, and it is likely that these contaminants were associated with upgradient industrial activities in those areas. In view of the absence of significant BTEX detections at the site and because the proposed HCID methodology and TPH-G analysis have the ability to detect the presence of gasoline-range hydrocarbons, BTEX compounds are not specifically included in the proposed list of analytes.

3.3.4 Pesticides

Pesticides are not commonly associated with the type of asphalt manufacturing known to have occurred at the T-117 site, nor has there been a documented history of widespread pesticide use at the site. Furthermore, pesticides are not a chemical of concern currently identified in the sediment within the T-117 early action area. Nevertheless, traces of Aldrin and dieldrin were observed in several samples from soil included in the 1999 removal area (URS 1994), although the results were qualified.

In addition, pesticides were reported in soil samples obtained from the site in 1991 and 1994 (Parametrix 1991; URS 1994). These included 4-4'DDT, dieldrin, endrin, and gamma-chlordane. Heptachlor epoxide was also detected in a sample of the contents of the buried railroad tank car. DDT was reported in concentrations ranging from 0.016 to 23 mg/kg. However, the unqualified concentrations reported for DDT co-varied with the concentrations of Aroclor 1260 reported for the same data set. It is known that the co-quantification of PCBs and chlorinated pesticides such as DDT can result in over-estimation of the pesticide in samples enriched in chlorinated biphenyls.

Although the impact of pesticides at the site has shown to be minimal, soil samples from boreholes C-3 and C- will be analyzed for DDT, DDD, aldrin, and dieldrin. This analysis will assist by further characterizing the soil conditions on the site and provide additional quantitative information on residual contaminants that might still be at the site in the vicinity of previously detected pesticides.

3.3.5 Phthalates

Experience within the LDW indicates that phthalates are primarily associated with sources in upland urban watersheds and are subsequently transported to surface water through storm drains or combined sewer systems. Phthalates have also been identified in association with some waste oils (King County and SPU 2004).

The T-117 area does not include large urban stormwater outfalls that can serve as potential sources of phthalates. Although phthalates have been detected in groundwater seeps, they have not been emanating from the site in the concentrations or quantities that would impact adjacent river sediment (Windward et al. 2005b).

In order to check for the presence of phthalates at the site, shallow soil samples from boreholes C-5, D-4, and E-1 will be analyzed for phthalate compounds simultaneously with the scheduled PAH analyses. The sample from borehole C-5 will be analyzed for phthalates that may have accumulated in the former roadway ponded area during the long history of drainage to that location. Analysis of samples from borehole D-4 will provide an opportunity to detect phthalates that might have been released in the process area in association with waste oils. Borehole E-1 is in another area where oil has been detected in soil and is also a location where runoff accumulated near the roadway area and catch basin 5.

3.3.6 Metals

Arsenic, copper, cadmium, chromium, lead, and zinc have historically been detected in site soils and catch basins (Parametrix 1991; SECOR 1997; URS 1994; Windward et al. 2003, 2005b). Some of these metals are believed to be associated with waste oils formerly used and released in the historical process areas of the site. These metals will be analyzed in samples from select boreholes in the proximity of former plant operations and waste oil storage, and where elevated levels of petroleum hydrocarbons are suspected or known to exist, and to provide information about the nature and extent of these metals (see Table 3-2).

Arsenic has been detected at T-117 in soil samples collected from the former drainage ditch, former roadway, catch basins and the south drainage ditch area (URS 1994; Windward et al. 2005b). The recent (2003) sampling of the catch basins and south ditch area detected arsenic concentrations ranging from undetected to 24 mg/kg, which are within the range of low-to-moderate arsenic levels typical of soils impacted by area-wide sources, such as the Tacoma-Asarco smelter according to the Area-Wide Soil Contamination Task Force (2003).

Arsenic is naturally occurring in rocks and minerals and is also believed to be associated with industrial waste oils. Surface and stormwater runoff can potentially cause arsenic to be leached. Arsenic will be analyzed in samples from select boreholes in the proximity of where elevated levels of petroleum hydrocarbons are suspected or known to exist and in areas where surface water runoff was known to accumulate.

3.3.7 Grain size and total organic carbon

At the discretion of the FCs, select soil samples will also be analyzed for grain size. Samples will be selected based on their observed representation of encountered soil stratigraphy. Only the most shallow soil sample from each borehole will be analyzed for total organic carbon (TOC).

3.4 SAMPLING DEPTHS

As indicated in Table 3-2, most boreholes will extend to a depth of 6.5 ft. Selection of the 6.5-ft depth is supported by the depths of elevated PCB concentrations detected in the numerous boreholes already installed at the site to date (Figures 3-2 and 3-3). FCs have the prerogative to obtain deeper samples if observations in a particular borehole warrant such sample collection. As shown in Table 3-2, some boreholes will be drilled to greater depths when necessary to bracket a previously detected elevated concentration at depth or when it will be useful to evaluate potential deeper contaminants (i.e., at borehole D-2).

4.0 Data Collection and Quality Control

This section describes the methods that will be used to collect and process soil samples. Elements include sample collection procedures and analytical methods, decontamination procedures, sample handling and custody requirements, QC measures, instrument and equipment testing, inspection and maintenance, instrument calibration, supply inspection and acceptance, and data management.

4.1 SAMPLING METHODS

All field activities will be performed under the direction of the FCs or other oversight personnel. EPA and Ecology will be notified of the field schedule and may provide oversight during field activities. Sampling will be accomplished by a joint operation of Windward and DOF personnel. The various sampling options are detailed below and will be discussed further with EPA, as necessary.

4.1.1 Sample identification

Each sampling location will be assigned a unique alphanumeric identification (ID) number. The first four characters will be T117 to designate the T-117 upland area. This will be followed by a letter (A, B, C, D, E, or F) and number combination to designate the area and location from which the sample is collected. For example, T117-A1 would identify the location as T-117 Area A, borehole 1.

Individual sample IDs will be further identified by the addition of two letters to indicate the type of sample (e.g., SB for soil boring, SS for surface sample, GS for grab sample). Sample IDs will also include information on the sampling depth. Sample IDs for the five boreholes that will be sampled on a continuous basis (B-7, D-3, D-6, D-7, and E-1) will include the depth range (at 1.5-ft intervals beginning at 1.5 ft) up to the total depth of the borehole (e.g., 1.5 to 3 ft = 1.5-3.0, 3 to 4.5 ft = 3.0-4.5, 4.5 to 6 ft = 4.5-6.0). Thus, for example, a soil boring sample from location T117-B7 at a sampling depth interval of 3 to 4.5 ft would be labeled T117-B-7-SB-3.0-4.5.

Samples IDs for all other boreholes will include characters that identify the depth interval of the soil collected (i.e., 01 = 0 to 1.5 ft, 02 = 2.5 to 4 ft, 03 = 5 to 6.5 ft, 04 = 7.5 to 9 ft, 05 = 10 to 11.5 ft, 06 = 12.5 to 14 ft, and 07=15 to 16.5 ft). Thus, for example, a soil boring sample from location T117-A1 at a depth of 0 to 2.5 ft would be labeled T117-A1-SB-01.

Field QC samples will be assigned modified sample identifiers as described below:

- Field duplicates will be blind and identified using sequential sample numbers starting with 201 (e.g., T117- A1-SB-201).
- Rinsate blanks will be assigned an “RB” identifier (e.g., T117-A1-SB-RB).

4.1.2 Field operations and sample collection equipment

The following sections provide information on positioning and sampling methods.

GPS borehole positioning

Soil sampling location coordinates will be measured after completion by land-survey methods to produce positioning accuracy to within 0.5 ft. Washington State Plane coordinates North (NAD 83) will be used for the horizontal datum.

