Harris Avenue Shipyard

Data Gaps Investigation Sampling Analysis Plan and Quality Assurance Project Plan

Prepared for

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List of Abbreviations and Acronyms

Acronym/ Abbreviation	Definition
ALS	ALS Laboratory
ARI	Analytical Resources, Inc
bgs	Below ground surface
DAHP	Department of Archaeology and Historic Preservation
DI	Deionized
DO	Dissolved oxygen
DQO	Data quality objective
Ecology	Washington State Department of Ecology
GPS	Global Positioning System
HRA	Historical Research Associated, Inc.
ID	Identification code
IDW	Investigation-derived waste
LCS	Laboratory control sample
LNAPL	Light non-aqueous phase liquid
MS	Matrix spike
MSD	Matrix spike duplicate
MTCA	Model Toxics Control Act
NTU	Nephelometric turbidity unit
PID	Photoionization detector
Port	Port of Bellingham
PPE	Personal protective equipment
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative percent difference
SAP	Sampling and Analysis Plan
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
WAC	Washington Administrative Code

1.0 Project Description

This Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) prepared by Floyd|Snider on behalf of the Port of Bellingham (Port) describes the organization, objectives, planned activities, and specific quality assurance (QA)/quality control (QC) procedures associated with the Data Gaps Investigation being conducted as part of the Site-Wide Remedial Investigation/Feasibility Study (RI/FS) activities for the Harris Avenue Shipyard (Site) located in Bellingham, Washington. The scope and rationale of the Data Gaps Investigation was presented to the Washington State Department of Ecology (Ecology) on November 15, 2012 and is intended to fill data gaps and provide necessary information to complete the RI/FS for the Site.

This plan was developed in accordance with Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004), Washington State Model Toxics Control Act (MTCA) Washington Administrative Code (WAC) 173-340-820 (Ecology 2007), and Ecology's *Sediment Sampling and Analysis Plan Appendix* (Ecology 2008). This document describes specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses associated with this investigation.

1.1 INTRODUCTION

The Data Gaps Investigation field activities include the following:

- Groundwater sampling
- Soil sampling
- Monitoring well installation
- Bank/intertidal sampling
- Surface sediment sampling

A summary of the Data Gaps Investigation activities are summarized in Table 1.1 and Figure 1.1.

1.2 PROJECT SCHEDULE

Data Gap Investigation activities are proposed to commence in the first quarter of 2013 pending the approval of this SAP/QAPP. It is estimated that field work (including soil, groundwater, and surface sediment sampling) will be underway the last week of January/first week of February 2013.

1.3 SAP/QAPP ORGANIZATION

The sections of this SAP/QAPP present the following material:

- **Section 2.0—Project Organization and Responsibility:** describes the project management structure of the project.

- **Section 3.0—Field Activities:** summarizes the general methods and procedures to be used to during the investigation at the site including the handling and tracking of sample custody.
- **Section 4.0—Sampling Procedures:** summarizes the protocols used for field investigation sampling.
- **Section 5.0—Laboratory Quality Assurance Objectives:** details the laboratory procedures for ensuring data quality is maintained for field sampling, following chain-of-custody protocols, laboratory analyses, and reporting.
- **Section 6.0—Data Reduction, Validation, and Management:** describes the laboratory review and handling of data and reporting, and data validation procedures.
- **Section 7.0—Corrective Actions:** discusses corrective actions for both field and laboratory personnel to address and document when issues arise during work activities.
- **Section 8.0—Reporting:** summarizes the content of the report that will be produced after the field and laboratory efforts are complete.
- **Section 9.0—References:** provides a list of materials used to develop the SAP/QAPP.

2.0 Project Organization and Responsibility

Under the authorization of the Port, Floyd|Snider will perform field activities as part of the Data Gaps Investigation for the Site-Wide RI/FS. ALS Laboratory Group (ALS) and Analytical Resources, Inc. (ARI) in Tukwila, Washington are the primary project laboratories providing all environmental laboratory analyses. The various QA field, laboratory, and management responsibilities of key project personnel are defined below.

2.1 MANAGEMENT RESPONSIBILITIES

Mike Stoner—Port of Bellingham Point of Contact

Mike Stoner is the Port's point of contact and control for matters concerning the project. He will perform the following tasks:

- Define project objectives.
- Orient Floyd|Snider as to the project's special considerations.
- Communicate with Ecology and project stakeholders.
- Review and approve all reports (deliverables) before submission to stakeholders.
- Represent the project team at meetings and public hearings.

Stephen Bentsen—Floyd|Snider Project Manager

Stephen Bentsen, Project Manager, will have overall responsibility for project implementation. As Project Manager he will be responsible for the overall QA on this project to ensure that it meets technical and contractual requirements. The Project Manager will report directly to the Port's Point of Contact and is responsible for technical QC and project oversight.

The Project Manager will perform the following tasks:

- Monitor project activity and quality.
- Provide overview of field activities to the Port and its tenants.
- Prepare and review RI/FS reports.
- Provide technical representation of project activities.
- Approve the SAP/QAPP.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

Elena Ramirez—Floyd|Snider QA Manager

The QA Manager reports directly to the Floyd|Snider Project Manager and will be responsible for ensuring that all QA/QC procedures for this project are followed. The QA Manager will be responsible for coordinating the data validation of all sample results from the analytical laboratories. Additional responsibilities include the following:

- Overview and review of field QA/QC.

- Coordinate supply of performance evaluation samples and review results from performance audits.
- Coordinate review and data validation of laboratory QA/QC.
- Advise on data corrective action procedures.
- Prepare and review the RI/FS report.
- QA/QC representation of project activities.
- Approve of the SAP/QAPP.

2.3 LABORATORY RESPONSIBILITIES

ALS and ARI will perform all analytical services in support of the Site-Wide RI/FS work activities.

Rick Bagan (ALS Project Manager) and Sue Dunnihoo (ARI Project Manager)

The Laboratory Project Managers will report directly to the Floyd|Snider QA Manager and will be responsible for the following:

- Ensure all resources of the laboratory are available.
- Advise Floyd|Snider's QA Manager of laboratory status.
- Review and approve of final analytical reports.
- Coordinate laboratory analyses.
- Supervise in-house chain-of-custody procedures.
- Schedule sample analyses.
- Oversee data review.

2.4 FIELD RESPONSIBILITIES

Elena Ramirez—Floyd|Snider Field QA Officer

The Field QA Officer will be responsible for leading and coordinating the day-to-day activities in the field. The Field QA Officer will report directly to the Floyd|Snider Project Manager.

Specific responsibilities include the following:

- Coordinate day-to-day activities with the Project Manager.
- Develop and implement work plans, and set the field schedule.
- Coordinate and manage field staff including sampling and drilling.
- Review technical data provided by the field staff including field measurement data.
- Adhere to work schedule.
- Coordinate and oversee subcontractors.

- Identify problems, resolve difficulties in consultation with the Project Manager, implement and document corrective action procedures, and communicate between team and upper management.
- Prepare the data report.

3.0 Field Activities

This section summarizes the proposed field activities in support of investigation related sampling and procedures to achieve the objectives of this work. Specific sampling protocols are outlined below in Section 4.0 Sampling Procedures.

3.1 FIELD NOTES

As part of routine field activities, the following information will be recorded on the field forms (Field Daily Form or project notebooks), as appropriate:

- Project name
- Project staff
- Visitors to the site, including arrival and departure times
- Date and time of events
- Weather conditions
- Description of field activities, including sampling locations and samples collected
- Field instrument (e.g., multi-parameter probes, photoionization detector [PID]) documentation including calibration results or references to calibration results

Additional information that should be recorded in field books and field daily forms, if available, includes:

- Unusual circumstances that affect data interpretation
- Site conditions (if noteworthy)
- Health and safety monitoring data (if required)
- Identification of any split samples provided during monitoring events

3.2 SAMPLE HANDLING AND CUSTODY DOCUMENTATION

Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are reported. A sample log form and field logbook entries will be completed for each location occupied and each sample collected.

3.2.1 Sample Handling

To control the integrity of the samples during transit to the laboratory and during holding prior to analysis, established preservation and storage measures will be taken. The Field QA Officer will check all container labels, custody form entries, and logbook entries for completeness and accuracy at the end of each sampling day.

Sample containers will be labeled at the time of sampling, clearly identifying the project name, project number, location name, sample number, sampler's initials, sample number, date and time of collection, analysis to be performed, and preservative, if used.

3.2.2 Sample Chain-of-Custody

Technical field staff will be responsible for all sample tracking and custody procedures in the field, and chain-of-custody procedures will be strictly followed. The Field QA Officer will be responsible for final sample inventory and will maintain sample custody documentation.

At the end of each day, and prior to transfer, Chain-of-Custody Form entries will be made for all samples. All Chain-of-Custody Forms will be completed in indelible ink. All sample information (i.e., sample names, sampling date/time, sample matrix, number of containers, etc.), including all required analyses, will be logged onto a Chain-of-Custody Form prior to formal transfer of sample containers to the analytical laboratory. The sampler will place the original form in a clear plastic bag inside the sample cooler with the samples. The Chain-of-Custody Forms will be completed and placed inside each individual cooler.

The samples will be considered to be in custody if one of the following is maintained:

- The samples are in someone's physical possession
- The samples are in someone's view
- The samples are locked up or secured in a locked container or vehicle or otherwise sealed so that any tampering would be evident
- The samples are kept in a secured area, restricted to authorized personnel only

Any time possession of the samples is transferred, the individuals relinquishing and receiving the samples will respectively sign, date, and note the time of transfer on the Chain-of-Custody Form. This form also documents the transfer of custody of samples from the sampler to the laboratory. Each shipment of sample coolers will be accompanied by Chain-of-Custody Forms.

Copies of all forms will be retained as appropriate and included as appendices to QA/QC reports to management.

3.2.3 Sample Transport

Table 3.1 summarizes sample size requirements, container type, preservation method (if applicable), and holding times for analytes by media type.

Prior to transport, sample containers will be wrapped and securely packed inside the cooler with ice packs or crushed ice by the field technician. The original, signed Chain-of-Custody Forms will be transferred with the cooler. Samples will be delivered to the laboratory under chain-of-custody protocol following completion of sampling activities on the day of sample collection or the following day depending on the field sampling duration, or shipped directly to the laboratory, if appropriate.

3.2.4 Sample Receipt

The designated sample receiver at the laboratory will accept custody of the samples and verify that the Chain-of-Custody Forms match the samples received. The ARI and/or ALS Project Managers and/or sample receiver will ensure that the Chain-of-Custody Forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the Chain-of-Custody Forms. Upon receipt, the laboratory will contact the Data QA Manager or the Floyd|Snider Project Manager immediately if discrepancies are discovered between the Chain-of-Custody Forms and the sample shipment. The ARI and/or ALS Project

Managers, or designee, will specifically note any coolers that do not contain ice packs or are not sufficiently cold upon receipt.

3.2.5 Sample Shipment

Technical field staff will be responsible for all sample tracking and custody procedures in the field. The Field QA Officer will be responsible for final sample inventory and will maintain sample custody documentation. At the end of each day, and prior to transfer, custody form entries will be made for all samples. Each shipment of coolers will be accompanied by custody forms; the forms will be signed at each point of transfer and will include sample numbers. All custody forms will be completed in indelible ink. Copies of all forms will be retained as appropriate and included as appendices to QA/QC reports to management.

Prior to shipping, sample containers will be wrapped and securely packed inside the cooler with ice packs or crushed ice by the field technician or designee. The original, signed custody forms will be transferred with the cooler. The cooler will be secured and appropriately sealed and labeled for immediate shipping. Samples will be shipped to the laboratory following completion of sampling activities.

3.3 LOCATION CONTROL

Locations sampled in the uplands and intertidal sediments will be marked in the field using spray paint, marking stakes, or hand tape measurements referenced from permanent objects to delineate locations sampled during the investigation. Sample locations as shown on Figure 1.1 are approximate and may have to be adjusted in the field due to the presence of utilities, unknown structures, or access issues.

Upland soil boring locations, prior to the commencement of drilling activities, will be “cleared” for underground utilities and possible subsurface obstructions. If a proposed sample location is not feasible, the sample location will be moved to a feasible location as close to the original location as possible.

If a soil boring cannot be advanced at a selected location due to a previously unknown obstruction, an effort will be made to relocate the boring within the general vicinity while remaining in an area that has been “cleared” of detectable subsurface structures—typically within 5 feet of the original location. If a location within the “cleared” area cannot be safely advanced, the soil boring location will abandoned and field personnel will document the refusal.

If the sample locations change significantly or additional sample locations are determined to be necessary, an attempt to notify Ecology will be made prior to advancing the boring.

Subsequent to sampling, the locations will be surveyed using a professional licensed surveyor to provide detailed location elevation and X/Y coordinate details. Photographs will also be taken of each sampling location.

Prior to surface sediment sampling, sample location coordinates will be logged into the Global Positioning System (GPS) on board the sampling vessel. Coordinates for the surface sediment locations will be recorded within an accuracy of at least ±3 meters. The surface sediment sample location will be positioned with a GPS unit to determine the sample location and water depth.

3.4 EQUIPMENT DECONTAMINATION

Field sampling equipment, such as hand core samplers and stainless steel trowels, will be cleaned before the start of work and either the equipment will be cleaned between each sampling location or dedicated to a specific sample location. Equipment for reuse will be decontaminated aboard the vessel if space permits and is more convenient, or on the shore, according to the procedure below, before each sample is collected.

3.4.1 Upland Decontamination Protocol

1. Fresh water or steam cleaning jet will be sprayed over equipment to dislodge and remove any soil or sediment.
2. Surfaces of equipment contacting sample material will be scrubbed with brushes using an Alconox solution, or will be steam cleaned.
3. Equipment will undergo a rinse of deionized (DI) water to remove the Alconox solution if used.

3.4.2 Over-water Decontamination Protocol

1. Seawater will be sprayed over equipment to dislodge and remove any remaining sediments.
2. Surfaces of equipment contacting sample material will be scrubbed with brushes using an Alconox solution.
3. Scrubbed equipment will be rinsed and scrubbed with DI water.
4. Equipment will undergo a final spray rinse of DI water.
5. A rinsate blank QC sample will be collected following the completion of sample collection.

3.5 DISPOSAL OF INVESTIGATION-DERIVED WASTE

Waste derived will be managed and disposed of in accordance with applicable waste management regulations. Investigation-derived waste (IDW) includes the following liquids and solids:

- Purge water
- Decontamination wash water
- Soil drill cuttings, including non-soil debris that may be removed from the subsurface during drilling
- Disposable materials used during field work that may be impacted by contaminated media, or decontamination wash water (e.g., disposable personal protective equipment [PPE], used filters, plastic sheeting, paper towels, tubing, etc.)

The approach to handling and disposal of these materials is as follows. For IDW that is containerized (e.g., soil cuttings and groundwater purge water), 55-gallon drums approved by Washington State Department of Transportation will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., "soil cuttings"), the dates on which the wastes were placed in the container, the owner's name and contact information of the field person generating the waste, the site name, and the boring(s) or well(s) from which they were obtained or extracted. At the end of each day, the drums will be transferred to a designated temporary storage area.

This waste will be managed in accordance with applicable regulations and standards. Containerized IDW within drums will be characterized relative to hazardous waste criteria as noted below. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used as appropriate for disposal.

Soil analytical results from investigative work will be used in conjunction with additional sample analysis for Resource Conservation and Recovery Act (RCRA) 8 Metals plus copper, nickel, and zinc. Groundwater analytical results will be used to characterize purge water containerized on-site.

All disposable sampling material and PPE (e.g., paper towels, disposable coveralls, and gloves) used in sample processing 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 municipal solid waste refuse container for disposal at a solid waste landfill.

3.6 CULTURAL RESOURCES MANAGEMENT

Historical Research Associated, Inc. (HRA) provided recommendations for the type of future site activity that would require additional archaeological observations. They recommended further archaeological monitoring only during remedial activities associated with the removal of contaminated soils, concentrating in the southeastern portion of the Site in the vicinity of FS-09a and the locations where concrete was observed in soil boring locations at the approximate interface between historic-period fill and undisturbed native soils and an additional 3 feet below this contact into native materials (HRA 2011 and Floyd|Snider 2011).

The planned ground disturbing activities (well installation and soil borings) will produce minimal ground disturbance and the proposed soil borings will primarily be limited to the fill soils overlaying the historical tidal flats, within medium or low probability zones for archaeological artifacts. The following procedures will be implemented to address the possibility of encountering cultural artifacts:

- The soils in the borings will be logged by a geologist or under the supervision of a geologist, with attention paid to looking for evidence of non-soil materials.
- If apparent archaeological artifacts are encountered, the Port will be notified immediately. The Port will notify Ecology, Washington Department of Archaeology and Historic Preservation (DAHP), the Lummi Nation, and Nooksack Tribe, and will invite the parties to attend an on-site inspection with a professional archaeologist contracted by the Port. An archaeologist will document the discovery in a report submitted to DAHP so that they may control access to information regarding potential sensitive-site locations, in accordance with Chapter 27.53 Revised Code of Washington (RCW); the report will be referenced, but not included, in the Site RI/FS report.
- In the event of an inadvertent discovery of potential human remains, work will be immediately halted in the discovery area, and the apparent remains will be covered and secured against further disturbance. The City of Bellingham Police Department

and Whatcom County Medical Examiner would be immediately contacted, along with DAHP and authorized Tribal representatives. A treatment plan would be developed by a professional archaeologist at HRA in accordance with applicable state law.

4.0 Sampling Procedures

The work will involve collecting soil, groundwater, and surface sediment samples (0 to 12 cm) for laboratory analysis at the locations shown in Figure 1.1. The analyses to be performed at each location are summarized in Table 1.1. Sampling jar information is included in Table 3.1.

The sampling procedures and analyses will be performed in accordance with the following:

- U.S. Environmental Protection Agency (USEPA) Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, fourth update (USEPA 2000)
- USEPA Groundwater Sampling and Monitoring with Direct Push Technologies
- USEPA Region 9 Technical Guidelines for Accurately Determining Volatile Organic Compound (VOC) Concentrations in Soil and Solid Matrices
- Ecology's *Sediment Sampling and Analysis Plan Appendix* (Ecology 2003)
- Puget Sound Estuary Program (PSEP) guidelines (PSEP 1997)
- USEPA's Methods for Collection, Storage, and Manipulation of Sediment for Chemical and Toxicological Analysis (USEPA 2001)

4.1 SAMPLE DOCUMENTATION

In addition to daily field sheets, sample specific documentation will be generated during field activities. These will include:

- Field Log Sheets
- Groundwater Sampling Forms
- Sediment Sampling Forms

Examples of these forms are included in Appendix A Field Forms.