Soil sampling

Boreholes will be completed using either a hollow-stem auger drill or a sonic drilling system, both deployed from a drill rig. Installation of the boreholes at the majority of proposed locations will require drilling through varying thicknesses of asphalt and concrete. To promote efficiency in the drilling effort, a concrete corer will be used as necessary to remove the overlaying concrete/asphalt surfaces to clear the way for subsurface drilling using the hollow-stem auger. Sonic drilling will be mobilized to the site only as a last resort to achieve sampling access at locations where penetration is not otherwise feasible.

Special precautions will be taken during borehole advancement and soil sampling to prevent possible impacts to the immediate area from potentially contaminated soils and to protect the sampling area from inclement weather, which is common during the month of January. Plastic sheeting or other appropriate means will be used to protect the immediate area of the borehole location to help contain soil brought to the surface during the installation process. Absorbent materials will be available and used as necessary to remove oily sheens that may appear in the immediate sampling area. Depending on weather conditions, the sampling area above the borehole may be sheltered with a tarp to prevent rainwater from interfering with the boring and soil sampling process. Any runoff leaving the drilling area will be periodically checked for entrained solids and measures taken as necessary to retain solids from moving with the runoff into the stormwater drainage systems

The sampling data will be recorded on the boring logs (Form 1). Soil samples will be collected using SPT methods (ASTM D 1586). A 2.5-in.-outside-diameter split-barrel sampler will be driven a distance of 18 in. with a 140-lb drive hammer (depending on the drill rig used), providing SPT data for engineering evaluation and soil samples for analytical testing.

Within each borehole, except those designated for continuous sampling, a representative 1.5-ft soil sample will be collected at 2.5-ft intervals up to the depth of the borehole (see Table 3-2) for analytical testing. Each soil sample will be visually classified in general accordance with ASTM D 2487 (the Unified Soil Classification System); and if stratified soil conditions are encountered in the boreholes, care will be taken to place only one material type in each jar. Soil samples will be placed in laboratory-supplied containers, which will then be placed in coolers and delivered to the laboratory in accordance with the protocols outlined in this QAPP. Standard equipment decontamination procedures (see Section 4.1.3) will be followed between samples and between boreholes, including steam cleaning of the auger prior to each borehole installation.

Specially designated boreholes B-7, D-3, D-6, D-7, and E-1 will be sampled on a continuous basis. Within each borehole, 1.5-ft soil samples will be collected throughout the soil depth up to the total depth of the borehole (see Table 3-2) for analytical testing. Once obtained, the soil samples will be evaluated, handled, and delivered to the laboratory as described above and in accordance with the protocols outlined in this QAPP. As with all boreholes, standard equipment decontamination procedures (see Section 4.1.3) will be followed between samples and between boreholes, including steam cleaning of the auger prior to each borehole installation.

The potential exists for the auger to encounter asphalt or other large obstructions. For asphalt at depth, the borehole will be rejected if the FCs determine (through direct observation) that the asphalt is potentially being carried down by the auger flights. The purpose of this is to avoid contaminating deeper sample material, particularly on an auger bit that had been warmed from friction with soil. Any asphalt encountered will be logged and, if determined necessary by the FCs, the borehole will be repositioned. For large obstructions, the borehole will be accepted to the obtainable depth, but another attempt will be made to bore to the desired depth within 10 ft of the original location. If a sample cannot be obtained to represent the soil conditions, a different sample location may be selected.

All soil samples should include a field description of the presence of oil as defined below:

- **No visible evidence** – No visible evidence of oil in the soil sample.
- **Staining** – Visible staining in the soil. Can be visible as mottling or in bands. Typically associated with fine-grained soils.
- **Coating** – Visible coating on soil grains. Typically associated with coarse-grained soils.
- **Free oil** – Visible oil in the soil sample. NAPL appears as a separate liquid in the soil pores.

Observations will be recorded on the boring log.

4.1.3 Decontamination procedures

All soil homogenizing equipment, which includes the mixing bowl and stainless steel implements, will be decontaminated based on EPA guidelines (1999; 2002b) between locations or samples using the following procedures:

1. Rinse with site or distilled water and wash with scrub brush until free of soil.
2. Wash with phosphate-free detergent.
3. Rinse with site or distilled water.
4. Rinse with distilled water.

Acid or solvent washes will not be used in the field because of safety considerations and problems associated with rinsate disposal and sample integrity.

Any sampling equipment that cannot be cleaned to the satisfaction of the FC will not be used for any further sampling activity. Soil boring drilling equipment will be steam cleaned in a self-contained decontamination trailer between locations.

4.1.4 Disposal of field-generated waste

Excess soil and any contaminated water (i.e., from equipment decontamination) that remains after all sampling is completed will be stored in appropriate drums onsite. Drums will be labeled with adhesive labels that state "This container is on hold pending analysis" and marked according to the contents, origin of materials, date of generation, address, and contact name. FCs will be responsible for maintaining an inventory of drums and corresponding sources of materials contained therein in the field logbook. Materials will be characterized as necessary and properly disposed of after completion of the sampling program. All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the site by sampling personnel and placed in a standard refuse container for disposal as solid waste.

Waste soils and other solids will be disposed of appropriately at an approved landfill or incinerated, consistent with hazardous materials and TSCA regulations. Decontamination water will also be managed in accordance with hazardous materials and TSCA regulations as necessitated by the level of contamination.

4.2 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

This section describes how individual samples will be processed, labeled, tracked, stored, and transported to the laboratory for analysis. In addition, this section describes sample custody procedures and shipping requirements. Sample custody is a critical aspect of environmental investigation. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the delivery of sample results to the recipient.

4.2.1 Sample handling procedures

The analytical laboratory will provide certified-clean sample containers. Soil samples will be placed in appropriately sized, certified-clean, wide-mouth glass jars and capped with Teflon®-lined lids. With the exception of TPH-G samples, all sample containers will be filled leaving a minimum of 1 cm of headspace to prevent breakage during shipping and storage. TPH-G sampling containers with be filled completely, with zero headspace. The types of sample containers to be used and sample volumes are presented in Table 4-1. Each jar will be sealed, labeled, and stored under appropriate conditions as outlined in Table 4-1.

Sample labels will be waterproof and self-adhering. Each sample label will contain the project number, sample identification, preservation technique, analyses, date and time of collection, and initials of the person(s) preparing the sample. A completed sample label will be affixed to each sample container.

Table 4-1. Sample volume requirements and storage containers

Sample Type	Number of Containers	Container Size and Type	Thermal Preservation
Soil Samples			
Metals (arsenic, copper, cadmium, chromium, lead and zinc)	1	4-oz glass jar	cool/4 ±2°C
PCBs, PAHs, pesticides, and phthalates, % solids	1[a]	16-oz glass jar	cool/4 ±2°C
TPH-HCID	1	8-oz glass jar	cool/4 ±2°C
TPH-Dx	1[a]	8-oz glass jar	cool/4 ±2°C
TPH-G	1[a]	2-oz glass jar with septa cap (zero headspace)	cool/4 ±2°C
Grain size	1[b]	16-oz glass jar	(none)
TOC	1	4-oz glass jar	cool/4 ±2°C
Aqueous Samples (rinsate blanks)			
Metals	1	500-mL HDPE jar	cool/4 ±2°C
PCBs, PAHs, pesticides, phthalates	2	500-mL glass amber jar	cool/4 ±2°C
TPH-HCID and TPH-Dx	2	500-mL glass amber jar	cool/4 ±2°C
TPH-G	3	40-mL VOA vials with septa cap (zero headspace)	cool/4 ±2°C

[a] An additional container should be collected for matrix spike and matrix spike duplicate samples.