4.2 SAMPLE NOMENCLATURE

4.2.1 Soil Boring

The sample naming format that will be used for boring soil samples is: "Boring location number—sample depth interval—month/day/year of collection." For example, a soil boring sample collected from FS-10 at the 2.5 to 3.0 foot depth interval on March 12, 2011, would be labeled **FS-10-2.5-3.0-031211**. Quality control samples, such as field duplicates, and equipment rinsate blanks will be named according to the boring location where they were collected, as described in Section 4.2.4.

4.2.2 Groundwater

The sample naming format that will be used for groundwater samples is: "Well or boring location number—media type/fraction—month/day/year of collection." For example, a groundwater sample collected from FS-10 that was filtered groundwater on March 12, 2011, would be labeled

FS-10-GWF-031211. If any fraction of groundwater that was collected was not field filtered, then it would be labeled **FS-10-GW-301211**. Quality control samples, such as field duplicates, and equipment rinsate blanks will be named according to the boring location where they were collected, as described in Section 3.2.4.

4.2.3 Sediment

The sample naming format that will be used for sediment samples is: "Location number—sample depth interval (cm)—month/day/year of collection." For example, a sediment sample collected from SG-07 that was a surface grab (0 to 12 cm) on March 12, 2011, would be labeled **SG-07-0-12-031211**. Quality control samples, such as field duplicates, and equipment rinsate blanks will be named according to the boring location where they were collected, as described in Section 3.2.4.

4.2.4 Quality Control

The sample naming format that will be used for field quality control samples will replicate the primary sample and will include the following deviations as appropriate.

Field duplicates will use the same sample naming process as the primary sample except that a fictitious location number will be created. Use the same alpha characters from the original location name and generate a new location number by subtracting the original location number from 100. The field duplicate name includes: "Fictitious location number—sample depth interval—month/day/year of collection." For example, a duplicate field sample collected from FS-07 that was collected from the 2.5 to 3.0 foot sample interval on March 12, 2011, would be labeled **FS-93-2.5-031211**.

Equipment rinsate blanks will use the same sample naming process as groundwater samples except that a fictitious media type will be used—RW. The location number will be used where the equipment rinsate blank is collected. The equipment rinsate blank name includes: "Location number—fictitious media type—month/day/year of collection." For example, an equipment rinsate blank collected at SG-07 on March 12, 2011, would be labeled **SG-07-RW-031211**.

Trip blanks will use the same sample naming process as groundwater samples except that a fictitious media type will be used—TB The first location number will be used where volatile samples are collected for that day or placed in that cooler. The trip blank name includes: "Location number—fictitious media type—month/day/year of collection." For example, a trip blank labeled at FS-10 on March 12, 2011, would be labeled as **FS-10-TB-031211**.

4.3 SOIL BORING SAMPLING PROTOCOL

Soil samples will be collected from soil borings advanced using direct-push rig (e.g., Geoprobe™ or Strataprobe™) or through a split-spoon sampler advanced by a hollow stem auger. Soil samples will be collected from the proposed boring locations as shown in Figure 1.1. All borings will be monitored and documented by a field technician under the supervision of a licensed geologist. When using direct-push technology, soil samples will be collected continuously using a 4-foot-long lined sampler. Sampling will start at the ground surface and continue until the boring target depth is reached. If contamination is encountered during the advancement of the boring, sampling will continue until no indications of contamination are noted on the sample.

Soil will be screened for organic vapors using a PID and a headspace screening technique. Selected intervals showing elevated PID response will be collected and analyzed for volatile petroleum products, specifically for gasoline-range organics.

Soil samples will be collected in approximately 0.5-foot intervals that will be discretely sampled for several chemical groups (refer to Table 1.1). Volatile compounds (such as gasoline-range organics) will be sampled in the field from the soil core using protocols to minimize the loss of volatile compounds (USEPA 2005). This sampling method uses a disposable plastic corer to collect a sample that is field preserved and stored (in glass VOAs) to minimize the loss of volatiles during storage and transport. Soil samples for semi- or non-volatile compounds will be collected using bulk discrete sampling techniques and placed into glass jars. Samples will be placed in a field cooler and packed with ice. Standard chain-of-custody procedures will be implemented for all sampling events.

In addition, the shoreline area will be assessed for the potential presence and thickness of light non-aqueous phase liquid (LNAPL) accumulation during soil boring advancement and well installation. Soil samples will be collected in the smear zone and below the water table, and inspected for LNAPL accumulation using field tests (paper towel, shake test, sheen, etc.). The sample locations presented on Figure 1.1 and additional borings will be performed based on field conditions to adequately define the extent of petroleum contamination.

Soil borings will be described in accordance with professional standards for the environmental industry and will include detailed descriptions of materials encountered during drilling, including soil types classified using a modified *Standard of Practice for Description and Identification of Soils (Visual-Manual Procedure*, ASTM D-2488-00), the presence of fill, debris, and contamination (visual and/or odors).

4.4 WELL INSTALLATION AND DEVELOPMENT

Monitoring wells will be installed following the "Minimum Standards for Construction and Maintenance of Wells" outlined in WAC 173-160. Borings will be advanced and wells completed by Cascade Drilling, LP of Woodinville, Washington. Well locations are shown in Figure 1.1. The boreholes for the wells will be drilled using standard hollow-stem auger techniques. Auger boreholes will be advanced using a 4-inch inner diameter auger. Split-spoon soil core will be collected every 2 feet during advancement of the soil boring auger. Soils will be described on the soil logging and well installation form in accordance with the protocols described above (Section 4.3). The well screen placement will be determined by field observations and the type of samples to be collected at the well point. The objective is to place the well screen within the permeable soils and, if possible, avoid lenses of silt or confining layers.

The monitoring wells will be constructed with 5- to 10-foot screens set approximately 10 feet below ground surface (bgs). All wells will be constructed of 2-inch-diameter, flush-threaded, Schedule 40 polyvinyl chloride (PVC) well casings and screens. Well screen assemblies will consist of a 5-foot length of 0.020-inch (20-slot) machine-slotted, flush-threaded, Schedule 40 PVC set in a 10/20 sand or equivalent silica sand filter pack. The well design includes a 0.5-foot-long flush-threaded, Schedule 40 PVC sump with a flush-threaded end cap. The sand filter pack will be installed by pouring sand into the annular space between the well casing and auger as the auger is withdrawn. A weighted tape will be used to monitor filter pack placement and depth during installation. The sand filter pack will extend 3 feet above the top of the screened interval. A minimum 2-foot-thick seal of hydrated bentonite chips will be installed in the annular space immediately above the sand filter pack and hydrated with potable water if installed above the water table. The remainder of the annular space will be sealed with bentonite grout or hydrated bentonite chips to within 1 foot of the ground surface.

The monitoring wells will be secured with flush-to-ground locking steel protective monuments with expansion seals on the well casing to minimize the potential for surface water entering the monument.

Well development will be completed by continuous pumping at a steady rate using a portable pump. Wells will be developed using the described methodologies or equivalents at least 48 hours following well installation. Well development equipment will be decontaminated by pumping clean water through the pump and washing to the satisfaction of the field technical staff. Well development will be terminated when the variation in the turbidity Nephelometric Turbidity Units (NTU) readings is less than 10 percent. Installed wells will be labeled with a permanent marker on the well casing on the well cover of flush mounts. All newly installed monitoring wells will be surveyed by a licensed surveyor.

4.5 GROUNDWATER SAMPLING PROTOCOL

Groundwater samples will be collected from all monitoring wells during a site-wide monitoring event. Using information gathered during an earlier tidal study, all monitoring wells will be sampled at a low tide cycle to establish baseline groundwater data. Monitoring wells will be purged and sampled using low-flow sampling techniques using a peristaltic pump with disposable polyethylene and flexible tubing type tubing.

Groundwater screening samples will be collected directly from soil boring locations with retractable drop-down type screen samplers made of stainless steel or temporary well points installed with 1 inch PVC. Groundwater that enters the screen will be coarsely filtered. Once the groundwater level has been determined inside the screen, a disposable polyethylene tube will be inserted into the screen and attached to a peristaltic pump. The groundwater sample will be collected as the pumped water begins to clear. After collection, the polyethylene tubing will be discarded. Any equipment to be reused will be decontaminated as previously outlined. At most locations, the sample will be collected between 5 to 10 feet bgs. Salinity will be measured at each boring location prior to sample collection.

4.5.1 Measuring Depth to Water in the Groundwater Monitoring Well Network

1. Open protective casing. Observe and note on the field log the condition of monument/well.
2. Decontaminate water level indicator by rinsing with DI water.
3. Drop water level indicator into well and determine water level by means of beeper. Measure mark to the nearest 0.01 foot. Record this value, with date and time, on the field log as the static depth to water.
4. Decontaminate water level indicator.

4.5.2 Purging Groundwater Monitoring Wells and Soil Borings

1. Lower tubing connected to a low-flow peristaltic pump into the well.

2. Engage the pump and begin purging the well. All purge water will be containerized and properly disposed of according to state and federal regulations and as noted above.
3. Purge the well at low-flow rates not to exceed 0.5 liters per minute. The purge rate can be increased to one liter per minute if the purge water is observed to be generally non-turbid (less than 50 NTU) and the purging creates less than 0.5 foot of drawdown in the well. Because water levels may fluctuate in the monitoring wells with the tide, the drawdown will be measured and compared against this criterion in the first 5 minutes of purging.
4. Adjust the pump controller to achieve an acceptable purge rate.
5. During purging, field parameters (temperature, pH, dissolved oxygen [DO], specific conductance, salinity, oxidation reduction potential [ORP], and turbidity) in the purge water will be recorded at 3- to 5-minute intervals. Record the time and parameter values (including units) and purge rate on the field log for each set of readings. If the field measurements for turbidity, DO, and specific conductance are approximately stable (within 10 percent) for three consecutive readings, the groundwater sample will be collected. If DO is less than 5 milligrams per liter (mg/L), three consecutive readings within 1 mg/L will be considered stable. Should the turbidity readings be negative values, the measurement will be recorded as less than 1. Salinity will be a stabilization parameter; groundwater that has high salinity (greater than approximately 5,000 parts per trillion [ppt]) will not be sampled unless verified to be continuously saline during a complete low-tide cycle. Depth to water will be measured and recorded during the first 5 minutes of purging to calculate drawdown, as discussed above. Because these field parameters (particularly turbidity) may not reach these stringent stabilization criteria at a particular well, collection of each groundwater sample will be based on the field personnel's best professional judgment at the time of sampling. The last set of field parameters measured during purging will represent field parameters for the groundwater sample. Field parameters will not be collected at the soil boring locations.
6. Record all field measurements and observations legibly on the field forms.

4.5.3 Groundwater Sample Collection

1. After purging the well and labeling the bottles, collect the groundwater sample by directly filling the lab-provided bottles from the pump discharge line (maintain the same flow rate as during purging). In this way, only dedicated tubing will be used in sampling and there will be no need for equipment decontamination (other than the water level indicator). The specific bottles to be filled for each chemical analysis will be communicated by the laboratory.
2. Immediately place all labeled, filled bottles in coolers packed with ice.
3. Samples collected for any dissolved groundwater fraction will be field filtered using a new, certified-clean, disposable, pre-purged, in-line 0.45-micron high-capacity groundwater sampling capsule filter.

4.6 BANK/INTERTIDAL SEDIMENT SAMPLING PROTOCOL

Bank/intertidal samples will be collected by hand using a decontaminated hand-held auger or trowel where sampling locations are accessible by foot and appropriate. Bank/intertidal samples will be collected from the proposed sampling locations as shown in Figure 1.1. Bank/intertidal samples will be collected using an auger and/or trowel to scoop the surface of sediment, 0 to 12 cm, as measured with a ruler. The sediment sample will be visually classified in accordance with ASTM D 2488. The sediment descriptions will be recorded on a sediment sampling form and photographed. The sediment will be placed in a decontaminated stainless steel bowl and homogenized until the sediment is uniform in color and texture. Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completely filled out, and the containers stored on ice.

In the event that the sample acceptance criteria are not achieved, the sample will be rejected and the location re-sampled. If the required penetration depth or sufficient sample volume cannot be achieved at any of the selected sampling locations, it will be relocated within 5 to 10 feet of the target location. The new sampling location will be recorded in the field logbook.

As part of sample collection, the following information will be recorded on the sediment sampling form:

- Date and time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Depth of water at the location
- Sediment sample depth and sediment description
- Sample recovery
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation)
- Presence of debris (e.g., wood chips, wood fibers, anthropogenic artifacts)
- Presence of oily sheen
- Odor

Any sediment sampling equipment that is reused at multiple locations will be decontaminated as described above (refer to Section 3.5).

4.7 NEARSHORE MARINE SURFACE SEDIMENT SAMPLE COLLECTION

Surface sediment samples will be collected from the proposed sampling locations as shown in Figure 1.1 from the surface interval of 0 to 12 cm. Contingency surface sediment samples will also be collected from the surface interval (0 to 12 cm).

For all sediment samples, sampling will be collected by a modified van Veen Power Grab sampler attached to a vessel operated by Research Support Services (RSS) of Bainbridge Island, Washington. The sampling assembly is a 0.2-square-meter sampler used to collect large-volume surface samples from the top 12 cm of the sediment surface. A pneumatic ram closes the grab around debris and surface sediment and brings it to the surface for processing. All sediment samples will be visually classified and the total penetration of the sampler measured. The sediment descriptions, along with the sampling time, sampling coordinates, and diver notes will be recorded on sample collection forms. Photographs of each sample will be taken.

The individual sediment samples will be placed in a decontaminated stainless steel bowl and homogenized until the sediment is uniform in color and texture. Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completely filled out, and the containers stored on ice.

As part of sample collection, the following information will be recorded on the sediment sampling form:

- Date and time, and name of the person logging the sample
- Weather conditions
- Sample location number
- Depth of water at the location
- Sediment sample depth and sediment description
- Sample recovery
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation)
- Presence of debris (e.g., wood chips, wood fibers, anthropogenic artifacts)
- Presence of oily sheen
- Odor

Any sediment sampling equipment that is reused at multiple locations will be decontaminated as described above (refer to Section 3.5).

5.0 Laboratory Quality Assurance Objectives

This SAP/QAPP establishes QC procedures and QA criteria to meet the data quality objectives (DQOs) set forth for the field activities to be conducted as part of this Data Gaps investigation. The overall QA objective is to specify laboratory procedures for ensuring data quality is maintained for field sampling, chain-of-custody protocol, laboratory analyses, and reporting. Table 5.1 presents the target reporting limits for each analytical method as performed by ALS and ARI. These reporting limits are goals only, insofar as instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the desired reporting limit and associated QC criteria. In such instances, the laboratory will report the reason for any deviation from these reporting limits. Table 3.1 outlines QA analytical requirements, methods, sample preservation, bottle types, and sample holding times. Table 5.2 identifies data quality assurance criteria.

Specific procedures for sampling, chain-of-custody protocol, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field/laboratory equipment, and corrective action are described in other sections of this SAP/QAPP.

5.1 LABORATORY QUALITY ASSURANCE OBJECTIVES

Analytical DQOs include obtaining data that are technically sound and properly documented, having been evaluated against established criteria for the principle data quality indicators (i.e., precision, accuracy, representativeness, completeness, and comparability) as defined in Ecology and USEPA guidance (Ecology 2004 and USEPA 1998). Data quality assurance criteria are presented in Table 5.2.

The quality of analytical data generated is assessed by the frequency and type of internal QC checks developed for analysis type and method. Laboratory results will be evaluated by reviewing analytical results of method blanks, matrix spikes (MS), duplicate samples, laboratory control samples (LCSs), calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

5.2 PRECISION

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through MS/matrix spike duplicate (MSD) samples for organic analysis and through laboratory duplicate samples for inorganic analyses.

Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one per laboratory analysis group or 1 in 20 samples, whichever is more frequent per matrix analyzed, as practical. Laboratory precision will be evaluated against quantitative relative percent difference (RPD) performance criteria.

Field precision will be evaluated by the collection of blind field duplicates at a minimum frequency of one per laboratory analysis group or 1 in 20 samples. Currently, no performance criteria have been established for field duplicates. Field duplicate precision will therefore be screened against a RPD of 75 percent for all samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit, where the percent error (expressed as RPD) increases. The equations used to express precision are as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:
RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

5.3 ACCURACY

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Analytical accuracy may be assessed by analyzing "spiked" samples with known standards (surrogates, LCSs, and/or MS) and measuring the percent recovery. Accuracy measurements on MS samples will be carried out at a minimum frequency of 1 in 20 samples per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences of a specific matrix, the laboratory will perform MS/MSDs only on samples from this investigation and not from other projects. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against quantitative LCS, MS, and surrogate spike recoveries using limits for each applicable analyte. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:
%R = percent recovery
S = measured concentration in the spiked aliquot
U = measured concentration in the unspiked aliquot
C_{sa} = actual concentration of spike added

5.4 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care will be taken in the design of the sampling program to ensure sample locations are properly selected, sufficient numbers of samples are collected to accurately reflect conditions at the location(s), and samples are representative of the sampling location(s). A sufficient volume of sample will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

Selected analytes were identified as contaminants of concern based on previous sampling investigations.

5.5 COMPARABILITY

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. In order to insure results are comparable, samples will be analyzed using standard USEPA methods and protocols. Calibration and reference standards will be traceable to certified standards and standard data reporting formats will be employed. Data will also be reviewed to verify that precision and accuracy criteria were achieved and, if not, that data were appropriately qualified.

5.6 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:

$$C = \frac{\text{(Number of acceptable data points) x 100}}{\text{(Total number of data points)}}$$

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

5.7 QUALITY CONTROL PROCEDURES

Sampling procedures for this investigation are described in detail in Section 4.0.

5.7.1 Field Quality Control Procedures

Trip blanks will be included in each cooler with samples being analyzed for VOCs to ensure the sample containers do not contribute to any detected analyte concentrations and to identify any artifacts of improper sample handling, storage, or shipping. A rinsate blank QC sample will also be collected for each sampling event on the non-dedicated field equipment (i.e., stainless steel bowl and spoon) to ensure field decontamination procedures are effective. All field QC samples will be documented in the field logbook and verified by the QA Manager or designee. A blind field duplicate will be collected at a frequency of 1 in 20 samples to evaluate the efficiency of field decontamination procedures, variability from sample handling, and site heterogeneity.