[b] Two additional containers should be collected for laboratory replicate samples.

VOA – volatile organic aromatics

HDPE – high-density polyethylene

4.2.2 Sample custody procedures

Samples are considered to be in custody if they are: 1) in the custodian's possession or view; 2) retained in a secured place (under lock) with restricted access; or 3) placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). Custody procedures will be used for all cores and samples throughout the collection, transport, and analysis, and for all data and data documentation, whether in hard copy or electronic format.

Custody procedures will be initiated during soil collection. A chain-of-custody (COC) form will accompany samples from the field to the analytical laboratory. Each person who has custody of the samples will sign and date the COC form and ensure that the samples are not left unattended unless properly secured. Minimum documentation for sample handling and custody will include:

- Core or sample location, project name, and unique identification number
- Core or sample collection date and time
- Any special notations on sample characteristics or problems
- Initials of the person collecting the core or sample

- Date on which the core or sample was sent to the field processing area or laboratory
- Shipping company name and waybill number

The FC will be responsible for all tracking and custody procedures for cores and samples in the field. The FC will be responsible for final sample inventory and will maintain custody documentation. The FC or designee will also complete COC forms prior to transferring samples from the field processing area to the analytical laboratory. At the end of each day, and prior to transfer, COC entries will be made for all samples. Information on the labels will be checked against sample log entries and sample tracking forms; and samples will be recounted. COC forms will accompany all samples. The COC forms will be signed at each point of transfer. Copies of all COC forms will be retained and included as appendices to QA/QC reports and data reports. Samples will be hand delivered in sealed coolers to the laboratory.

The laboratories will ensure that COC forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the COC forms. The laboratory personnel will also record cooler temperatures on the COC forms for all coolers. The laboratories will contact the FC and QA/QC coordinator immediately if discrepancies are discovered between the COC forms and the sample shipment upon receipt.

At the laboratory, a sample delivery group (SDG) number will be assigned. A unique sample identifier will be assigned to each sample (using either project ID or laboratory ID). The laboratory will ensure that a sample tracking record follows each sample through all stages of laboratory processing and storage. The sample tracking record must contain, at a minimum, the name/initials of responsible individuals performing the analyses, dates of sample extraction/preparation and analysis, the type of analysis being performed, and the storage unit(s).

4.2.3 Shipping requirements and receipt

Coolers containing samples will be hand delivered to ARI. The temperature inside the cooler(s) containing soil samples will be checked upon receipt at the laboratory using an infrared device or calibrated thermometer. The laboratory will specifically note any coolers that do not contain ice packs or that are not sufficiently cold (above 4° ± 2°C) upon receipt. Samples received below 2°C but not frozen will be considered acceptable.

4.3 ANALYTICAL METHOD REQUIREMENTS

Table 4-2 presents the analytical methods and sample handling requirements to be used during this uplands investigation. All methods selected represent standard methods used for the analysis of these analytes in soil. If the project method detection limit (MDL) cannot be attained, the laboratory project manager in consultation with the QA/QC coordinator and EPA will determine the remedy to be used. The laboratory will provide the chemical analysis results 1 week following the delivery of the samples. If TPH analysis is necessary based on the results of the HCID, the laboratory will have an additional week to submit the TPH results.

Table 4-2. Laboratory analytical methods and sample handling requirements for soil samples

ANALYTE	METHOD	REFERENCE	MAXIMUM SAMPLE HOLDING TIME	PRESERVATIVE
PCBs as Aroclors	GC/ECD	EPA 8082	14 days to extract,[a] 40 days to analyze	cool/4 ±2°C
Pesticides	GC/ECD	EPA 8081A	14 days to extract,[a] 40 days to analyze	cool/4 ±2°C
PAHs, phthalates[b]	GC/MS	EPA 8270D	14 days to extract,[a] 40 days to analyze	cool/4 ±2°C
Metals[c]	ICP-AES	EPA 6010B	6 months	cool/4 ±2°C[d]
Hydrocarbon identification	GC/FID	NWTPH-HCID	14 days to extract, 40 days to analyze	cool/4 ±2°C[e]
TPH – gasoline	GC/FID	NWTPH-G	14 days	cool/4 ±2°C[e,f]
TPH – diesel and oil (TPH-Dx)	GC/FID	NWTPH-D	14 days to extract,[a] 40 days to analyze	cool/4 ±2°C
Grain size	Sieve/hydrometer	ASTM D854	none	none
TOC	combustion	Plumb (1981)	28 days	cool/4 ±2°C
Total solids	oven-dried	EPA 160.3	7 days	cool/4 ±2°C

[a] Maximum holding time to extract aqueous rinsate blanks is 7 days.

[b] Target PAHs include anthracene, pyrene, dibenzofuran, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, fluoranthene, benzo(k)fluoranthene, acenaphthylene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, benz(a)anthracene, acenaphthene, phenanthrene, fluorene, 1-methylnaphthalene, naphthalene, and 2-methylnaphthalene.

[c] Arsenic, copper, cadmium, chromium, lead, and zinc.

[d] Aqueous rinsate blanks will be preserved with nitric acid.

[e] Aqueous rinsate blanks will be preserved with hydrochloric acid.

[f] Zero headspace.

AES – atomic emission spectrometry
ASTM – American Society for Testing and Materials
ECD – electron capture detection
FID – flame ionization detection
GC – gas chromatography
ICP – inductively coupled plasma
MS – mass spectrometry
TOC – total organic carbon
TPH – total petroleum hydrocarbon

4.4 QUALITY OBJECTIVES AND CRITERIA FOR CHEMICAL MEASUREMENT DATA

The overall data quality objective (DQO) for this project is to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality. Table 4-3 lists specific data quality indicators (DQIs) for each analysis. Interferences in individual samples may result in an increase in the reported detection limits. To achieve the required low detection limits, some modifications to the methods may be necessary.

Table 4-3. Summary of data quality indicators for soil samples

Analyte	Units (dw)	Sensitivity		Precision	Accuracy	Completeness
		RL	MDL			
PCBs as Aroclors	µg/kg	33	6.65	±50%	34 – 149%	95%
Pesticides	µg/kg	1.7 – 3.3	0.721 – 1.56	±50%	12 – 166%	95%
PAHs	µg/kg	67	22.4 – 42.2	±50%	30 – 160%	95%
Phthalates	µg/kg	67	27.6 – 64.6	±50%	30 – 160%	95%
Metals	mg/kg	0.2 – 5.0	0.04 – 0.78	±30%	70 – 130%	95%
HCID – gasoline	mg/kg	20	na	±50%	50 – 150%	95%
HCID – diesel No. 2	mg/kg	50	na	±50%	50 – 150%	95%
HCID – motor oil	mg/kg	100	na	±50%	50 – 150%	95%
TPH-gasoline	mg/kg	5.0	3.18	±50%	30 – 130%	95%
TPH-Dx	mg/kg	5.0	0.943	±50%	30 – 130%	95%
TOC	%	0.02	0.01	±30%	70-130%	95%
Grain size	%	0.1	na	±30%	na	95%
Total solids	% ww	0.01	na	±20%	na	95%

na – not applicable

RL – reporting limit

The parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity. These parameters are discussed in the following subsections.