5.7.2 Laboratory Quality Control Procedures

Laboratory Quality Control Criteria. Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits were exceeded. If control limits are exceeded in the sample group, corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented and reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities identified in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis.

Laboratory Duplicates. Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of 1 duplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent.

Matrix Spikes and Matrix Spike Duplicates. Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. A minimum of 1 MS/MSD will be analyzed for every sample group or for every 20 samples, whichever is more frequent. MS/MSD analyses will be performed on project-specific samples (i.e., batch QC using samples from other projects is not permitted).

Laboratory Control Samples. An LCS is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The blank spike compound recovery assesses analytical accuracy in the absence of any sample heterogeneity or matrix effects.

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 result will be corrected for recovery using these values.

Method Blanks. Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank will be analyzed for every extraction batch or for every 20 samples, whichever is more frequent.

6.0 Data Reduction, Validation, and Reporting

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA Manual. QC data resulting from methods and procedures described in this document will also be reported.

6.1 DATA REDUCTION AND REPORTING

The laboratory will be responsible for internal checks on 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. The analytical laboratories will be required, where applicable, to report the following:

- **Project Narrative.** This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary should discuss, but not be limited to, QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered (actual or perceived) and their resolutions will be documented in as much detail as necessary.
- **Sample Identification Codes.** Records will be produced that clearly match all blind duplicate QA samples with laboratory sample identification codes (IDs).
- **Chain-of-Custody Records.** Legible copies of the custody forms will be provided as part of the data package. This documentation will include the time of receipt and 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 when applicable:
  - Field sample ID and the corresponding laboratory identification code:
    - Sample matrix.
    - Date of sample extraction.
    - Date and time of analysis.
    - Weight and/or volume used for analysis.
    - Final dilution volumes or concentration factor for the sample.
    - Percent moisture in solid samples.
    - Identification of the instrument used for analysis.
    - Method reporting and quantitation limits.
  - Analytical results reported with reporting units identified.
  - All data qualifiers and their definitions.
  - Electronic data deliverables (EDDs).
- **Quality Assurance/Quality Control Summaries.** This section 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 (refer to above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.

- **Method Blank Analysis.** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
- **Surrogate Spike Recovery.** All surrogate spike recovery data for organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed.
- **Matrix Spike Recovery.** All MS recovery data for metals and organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed. The RPD for all duplicate analyses will be reported.
- **Matrix Duplicate.** The RPD for all matrix duplicate analyses will be reported.
- **Blind Duplicates.** Blind duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

6.2 DATA VALIDATION

Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

A data quality review of the analytical data will follow USEPA National Functional Guidelines in accordance with the QAPP limits (USEPA 2008 and 2004). All chemical data will be reviewed with regard to the following:

- Chain-of-custody/documentation
- Sample preservation and holding times
- Instrument performance (calibration, tuning, sensitivity)
- Method blanks
- Reporting limits
- Surrogate recoveries
- MS/MSD recoveries
- LCS recoveries
- Laboratory and field duplicate RPDs

The Data Validation summary report will be presented as an appendix to the data reports. Validated data will be entered into the project database and uploaded to Ecology's Environmental Information Management (EIM) system.

7.0 Corrective Actions

Corrective action procedures are described in this section.

Corrective Action for Field Sampling. The Field QA Officer will be responsible for correcting field errors in sampling or documenting equipment malfunctions during the field sampling effort. The Project Manager, along with the Field QA Officer, will be responsible for resolving situations in the field that may result in non-compliance with the SAP/QAPP. All corrective measures will be immediately documented in the field logbook.

Corrective Action for Laboratory Analyses. The laboratory is required to comply with their Standard Operating Procedures (SOPs). The ALS and ARI Project Managers will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this SAP/QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

If any QC sample exceeds the project-specified control limits, the analyst will identify and correct the anomaly before continuing with the sample analysis. The analyst will document the corrective action taken in a memorandum submitted to the QA Manager. 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, and/or re-extraction) will be submitted with the data package.

8.0 Data Reporting

The Site-Wide RI/FS report will document activities associated with the collection, transportation, and laboratory analysis of groundwater, soil, and sediment samples. The report will include the following:

- A description of the purpose and goals of the investigation.
- A summary of the field sampling and laboratory analytical procedures, referencing this SAP/QAPP and identifying any deviations resulting from field conditions.
- A general vicinity map showing the location of the Site and a sampling location map. Coordinates (i.e., latitude and longitude or state plan coordinates) will be reported in an accompanying table for the sampling locations.
- Data tables for all media summarizing the chemical and conventional analytical results, as well as pertinent QA/QC data. The data tables will include sample location numbers, sample IDs, dates of sample collection, depths of sample collection, and whether the sample was a duplicate.
- Interpretation of the results of this investigation, incorporating the results of previous investigations relative to the nature and extent of contamination on the Site as well as potential contamination sources. All analytical results will be compared to the MTCA and Sediment Management Standards (SMS) criteria as appropriate.
- QA reports and laboratory data reports as appendices or attachments.
- Copies of field logs and Chain-of-Custody Forms as appendices or attachments.

Upon completion of the data validation process, data will be submitted to the Ecology Environmental Information Management (EIM) Database.

9.0 References

American Society for Testing and Materials (ASTM). 2000. *Standard of Practice for Description and Identification of Soils (Visual-Manual Procedure* (ASTM D-2488-00).

Historical Research Associates, Inc. (HRA). 2011. *REDACTED Archaeological Monitoring for the Proposed Harris Avenue Shipyard Supplemental Site Investigation, Whatcom County, Washington*. Seattle, Washington. August.

Floyd|Snider. 2011. *Harris Avenue Shipyard Remedial Investigation/Feasibility Study Data Report*. Seattle, Washington. December.

Puget Sound Estuary Program (PSEP). 1997. *Final Report: Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound*. Prepared for U.S. Environmental Protection Agency. Seattle, Washington.

U.S. Environmental Protection Agency (USEPA). 1998 *USEPA Guidance Document for Quality Assurance Project Plans*. Publication EPA QA/G-5, EPA/600/R-98/018.

———. 2000. *USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. SW-846, fourth update.

———. 2004. *USEPA National Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* OSWER 9240.1-45, EPA 540-R-04-004. Office of Superfund Remediation and Technology Innovation (OSRTI), Washington, D.C. October.

———. 2005. *USEPA Region 9 Technical Guidelines for Accurately Determining Volatile Organic Compound Concentrations in Soil and Solid Matrices.* EPA R9QA/05.2. December.

———. 2008. *USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review*. EPA-540/R-99/008. October.

Washington State Department of Ecology (Ecology). 2004. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies.* Publication No. 04-03-030. Revision of Publication No. 01-03-003. July.

———. 2007. *Model Toxics Control Act Regulation*. Chapter 173-340 WAC. 12 October.

———. 2008. *Sediment Sampling and Analysis Plan Appendix.* Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Publication No. 03-09-043. February.

Harris Avenue
Shipyard

Data Gaps Investigation Sampling Analysis Plan and Quality Assurance Project Plan

Tables

Table 1.1
Sample Analytical Summary

Location	Depth/ Interval	Media Type	Analysis and Number of Samples by Location[1]								
			VOCs	SVOCs	TPH	VPH/EPH	Metals	Dioxins/ Furans	PCBs	TOC	Physical Parameters[2]
Soil and Groundwater											
FS-19	40 ft bgs	Soil	--	--	3	1	--	--	--	--	2
FS-20	25 ft bgs	Soil	--	2	2	2	2	1	--	--	--
		DP-GW	--	1	1	--	1	--	--	--	--
FS-21	25 ft bgs	Soil	--	2	2	2	2	--	--	--	--
		DP-GW	--	1	1	--	1	--	--	--	--
FS-22	25 ft bgs	Soil	--	2	2	--	2	--	--	--	--
		DP-GW	--	1	1	--	1	--	--	--	--
FS-23 to FS-29[3]	25 ft bgs	Soil	--	(2)	(2)	--	(2)	--	--	--	--
FS-23 to FS-29[3]	Various	DP-GW	--	(1)	(1)	--	(1)	--	--	--	--
FS-30	25 ft bgs	Soil	--	2	2	--	2	--	--	--	--
		DP-GW	--	1	1	--	1	--	--	--	--
MW-10A	20 ft bgs	Soil	--	2	2	--	2	--	--	--	1
MW-10B	30 ft bgs	Soil	--	1	1	--	1	--	--	--	1
MW-11	20 ft bgs	Soil	--	2	2	--	2	--	--	--	--
Existing MWs[4]	Various	MW-GW	1	1	1	1[5]	1	--	--	--	--
SFS-01	0–4 in	Soil	--	--	--	--	--	1	--	--	--
SFS-02	0–4 in	Soil	--	--	--	--	--	1	--	--	--

Table 1.1
Sample Analytical Summary

Location	Depth/ Interval	Media Type	Analysis and Number of Samples by Location[1]								
			VOCs	SVOCs	TPH	VPH/EPH	Metals	Dioxins/ Furans	PCBs	TOC	Physical Parameters[2]
Sediments											
HA-09	0–12 cm	Sediment	--	1	--	--	1	--	1	1	1
HA-10	0–12 cm	Sediment	--	--	--	--	1	--	--	--	1
HA-11	0–12 cm	Sediment	--	--	--	--	1	--	--	--	1
SG-05	0–12 cm	Sediment	--	1	--	--	1	--	1	1	1
SG-06	0–12 cm	Sediment	--	1	--	--	--	1	--	1	1
SG-07	0–12 cm	Sediment	--	1	--	--	--	1	--	1	1
SG-08	0–12 cm	Sediment	--	1	--	--	1	--	1	1	1
SG-09	0–12 cm	Sediment	--	1	--	--	1	--	1	1	1
SG-10[6]	0–12 cm	Sediment	--	1	--	--	1	--	1	1	1
SG-11[6]	0–12 cm	Sediment	--	1	--	--	1	--	1	1	1
SG-12	0–12 cm	Sediment	--	1	--	--	--	1	--	1	1
SG-13	0–12 cm	Sediment	--	1	--	--	--	1	--	1	1

Notes:
-- Will not be analyzed.
(#) Number of proposed samples per contingency sample location. Final sample totals will be based on the number of contingency locations advanced.
1 Refer to Tables 3.1, 5.1, and 5.2 for analytical methods.
2 Physical parameters include porosity, water content, bulk density, and organic carbon fraction (for soil only), and total solids and grain size (for sediments).
3 Contingency sample location that will be determined during field activities based on field conditions.
4 Existing Monitoring Wells include MW-1, MW-02A, MW-4, MW-5, MW-06, MW-07, MW-08, MW-09.
5 Only at select groundwater monitoring wells (limited to three locations).
6 Samples will be collected and archived for possible future analyses pending the data results of nearby locations.

Table 1.1
Sample Analytical Summary

Location	Depth/ Interval	Media Type	Analysis and Number of Samples by Location[1]								
			VOCs	SVOCs	TPH	VPH/EPH	Metals	Dioxins/ Furans	PCBs	TOC	Physical Parameters[2]

Abbreviations:

bgs	Below ground surface.
DP-GW	Groundwater sample taken from direct push.
EPH	Extractable petroleum hydrocarbon.
MW	Monitoring Well.
MW-GW	Groundwater taken from monitoring well.
PCB	Polychlorinated biphenyl.
QC	Quality control.
SVOC	Semivolatile organic carbon.
TOC	Total organic carbon.
TPH	Total petroleum hydrocarbon.
VOC	Volatile organic carbon.
VPH	Volatile organic hydrocarbon.

Table 3.1
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Analysis Method	Detection Limit	Reporting Limit (PQL)[1]
Groundwater Samples			
Total Petroleum Hydrocarbons *Diesel Range* *Heavy Oil Range* *Gasoline Range*	 NWTPH-Dx NWTPH-Dx NWTPH-Gx	 Diesel: 13 µg/L Oil: 108 µg/L Gas: 13 µg/L	 Diesel: 130 µg/L Oil: 250 µg/L Gas: 50 µg/L
Extractable Petroleum Hydrocarbons (EPH)	NWEPH	50 µg/L	50 µg/L
Volatile Petroleum Hydrocarbons (VPH)	NWVPH USEPA Method 8021	0.8–2.4 µg/L	50 µg/L
BTEX	USEPA Method 8021	0.02–0.07 µg/L	2 µg/L
Dissolved Metals (Ag, As, Be, Cd, Cu, Ni, Pb, Sb, Se, Tl, Zn) Dissolved Mercury	USEPA Method 200.8 USEPA Method 245.1—Low Level	0.2–2.2 µg/L 0.12 ng/L	1–2.5 µg/L 1 ng/L
Volatile Organic Compounds	USEPA Method 8260C	0.01–2 µg/L	0.01–10 µg/L
Semivolatile Organic Compounds	USEPA Method 8270D/SIM—Low Level	0.02–3.7 µg/L	0.02–10 µg/L
Soil Samples			
Total Petroleum Hydrocarbons *Diesel Range* *Heavy Oil Range* *Gasoline Range*	 NWTPH-Dx NWTPH-Dx NWTPH-G	 Diesel: 11.8 mg/kg Oil: 22.9 mg/kg Gas: 0.9 mg/kg	 Diesel: 25 mg/kg Oil: 50 mg/kg Gas: 3 mg/kg
Extractable Petroleum Hydrocarbons (EPH)	NWEPH	1.1–1.8 mg/kg	5 mg/kg
Volatile Petroleum Hydrocarbons (VPH)	NWVPH	0.1–0.2 mg/kg	5 mg/kg
BTEX	USEPA Method 8021	0.02–0.7 µg/kg	5–10 µg/kg
Metals (Ag, As, Be, Cd, Cr, Cu, Ni, Pb, Sb, Se, Tl, Zn) Mercury	USEPA Method 6010 USEPA Method 7471—Low Level	0.05–0.9 mg/kg 0.0004 mg/kg	0.1–1 mg/kg 0.02 mg/kg
Semivolatile Organic Compounds	USEPA Method 8270D/SIM—Low Level	5–374 µg/kg	5–1,000 µg/kg
Dioxin/Furans	USEPA Method 1613	0.2–0.5 ng/kg	1–5 ng/kg

Table 3.1
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Analysis Method	Detection Limit	Reporting Limit (PQL)[1]
Sediment Samples			
Semivolatile Organic Compounds (SMS)	USEPA Method 8270/SIM—Dual Scan	1–100 µg/kg	5–400 µg/kg
Hexachlorobenzene/Hexachlorobutadiene	USEPA 8081A	0.1 µg/kg	1 µg/kg
Metals (SMS; Ag, As, Cd, Cr, Cu, Hg, Pb, Zn)	USEPA Method 6010B	0.02–0.2 mg/kg	0.2–5 mg/kg
Mercury	USEPA Method 7471B—Low Level	0.002 mg/kg	0.025 mg/kg
Dioxin/Furans	USEPA Method 1613	0.2–0.5 ng/kg	1–5 ng/kg
Polychlorinated Biphenyls	USEPA Method 8082A	0.0006 mg/kg	0.004 mg/kg
Total Organic Carbon	USEPA Method 9060	0.0047% (47 mg/kg)	0.02 % (200 mg/kg)
Total Solids	SM 2540B/PSEP	NA	0.1%
Grain Size	PSEP 1997	NA	0.01%

Note:

1 All reporting limits shown are method PQLs from either ALS Laboratory Group in Everett, Washington or Analytical Resources Inc. laboratory in Tukwila, Washington. SVOC, PCB, inorganic results reported undetected to reporting limit. Dioxin results reported undetected to EDL.

Abbreviations:

Ag Silver.
As Arsenic.
Be Beryllium.
BTEX Benzene, toluene, ethylbenzene, xylenes.
Cd Cadmium.
Ch Chromium.
Cu Copper.
Hg Mercury.
NA Not applicable.
Ni Nickel.
Pb Lead.
PCB Polychlorinated biphenyl.
PQL Practical Quantitation Limit.
PSEP Puget Sound Estuary Program.
SMS Sediment Management Standard.
SVOC Semivolatile organic compound.
USEPA U.S. Environmental Protection Agency.

Table 5.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Groundwater Samples				
TPH—Heavy Oil-Range and Diesel-Range	NWTPH-Dx	(2) 500-mL amber glass	None, cool to 4°C	7 days to extract, then 40 days to analyze
TPH—Gasoline-Range	NWTPH-Gx	(2) 40-mL, VOA vials[1]	HCl to pH <2.0, cool to 4°C	14 days to analyze
TPH Identification	NWTPH-HCID	(2) 500-mL amber glass	None, cool to 4°C	7 days to extract, then 40 days to analyze
Extractable Petroleum Hydrocarbons (EPH)	NWEPH	(2) 500-mL amber glass	None, cool to 4°C	7 days to extract, then 40 days to analyze
Volatile Petroleum Hydrocarbons (VPH)	NWVPH USEPA Method 8021	(3) 40-mL VOA vials[1]	HCl to pH <2.0, cool to 4°C	14 days to analyze
BTEX	USEPA Method 8021	Analyzed from TPH-G sample volume	HCl to pH <2.0, cool to 4°C	14 days to analyze
Dissolved Metals Dissolved Mercury	USEPA Method 200.8 USEPA Method 245.1—Low Level	(1) 500-mL HDPE	HNO_3 to pH<2, cool to 4°C (field filtered)	6 months
Volatile Organic Compounds	USEPA Method 8260C	(3) 40-mL VOA vials[1]	HCl to pH <2, cool to 4°C	14 days to analyze
Semivolatile Organic Compounds	USEPA 8270D/SIM—Low Level	(2) 500-mL amber glass	None, cool to 4°C	7 days to extract, then 40 days to analyze

Table 5.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Soil Samples				
TPH—Heavy Oil-Range and Diesel-Range	NWTPH-Dx	(1) 8-oz WMG	None, cool to 4°C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
TPH—Gasoline-Range	NWTPH-Gx	(2) 40-mL VOA vials[2]	MeOH, cool to 4°C	14 days to analyze
Extractable Petroleum Hydrocarbons (EPH)	NWEPH	(1) 8-oz WMG	None, cool to 4°C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Volatile Petroleum Hydrocarbons (VPH)	NWVPH USEPA Method 8021	(2) 40-mL VOA vials[2]	MeOH, cool to 4°C	14 days to analyze
BTEX	USEPA Method 8021	Analyzed from TPH Gasoline-Range sample volume	MeOH, cool to 4°C	14 days to analyze
Metals (Ag, As, Be, Cd, Cr, Cu, Ni, Pb, Sb, Se, Tl, Zn) Mercury	USEPA Method 6010 USEPA Method 7471—Low Level	(1) 4-oz WMG	None, cool to 4°C	6 months (or freeze for 1 year)
Semivolatile Organic Compounds	USEPA Method 8270D/SIM—Low Level	(1) 8-oz WMG	None, cool to 4°C	14 days to extract, then 30 days to analyze (or freeze for 1 year)
Dioxins/Furans	USEPA Method 1613	(1) 8-oz Amber WMG	None, cool to 6°C	1 year