4.4.1 Precision

Precision is the measure of the reproducibility among individual measurements of the same property, usually under similar conditions, such as multiple measurements of the same sample. Precision is assessed by performing multiple analyses on a sample and is expressed as an RPD when duplicate analyses are performed and as a percent relative standard deviation (%RSD) when more than two analyses are performed on the same sample (e.g., triplicates). Precision is assessed by laboratory duplicate analyses (duplicate samples, matrix spike duplicates, LCS duplicates) for all parameters. When duplicate samples are not available or spiking of the matrix is inappropriate; precision is assessed by laboratory triplicate analyses (e.g., TOC, grain size measurements). Precision measurements can be affected by the nearness of a chemical concentration to the MDL, where the percent error (expressed as either %RSD or RPD) increases. The data quality indicator (DQI) for precision varies depending on the analyte (see Table 4-3). The equations used to express precision are as follows:

$$\text{RPD} = \frac{(\text{measured conc} - \text{measured duplicate conc})}{(\text{measured conc} + \text{measured duplicate conc}) \div 2} \times 100$$

$$\%\text{RSD} = (\text{SD}/\text{D}_{\text{ave}}) \times 100$$

where:

$$\text{SD} = \sqrt{\left(\frac{\left(\sum \text{Dn} - \text{D}_{\text{ave}}\right)^2}{(n-1)}\right)}$$

D = sample concentration
D_{ave} = average sample concentration
n = number of samples
SD = standard deviation

4.4.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as a percentage of the true or reference value for reference material, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The DQI for accuracy varies, depending on the analyte (Table 4-3). The equations used to express accuracy are as follows.

For reference materials:

$$\text{Percent of true value} = \frac{\text{measured value}}{\text{true value}} \times 100$$

For spiked samples:

$$\text{Percent recovery} = \frac{\text{spike sample result} - \text{unspiked sample result}}{\text{amount of spike added}} \times 100$$

4.4.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. The sampling approach was designed to address the specific objectives described in Section 3.0. Assuming those needs are met, the samples collected should be considered adequately representative of the environmental conditions they are intended to characterize.

4.4.4 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this investigation, comparability of data will be established through the use of program-defined general methods and reporting formats and the use of common, traceable calibration and reference materials from the National Institute of Standards and Technology or other established sources.

4.4.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100$$

The DQI for completeness for all components of this project is 95%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

4.4.6 Sensitivity

Analytical sensitivity is a measure of both the ability of the analytical method to detect the analyte and the concentration that can be reliably quantified. The minimum concentration of the analyte above which a data user can be reasonably confident that the analyte was detected is the MDL. The minimum concentration that can be reliably quantified is the reporting limit (RL). ARI uses both MDLs and RLs for reporting analyte concentrations. For this study, MDLs and RLs will be used as measures of sensitivity for each of the analyses conducted by ARI. Results will be reported at or below the MDLs presented in Table 4-3. The laboratory will report detected concentrations above the RL without qualification and will report detected concentrations between the sample-specific MDL and the RL with a "J" qualifier indicating that the concentration is an estimate.

4.5 QUALITY ASSURANCE/QUALITY CONTROL

4.5.1 Field quality control criteria

Although validation guidelines have not been established for field QC samples, their analysis is useful in identifying potential problems that could result from sample collection or sample processing in the field. All field QC samples will be documented in the field logbook and verified by the QA/QC coordinator or a designee.

Field QC samples will be used to evaluate the efficiency of field decontamination procedures and variability due to sample handling. Two types of field QC samples will be collected: rinsate blanks for the sampling equipment and field duplicates. These sample types are further described below. Locations for the collection of field QC samples will be selected in the field by the FC.

Rinsate blanks

Rinsate blanks are used to assess whether and/or to what degree contamination is crossing from one sample to the next during sample collection or processing. A rinsate blank is created by rinsing the decontaminated sample processing equipment with deionized water. This water is collected in a clean jar and submitted to the laboratory for analysis. A minimum of one rinsate blank per 20 samples will be submitted for chemical analysis. If a particular sample is suspected of being highly contaminated, a rinsate blank should be collected after processing that sample. The rinsate blank will be submitted to the laboratory in the same manner as the environmental samples and will be analyzed for metals and organic parameters. If any chemicals of concern are detected in the rinsate blank, samples may be qualified or rejected depending on the magnitude of the concentration. In such a case, the independent, third-party data validator will determine the validity of the data.

Duplicate samples

Homogenized soil will be collected and analyzed in duplicate to evaluate heterogeneity attributable to sampling handling. A minimum of one field duplicate will be submitted per 20 samples. As guidance, the RPD for homogenate duplicate soil samples should be within 75%.

Trip blanks

Trip blanks will be used to determine whether volatile contaminants are introduced to samples during holding, shipping, or storage prior to analysis. Trip blanks will consist of deionized water sealed in a VOC sample container by the analytical laboratory. Trip blanks will be transported from the laboratory to the field, will remain in the cooler during sampling, and will be returned to the laboratory unopened for TPH-G analysis. One trip blank will be included in each cooler that contains samples to be analyzed for TPH-G.

4.5.2 Chemical analyses

Before analyzing the samples, the laboratory must provide written protocols for the analytical methods to be used, calculate MDLs for each analyte in each matrix of interest, and establish an initial calibration curve for all analytes. The laboratory must demonstrate their continued proficiency by participation in inter-laboratory comparison studies and through repeated analysis of certified reference materials, calibration checks, laboratory reagent blanks, and spiked samples.

Determination of method detection limits

The MDL is defined as the lowest concentration of an analyte or compound that a method can detect in either a sample or a blank with 99% confidence. The laboratory determines MDLs using standard procedures outlined in 40 CFR 136. In summary, seven or more replicate samples will be fortified at 1 to 5 times (but not to exceed 10 times) the expected MDL concentration. The MDL is then determined by calculating the standard deviation of the replicates and multiplying by the student's t-value (a factor of 3.14 for seven MDL replicates). MDLs should be verified annually, or when a major modification to the analytical equipment is made.

Sample delivery group

Project- and/or method-specific QC measures such as matrix spikes and matrix duplicates will be analyzed per SDG or sample preparatory batch. An SDG is defined as no more than 20 samples or a group of samples received at the laboratory within a 2-week period. Although an SDG may span 2 weeks, all holding times specific to each analytical method will be met for each sample in the SDG.

Laboratory quality control criteria

The analyst will review results of QC analyses (described below) from each SDG immediately after it has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded. If control limits are exceeded in the SDG, corrective action must be taken immediately, such as method modifications followed by reprocessing of the affected samples. If acceptable correction actions can not be completed before maximum holding times expire or processing a subsequent SDG, the QA/QC coordinator will be contacted immediately.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, or other documented, reliable, commercial sources. The accuracy of the standards will be verified by comparison with an independent standard. Laboratory QC standards are verified a multitude of ways. Second-source calibration verifications are run (i.e., same analytes of interest made by two different manufacturers) immediately following calibrations. New working standard mixes (calibrations, spikes, etc.) are verified against the results of the original solution and must be within 10%. Newly purchased standards are verified against current data. Any impurities found in the standard will be documented. The following sections summarize the procedures that will be used to assess data quality throughout sample analysis. Table 4-4 presents the required frequencies for laboratory QC analyses. The associated control limits for precision and accuracy are presented in Table 4-3.

Table 4-4. Quality control analysis frequencies

	Frequency									
Analyte	Initial Calibration	Second Source Initial Calibration Verification	Continuing Calibration Verification	Laboratory Control Samples	Method Blanks	Matrix Spikes	Matrix Spike Duplicates	Matrix Replicates	Surrogate Spikes	Field Replicates
PCB Aroclors	prior to analysis	after initial calibration	every 20 injections or 12 hrs, whichever is more frequent	1 per prep batch	1 per prep batch	1 per prep batch or SDG	1 per prep batch or SDG	na	each sample	1 per 20 samples
Pesticides[a]	prior to analysis	after initial calibration	every 20 injections or 12 hrs, whichever is more frequent	1 per prep batch	1 per prep batch	1 per prep batch or SDG	1 per prep batch or SDG	na	each sample	1 per 20 samples
Metals	daily, prior to analysis	after initial calibration	every 10 samples	1 per prep batch	1 per prep batch	1 per prep batch or SDG	na	1 per prep batch or SDG	na	1 per 20 samples
PAHs	prior to analysis	after initial calibration	At the start of the 12-hr analytical batch	1 per prep batch	1 per prep batch	1 per prep batch or SDG	1 per prep batch or SDG	na	each sample	1 per 20 samples
Phthalates	prior to analysis	after initial calibration	At the start of the 12-hr analytical batch	1 per prep batch	1 per prep batch	1 per prep batch or SDG	1 per prep batch or SDG	na	each sample	1 per 20 samples
TPH-HCID	single point, prior to analysis	na	daily	na	1 per prep batch	na	na	1 per 10 samples	each sample	1 per 20 samples
TPH-G	prior to analysis	after initial calibration	before and after sample analysis	1 per prep batch	1 per prep batch	1 per prep batch or SDG	1 per prep batch or SDG	na	each sample	1 per 20 samples
TPH-Dx (extended)	prior to analysis	after initial calibration	before and after sample analysis	1 per prep batch	1 per prep batch	1 per prep batch or SDG	1 per prep batch or SDG	na	each sample	1 per 20 samples
Grain size	na	na	na	na	na	na	na	1 per batch or SDG	na	1 per 20 samples
TOC	prior to analysis	after initial calibration	every 10 samples	na	1 per prep batch	1 per batch or SDG	na	1 per batch	na	1 per 20 samples

[a] Aroclor standards will be run as interference check samples for this analysis.

batch – group of samples of the same matrix analyzed or prepared at the same time, not to exceed 20 field samples

na – not applicable

TPH-Dx – total petroleum hydrocarbons – diesel and oil extended

TPH-G – total petroleum hydrocarbons – gasoline

Matrix replicates

Analytical replicates provide information on the precision of the analysis and are useful in assessing sample heterogeneity and matrix effects. Analytical replicates are sub-samples of the original sample that are prepared and analyzed separately assuming sufficient sample volume is available. For metals and conventional measurements, a minimum of one matrix replicate will be analyzed for every batch of 20 samples or fewer.

Matrix spikes and matrix spike duplicates

The analysis of matrix spike samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate matrix spike analyses, information on the precision of the method is also provided. For organic analyses, a minimum of one matrix spike and matrix spike duplicate will be analyzed for each SDG or preparatory batch of 20 samples or fewer, when possible. For inorganic parameters, a matrix spike will be analyzed in each SDG or preparatory batch, when possible.

Method blanks

Method blanks consisting of a clean matrix are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of one method blank will be analyzed for each extraction/digestion batch of 20 samples or fewer.

Surrogate spikes

All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample results will be corrected for recovery using these values.

For PCB analyses, a decachlorobiphenyl (DCB) surrogate will be added to all samples and analyzed as a point of reference and indicator of retention time shifts. If an Aroclor is detected in the sample, the standard for the detected Aroclor must be analyzed within 72 hrs of detection and within a valid 12-hr sequence to confirm the presence of the Aroclor in the sample. The lab will also submit a summary of retention times and established retention time windows for the three to five major Aroclor peaks that will be used during analysis and will submit a summary of the retention time shifts of the DCB for both columns used in the analyses (columns may be added to the summary of analysis run log).

Laboratory control samples

Laboratory control samples (LCS) consist of a clean matrix and are fortified with the target analytes. The analyte recoveries are evaluated to measure the accuracy of the test methods. LCS recoveries will be reported by the laboratories; however, no sample results will be corrected for recovery using these values.

Internal standards spikes

Internal standards may be used for calibrating and quantifying organic compounds and/or metals by ICP-MS. If internal standards are used, all calibration, QC, and project samples will be spiked with the same concentration of the selected internal standard(s). Internal standard recoveries and retention times must be within method and/or lab criteria.

4.6 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

The FC will be responsible for overseeing the testing, inspection, and maintenance of all field equipment. The laboratory project manager will be responsible for ensuring that the laboratory equipment testing, inspection, and maintenance requirements are met. The calibration methods used in calibrating the analytical instrumentation are described in the following section.

4.7 INSTRUMENT CALIBRATION AND FREQUENCY

Initial calibrations will be performed on each instrument prior to sample analysis, after any major interruption to the analytical instrument, and/or when continuing calibration verifications do not meet the specified criteria. The number of points used in the initial calibration must be equal to or greater than those defined in each analytical method. Continuing calibration verifications will be performed every 12 hrs or 10 to 20 samples for the organic analyses, once every 10 samples for the inorganic analyses, and daily for conventional parameters to ensure proper instrument performance.

In addition, if an Aroclor is detected in a sample, then a standard for that specific Aroclor must be analyzed as a continuing calibration verification within 72 hrs of the original detection of the Aroclor.

Calibration of analytical equipment used for inorganic chemical analyses include calibration blanks, which account for the stability of the established baseline. Additionally, continuing calibration blanks will be analyzed immediately after the continuing calibration verification, at a frequency of one blank for every 10 samples analyzed for inorganic analyses. If the continuing calibration blank does not meet the specified criteria, all bracketing sample analyses must be reanalyzed. Analysis may resume once the source of contamination is shown to be clean, and after corrective actions have been taken to meet the method specifications. All project samples analyzed by an instrument found to be out of compliance must be reanalyzed.

4.8 INSPECTION AND ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Supplies and consumables for the field sampling effort will be inspected upon delivery and accepted if the condition of the supplies is satisfactory. For example, jars will be inspected to ensure that they are the correct size and quantity and were not damaged in shipment.

4.9 DATA MANAGEMENT

All field data will be recorded on field forms, which will be checked for missing information by the FC at the end of each field day and amended. Field forms will be archived in the Windward library.

ARI will submit data in an electronic format, as described in Section 5.4.2. The laboratory project manager will contact the QA/QC coordinator prior to data delivery to discuss specific format requirements.

A library of routines will be used to translate typical electronic output from laboratory analytical systems and to generate data analysis reports. The use of automated routines ensures that all data are consistently converted into the desired data structures and that operator time is kept to a minimum. In addition, routines and methods for quality checks will be used to ensure such translations are correctly applied.

Written documentation will be used to clarify how field and analytical laboratory duplicates and QA/QC samples were recorded in the data tables and to provide explanations of other issues that may arise. The data management task will include keeping accurate records of field and laboratory QA/QC samples so that project team members who use the data will have appropriate documentation. Data management files will be stored on a secure computer. Additional data management rules are presented in Appendix D.

5.0 Project Management

5.1 PROJECT ORGANIZATION AND TEAM MEMBER RESPONSIBILITIES

Figure 5-1 shows the overall project organization for additional data collection at T-117 and the individuals responsible for sample collection and analysis tasks. Table 5-1 presents the contact information for all team members involved in this investigation effort. The responsibilities of all team members are described in the following subsections.

Table 5-1. Project team contact information

NAME	TITLE	COMPANY	PHONE	EMAIL
Anita Lovely	Port of Seattle project manager	Lovely Consulting	o: 206.368.2477	alovely@seanet.com
Ravi Sanga	EPA project manager	EPA	o: 206.553.4092	sanga.ravi@epamail.epa.gov
Ginna Grepo-Grove	EPA QA officer	EPA	o: 206.553.1632	grepo-grove.gina@epa.gov

NAME	TITLE	COMPANY	PHONE	EMAIL
Warren Hansen, PE	project manager	Windward	o: 206.812.5434 c: 425.830.9459	warrenh@windwardenv.com
Jeffrey Fellows, PE	Windward project coordinator	Windward	o: 206.812.5409	jeffreyf@windwardenv.com
Susie McGroddy	QA/QC manager	Windward	o: 206.812.5421	susanm@windwardenv.com
David Cooper	field coordinator	DOF	o: 425.827.4588 c: 206.660.3466	dcooper@dofnw.com
Joanna Florer	field coordinator	Windward	o: 206.812 5410 c: 206.295.8956	joannaf@windwardenv.com
Marina Mitchell	QA/QC coordinator	Windward	o: 206.812.5424	marinam@windwardenv.com
Patrick Gibbons	data manager	Windward	o: 206.812.5412	patrickg@windwardenv.com
Susan Dunnihoo	laboratory project manager	ARI	o: 206.389.6156	sue@arilabs.com
Chris Ransom	data validation manager	EcoChem	o: 206.233.9332	cransom@ecochem.net

o – office

c – cell

5.1.1 Project management

Anita Lovely will serve as the Port project manager. Warren Hansen of Windward Environmental LLC (Windward) will be the upland investigation project manager. He will serve as liaison between the Port and the project team and will coordinate and participate in the development of technical deliverables. Jeffrey Fellows will serve as the Windward project coordinator. He will be responsible for overall project planning and coordination; production of work plans and project deliverables; and performing the administrative tasks needed to ensure timely and successful completion of the project. Ravi Sanga will serve as the EPA project manager. The project managers and coordinator will be involved in all aspects of the project, including reviewing and approving the QAPP and interpreting the results of the investigation.

5.1.2 Field coordination

Joanna Florer of Windward and David Cooper of Dalton, Olmsted & Fuglevand, Inc. (DOF) will be the FCs. The FCs are responsible for managing day-to-day sampling and general field and QA/QC oversight and for providing technical oversight of the soil boring work. They will also ensure that appropriate protocols for sample collection, preservation, and holding times are observed and oversee the delivery of environmental samples to the designated laboratories for chemical and physical analyses.

5.1.3 Quality assurance/quality control

Susan McGroddy of Windward will oversee QA/QC for the project. As the QA/QC manager, she will provide oversight for both the field sampling and laboratory programs and will supervise data validation and project QA coordination, including coordination with the EPA QA officer, Ginna Grepo-Grove. Marina Mitchell of Windward will serve the QA/QC coordinator. The QA/QC coordinator will ensure that samples are collected and documented appropriately and coordinate with the analytical laboratories to ensure that QAPP requirements are followed. Independent third-party data review and validation will be provided by Chris Ransom of EcoChem, Inc.

5.1.4 Laboratory project management

Analytical Resources, Inc. (ARI) of Seattle will perform chemical and physical analyses of the soil samples and rinsate blanks. Susan Dunnihoo will be ARI's project manager. The analytical testing laboratory will be responsible for:

- Adhering to the methods outlined in this QAPP, including those methods referenced for each analytical procedure
- Adhering to documentation, COC, and laboratory sample logbook procedures
- Implementing the laboratory QA/QC procedures defined in this QAPP
- Meeting all reporting requirements
- Delivering electronic data files as specified in this QAPP
- Meeting turnaround times for deliverables as specified in this QAPP
- Coordinating with EPA and the QA/QC contractor to perform laboratory and data audits

5.1.5 Data management

Patrick Gibbons of Windward will oversee data management to ensure that sampling parameters and analytical data are incorporated into the Windward database. Appropriate qualifiers following third-party data validation will also be incorporated in the database. Mr. Gibbons is also responsible for managing the export of the project data into data tables used in data reports and/or electronic submittals.

5.2 PROJECT/TASK DESCRIPTION AND SCHEDULE

Boreholes will be advanced in the T-117 Upland Area to generate chemical and physical data to aid in the determination of the extent of impacted soil at the site and to obtain general engineering characteristics in the Upland Area. The rationale for the field elements is discussed in detail in Section 3.0.

Field sampling will be initiated following EPA's approval of this QAPP. Field sampling is currently anticipated to begin January 2006. The laboratory will provide the results of chemical analyses one week following delivery of the samples. Data will be validated within three weeks of receiving data packages from the laboratory. A draft data report will be submitted to EPA three weeks after Windward's receipt of validated data. The final data report will be submitted to EPA three weeks after the Port's receipt of comments from EPA.

5.3 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

The Superfund Amendments and Reauthorization Act (SARA) of 1986 required the Secretary of Labor to issue regulations providing health and safety standards and guidelines for workers engaged in hazardous waste operations. The 29 CFR 1910.120 Occupational Safety and Health Administration (OSHA) regulations require training to provide employees with the knowledge and skills enabling them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hr HAZWOPER training course and 8-hr refresher courses, as necessary, to meet the OSHA regulations.

5.4 DOCUMENTATION AND RECORDS

5.4.1 Field observations

All field activities will be recorded in a field logbook maintained by the FC. The field logbook is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period. The field logbook will include a description of all sampling activities, conferences associated with field sampling activities, and weather conditions, as well as a record of sampling personnel. All modifications to the procedures and plans identified in this QAPP and the HSP (Appendix A) will be documented in the field logbook and on a Protocol Modification Form (Appendix C). The field logbook will consist of bound, numbered pages, and all entries will be made in indelible ink.

After sample collection, the following information will be recorded on the boring log (Appendix C):

- Name of person logging sample
- Date and time of collection or logging
- Names of crew members
- Weather conditions
- Sample ID
- Sample depth
- Physical observations of soil, including the presence of foreign objects, color, presence of sheens (see specific criteria on the boring log [Appendix C] or in Section 4.1.2), apparent grain size, moisture, plasticity, and odor
- Geologic stratigraphy and the presence of any water-bearing layers
- Sampler penetration depth

- Blow counts
- SPT results

5.4.2 Laboratory records

Laboratories will be responsible for internal checks on sample handling and analytical data reporting and will correct errors identified during the QA review. Close contact will be maintained with the laboratories to resolve any QC problems in a timely manner. Items to be included in the laboratory data package follow.

Project narrative

The project narrative will be a summary, in the form of a cover letter, and will identify any problems encountered during any aspect of sample receipt and analysis and their resolution. The summary will include, but not be limited to, discussion of QC, sample shipment, sample storage, and analytical difficulties.

Chain-of-custody forms

Legible copies of the COC forms will be provided as part of the data package. This documentation will include the date and time of receipt, cooler temperatures, and the condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.

Sample results

The data package will summarize the results for each sample analyzed. The summary will include the following information, as applicable:

- Field sample ID and the corresponding laboratory identification code
- Sample matrix
- Date of sample extraction/digestion
- Date and time of analysis
- Weight and/or volume used for analysis
- Final dilution volumes or concentration factor for the sample
- Total solids in the samples
- Identification of the instruments used for analysis
- RLs
- All data qualifiers and their definitions

QA/QC summaries

These summaries will contain the results of all QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (see above). The laboratory will make no recovery or blank corrections. The required summaries are listed below.

- The calibration data summary will contain the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent relative standard deviation, relative percent differences (RPD), and retention time for each analyte will be listed, as appropriate. Results for standards to indicate instrument sensitivity will be reported.
- The internal standard area summary will report the internal standard areas and retention times, as appropriate.
- The method blank analysis summary will report the method blank analysis associated with each sample and the concentrations of all compounds of interest identified in these blanks.
- The surrogate spike recovery summary will report all surrogate spike recovery data for organic analyses. The names and concentrations of all compounds added, percent recoveries, and QC limits will be listed.
- The matrix spike recovery summary will report the matrix spike or matrix spike/matrix spike duplicate recovery data for analyses, as appropriate. The names and concentrations of all compounds added, percent recoveries, and QC limits will be included in the data package. The RPD for all matrix spike duplicate analyses will also be reported.
- The matrix duplicate summary will report the RPD for all matrix duplicate analyses. The QC limits for each compound or analyte will be listed.
- The laboratory control analysis summary will report the results of the analyses of laboratory control samples (LCSs). The QC limits for each compound or analyte will be included in the data package.
- The relative retention time summary and analytical sequence reports will report the relative retention times for the primary and confirmational columns of each analyte detected in the samples, as appropriate.
- Instrument performance check , tune ion abundances
- Silica gel verification checks

Original data

Legible copies of the original data generated by the laboratory will be provided, including the following:

- Sample extraction/digestion, preparation, and cleanup logs
- Instrument analysis logs for all instruments used on days of calibration and analysis

- Reconstructed ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and LCSs
- Final chromatograms used in the identification and quantification of gas chromatography (GC) methods for each sample
- Unenhanced and enhanced spectra of detected compounds with associated best-match spectra for each sample
- Printouts and quantitation reports for each instrument used, including reports for all samples, standards, blanks, calibrations, spikes, replicates, and LCSs

The contract laboratories for this project will submit data electronically, in delimited-text format. Guidelines for electronic data deliverables for chemical data are as follows:

- Each row of data will contain only one analyte for a given sample. Therefore, one complete sample will require multiple rows.
- If a comma-separated value file format has been used, all fields must have quotations around each entry to avoid field value confusion. For example, "Indeno(1,2,3-cd)pyrene."
- Each result, RL, and detection limit (DL) must show the proper significant figures and sensitivity. These entries should have no non-number characters within the field (i.e., apostrophes, commas).
- If a result for an analyte is below the MDL, the laboratory qualifier will be U, and the value in the result column will be the RL. Quantified results between the MDL and the RL will be J-qualified by the laboratory.
- Analytical results of laboratory samples for QA/QC will be included and clearly identified in the sample type code field.
- If replicate analyses are conducted on a submitted field sample, they too will be included and clearly identified in the sample type code.
- Wherever possible, all analytes and replicates for a given sample will be grouped together.

The electronic data deliverable (EDD) format for chemical data is provided in Table 5-2. All fields are required in the order listed. Entries listed as required must be present for all individual records (rows). Optional entries may not be applicable to all records.

Table 5-2. Electronic data deliverable format for chemical data

REQUIRED FIELDS	ENTRY IN FIELD REQUIRED OR OPTIONAL
Project code	required
Event ID	required
Sample name	required
Sample date / time	required
Analysis location	required
Laboratory name code	required
Parent sample name	optional
Laboratory sample ID	required
Sample type code	required
Sample delivery group	required
Standard analytical method name	required
Laboratory analytical method name	optional
CAS number	optional
Chemical name	required
Result value	required
Result unit	required
Laboratory flag	optional
Validator flag	optional
Result type code	required
Detect flag	required
Reporting limit	required
Dilution factor	required
Sample matrix code	required
Total or dissolved	required
Basis	required
Analysis date time	required
Method detection limit	required
Laboratory prep method name	required
Prep date / time	required
Test batch ID	required
Result error delta	optional
Tic retention time	optional
Result comment	optional
QC original concentration	optional
QC spike added	optional
QC spike measured	optional
QC spike recovery	optional
QC duplicate original concentration	optional
QC duplicate spike added	optional

REQUIRED FIELDS	ENTRY IN FIELD REQUIRED OR OPTIONAL
QC duplicate spike measured	optional
QC duplicate spike recovery	optional
QC relative percent difference (RPD)	optional
QC spike lower confidence limit	optional
QC spike upper confidence limit	optional
QC RPD confidence limit	optional
Laboratory analytical method description	optional
Laboratory flag description	optional

The laboratory will provide an EDD in this format. Upon receipt of the EDD, a unique Windward identifier will be added to each record in the EDD. Data managers will then provide the data validator with the Windward EDD for use in data validation and qualification.

5.4.3 Data reduction

Data reduction is the process by which original data are converted or reduced to a specified format or unit to facilitate analysis of the data. For example, a final analytical concentration may need to be calculated from a diluted sample result. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which are subjected to further review by the laboratory QC reviewer, the QA/QC coordinator, and independent reviewers. The data will be generated in a form amenable to review and evaluation. Data reduction may be performed manually or electronically. If performed electronically, all software used must be demonstrated to be true and free from unacceptable error.

During chemical analysis, samples will be diluted after the initial analysis if the estimated concentration for one or more of the target analytes is above the calibration curve. In these instances, concentrations from the initial analysis will be identified as the "best result" for all target analytes other than the chemical(s) that was/were originally above the calibration range. The "best result" for this qualified analyte(s) will be taken from the diluted sample.

5.4.4 Data report and technical memorandum

A data report that documents all activities associated with the collection, handling, and analysis of samples will be prepared. At a minimum, the following will be included in the data report:

- Introduction and purpose
- Summary of all field activities, including descriptions of any deviations from the approved QAPP

- Information on sampling equipment
- Dates of field activities
- Soil sampling locations reported in latitude and longitude to the nearest one-tenth of a second and in northing and easting to the nearest foot
- Plan view of the project showing the actual sampling locations
- A summary of the QA/QC review and resulting qualification of the analytical data
- Data validation report (appendices)
- Results from the analyses of field samples, both as summary tables in the main body of the report and appendices with data forms submitted by the laboratories
- Boring logs and observations including measurements of foundation and pavement thicknesses, physical characteristics of the penetrated soil column, and information on the presence of any large debris or waste masses encountered during the investigation.

Data will be validated within 15 working days of receiving the final data package from the laboratory, and the draft data report and technical memorandum will be submitted 30 working days after receiving the final data package from the laboratory. A final data report will be submitted to the agencies 14 days after receiving comments on the draft report.

The accompanying technical memorandum will include an evaluation of the results of the sampling investigation and, at a minimum, recommendations for:

- Management of Upland Area soils taking into account the existing response actions in place at T-117 (e.g., containment, removal)
- Upland Area removal action(s) and cleanup levels
- Institutional controls
- Modifications to the inshore boundary of the NTCRA band and sediment removal area

6.0 Assessment and Oversight

6.1 COMPLIANCE ASSESSMENTS AND RESPONSE ACTIONS

6.1.1 Compliance assessments

Laboratory and field performance assessments consist of onsite reviews (as specified by EPA) of QA systems and equipment for sampling, calibration, and measurement. EPA personnel may conduct a laboratory audit prior to sample analysis. Any pertinent laboratory audit reports will be made available to the QA/QC coordinator upon request. All laboratories are required to have written procedures that address internal QA/QC; these procedures will be submitted for review by the QA/QC coordinator to ensure compliance with the QAPP. All laboratories and QA/QC coordinator are required to ensure that all personnel engaged in sampling and analysis tasks have appropriate and documented training.

6.1.2 Response actions for field sampling

The FC, or a designee, will be responsible for correcting equipment malfunctions throughout field sampling and for resolving situations in the field that could potentially result in nonconformance or noncompliance with the QAPP. All corrective measures will be immediately documented in the field logbook, and Protocol Modification Forms (Appendix C) will be completed.

6.1.3 Corrective action for laboratory analyses

Analytical laboratories are required to comply with the standard operating procedures previously submitted to the QA/QC coordinator. The laboratory project manager will be responsible for ensuring that appropriate corrective actions are initiated as necessary for conformance with this QAPP. All laboratory personnel will be responsible for immediately reporting to the laboratory project manager any problems that could potentially compromise the quality of the data.

The QA/QC coordinator will be notified immediately if any QC sample exceeds the project-specified control limits (Table 4-3). The analyst will identify and correct the anomaly before continuing with the sample analysis. The laboratory project manager will document the corrective action taken in a memorandum submitted to the QA/QC coordinator within 5 days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package using a corrective action form provided by the laboratory.

6.2 PROGRESS REPORTS

Monthly progress reports will include the status of the sampling event and dates for when sampling is completed and samples have been submitted for analysis, when information is received from the laboratory, and when analysis is complete. The status of the samples and analyses will be indicated with emphasis on any deviations from the QAPP. A data report will be written after validated data are available for each sampling event. These reports will be delivered electronically to the Port and EPA project managers. The data report will include the data validation report and laboratory-generated summaries of analytical results (Form 1) with the associated QC results. The full analytical data package, including the raw analytical results will be available for review upon request.

7.0 Data Validation and Usability

7.1 DATA VALIDATION

The data review process begins in the laboratory with the evaluation of the data by the analysts, supervisory personnel, and/or QA specialists. The laboratory is responsible for ensuring that the analytical data are correct and complete, that appropriate procedures have been followed, and that QC results are within acceptable limits. The QA/QC coordinator is responsible for ensuring that all analyses performed by the laboratory are correct, properly documented, and complete and that they satisfy the project data quality objectives specified in this QAPP.

Data are not considered final until validated by an independent third-party. Data validation will be conducted following the most current EPA (1999; 2002b) guidance and the requirements specified in this QAPP. Independent third-party data review and summary validation of the analytical data will be conducted by EcoChem, Inc. For analytical chemistry data, a minimum of 20% or two SDGs will undergo full data validation. Full data validation parameters include:

- Evaluation of COC and sample-handling procedures
- Analysis holding times
- QC analysis frequencies
- Instrument initial calibration
- Instrument continuing calibration verifications
- LCS recoveries
- Laboratory blank contamination
- Surrogate recoveries
- Internal standard areas and retention time shifts
- Matrix spike recoveries
- Matrix spike/matrix spike duplicate RPDs
- Compound identifications
- Compound quantitation
- Instrument performance check; tune ion abundances
- Silica gel verifications

If no discrepancies are found between the reported results and raw data in the SDGs that undergo full data validation, then validation may proceed as a summary validation on the rest of the data using all the QC forms submitted in the laboratory data package. As part of the summary validation, all summary forms for calibrations, instrument performance, surrogate recoveries, and internal standard summaries will be reviewed. QA review of the chemistry data will be performed in accordance with the project QA requirements, the technical specifications of the analytical methods (see Table 4-4), and EPA guidance for organic and inorganic data review (1999; 2002b). The EPA project manager may have EPA peer review the third-party validation or perform data assessment/validation on a percentage of the data.

Any data qualification resulting from the data validation will be noted in a validation report submitted to the QA/QC coordinator. Qualification will also be added by the validator to the "validator flag" field of the EDD provided by Windward. All lab qualifiers that remain unchanged as a result of data validation must also be carried through into the validator flag field of the EDD.

7.2 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Data quality assessment will be conducted by the QA/QC coordinator in accordance with EPA guidelines. The results of the independent third-party review and validation will be reviewed, and cases where the projects DQIs were not met will be identified. The usability of the data will be determined in terms of the magnitude of the DQI exceedance, as well as the importance of the data with respect to other historical data sets, and compiled and summarized in the data gaps analysis report (Windward et al. 2003).

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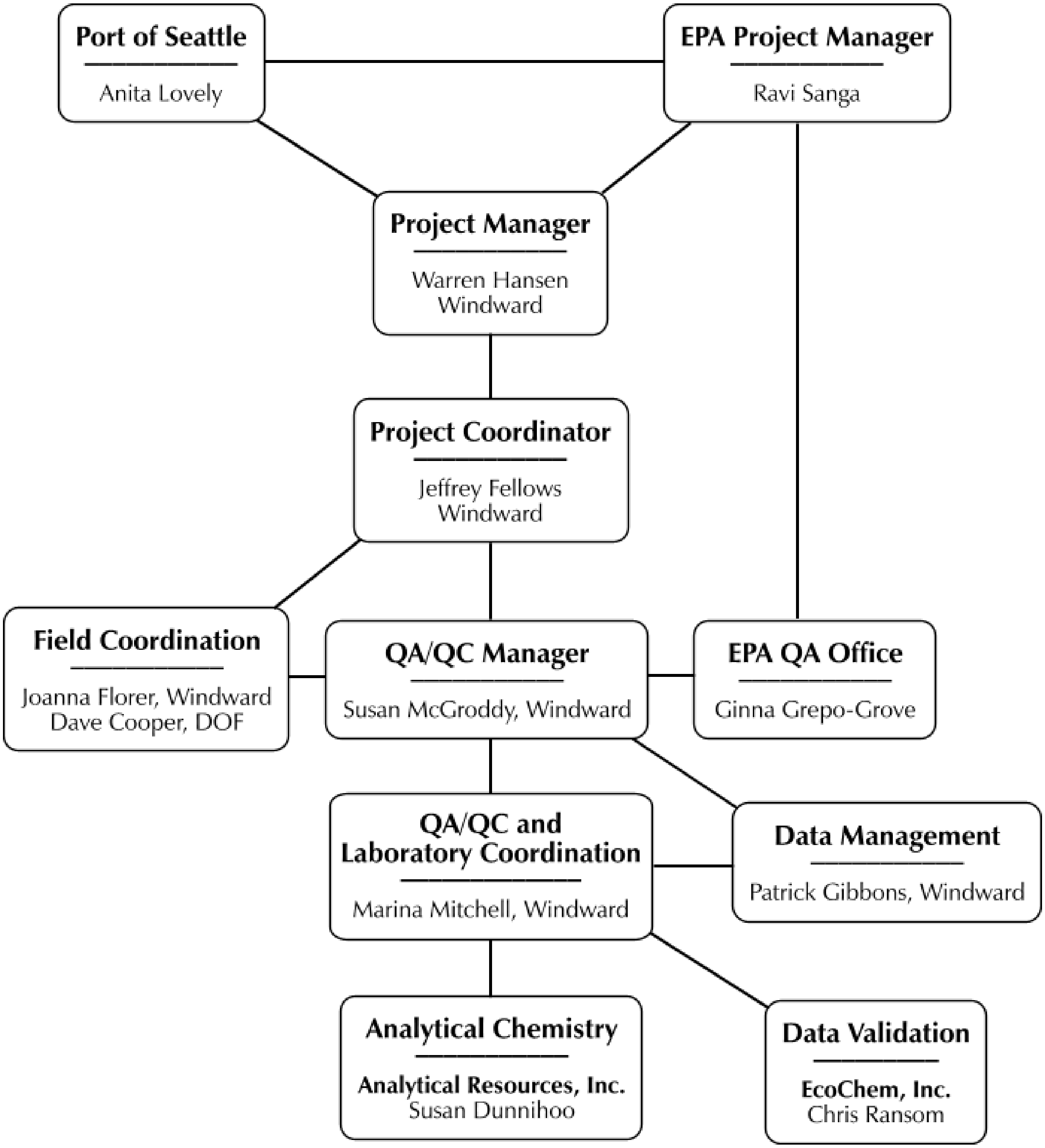

Figure 5-1.Project organization and team responsibilities