Table 5.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Soil Samples (continued)				
Total Porosity	ASTM D-7263	Soil Core	None, cool to <6°C	6 months
Moisture Content	ASTM D-2216			
Bulk Density	ASTM D-2937			
Fractional Organic Carbon	ASTM D-2974	(1) 8 oz WMG	None, cool to <6°C	6 months
Sediment Samples				
Semivolatile Organic Compounds (SMS) Hexachlorobenzene/Hexachlorobutadiene	USEPA Method 8270/SIM–Dual Scan USEPA Method 8081A	(1) 8 oz WMG	None, cool to <6°C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Metals (SMS; Ag, As, Cd, Cr, Cu, Hg, Pb, Zn) Mercury	USEPA Method 6010B USEPA Method 7471B—Low Level	(1) 4-oz WMG	None, cool to 6°C	6 months (or freeze for 1 year) 28 days
Dioxin/Furans	USEPA Method 1613B	(1) 8-oz Amber WMG	None, cool to <6°C	1 year
Polychlorinated Biphenyls	USEPA Method 8082A	(1) 8-oz WMG	None, cool to <6°C	14 days to extract, then 40 days to analyze (or freeze for 1 year)

Table 5.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Analyses	Method	Bottle Type	Preservative	Holding Time
Sediment Samples (continued)				
Total Organic Carbon	USEPA Method 9060	(1) 4-oz WMG	None, cool to <6°C	14 days to prep, then 6 months to analyze (or freeze for 1 year)
Total Solids	SM2540B/PSEP	Take from TOC jar	None, cool to <6°C	6 months
Grain Size	PSEP	(1) 16-oz WM HDPE	None, cool to <6°C	6 months

Notes:
1 No head space in sample container.
2 Soil samples for volatile organic compound analyses collected using USEPA Method 5035A with a soil Teflon corer.

Abbreviations:
- ASTM American Society of Testing and Materials.
- BTEX Benzene, toluene, ethylbenzene, and xylenes.
- HCl Hydrochloric acid.
- HCID Hydrocarbon identification.
- HDPE High-density polyethylene.
- HNO_3 Nitric acid.
- MeOH Methanol.
- PSEP Puget Sound Estuary Program.
- SIM Select ion monitoring.
- SMS Sediment Management Standard.
- TOC Total organic carbon.
- TPH Total petroleum hydrocarbon.
- USEPA U. S. Environmental Protection Agency.
- VOA Volatile organic analysis.
- WM Wide-mouth.
- WMG Wide-mouth glass jar.

Table 5.2
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit	Precision	Accuracy	Completeness	Reference
Groundwater Samples							
Total Petroleum Hydrocarbons *Diesel Range* *Heavy Oil Range* *Gasoline Range*	Water	µg/L	Diesel: 130 Oil: 250 Gas: 50	± 50%	± 60%	95%	NWTPH-Dx NWTPH-Dx NWTPH-Gx
Extractable Petroleum Hydrocarbons (EPH)	Water	µg/L	50	± 50%	± 50%	95%	NWEPH
Volatile Petroleum Hydrocarbons (VPH)	Water	µg/L	50	± 50%	± 50%	95%	NWVPH USEPA Method 8021
Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	Water	µg/L	2	± 50%	± 50%	95%	USEPA Method 8021
Metals (Ag, As, Be, Cd, Cu, Ni, Pb, Sb, Se, Tl, Zn) Mercury	Water	µg/L ng/L	1–2.5 1	± 50%	± 50%	95%	USEPA Method 200.8 USEPA 245.1–Low Level
Volatile Organic Compounds	Water	µg/L	0.01–10	± 50%	± 50%	95%	USEPA Method 8260C
Semivolatile Organic Compounds	Water	µg/L	0.02–10	± 50%	± 60%	95%	USEPA Method 8270D/SIM–Low Level

Table 5.2
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit	Precision	Accuracy	Completeness	Reference
Soil Samples							
Total Petroleum Hydrocarbons *Diesel Range* *Heavy Oil Range* *Gasoline Range*	Soil	mg/kg	Diesel: 25 Oil: 50 Gas: 3	± 50%	± 50%	95%	NWTPH-Dx NWTPH-Dx NWTPH-G
Extractable Petroleum Hydrocarbons (EPH)	Soil	mg/kg	5	± 50%	± 50%	95%	NWEPH
Volatile Petroleum Hydrocarbons (VPH)	Soil	mg/kg	5	± 50%	± 50%	95%	NWVPH USEPA Method 8021
Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	Soil	µg/kg	5–10	± 50%	± 50%	95%	USEPA Method 8021
Metals (Ag, As, Be, Cd, Cr, Cu, Ni, Pb, Sb, Se, Tl, Zn) Mercury	Soil	mg/kg	0.1–1 0.02	± 20%	± 25%	95%	USEPA Method 6010 USEPA Method 7471—Low Level
Semivolatile Organic Compounds	Soil	µg/kg	5–1,000	± 50%	± 60%	95%	USEPA Method 8270D/SIM—Low Level
Dioxins/Furans	Soil	ng/kg	1–5	± 30%	± 30%	95%	USEPA Method 1613
Sediment Samples							
Semivolatile Organic Compounds (SMS)	Sediment	µg/kg	1–400	± 50%	± 60%	95%	USEPA Method 8270D/SIM–Low Level

Table 5.2
Data Quality Assurance Criteria

Parameter	Matrix	Units	Reporting Limit	Precision	Accuracy	Completeness	Reference
Sediment Samples (continued)							
Metals (Ag, As, Cd, Cr, Cu, Hg, Pb, Zn)	Sediment	mg/kg	0.1–2	± 20%	± 25%	95%	USEPA Method 6010B
Mercury			0.02				USEPA Method 7471B—Low Level
Dioxins/Furans	Sediment	ng/kg	1–5	± 30%	± 30%	95%	USEPA Method 1613
Polychlorinated Biphenyls	Sediment	mg/kg	0.004	± 40%	± 65%	95%	USEPA 8082A
Total Organic Carbon	Sediment	mg/kg or %	200 or 0.02	± 20%	± 20%	95%	USEPA Method 9060
Total Solids	Sediment	%	0.1	± 25%	± 20%	95%	USEPA Method 160.3
Grain Size	Sediment	%	0.01	± 25%	± 20%	95%	PSEP 1997

Note:

1 All reporting limits shown are method PQLs from either ALS Laboratory Group in Everett, Washington or Analytical Resources Inc. laboratory in Tukwila, Washington

Abbreviations:

Ag Silver.
As Arsenic.
Be Beryllium.
Cd Cadmium.
Cr Chromium.
Cu Copper.
Hg Mercury.
Ni Nickel.
Pb Lead.
PQL Practical Quantitation Limit.
PSEP Puget Sound Estuary Program.
v Antimony.
Se Selenium.
SIM Select ion monitoring.
SMS Sediment Management Standards.
Tl Thallium.
USEPA U.S. Environmental Protection Agency.
Zn Zinc.

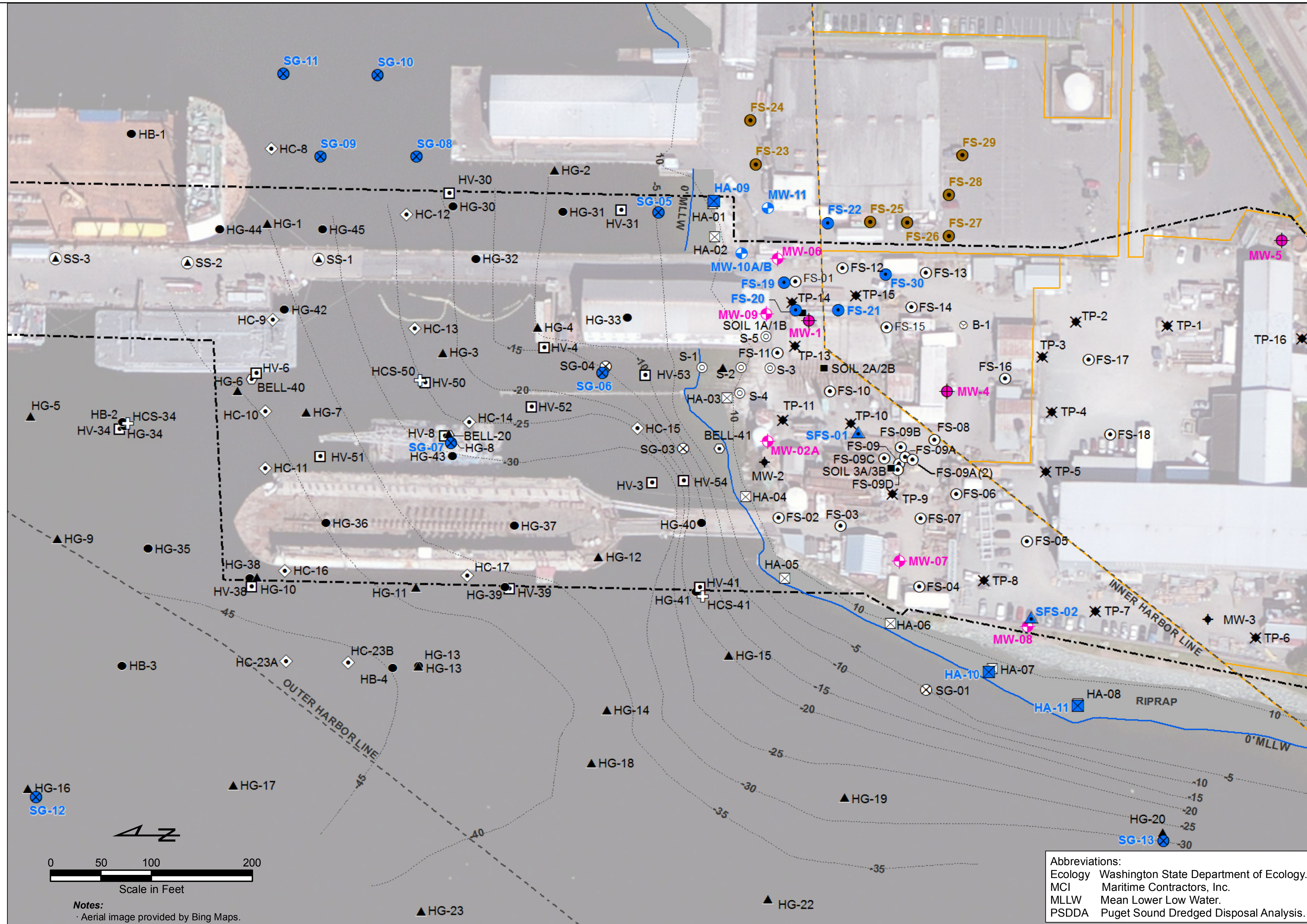
Harris Avenue
Shipyard

Data Gaps Investigation Sampling Analysis Plan and Quality Assurance Project Plan

Figure

Legend

- Proposed Monitoring Well Location
- Proposed Boring Location
- Proposed Contingency Boring Location
- Proposed Surface Soil Sample Location
- Proposed Intertidal Sediment Sample Location
- Proposed Surface Sediment Grab Sample Location
- MCI and Ecology Offshore Grab Sample Location (1993)
- MCI and Ecology Upland Grab Sample Location (1993)
- Geoengineers Grab Sample Location (1996)
- PSDDA Vibracore Sample Location (2003)
- RETEC Phase 2 Grab Sample Location (1998)
- RETEC Phase 2 Test Pit Location (1998)
- RETEC Phase 2 Boring Location (1998)
- RETEC Sample Location (2005)
- RETEC RI/FS Cesium Core Sample Location (2004)
- RETEC RI/FS Grab Sample Location (2003, 2004, 2006)
- RETEC RI/FS Vibracore Sample Location (2004)
- Floyd|Snider Grab Sample Location (2011)
- Floyd|Snider Geoprobe Location (2011)
- Floyd|Snider Hand Auger Location (2011)
- Floyd|Snider Monitoring Well Location
- RETEC Monitoring Well
- Inaccessible or Decommissioned Monitoring Well
- Approximate Site Boundary
- Tax Parcels
- 1998 Bathymetry Data
- Harbor Line
- Mean Lower Low Water Level
- Riprap or Beach



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Data Gaps Investigation
Harris Avenue Shipyard
Bellingham, Washington

Figure 1.1
Proposed Sample Locations

F:\projects\POB-HARRIS\GIS\MXD\RIFS Data Report\Figure 1.1 (Proposed Sample Locations - PDF Version).mxd
12/14/2012

Harris Avenue
Shipyard

Data Gaps Investigation
Sampling Analysis Plan and Quality Assurance Project Plan

Appendix A
Field Forms

Date__________________

Floyd|Snider Field Activities Report

Page _________of______

Project ________________________________ **Job No.** ______________________

Project Activity ______________________________ **Project Manager** ____________________

Description of site work activities, work locations, equipment used, site conditions, field personnel and visitors, safety and work meetings, and other notable events/occurrences.

Unsatisfactory Conditions & Recommended Corrections ______________________________

____

____

____

F|S Personnel (Sign)____________________ **Print**____________________ **Date**_________

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Boring ID: Boring ID

Drill Date: Feb. 31, 2008
Logged By: Geologist's Name
Drilled By: Driller / Company

Coordinate System: NAV83
Ground Surface Elevation: NA
Latitude/Northing:
Longitude/Easting:
Boring Location:

Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x4' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): Depth
Groundwater ATD (ft bgs): Water

Client: Client
Project: Project Name
Task: Task No.
Address: Site Address, city
Address - 2nd Line

Remarks:
Remarks Line 2

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
				1		
				2		
				3		
				4		
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: Boring ID

Drill Date: Feb. 31, 2008
Logged By: Geologist's Name
Drilled By: Driller / Company

Coordinate System: NAV83
Ground Surface Elevation: NA
Latitude/Northing:
Longitude/Easting:
Boring Location:

Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x4' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): Depth
Groundwater ATD (ft bgs): Water

Client: Client
Project: Project Name
Task: Task No.
Address: Site Address, city
Address - 2nd Line

Remarks:
Remarks Line 2

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				20		
				21		
				22		
				23		
				24		
				25		
				26		
				27		
				28		
				29		
				30		
				31		
				32		
				33		
				34		
				35		
				36		
				37		
				38		
				39		
				40		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date: Feb. 31, 2008
Logged By: Geologist's Name
Drilled By: Driller / Company
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x4' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): Depth
Groundwater ATD (ft bgs): Water

Client: Client
Project: Project Name
Site Location: Site Address, city
Address - 2nd Line

Ground Surf Elev. & Datum:
Coord. System:
Latitude/Northing: NA
Longitude/Easting: NA
Casing Elevation:

Remarks: Ground Surface Conditions, etc.

PID (ppm)	DRIVE / RECOVERY	SAMPLE INTERVAL	DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION: (color, grading, primary classification/description, (optional size fraction), secondary classification/description, moisture)	MONITORING WELL DETAIL
			0			
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

Notes:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date: Feb. 31, 2008
Logged By: Geologist's Name
Drilled By: Driller / Company

Ground Surf Elev. & Datum:
Coord. System:
Latitude/Northing: NA
Longitude/Easting: NA
Casing Elevation:

Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x4' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): Depth
Groundwater ATD (ft bgs): Water

Client: Client
Project: Project Name
Site Location: Site Address, city
Address - 2nd Line

Remarks: Ground Surface Conditions, etc.

PID (ppm)	DRIVE / RECOVERY	SAMPLE INTERVAL	DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION: (color, grading, primary classification/description, (optional size fraction), secondary classification/description, moisture)	MONITORING WELL DETAIL
			20			
			21			
			22			
			23			
			24			
			25			
			26			
			27			
			28			
			29			
			30			
			31			
			32			
			33			
			34			
			35			
			36			
			37			
			38			
			39			
			40			

Notes:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name:______________________________ Date of Collection: ______________________________

Project Number:______________________________ Field Personnel: ______________________________

Purge Data

Well ID: ____________________ Secure: ☐ Yes ☐ No Well Condition/Damage Description: ____________________

____

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No One Casing Volume (gal): ____________________

Depth of water (from top of well casing): ____________________ Well Casing Type/Diameter/Screened Interval: ____________________

After 5 minutes of purging (from top of casing): ____________________

Begin purge (time):____________________

End purge (time): ____________________

Gallons purged: ____________________

Purge water disposal method: ____________________

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO	Conductivity	Turbidity	Temp	ORP	Comments

Sampling Data

Sample No:____________________ Location and Depth: ____________________

Date Collected (mo/dy/yr): ____________________ Time Collected: ____________ ☐ AM ☐ PM Weather: ____________________

Type: ☐ Ground Water ☐ Surface Water Other: ____________________ Sample: ☐ Filtered ☐ Unfiltered Other:____________________

Sample Collected with: ☐ Bailer ☐ Pump Other: ____________________ Type: ____________________

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☐ Horiba U-50 Other:____________________

Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or dedicated silicon and poly tubing Other: ____________

Sample Description (Color, Turbidity, Odor, Other): ____________________

Sample Analyses

TPH-D	(HCl) ☐	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☐	BTEX	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:

Signature: ______________________________ **Date:** ____________________

SURFACE SEDIMENT SAMPLE COLLECTION FORM

Date/Time Collected: ______________________

Weather: ______________________

Field Personnel: ______________________

Sample Type:

☐ 1. Surface Sample (0-12 cm)

Sample ID/Design. ______________________

Sample Method (Van Veen Power Grab)

Datum (Horizontal/Vertical) ______________________

Leadline Water Dept: ____________ (A)

Predicted Tide Elevation ____________ (B)

Mudline Elevation ____________ (B-A)

Actual Tide Elevation ____________

Run # or Composite Pt	Time	Latitude (Northing)	Longitude (Easting	Sample Criteria (Surface Grab Only)					Accept Sample Y/N	Comments (Include depth of sample)
				1	2	3	4	5		

Acceptance criteria: 1 Overlying water is present, 2 Water has low turbidity, 3 Sampler is not over filled, 4 Sample surface is flat, 5 Desired sample depth is reached

Decon Procedure (Alconox Wash, DI water rinse, other):______________________

Sediment Sample Description

Sediment Sample Description (density, moisture, color, minor constituents, major constituents, other observations - *see field ref cards):

Sample containers filled (number and type):

Laboratory analysis:

Diver Comments etc: