

SAMPLING AND ANALYSIS PLAN

Western Port Angeles Harbor RI/FS

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ACRONYMS AND ABBREVIATIONS

ACG	analytical concentration goal
Agreed Order	Agreed Order No. DE9781
ASTM	American Society for Testing and Materials
CSL	Cleanup Screening Level
COC	chain-of-custody
DGPS	differential global positioning system
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GAC	granular activated carbon
GC/MS	gas chromatography/mass spectrometry
GPS	global positioning system
Integral	Integral Consulting Inc.
MLLW	mean lower low water
MS/MSD	matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
NAD 83	North American Datum of 1983
NPIUSA	Nippon Paper Industries USA Co., Ltd.
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PPE	personal protective equipment
PRC	performance reference compound
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
RI/FS	remedial investigation and feasibility study
SAP	sampling and analysis plan
SMS	Sediment Management Standards

SOP	standard operating procedure
SOW	statement of work
SPI	sediment profile imaging
SPME	solid-phase microextraction
SQS	Sediment Quality Standards
TCDD	tetrachlorodibenzo- <i>p</i> -dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalent concentration
TOC	total organic carbon
TVS	total volatile sulfides
WAC	Washington Administrative Code
WPAH Group	Western Port Angeles Harbor Group

1 INTRODUCTION

Port Angeles Harbor, Washington, has been identified as a priority environmental cleanup and restoration project by the Washington State Department of Ecology (Ecology) as part of the Puget Sound Initiative. Under Agreed Order No. DE9781 (Agreed Order), the Western Port Angeles Harbor Group¹ (WPAH Group) has agreed to perform a remedial investigation and feasibility study (RI/FS) of Western Port Angeles Harbor (Figure 1-1). The Western Port Angeles Harbor RI/FS work plan (WPAHG 2013) is Exhibit B to the Agreed Order, and describes data gaps and data collection to complete the final RI/FS report.

Consistent with the Agreed Order and associated work plan, this RI/FS addresses sediments located below mean higher high water within the Western Port Angeles Harbor study area, located west of the Rayonier study area and south of the Ediz Hook spit, except in areas where this tidal level is covered by riprap or bulkheads. In this case, the RI/FS addresses sediments below the toe of the riprap slope or bulkhead.

This sampling and analysis plan (SAP) describes the data collection tasks and associated methods that will be performed in the Western Port Angeles Harbor RI/FS, to complete the final RI/FS report. Ecology and the WPAH Group have the mutual objective of completing the remedial action called for under the Agreed Order by January 2015.

The purpose of this SAP is to document how the field investigation will be implemented. This SAP refers to sections of the SAP used by Ecology and Environment, Inc. (Ecology 2008a) when information and methods are the same. This SAP also follows the requirements of the Washington State Model Toxics Control Act (MTCA) Chapter 173-340 Washington Administrative Code (WAC) (Ecology 2001) and the guidance for SAP development provided in Ecology (2008b). This SAP provides the following information:

- Site background
- Study design
- Overview of field methods
- Overview of laboratory methods
- Overview of quality assurance and quality control (QA/QC) requirements for field and laboratory activities
- Data reporting
- Project team responsibilities.

¹ Members of the WPAH Group include City of Port Angeles, Georgia-Pacific LLC, Merrill & Ring, Nippon Paper Industries USA Co., Ltd., and Port of Port Angeles.

2 BACKGROUND

Background information including a description of the Port Angeles Harbor and information developed from previous investigations is provided in Ecology (2008a, 2012a) and WPAHG (2013).

A number of investigations of the harbor sediments have been conducted beginning in the early 1970s. The RI/FS work plan evaluated historical data from 2002 to present that will be used in the RI/FS to document current environmental conditions. Table 2-1 provides the surveys and the types of analyses conducted during this time period. These data are mapped and discussed in *Port Angeles Harbor Marine Environment Screening Level Human Health and Ecological Risk Assessment, Final Report* (Ecology 2012b), *Port Angeles Harbor Sediment Characterization Study Sediment Investigation Report, Port Angeles, Washington* (Ecology 2012a), and *Port Angeles Harbor Supplemental Data Evaluation to the Sediment Investigation Report, Port Angeles, Washington* (NewFields 2012a).

The available data constitute the majority of the data needed to prepare the RI/FS. A final data collection effort (as provided in this SAP) will fill remaining data gaps in the remedial investigation and provide additional information for use in the feasibility study.

This field investigation is anticipated to fill specific remaining data gaps that are identified in the RI/FS work plan (WPAHG 2013) that is Exhibit B to the Agreed Order. Details on specific objectives of this field investigation to support the RI/FS are provided in the work plan.

3 STUDY DESIGN

This section describes the study design for the Western Port Angeles Harbor field investigation. A summary of the analytical parameters for each sediment sampling station is provided in Table 3-1.

3.1 EVALUATION OF BENTHIC CONDITIONS

Certain data gaps were identified in the RI/FS work plan that need to be filled to complete the RI/FS in Western Port Angeles Harbor. They will be filled through a combination of sediment bioassays and sediment profile imaging (SPI).

3.1.1 Sediment Bioassays

Bioassays will be conducted on two sets of stations.

3.1.1.1 Full Suite Bioassays

Full suite bioassays will be conducted at the 20 locations shown in Figure 3-1. These locations were selected for the bioassays for one of the following reasons:

1. They had exceedances of either Washington State Sediment Management Standards (SMS) Sediment Quality Standards (SQS) or Cleanup Screening Levels (CSL)
2. They were located between existing stations with SQS chemical exceedances
3. They represented an area for which toxicity data was lacking.

Full suite bioassays will include the 10-day amphipod bioassay using *Eohaustorius estuarius*, the larval development bioassay using the mussel *Mytilus galloprovincialis* with the resuspension protocol (Kendall et al. 2012), and the 20-day *Neanthes* sp. growth test.

A number of chemical analyses will be conducted on sediments from each full suite station. Some stations already have data for some or all of the SMS chemicals. The goal of the SMS chemistry sampling and analyses at the full suite bioassay stations is to analyze those SMS chemicals that are currently missing at those stations. When this task has been completed, all inner harbor sediment stations sampled by Ecology (2008a) and for this RI/FS will have data for all SMS chemicals. As discussed during the April 5, 2013, meeting with Ecology (Lawson 2013a, pers. comm.), chemical analyses at the two full suite bioassay stations along Ediz Hook will be limited to conventional analyses and black carbon. Table 3-2 identifies existing chemical data and the chemical analyses that will be performed at each full-suite toxicity station.

A number of conventional analyses will be analyzed at each full suite bioassay station including total organic carbon (TOC), total volatile solids (TVS), total solids, and grain size. In addition, porewater ammonia and porewater sulfides data will be generated for each field-collected sediment sample for use in evaluating the toxicity data, and black carbon will be analyzed to support the feasibility study (see Section 5.1).

3.1.1.2 Larval Bioassays

Larval bioassays will be conducted at 27 additional locations using the mussel *Mytilus galloprovincialis* with the resuspension protocol (Kendall et al. 2012) (Figure 3-1). Previous larval bioassays at these locations may have exceeded SQS biological criteria due to possible false positive results attributed to larval entrainment in flocculent sediments. The new bivalve larval resuspension bioassay results will be used to reflect current sediment quality conditions in the RI/FS.

Each larval bioassay station will undergo the same conventional analyses as do the full-suite bioassay stations: TOC, TVS, total solids, and grain size. Porewater ammonia and porewater sulfides data will be generated for each field-collected sediment sample for use in evaluating the toxicity data and black carbon will be analyzed to support the feasibility study.

3.1.2 Sediment Profile Imaging

The objective of the SPI survey is to evaluate and delineate (to the extent practicable) the extent of wood debris deposits and to provide information on benthic habitat quality. SPI images will be collected at the 92 locations shown in Figure 3-2 and Table 3-3. Images may be obtained at several additional locations, based on the overnight review of images taken during the survey, to ensure gradients in habitat conditions (e.g., wood debris) are adequately represented. All images will undergo a preliminary review and images from up to 92 locations will undergo full analysis with those locations selected to ensure good representation of habitat gradients.

Resulting data will also be compared with SPI data collected in 1998 (SAIC 1999) to evaluate the potential for habitat recovery. Plan view images will also be collected at each location to evaluate surface sediment features. Three replicate images (SPI and plan view) will be taken at each location.

The following qualitative metrics will be determined from the images:

Metric	Notes
Sediment Profile Imaging (SPI) Camera	
Depth of apparent redox potential discontinuity	Thickness of high-reflectance, near-surface sediments is a measure of oxygen penetration into the sediment. The depth of the apparent redox potential discontinuity layer between oxidized (sub-oxic) and reduced chemical conditions in the

Metric	Notes
Infaunal successional stage	sediment column are an important time-integrator of dissolved oxygen conditions within sediment pore waters. Based on the benthic successional paradigm described in Rhoads and Germano (1982), the degree of infaunalization (type of benthic infaunal assemblages present and extent of sediment reworking) is indicative of disturbance history of an area.
Benthic invertebrates	Presence of benthic invertebrates
Presence and amount of wood debris	Visual estimate of approximate wood debris amount/percent cover: None = none Trace = <5 percent Low = 5–20 percent Medium = 20–50 percent High = >50 percent
Sediment grain size	Visually estimated by overlaying a grain-size comparator.
Boundary roughness	Vertical distance between highest and lowest point at the sediment-water interface may reflect biogenic and/or physical disturbance factors.
Sediment Plan View Camera	
Mega and epifaunal species	Presence of fish, crabs, holothuroidae
Lebensspuren	A measure of tracks, trails, burrows, and mounds
Beggiatoa	Presence of beggiatoa mats
Debris	Visual estimate of approximate debris amount/ percent cover: None = none Trace = <5 percent Low = 5–20 percent Medium = 20–50 percent High = >50 percent

3.2 INFORMATION TO SUPPORT THE FEASIBILITY STUDY

The extent to which cleanup alternatives meet SMS and MTCA requirements will be used as lines of evidence in the feasibility study. As discussed in the Western Port Angeles Harbor RI/FS work plan, information on the potential bioavailability of chemicals of concern that drive risk to human health will help focus the feasibility study on high priority areas and may contribute to the lines-of-evidence evaluation. Bioavailability of PCBs and dioxins/furans will be evaluated using laboratory bioaccumulation testing, and additional lines of evidence related to bioavailability may include solid-phase microextraction (SPME) testing to derive porewater concentrations of PCBs and dioxins/furans, along with black carbon analyses. Treatability testing will also be conducted on sediments collected from two stations.

3.2.1 Laboratory Bioaccumulation

Laboratory bioaccumulation testing will be undertaken at 15 locations in Western Port Angeles Harbor (Figures 3-3 and 3-4, and Table 3-4). These locations represent a range of both dioxin/furan and polychlorinated biphenyl (PCB) concentrations in sediment. Triplicate analyses will be conducted at two of these locations (i.e., Stations WPAH004 and WPAH050). Bioaccumulation testing will generally follow regional Dredged Material Management Program testing methods and will expose two species (adult bivalve [*Macoma nasuta*] and adult polychaete [*Nephtys caecoides*]) to site sediments for 45 days followed by chemical analysis of the tissues for dioxin/furans, PCB congeners, and lipids. Dredged Material Management Program guidelines for laboratory bioaccumulation testing will be used as the testing protocols (Corps 2013; Lee et al. 1989) with the following modifications as provided in Kendall and McMillan (2009):

- The exposure period will be extended from 28 days to 45 days.
- Once a week during the exposure period, 175 mL of test sediment will be added to each test chamber.
- Wet weight biomass of 10 individual organisms per replicate will be measured at the beginning and end of the exposure period for test, control, and reference samples to estimate net individual growth and to evaluate the health of the test animals.
- Two of the bioaccumulation stations will be run as laboratory triplicates and the remaining will be run as individual samples.

Results from the bioaccumulation tests will provide information on the bioavailability of dioxins/furans and PCBs in sediments from the western harbor.

Field sediments collected for bioaccumulation testing will be analyzed for dioxin/furans, PCB congeners, and black carbon. The dioxin/furan and PCB sediment chemical data will be compared with the resulting tissue and SPME chemical data following sediment exposures to evaluate tissue/porewater/sediment relationships. The black carbon data will also be evaluated with the tissue data to determine the extent to which black carbon may naturally sequester these bioaccumulative chemicals. These evaluations may be used in the feasibility study to help evaluate remedial alternatives.

3.2.2 Porewater Chemistry via Solid-Phase Microextraction

Concurrently with the 15 laboratory bioaccumulation exposures and related replicates, SPME fibers will be deployed in the laboratory aquaria housing the bioaccumulation test organisms. The SPME fibers provide a new method to determine porewater concentrations of dioxins/furans and PCBs (USEPA 2012) and may be used as an additional line of evidence in the feasibility study. Following deployment in the bioaccumulation aquaria, the fibers will be analyzed for dioxin/furans and PCB congeners.

3.2.3 Treatability Testing

At two of the stations where sediments will be collected for bioaccumulation and SPME testing, additional sediment will be collected for treatability testing using granular activated carbon (GAC) (Figures 3-3 and 3-4, Table 3-4). GAC addition to sediment has been successfully used to further sequester bioaccumulative organic compounds such as PCBs and dioxin/furans. At the two Western Port Angeles Harbor locations depicted in Figures 3-3 and 3-4 and listed in Table 3-4, a second set of bioaccumulation and SPME tests will be conducted. Prior to test initiation, GAC will be mixed into the sediment at a dose of approximately 4 percent by dry weight (a typical GAC dose used at other *in situ* sediment treatment sites across the U.S. and in Norway; Ghosh et al. [2011]) and then the tests will be performed in a manner identical to that for the original bioaccumulation tests (i.e., bioaccumulation test chambers will contain *M. nasuta*, *N. caecoides*, and the SPME fibers). The resulting data will be compared to the data from the same locations that did not have GAC added to determine whether GAC influenced the uptake of PCBs and dioxin/furans by the test organisms. This information may be used in the feasibility study to evaluate potential remedial alternatives.

4 FIELD SURVEY AND SAMPLING METHODS

This section describes the methodology for positioning, sample collection, processing, identification, documentation, equipment decontamination, and handling of investigation-derived waste for the field investigation. The laboratory methods for chemical analysis, bioassays, bioaccumulation, and SPME testing are presented in Section 5.

4.1 SAMPLING VESSELS AND FIELD EQUIPMENT

The Bio-Marine Enterprise 42 ft research vessel *Kittiwake* will be used for the SPI survey and to collect surface sediment samples at harbor sampling sites. Sediment will be collected from the *Kittiwake* using either a stainless-steel pneumatic power grab device or a gravity driven dredge, such as a stainless-steel van Veen (modified 0.1 m², or 1.1 ft²), or similar grab device.

Surface sediment samples at three locations in the lagoon at the Nippon Paper Industries USA Co., Ltd. (NPIUSA) paper mill will be accessed either by foot at low tide or with a small skiff at high tide. These samples will be collected using a stainless-steel grab sampler (e.g., modified petite-Ponar), stainless-steel hand-held corers or a stainless-steel shovel or spade (or equivalent type of equipment).

An Ocean Imaging Systems 3731 SPI camera system provided and operated by Germano & Associates, will be deployed from the *Kittiwake* for the collection of all images in Port Angeles Harbor. Images will not be taken in the lagoon because a sampling vessel capable of deploying either an open-water or hand-held SPI camera system is not available for operations in the lagoon environment.

4.2 STATION LOCATION POSITIONING AND NAVIGATION

Station location positioning and navigation methods for this investigation will follow those of the Port Angeles Harbor Sediment Characterization Study SAP (Ecology 2008a). A differential global positioning system (DGPS) will be used for station positioning for all vessel-based sampling stations (Table 4-1). The DGPS receiver will be capable of surveying positions accurate to within 2 m. The vessel will have navigation equipment that provides accurate station positioning and ensures that sample stations and water depths are accurately recorded. For samples collected in the lagoon, a hand-held global positioning system (GPS) unit will be used to record the sampling station coordinates. Accuracy of the hand-held GPS unit will be within 3 m.

Horizontal coordinates will be projected to the Washington State Plane (North) coordinate system under the North American Datum of 1983 (NAD 83). The vertical datum will be the

mean lower low water (MLLW) datum. Vertical control measured by the vessel depth finder will be corrected for tidal influence after field activities are completed (Ecology 2008a).

Before fieldwork is initiated, a control check point such as a dock or piling will be established that can be accessed by the sampling vessel. At the beginning and end of each day, the height of the check point will be determined from the vessel, averaged and compared to the known coordinates.

For vessel-deployed sampling, the DGPS receiver will be placed above the sampling device deployment boom to accurately record the position of the sampling device. At surface sediment grab stations, once the sampling device has been deployed, the actual position will be recorded when the device reaches the sediment floor and the deployment cable is in a vertical position. At these locations, water depths will be measured directly by the vessel depth finder and converted to mudline elevations after correction for tide (Ecology 2008a).

4.3 SURFACE SEDIMENT SAMPLING

As noted in Section 4.1, surface sediment will be collected using either a stainless-steel pneumatic power grab device or a gravity driven dredge, such as a stainless-steel van Veen (modified 0.1-m²), or smaller hand-deployed grab device if necessary. If accessible during low tide, surface sediment samples from the lagoon may be collected directly with stainless-steel spoons and bowls.

Sediment grab sampling methods will follow those of Ecology (2008a). Up to three grab attempts will be made at each proposed sampling location to obtain the minimum sediment volume needed to perform all necessary analyses specific to each station. If, after three grabs, the minimum sediment volume has not been met, the station will be moved to a new location at the discretion of the field team lead. This new location will be chosen based on similar location characteristics and using best professional judgment. Up to three attempts to relocate a station will be made (for a total of nine possible grab attempts). If it is not possible to obtain a successful sample from any of these three locations, then the Integral Consulting Inc. (Integral) project manager will be notified and will consult with the WPAH Group and Ecology regarding possible station relocation.

Surface sediment samples will be collected from the 0–10 cm (0–4 in.) interval. As detailed above, it may require multiple grabs to obtain an adequate sample volume for all analyses. Compositing and homogenization of samples is described below. Samples will be collected as described in Standard Operating Procedure (SOP) SD-04 for surface sediment sampling (Appendix B). Samples will be carefully collected following USEPA (1997a) procedures:

1. Position the sampling vessel at the targeted sampling location.
2. Set the sampler jaws in the open position, place the sampler over the edge of the boat, and lower the sampler to the bottom and trip the sampler to collect the sample.
3. Record the location using the DGPS; measure and record the water depth.
4. Retrieve the sampler and place it securely on the sampling vessel.
5. Examine the sample for the following sample acceptance criteria per USEPA (1997a); if criteria are not achieved, the sample will be rejected and another collection attempt will be made:
 - The sampler is not overfilled with sample to prevent the sediment surface from pressing against the top of the sampler.
 - The sample does not contain large foreign objects such as trash or debris. A sample that is rock/gravel fill will be rejected in favor of depositional material (sand/silt/clay).
 - Overlying water is present in the sampler (indicates minimal leakage).
 - The overlying water is not excessively turbid (indicates minimal sample disturbance).
 - The sediment surface is relatively flat (indicates minimum of disturbance or winnowing).
 - The desired penetration depth is achieved (several centimeters more than the targeted sample depth). If after three attempts the targeted penetration depth (i.e., 10 cm) cannot be met, then the following penetration depths will be achieved at a minimum depending on substrate (USEPA 1987):
 - 4–5 cm for medium-coarse sand
 - 6–7 cm for fine sand.
6. Siphon off any overlying surface water.
7. Collect samples for TVS analysis and porewater ammonia and sulfides analyses directly from the grab sampler and place the sediment aliquots in appropriate, pre-cleaned, labeled sample containers (Table 4-2).
8. Measure and collect the top 10 cm (4 in.) with a stainless steel spoon, avoiding any sediment that is in contact with the inside surface of the grab sampler, and then place the sediment into a stainless steel bowl and cover with aluminum foil.
9. Record the following observations of sediment sample characteristics in the field logbook (USEPA 1997a; SOP AP-02); if more sample volume is required, then repeat steps 1 through 8:

- Texture
 - Color
 - Biological organisms or structures (for example, shells)
 - Presence of debris (natural or anthropogenic objects)
 - For wood debris, characterize using following categories:
 - Logs or large wood pieces
 - Small wood and/or bark chips (wood chips)
 - Very fine wood particles and/or fibers (wood pulp)
 - Trace to sparse wood pulp/chips mixed within the sediment column
 - Sparse, scattered wood pieces on top of the sediment surface
 - Presence of oily sheen or obvious contamination
 - Odor (for example, hydrogen sulfide or petroleum)
10. Wash excess sediment back into the water away from any areas remaining to be sampled.
 11. Once sufficient sediment volume has been collected, homogenize the sample by mixing with a stainless steel spoon until a consistent color and texture are achieved. Place sample material in the appropriate, pre-cleaned, labeled sample containers. Place jars in a cooler on ice and maintained at approximately 4°C and prepare for shipment to the analytical or biological laboratory as described in Section 4.8.
 12. Obtain an aliquot of sediment from the homogenated sediment and collect a gross field measurement of percent fines from each bioassay station to aid in directing the collection of reference station samples for the bioassay tests, which can be dependent upon percent fines. The gross field grain size measurement will be determined by following procedures provided in USEPA (1997a).
 13. Confirm all relevant documentation has been completed, entries are accurate, and paperwork has been signed.
 14. Decontaminate all sampling equipment as described in Section 4.5 before proceeding to the next sampling location.

A matrix spike/matrix spike duplicate (MS/MSD) sample will be collected randomly at the field team lead's discretion at a frequency of 5 percent of samples collected. Aliquots of homogenized sediment will also be collected for bioassay and/or bioaccumulation testing. The sample containers and related analyses that will be obtained from each location are presented in Table 4-2.

Manual sampling methods may be used in the lagoon during low tide conditions. The field crew will manually sample sediments by either a hand-held grab sampler (e.g., modified petite-Ponar) or by scooping and compositing sediment with stainless steel spoons and bowls. Surface sediment sampling is expected to require 10 field days.

4.4 BIOASSAY REFERENCE AREA

Three reference area samples will be collected for this study. The grain size composition of the reference area sediment will be as similar as possible to that of the sediment grain-size range observed at the site (USEPA 1997e).

Reference samples will be collected from Carr Inlet and will target site grain size ranges of <20 percent fines, 20–50 percent fines and 50–80 percent fines, respectively. These grain-size ranges encompass the grain-size ranges previously found at the bioassay stations in Western Port Angeles Harbor. Possible reference stations and historical grain sizes are:

- CR-12: 12.8 percent fines
- CR23W: 33.3 percent fines
- CR02: 60.6 percent fines.

A gross field measurement of percent fines will be made at each of the proposed reference area stations prior to sample collection to confirm that the correct grain size range has been obtained. If the grain size at a reference station is determined in the field to be outside of the desired range, then the station will be moved in consultation with Integral's project manager. The gross field grain size measurement will be determined by following procedures provided in USEPA (1997a).

4.5 SPI SURVEY

All SPI images will be collected using an Ocean Imaging Systems 3731 camera. This camera collects photographs of the sediment column in profile, producing images with even illumination over the entire field of view with no resulting shadows or hot spots. The digital sediment profile camera uses a Nikon D7000 camera inside the housing with a 16.2 megapixel CCD array and 12-bit RGB color. More than 1,000 high resolution images can be stored before the camera's memory capacity is exceeded. Appendix D is an SPI quality assurance project plan (QAPP) describing the camera's operation and detailed image analysis procedures and quality assurance steps.

To optimize the mapping of the extent of wood debris deposits in the harbor, a review of the images collected each survey day will be conducted as follows. At the end of each day, the

digital photos from the day's sampling and the associated positional data file will be transferred by Germano & Associates' field personnel to Integral. The images will be scanned for relative wood debris amount/cover (e.g., none, trace, low, medium, high) by Integral (Gene Revelas) and a simple map of these estimates will be prepared. This preliminary map will be provided to Ecology's designated representative or NewFields and discussed by phone or in person by noon of the following day. If the need to modify any target SPI station locations is identified, then this information will be provided immediately to the field team lead and Germano & Associates field staff so that locations may be adjusted as needed. The SPI survey is expected to require three field days. The boat will not be demobilized until images from the third field day have been reviewed.

4.6 EQUIPMENT DECONTAMINATION

Following the Ecology SAP (Ecology 2008a), the sediment sampling equipment including grab samplers, compositing bowls, and sampling utensils will be thoroughly decontaminated prior to use in accordance with Puget Sound Estuary Program (PSEP) protocols (USEPA 1997a–e). The equipment will be scrubbed and washed with non-phosphate, nontoxic, biodegradable detergent and site water, followed by a rinse with heptane. A final rinse of the sediment compositing equipment with distilled water also will be performed. If a noticeable oily sheen or petroleum odor is observed, sampling bowls and utensils used to process those samples will not be used for subsequent sample processing.

Sediment sampling personnel will wear disposable nitrile gloves, which will be changed after handling each sample and between sampling stations to prevent cross-contamination (USEPA 1997a).

4.7 FIELD QUALITY CONTROL SAMPLES

Field quality control samples will be used to assess sample variability and to verify that cross contamination between samples has not occurred during sampling. If quality control problems are encountered, corrective actions (if appropriate) will be implemented to meet the project's data quality specifications. The following quality control samples will be collected in the field and analyzed by the analytical laboratory:

- Blind field split samples will be collected and analyzed to assess the variability associated with sample processing and laboratory variability. Blind field split samples for analysis of chemicals of concern will be collected at a minimum frequency of 1 field split sample per 20 sediment samples. Field splits will be assigned unique numbers and will not be identified as field splits to the laboratory.

- Equipment wipe blanks will be collected to help identify possible contamination from the sampling environment or from the sampling equipment (e.g., grab sampler). Equipment filter wipe blanks will be generated at approximately 5 percent of the sediment sampling locations. All equipment wipe samples will be clearly noted in the field logbook (e.g., sample identifier, equipment type, date and time of collection, analysis, and filter lot number).

A minimum of one field equipment wipe blank will be collected for each kind of sampling equipment used for collection of samples for chemical analyses. One equipment wipe will be prepared for each analysis type. (*Note:* Filter papers must be stored in their original box, wrapped carefully in three layers of aluminum foil, or contained in a glass jar. The filter paper box cannot be stored in plastic bags or containers.)

- Filter paper blanks are prepared in the field to evaluate potential background concentrations present in filter paper used for the equipment filter wipe blank. Filter paper blanks are unused filters, of the kind used for the equipment wipe samples, placed into sample jars in the field. Filter blanks will be collected at a minimum frequency of one for each lot number of filter papers used for collecting the equipment wipe blanks.
- Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. A temperature blank will be included with each sample cooler shipped to the testing laboratory.
- Three images will be collected at each SPI station. One SPI image from each station and a second image from 20 percent of the stations (for quality assurance purposes) will be analyzed for the selected biological and physical sediment features. Field quality control procedures for the SPI survey are provided in Appendix D.

4.8 SAMPLE IDENTIFICATION

Sample identifiers will be established before field sampling begins and assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., split samples) to ensure proper data analysis and interpretation, 2) to obscure the relationships between samples so that the laboratory analysis will be unbiased by presumptive similarities between samples, and 3) to track individual sample containers to ensure that the laboratory receives all of the material associated with a single sample. To accomplish these purposes, each container is assigned a sample number and a tag number for

each container submitted to the analytical laboratory. These codes and their uses are described below:

- **Sample Number**—The sample number is a unique number assigned to each sample. Sample numbers will be assigned sequentially in the field. The sample number is an arbitrary number assigned to each sample collected (e.g., SD0001, SD0002, FW0001, FB0001; where SD = sediment, FW = filter equipment wipe, FB = filter paper blank) for chemical analysis or bioassays.

All sample containers belonging to a given sample will have the same sample number. Any field split sample would have a different sample number and the sample numbers of related field quality control samples may not share any content. The sample number appears on the sample containers and the chain-of-custody (COC) forms, and analytical data will be reported by sample number.

- **Tag number**—A different sample tag number is attached to each sample container. The tag numbers are used by laboratories only to confirm that they have received all of the containers that were filled and shipped. Sample labels will be preprinted with a five-digit sequential tag number (e.g., 21116, 21117, 21118).

If the amount of material (i.e., everything associated with a single sample number) is too large for a single container, then each container will have the same sample number and a different sample label with a unique sample tag number (e.g., SD0007 [1 of 2], SD0007 [2 of 2]). A sample will also be divided between containers if a different preservation technique is used for each container (i.e., because different analyses will be conducted). The sample tag number will appear on the COC forms.

4.9 SAMPLE CONTAINERS AND LABELS

Sample aliquots submitted to the analytical, bioassay, and bioaccumulation testing laboratories will be placed in pre-cleaned sample containers and preserved as identified in Table 4-2. The procedure for sample storage and shipping is given in Section 4.9.

Sample labels will be made of self-adhering, waterproof material. Sample labels will be protected by packaging tape wrapped around the entire jar to prevent loss or damage of the labels during handling and storage.

4.10 SAMPLE PACKAGING AND TRANSPORT

Sample coolers and packing material will be supplied by the analytical laboratories. Individual sample jars will be labeled and placed into plastic bags and sealed. Glass jars will be placed in a manner to prevent breakage and separated in the cooler by bubble wrap or other shock-

absorbent material. Ice in sealed, double, plastic bags will be placed in the cooler for shipping (SOP AP-01). When a cooler is full, the completed COC form will be placed into a zip-locked bag and taped to the inside lid of the cooler. A temperature blank will be added to each cooler. Each cooler will be sealed with two COC seals, one each on the front and side of the cooler. Coolers containing samples for chemical analyses, bioassays, and bioaccumulation testing will be transported to the appropriate laboratory by courier or overnight shipping service.

After the chemistry samples have been received by the laboratory, they will be stored under refrigeration (4°C) or frozen (-20°C) if an archive chemistry sample. Samples for toxicity and bioaccumulation testing will be stored under refrigeration (4°C).

4.11 INVESTIGATION-DERIVED WASTES

Unless there is visible evidence of contamination, excess sediment material, decontamination water and rinse water will be returned to the site. Organic solvent decontamination fluids will be allowed to evaporate.

Used disposable personal protective equipment (PPE) such as nitrile gloves and disposable supplies (e.g., paper towels) will be disposed of as solid waste. If PPE contains residual sediments, it will be decontaminated using the procedures outlined in Section 4.3 and disposed of as solid waste. Waste material will be recycled as feasible (e.g., paper, plastic, aluminum).

4.12 FIELD DOCUMENTATION

A complete record of field activities will be maintained as described in SOP AP-02 (Appendix B).

4.12.1 Field Logbook

Field logbooks must be used to record all daily activities during field sampling events. All modifications, decisions, and/or corrective actions to the study design and procedures identified in this SAP will be discussed with and approved by the Integral project manager prior to field implementation and will be clearly documented in the field logbook.

4.12.2 Chain-of-Custody Procedures

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Samples will be retained in the field team's custody at all times until the samples are transported to the appropriate laboratory. Proper record-keeping and COC procedures will be implemented to allow samples to be traced from collection to final disposition. At the end of each day and prior to shipping or storage, COC forms will be

prepared for all samples to ensure that all collected samples are properly documented and traceable through storage, transport, and analysis and will include the following:

- **COC form**—The sample number and tag number of each sample container will be recorded on a COC form (example provided in Appendix C). The signed COC form will be secured to the inside top of each cooler identifying the sample collection date and time, the type of sample, the project and the field personnel. The COC form will be sent to the laboratory along with the sample. The COC forms will be completed in triplicate, with one copy retained by the field team lead.

An additional component of the COC process is the use of custody seals during sample shipping. Two custody seals (example provided in Appendix C) will also be placed across the lid of the cooler prior to shipping.

Additional details regarding COC procedures to be followed for this sampling event are provided in SOP AP-03 (Appendix B).

4.13 FIELD DATA MANAGEMENT

Daily field records (a combination of the field logbook, GPS and water depth records, and COC forms) will make up the main documentation for field activities. Upon completion of sampling, hard copy notes and forms will be scanned to create an electronic record for use in creating appendices to the data report. Information on sampling locations, dates, water depths, equipment, and other conditions, and sample identifiers will be entered into a project database.

5 LABORATORY METHODS

All the testing procedures used during this investigation will be performed in accordance with the most current SMS and USEPA (1997b–e) guidance and with Ecology (2008b) documentation, as applicable. Sediment samples will be analyzed for metals, semivolatile organic compounds, polycyclic aromatic hydrocarbons, dioxin/furans, PCB congeners, black carbon, grain size distribution, TOC, total solids, and TVS. Porewater samples will be analyzed for ammonia and sulfides. SPME and tissue samples from two species resulting from the bioaccumulation tests will be analyzed for dioxin/furans and PCB congeners. Tissue samples will also be analyzed for percent lipids. Nondetected results will be reported to the method detection limit for all analytes and matrices.

In addition, a suite of bioassays will be performed on the sediment samples (amphipod survival, larval development [with resuspension], and juvenile polychaete growth test).

With the exception of Alta, each laboratory participating in this program is Ecology-certified to perform the specific test. Alta is National Environmental Laboratory Accreditation Program-certified.

5.1 CHEMICAL ANALYSES

Chemical analyses will be conducted according to the protocols set forth in Section 6.1 of Ecology (2008a). The specific analyses and conventional parameters to be measured, the laboratories to be used (ALS Environmental, Alpha Analytical, AXYS Analytical Services, and SGS Analytical Perspectives), and analytical methods are presented in Tables 4-2, 5-1, and 5-2. Table 5-1 includes sediment analytical concentration goals (ACGs). Sediment ACGs are based on the practical quantitation limit for PCBs and dioxins, natural background for the remaining human health risk drivers, or the SQS or lowest apparent effects threshold for protection of benthic receptors as provided in NewFields (2012b). Tissue ACGs are based on the laboratory's current method detection and method reporting limits.

As discussed in Section 3.2.1, sediment black carbon analyses will be used in a weight-of-evidence feasibility study evaluation, along with tissue bioaccumulation and SPME data, to determine the extent to which black carbon may sequester bioaccumulative chemicals. While the proposed black carbon method (Gustafsson et al. 1997) is currently the most accepted method for this application, there are uncertainties inherent to all black carbon analysis methods. Accordingly, the black carbon data will be reviewed along with other measurements in an overall weight-of-evidence evaluation for the feasibility study.

5.2 BIOASSAYS

Full suite bioassays will include the 10-day amphipod bioassay using *E. estuarius*, the larval development bioassay using the mussel *M. galloprovincialis*, and the *Neanthes* sp. growth test. The bioassays will be performed by NewFields. Bioassays will be conducted using the methods stipulated in USEPA (1997e) with modifications to the mussel test per Kendall et al. (2012) for resuspension of the test sediment at test termination.

5.3 BIOACCUMULATION TESTING

Bioaccumulation testing will be performed by NewFields and will follow regional Dredged Material Management Program guidelines (Corps 2013; Lee et al. 1989) with modifications to the bioaccumulation test per Kendall and McMillan (2009) and will expose two species (adult bivalve [*Macoma nasuta*] and adult polychaete [*Nephtys caecoides*]) to site sediments for 45 days followed by chemical analysis of the tissues for dioxin/furans and PCB congeners. The bioaccumulation tests will run for 45 days to ensure uptake equilibrium for relatively hydrophobic dioxins/furans and PCBs.

5.4 SPME TESTING

SPME fibers will be installed concurrently with the bioaccumulation tests to measure porewater concentrations of dioxin/furans and PCBs. The fibers will be manufactured by Polymicro Technologies (Phoenix, AZ) with a polydimethylsiloxane coating of approximately 35 µm on a 500 µm diameter core. The fibers of approximately 1 m in length will be soaked sequentially in hexane and methanol, and then rinsed with distilled water and dried using Kimwipes. A fraction of the cleaned fibers (5 cm) will be sampled to confirm low initial levels of dioxin/furans and PCBs on the fibers.

The SPME fibers will be pre-impregnated with performance reference compounds (PRCs) to evaluate the uptake kinetics of dioxins/furans and PCBs to the fiber and estimate the fraction to steady state. ¹³C-labeled dioxin/furans including five dioxin congeners (2,3,7,8-TCDD, 1,2,3,7,8-PeCDD, 1,2,3,6,7,8-HxCDD, 1,2,3,4,6,7,8-HpCDD, and OCDD) and four furan congeners (2,3,7,8-TCDF, 1,2,3,7,8-PeCDF, 1,2,3,6,7,8-HxCDF, and 1,2,4,6,7,8-HpCDF) and six ¹³C₁₂-labeled PCB congeners (PCB8, PCB31, PCB60, PCB85, PCB128 and PCB182) will be used as PRCs. The mixture of the labeled dioxin/furans will be obtained from Cambridge Isotope Laboratories (Andover, MA) and the PCB mixture will be provided by SGS analytical laboratory.

Deionized water will be spiked with PRC stocks in methanol solution. Fibers and the spiked aqueous solution will be mixed for at least 2 weeks in a 4-in. diameter and 1-m long glass tube sealed with Teflon lined cap. Before installing the fibers in sediment within the bioaccumulation chambers, eight 5 cm fibers will be sampled to determine initial concentrations of PRCs: four

for dioxin/furan analysis and four for PCB analysis. The 5 cm fibers will be cut into approximately 1 cm long pieces and transferred into a 2 mL autosampling vial. The fibers will be spiked with the extraction standards from the analytical laboratory to verify extraction efficiency including the solvent transfer process. A volume of 1 mL of hexane will be added to the sampling vials to extract dioxin/furans and PCBs. The extract will be transferred to a new vial and further concentrated to 20 μ L before analysis.

In each bioaccumulation chamber, 11 cm of the spiked SPME fiber will be inserted horizontally into the sediment at a depth of approximately 1 cm below the sediment water interface. Decontaminated plastic twist ties will be attached to the center of the fiber and extended above the sediment–water interface to easily locate the fibers in the chamber. To reduce the detection limits, 2–3 m of the clean and unspiked fibers will be installed along with the spiked fiber. The un-spiked fibers will be cut into 30–40 cm long pieces to fit in the chamber. The length of the fiber will be adjusted depending on the volume of polydimethylsiloxane per length of the fiber used.

At the end of the 45-day bioaccumulation test, the fibers will be pulled out of the sediment with tweezers and wiped with damp tissue to remove the sediment particles. The middle 1 cm of the spiked fibers that was contacted by the twist tie will be removed. The remaining 10 cm fiber will be cut in half (5 cm each), one for PCBs and one for dioxin/furans. The unspiked fibers will be cut into 5 cm long pieces and transferred to a 60-mL glass vial along with one 5 cm spiked fiber. The vials will be placed in an ice-filled cooler and shipped to the analytical laboratory for analysis. The fibers will be spiked with a standard and then extracted with hexane. Analysis of dioxin/furans and PCBs will be performed in accordance with U.S. Environmental Protection Agency (EPA) Method 1613B and 1668B, respectively.

6 QUALITY ASSURANCE PROJECT PLAN

The purpose of the QAPP is to provide confidence in the project data results through a system of quality control performance checks of field data entry, laboratory analysis and laboratory data reporting, and appropriate corrective actions to achieve compliance with established performance and data quality criteria. This section presents the QA/QC procedures that will be implemented to ensure that the investigation data results are defensible and usable for their intended purpose.

6.1 MEASUREMENTS OF DATA QUALITY

Data quality objectives (DQOs) are qualitative or quantitative statements derived from the planning process. The DQOs are used to clarify the study objectives and define the appropriate type of data to collect to support project decisions. General acceptance or performance criteria for the collection, evaluation, or use of environmental data for this investigation are outlined in Sections 6 and 7 of Ecology (2008a).

Data quality indicators such as the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters (USEPA 2002) and analytical sensitivity will be used to assess conformance of data with quality control criteria. PARCC parameters are commonly used to assess the quality of environmental data. Definitions of the PARCC parameters can be found in Section 7.1 of Ecology (2008a).

6.2 QA/QC OF FIELD DATA

Information on sampling locations, dates, water depths, equipment, and other conditions, and sample identifiers will be entered into a project database. One hundred percent of hand-entered data will be verified based on hard copy records. Electronic quality assurance checks to identify anomalous values (approximately 10 percent of the data) will also be conducted following entry.

6.3 QA/QC SEDIMENT AND TISSUE SAMPLES FOR CHEMICAL ANALYSIS

Extensive and detailed requirements for laboratory quality control procedures are provided in the USEPA, American Society for Testing and Materials (ASTM), and Standard Method protocols that will be used for this study (Table 4-2). Every method protocol includes descriptions of quality control procedures, and many incorporate additional quality control requirements by reference to separate quality control chapters in the protocols. Quality control requirements include control limits and requirements for corrective action in many cases.

Quality control procedures will be completed by the laboratory, as required in each protocol and as indicated in this SAP.

For chemical analyses, the frequency of analysis of laboratory control samples, MS/MSDs or laboratory duplicates, and method blanks will be 1 for every 20 samples or 1 per extraction batch, whichever is more frequent. Internal standards will be added to every field sample and quality control sample, as required. Calibration procedures will be completed at the frequency specified in each method description. As required by EPA SW-846 methods, performance-based control limits are established by the laboratory. These and all other control limits specified in the method descriptions will be used by the laboratory to establish the acceptability of the data or the need for reanalysis of the samples. Laboratory control limits for recoveries of matrix spikes and laboratory control samples, and for relative percent difference of matrix spike duplicates and laboratory duplicates, are provided in Tables 6-1 and 6-2.

Quality control samples (i.e., laboratory method blanks, surrogate standards, laboratory control samples, matrix spike samples, matrix spike duplicate samples, and other laboratory quality control samples) as well as laboratory data reporting are more fully described in Section 7.2.1 of Ecology (2008a).

6.4 QA/QC FOR BIOASSAYS

This section summarizes the toxicity test QA/QC procedures to be implemented to ensure that the test results are valid. Negative and positive controls, reference sediment samples, water quality monitoring, and laboratory replication for the bioassays will be performed as stipulated in USEPA (1997e).

6.4.1 Negative and Positive Controls

The negative control is clean sediment or seawater tested in parallel with the test sediments under identical test conditions. For the amphipod and polychaete tests, negative control sediment will be run with each test batch. Negative control sediment is generally the sediment from which the test organisms were collected. For the larval test, a negative seawater control will be performed. The negative control provides an estimate of test organism general health during the test exposure period. The test acceptability criteria (i.e., performance standards) are partially based on the results of the negative controls:

- Amphipod bioassay—Mean mortality ≤ 10 percent and individual replicate mortality ≤ 20 percent
- Larval development bioassay—Mean normal survival > 70 percent

- Juvenile polychaete bioassay—10 percent mortality and performance guideline of a target growth rate of ≥ 0.72 mg/individual/day; control growth rates below 0.38 mg per individual per day will be considered a QA/QC failure.

The bioassays will also be conducted using a positive control (reference toxicant in clean, filtered seawater without sediment). Positive controls will provide information on the sensitivity of the test organism. NewFields will provide both negative and positive controls for the amphipod, larval development, and juvenile polychaete bioassays.

6.4.2 Reference Sediment

Reference sediments, which will closely match the grain size characteristics of the test sediments, will be tested with each batch of bioassay samples. The reference sediment will be used for test comparisons and interpretation. NewFields will collect the reference sediment from Carr Inlet. The test acceptability criteria (i.e., performance standards) are partially based on the results of the reference sediment:

- Amphipod bioassay—Performance standard of <25 percent mortality
- Larval development bioassay—Mean normal survival ≥ 65 percent of the mean normal survivorship measured in the seawater control
- Juvenile polychaete bioassay—Performance standard of ≥ 80 percent of the control growth.

6.4.3 Water Quality Monitoring

Water quality monitoring will be conducted for the amphipod, larval development, and juvenile polychaete bioassays as stipulated in USEPA (1997e). Water quality monitoring will be conducted for all test sediments, reference sediment, and negative controls. The monitoring will consist of daily measurements of salinity, temperature, pH, and dissolved oxygen. Ammonia and sulfides will be measured at test initiation and termination for all of the bioassays and will also be measured midway through the amphipod and polychaete bioassays.

6.4.4 Laboratory Replication

Five replicates will be performed for the amphipod, larval development, and juvenile polychaete bioassays as stipulated in USEPA (1997e).

6.5 QA/QC FOR BIOACCUMULATION TESTING

Water quality monitoring for the bioaccumulation tests will be performed as stipulated in regional Dredged Material Management Program guidelines (Corps 2013).

One exposure chamber will be tested per sample. Laboratory triplicates will be performed for two samples.

6.6 QA/QC FOR SPME TESTING

Fibers from two of the bioaccumulation/SPME test chambers will be analyzed in triplicate to assess inter-chamber variability of porewater concentrations, along with additional quality control samples including one fiber blank before spiking, one fiber blank during shipping, two method spiking blanks (one for initial measurement and one for termination), and four initial PRC concentration measurements.

6.7 DATA VALIDATION

All chemical laboratory data will be validated by EcoChem (Seattle, WA) according to protocols set forth in Section 7.4 of Ecology (2008a). All bioassay data will be validated by Integral by comparing methods, positive and negative control results, and water quality monitoring data to PSEP protocols (USEPA 1997e) and Ecology (2008b) method requirements. All bioaccumulation data will be validated by Integral by comparing methods and water quality monitoring data to Dredged Material Management Program guidelines (Corps 2013; Lee et al. 1989, with modifications as provided in Kendall and McMillan 2009).

In addition, laboratory data packages will be provided for chemistry data to allow independent data verification and validation. The chemistry data packages will consist of the sample results followed by a cover letter describing procedures used, analytical problems encountered, qualifiers used, reconstructed ion chromatogram (for gas chromatography/mass spectrometry [GC/MS]), mass spectra of detected target compounds (of GC/MS), chromatograms, quantification reports, and calibration data summaries. Dilution volumes, sample sizes, percent moisture, and surrogate recoveries will be presented on each summary sheet with the analytical results. A similar package will also be assembled for each laboratory quality control sample.

The following types of data will be reviewed:

- Analytical laboratory summary reports including QC summary data for surrogates, method blanks, laboratory control samples, and MS/MSD samples. Acceptance and performance criteria will be developed from the reported laboratory control limits.

- Calibration summary data will be checked to verify that all positive results for target compounds were generated under an acceptable calibration as defined by the analytical method.
- Laboratory reports will also be provided for the bioassays and the bioaccumulation exposures. Bioassay reports will include the QC summary data (i.e., negative and positive controls, reference sediment) and water quality monitoring data. Bioaccumulation reports will include water quality monitoring data. As noted above, Integral will validate the bioassay and bioaccumulation data.

7 DATA REPORTING

This section describes the data reporting requirements for the data collection activities described in this SAP.

7.1 SURFACE SEDIMENT CHEMISTRY DATA

Sediment chemistry data generated by this investigation will be compared with SMS numerical criteria. The concentration of dioxin/furan compounds and PCB congeners will be evaluated as a 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) toxic equivalent concentration (TEQ) using toxic equivalency factors (TEFs) provided by the World Health Organization for human, fish, and wildlife receptors (Van den Berg et al. 1998, 2006) and mandated for use by MTCA (173-340-708). The TEQ is the sum of the concentrations of individual congeners multiplied by their respective TEF values (potency relative to 2,3,7,8-TCDD). For congeners reported as nondetect in all samples in a given medium, the detection limit will be replaced with a value of zero. For congeners reported as nondetect that are detected in one or more samples within the data set, the detection limit will be replaced with a value equal to one-half of the method detection limit.

The sediment chemistry data will be presented in tables containing station locations, concentrations with qualifiers as appropriate, and exceedances of SQS and/or CSL numeric criteria. Porewater ammonia and sulfides, and TOC data will be included in the tables. Data for split samples will be averaged for each station.

7.2 BIOASSAY DATA

Bioassay data will be summarized by station and presented in tables. Replicate data from the bioassays will be averaged for each station. The tables will also contain the results of SMS narrative criteria evaluations.

7.3 TISSUE CHEMISTRY DATA

The tissue chemistry data will be presented in tables containing station locations, concentrations, and any data qualifiers assigned by the laboratory or during the data validation process.

7.4 SPME DATA

Dioxin/furan and PCB concentrations from the SPMEs will be tabulated. Dissolved porewater concentrations of dioxin/furans and PCBs will be calculated from the SPME data and also tabulated.

7.5 SEDIMENT PROFILE IMAGING DATA

SPI image review will include measurement of the following parameters: depth of the apparent redox potential discontinuity, infaunal successional stage, presence of benthic invertebrates, sediment grain size, boundary roughness, and presence and amount of wood debris. Plan view imagery will be used to record the presence of bryozoa, mega and epifaunal species, and evidence of Lebensspuren, as well as the presence and amount of bottom debris. These metrics will be tabulated along with sample location information. SPI and plan view images will be provided in an appendix.

7.6 DATA REPORT

A draft data report will be prepared with the following information:

1. Introduction
2. Deviations from this SAP
3. Maps showing proposed and actual sampling locations, data results, and spatial contours
4. Data tables (validated sediment chemistry, porewater ammonia and sulfides, tissue chemistry, bioassay results including comparisons with SMS narrative criteria, SPME chemistry, and porewater dioxin/furan and PCB concentrations as calculated from the SPME data)
5. SPI data tables and images
6. Data validation reports

Comments on the data report will be incorporated into the RI/FS report.

8 PROJECT MANAGEMENT

Implementation of this SAP will be conducted by Integral and subcontractors at the direction of the WPAH Group. The following sections describe the key roles and responsibilities of the project team.

8.1 PROJECT PLANNING AND COORDINATION

Betsy Day will serve as Integral's project manager and will have overall responsibility for executing the approved SAP, ensuring the proper collection and analysis of field samples, and reporting of analytical results.

Allison Geiselbrecht (Floyd | Snider) is the RI/FS project coordinator. She will prepare subcontracting agreements, provide review comments on the data report, and coordinate with Integral to perform SAP tasks. Dr. Geiselbrecht will be consulted if field activities require significant deviation from the agreed to Western Port Angeles Harbor RI/FS work plan.

8.2 SAMPLE COLLECTION

Jane Sexton will serve as Integral's field team lead and will be responsible for the collection and processing of sediment in accordance with this SAP. Tasks will include the visual description of sediment grab samples, sample processing, and delivery of the samples to the testing laboratories. Established protocols in this SAP for decontamination, sample preservation, holding times, and COC documentation will be observed.

8.3 QA/QC MANAGEMENT

Manon Tanner, Integral chemist, will serve as chemical laboratory coordinator and perform quality assurance oversight for the chemical testing programs. She will be responsible for preparing statements of work (SOWs) to subcontract state-certified laboratories and ensuring that laboratory procedures meet the required analytical quality control limits. She will oversee QA/QC data validation of the analytical chemistry results.

Jane Sexton, Integral biologist, will provide QA/QC data validation of the bioassay results. She will be responsible for preparing the SOW for the subcontract state-certified laboratory and ensuring that the quality control requirements specified in the respective toxicity and bioaccumulation testing methods are met.

Dr. Xiaoxia Lu, Anchor QEA chemist, will oversee SPME deployment, retrieval, and analysis, and will perform calculations of porewater concentrations using the SPME data.

Mark Johns (Exponent) is the project's QA/QC lead. He will ensure all data and reports have undergone thorough quality control checks before being released.

8.4 HEALTH AND SAFETY MANAGER

Eron Dodak will serve as the designated Integral health and safety manager. He will ensure that all Integral field personnel are properly trained. Jane Sexton will serve as the site health and safety manager. She will ensure that all Integral and subcontractor field personnel are fully aware of potential site hazards, conduct all work in a safe manner, wear appropriate PPE, and abide by the conditions set forth in the site-specific health and safety plan (Appendix A).

8.5 CULTURAL RESOURCES MONITORING

Derek Beery, City of Port Angeles archaeologist, prepared archaeological inadvertent discovery protocols for the sampling event in consultation with Ecology and the Lower Elwha Klallam Tribe (Appendix E). Based on previously reported results of sediment collection in the harbor, it was agreed upon that there is little likelihood that the penetration depth for the grab samples will adversely affect submerged archaeological sites in Western Port Angeles Harbor. For this reason, an archaeological monitor is not required to be present onboard the boat during collection operations. However, the City of Port Angeles archaeologist may alter this decision and request that an archaeological monitor observe the sediment collection activities onboard the sampling vessel.

The City of Port Angeles archaeologist will provide a brief training on archaeological issues to the field collection team at a pre-work meeting to ensure that they understand and comply with the archaeological protocols for inadvertent discoveries as provided in Appendix E. Personnel involved in sample collection who have not received this training will not be allowed to perform sample collection.

The primary goal of the inadvertent discovery protocols (Appendix E) will be documentation and proper handling of previously unknown items of archaeological interest collected inadvertently during the sampling process. The following steps will be carried out during the sampling event:

- The field team lead onboard the sampling vessel will review the sediment and any other materials present in the grab sample. If any items of archaeological interest are noted (non-human remains), then the field team lead will immediately protect the sample and notify the City of Port Angeles archaeologist. The City of Port Angeles archaeologist will inquire about the nature of the find and direct the sampling team on what to do next so that he may review the find and make determinations for proper contacts and

protocols. At this point all work at that station will halt until the City of Port Angeles archaeologist has made a determination regarding the find.

- The City of Port Angeles archaeologist will observe any items of archaeological interest within 24 hours of collection and will keep detailed notes on inadvertent discoveries including personnel present, location, time, and nature of the find. Screening of sample sediments will be at the discretion of the City of Port Angeles archaeologist. No sediments accompanying a find of archaeological interest shall be disposed of until released by the City of Port Angeles archaeologist.
- If the City of Port Angeles archaeologist determines that the items are not archaeological in nature, then work at that station may resume. If the City of Port Angeles archaeologist determines the find is a part of an archaeological site, then he will make the proper contacts and determine a course of action for that station. In this case, work may resume only at other sampling stations.
- If the find includes human remains, then the City of Port Angeles archaeologist will also immediately notify the Clallam County Coroner and the Port Angeles Police as stipulated by state law.
- In the event of a confirmed inadvertent discovery, the City of Port Angeles archaeologist will notify Integral's Project Manager, the City of Port Angeles Project Manager, and Ecology of the discovery within 1 day. The City of Port Angeles archaeologist will assemble all documentation and compose a preliminary assessment. The City of Port Angeles archaeologist will also notify the Lower Elwha Klallam Tribe's archaeologist of any confirmed inadvertent discovery within 1 day. Ecology may notify other interested tribes and parties of archaeological efforts or discoveries as part of their cultural resources responsibilities.

8.6 SUBCONTRACTOR SUPPORT

The project team includes the following subcontractors to support the data collection activities and laboratory services:

Sediment Profile Imaging

Germano & Associates

Joe Germano
12100 SE 46th Place
Bellevue, WA 98006
Phone: (425) 865-0199
joe@remots.com

Sampling Vessel

Bio-Marine Enterprises

Charles M. Eaton
2717 Third Ave. North
Seattle, WA 98109
Phone: (206) 282-4945
cmeaton@msn.com

Chemistry Analytical Laboratories

Alpha Analytical

Elizabeth Porta
320 Forbes Blvd.
Mansfield, MA 02048
Phone (508) 844-4124
eporta@alphalab.com

ALS Environmental

Greg Salata
1317 S. 13th Ave
Kelso, WA 98626
Phone: (360) 501-3376
gregory.salata@alsglobal.com

AXYS Analytical Services Ltd.

Georgina Brooks
2045 Mills Road W.
Sidney BC Canada
Phone (250) 655-5801
gbrooks@axys.com

SGS Analytical Perspectives

Trent Temperly
2714 Exchange Drive
Wilmington, NC 28405
Phone: (317) 370-9644
trent.temperly@sgs.com

Bioassay and Bioaccumulation Exposure Laboratory

NewFields

Bill Gardiner
4729 NE View Drive
Port Gamble, WA 98382
Phone: (360) 297-6080
bgardiner@newfields.com

Chemistry Data Validation

EcoChem, Inc.

Melissa Swanson
1011 Western Avenue, Suite 1011
Seattle, WA 98104
Phone: (206) 233-9332
mswanson@ecochem.net

8.7 SCHEDULE

The tentative schedule for the proposed field activities and deliverables is as follows:

Task	Proposed Date
Field planning	May 1, 2013
Field mobilization and sampling	
Sediment collection	June 25 – July 10, 2013
SPI	July 15 – 18, 2013
Field demobilization	
Sediment collection	July 11, 2013
SPI	July 19, 2013
Sample analysis	
Chemical	July 1 – September 30, 2013
Bioassays	July 1 – 31, 2013
Bioaccumulation/SPME	July 1 – August 31, 2013
Data validation	October 31, 2013
Data report to Ecology	75 days after receipt of final data validation package

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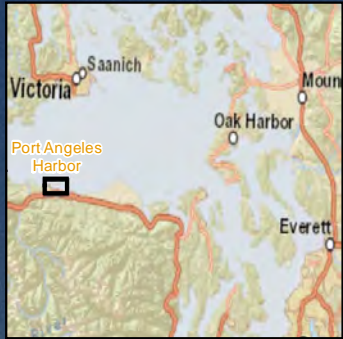
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FIGURES

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 Western Port Angeles Harbor Site

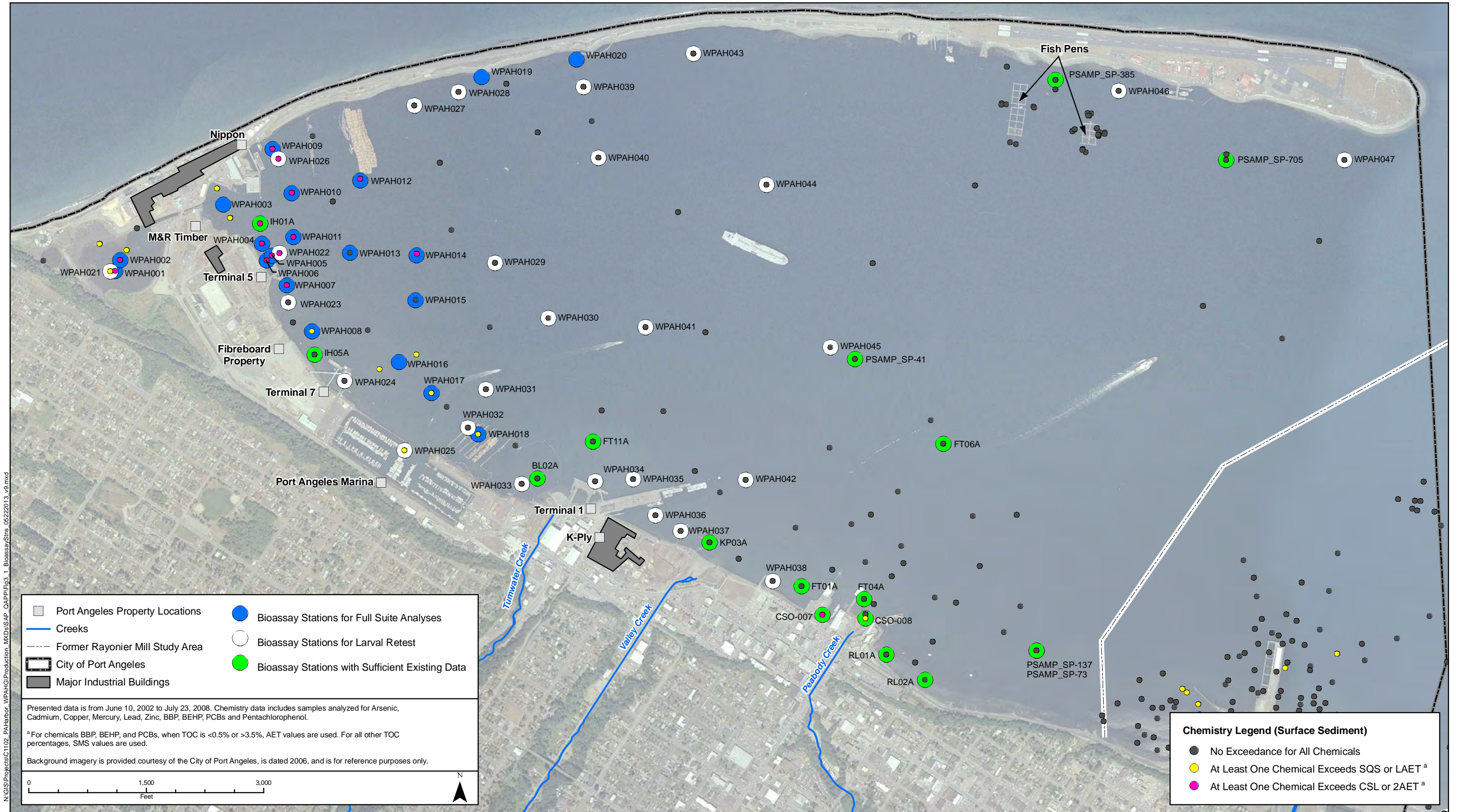
Background imagery is provided courtesy of the City of Port Angeles, is dated 2006, and is for reference purposes only.

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Figure 1-1.
General Location of Western Port Angeles Harbor Site
Western Port Angeles Harbor SAP



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Figure 3-1.
 Bioassay Sampling Locations
 Western Port Angeles Harbor RI/FS Work Plan



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Figure 3-2.
 Proposed SPI and Bioassay Sampling Locations
 Western Port Angeles Harbor SAP

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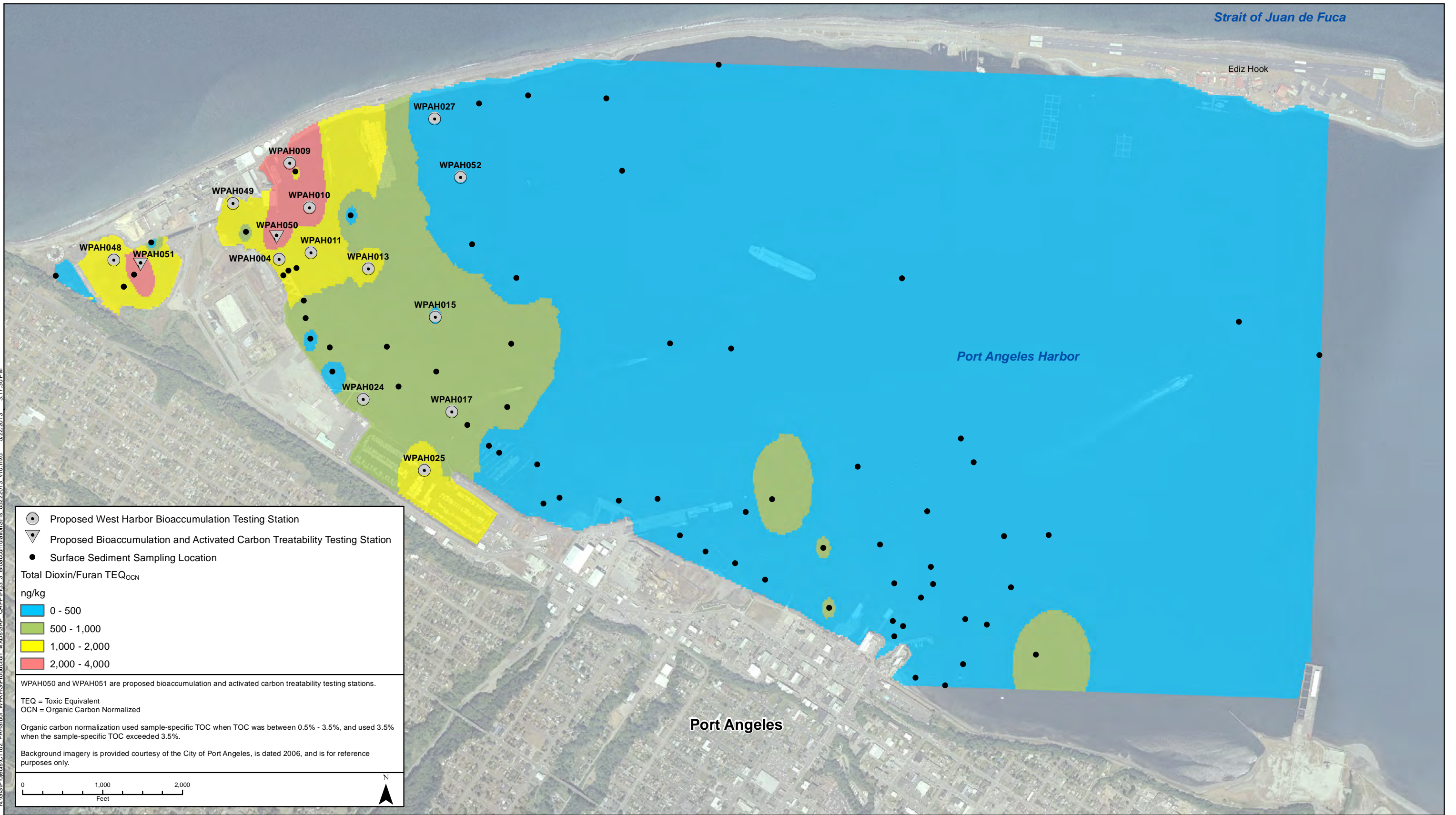


Figure 3-3.
Proposed Bioaccumulation Sampling Locations with Dioxin/Furan TEQ_{OCN} Western Port Angeles Harbor SAP

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Figure 3-4.
Proposed Bioaccumulation Sampling Locations
with Dioxin/Furan TEQ_{DW}
Western Port Angeles Harbor SAP

TABLES

Table 2-1. Historical Surveys of Environmental Conditions in Port Angeles Harbor, 2002–Present

Study Name ^a	Ecology EIM Study ID	Year Sampled	Sample Type	Collection Depths Described	Sample Number ^b	Analyte Groups					
						Metals	PCBs	Pesticides ^c	SVOCs	Dioxins/ Furans	Bioassay
American Gold Seafoods 2007 NPDES Sampling at Puget Sound Salmon Net Pens	AGS_NPDES_2007	2007	Sediment	0–2 cm	9 (5 reps each)	X					
NPDES Sampling during 2010: American Gold Seafoods Net-Pen Sites in Puget Sound	AGS_NPDES_2010	2010	Sediment	0–2 cm	8 (2 to 5 reps each)	X					
Cypress Ediz Hook Smolt 2003 NPDES Monitoring	CIPA2003	2003	Sediment	0–2 cm	18	X					
NOAA Mussel Watch Program	NOAA-Mussel-1986-08	2006	Sediment	0–30 cm	1	X	X	X	X		
Former Rayonier Mill Phase 2 Addendum Remedial Investigation	PAMILLRI	2006	Sediment	0–10 cm	72		X			X	
Port Angeles Harbor Sediment Investigation	PASED08	2008	Sediment	0–302 cm (variable)	201	X	X	X	X	X	X
Port Angeles NPDES Sediment Analysis	PA_STP04	2003–2004	Sediment	0–2 cm	13	X	X		X		X
City of Port Angeles 2010 NPDES Permit WA-0023973 Sediment Characterization	PA_STP10	2010	Sediment	0–10 cm	3	X	X		X		X
Environmental Baseline Investigation DNR Lease 22-077766	PORT ANGELES DNR08	2008	Sediment	0–52 inches (variable)	43	X	X		X	X	
The Puget Sound Assessment and Monitoring Program	PSAMP_SP	2002–2003	Sediment	0–3 cm (chemistry and bioassay); 0–17 cm (macroinvertebrate taxonomy)	33	X	X	X	X		X
Former Rayonier Mill Site	RAYONR05	2002	Sediment	0–10 ft (variable)	104	X	X	X	X	X	X
Former Rayonier WWTP Outfall Sediment Baseline Monitoring	RAYSED09	2010	Sediment	0–10 cm	7	X	X		X	X	X

Notes:

DNR = Washington State Department of Natural Resources
Ecology = Washington State Department of Ecology
EIM = Environmental Information Management
NOAA = National Oceanic and Atmospheric Administration
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
WWTP = wastewater treatment plant

^a Source: Ecology EIM System database.

^b Sample number reflects the number of sample IDs, and includes reference samples as applicable; not all samples were analyzed for all analyte groups indicated.

^c Organochlorine pesticides.

Table 3-1. Analyses to be Conducted at Each Sediment Sampling Station

RI/FS Station Number	Historical Station Identifier	Sediment										Porewater		Bioassays			Tissue Chemistry			SPMEs		Treatability Testing				
		TOC	Black carbon	Grain size	Total solids	Total volatile solids	Metals	PAHs	SVOCs	PCB congeners	PCDD/F	Archive	Ammonia	Sulfides	Amphipod	Larval	Polychaete	PCB congeners	PCDD/F	Percent lipids	PCB congeners	PCDD/F	PCB congeners	PCDD/F	PCB congeners	PCDD/F
Site																										
WPAH001	LA02A-01	X	X	X	X	X								X	X	X										
WPAH002	NPI-L1	X	X	X	X	X								X	X	X										
WPAH003	N/A	X	X	X	X	X	X	X	X					X	X	X										
WPAH004	NPI-PA8	X	X	X	X	X								X	X	X										
WPAH005	NPI-PA9	X	X	X	X	X								X	X	X										
WPAH006	WP-11-SD	X	X	X	X	X	X	X	X					X	X	X										
WPAH007	NPI-PA10	X	X	X	X	X								X	X	X										
WPAH008	WP-06-SD	X	X	X	X	X	X	X	X					X	X	X										
WPAH009	NPI-PA3	X	X	X	X	X								X	X	X										
WPAH010	NPI-PA4	X	X	X	X	X								X	X	X										
WPAH011	NPI-PA6	X	X	X	X	X								X	X	X										
WPAH012	IE13A	X	X	X	X	X								X	X	X										
WPAH013	WP-07-SD	X	X	X	X	X	X	X	X					X	X	X										
WPAH014	IE16A	X	X	X	X	X								X	X	X										
WPAH015	WP-05-SD	X	X	X	X	X	X	X	X					X	X	X										
WPAH016	N/A	X	X	X	X	X	X	X	X					X	X	X										
WPAH017	MA03A	X	X	X	X	X								X	X	X										
WPAH018	MA04A	X	X	X	X	X								X	X	X										
WPAH019 ^a	N/A	X	X	X	X	X								X	X	X										
WPAH020 ^a	N/A	X	X	X	X	X								X	X	X										
WPAH021	LA02A	X	X	X	X	X								X	X	X										
WPAH022	IH02A	X	X	X	X	X								X	X	X										
WPAH023	IH03A	X	X	X	X	X								X	X	X										
WPAH024	IH06A	X	X	X	X	X								X	X	X										
WPAH025	MA01A	X	X	X	X	X								X	X	X										
WPAH026	IE09A	X	X	X	X	X								X	X	X										
WPAH027	IE07A	X	X	X	X	X								X	X	X										
WPAH028	IE06A	X	X	X	X	X								X	X	X										
WPAH029	IE15A	X	X	X	X	X								X	X	X										
WPAH030	MA06A	X	X	X	X	X								X	X	X										
WPAH031	MA05A	X	X	X	X	X								X	X	X										
WPAH032	MA02A	X	X	X	X	X								X	X	X										
WPAH033	BL01A	X	X	X	X	X								X	X	X										
WPAH034	BL03A	X	X	X	X	X								X	X	X										
WPAH035	BL04A	X	X	X	X	X								X	X	X										
WPAH036	KP01A	X	X	X	X	X								X	X	X										
WPAH037	KP02A	X	X	X	X	X								X	X	X										
WPAH038	CSO-006	X	X	X	X	X								X	X	X										
WPAH039	IE04A	X	X	X	X	X								X	X	X										
WPAH040	IE14A	X	X	X	X	X								X	X	X										
WPAH041	BL06A	X	X	X	X	X								X	X	X										
WPAH042	KP05A	X	X	X	X	X								X	X	X										
WPAH043	IE03A	X	X	X	X	X								X	X	X										
WPAH044	BA01A	X	X	X	X	X								X	X	X										
WPAH045	KP06A	X	X	X	X	X								X	X	X										
WPAH046	FP01A	X	X	X	X	X								X	X	X										
WPAH047	EH02A	X	X	X	X	X								X	X	X										
WPAH048	LA01A	X	X	X	X	X																				
WPAH049	NPI-PA1	X	X	X	X	X																				
WPAH050	IH01A	X	X	X	X	X																				
WPAH051	LA03A	X	X	X	X	X																				
WPAH052	IE12A	X	X	X	X	X																				
Reference Area																										
CR02	CR02	X		X	X									X	X	X										
CR-12	CR-12	X		X	X									X	X	X										
CR23W	CR23W	X		X	X									X	X	X										

Notes:

- PAH = polycyclic aromatic hydrocarbon
- PCB = polychlorinated biphenyl
- PCDD/F = polychlorinated dibenzo-p-dioxin and dibenzofuran
- RI/FS = remedial investigation and feasibility study
- SMS = sediment management standards
- SVOC = semivolatile organic compound
- TOC = total organic carbon

^a Analytes as stipulated in Lawson (2013a, pers. comm.).

Table 3-2. Proposed Locations and Rationale for Full Suite Bioassays and Associated Chemical Analyses

Region	RI/FS Station Number	Historical Station Identifier	Approximate Depth (ft below MLLW) ^a	Reference for Existing Data	Cadmium	Mercury	Zinc	Phenol	PCBs, Sum of Congeners	Butyl Benzyl Phthalate	Existing Chemistry				Analytes Needed for Complete SMS Chemical Data ^{b,c}	Rationale for Bioassay Analysis
					SQS = 5.1 CSL = 6.7	SQS = 0.41 CSL = 0.59	SQS = 410 CSL = 960	SQS = 420 CSL = 1,200	LAET = 130 2LAET = 1,000	LAET = 63 2LAET = 900	Metals	PCBs (Aroclors or congeners)	Other SMS Analytes	Dioxin/Furan		
Lagoon	WPAH001	LA02A-01	Shallow	Exponent (2008)	7.6	0.6	-	-	na	-	√	√	√	√	None	CSL exceedance.
	WPAH002	NPI-L1	Shallow	Exponent (2008)	6.0	0.61	411	-	-	-	√	√	√	√	None	CSL exceedance.
Inner Harbor	WPAH003	N/A	9	New Station	na	na	na	na	na	na	na	na	na	na	SMS Chemicals	Mercury SQS exceedances at adjacent Stations NPI-PA1 and NPI-PA2. Results will represent this area.
	WPAH004	NPI-PA8	23	Exponent (2008)	-	0.67	-	-	-	-	√	√	√	√	None ^d	CSL exceedance.
	WPAH005	NPI-PA9	31	Exponent (2008)	-	1.10	-	-	-	-	√	√	√	√	None	CSL exceedance.
	WPAH006	WP-11-SD	25	Malcolm Pirnie (2007)	na	na	na	na	2,930	na	na	√	na	√	SMS Chemicals Except PCBs	2LAET exceedance.
	WPAH007	NPI-PA10	25	Exponent (2008)	-	0.66	-	-	-	-	√	√	√	√	None	CSL exceedance.
	WPAH008	WP-06-SD	28	Malcolm Pirnie (2007)	na	na	na	na	240	na	na	√	na	√	SMS Chemicals Except PCBs	LAET exceedance.
	WPAH009	NPI-PA3	25	Exponent (2008)	8.1	1.49	1,660	-	-	-	√	√	√	√	None ^d	CSL exceedance.
	WPAH010	NPI-PA4	46	Exponent (2008)	6.9	2.65	1,330	-	-	-	√	√	√	√	None ^d	CSL exceedance.
	WPAH011	NPI-PA6	47	Exponent (2008)	-	1.26	-	-	-	-	√	√	√	√	None ^d	CSL exceedance.
	WPAH012	IE13A	80	Ecology (2012a)	-	1.90	610	-	-	-	√	√	√	na	None	CSL exceedance.
	WPAH013	WP-07-SD	53	Malcolm Pirnie (2007)	na	na	na	na	-	na	na	√	na	√	SMS Chemicals Except PCBs ^d	Spatial data gap.
	WPAH014	IE16A	63	Ecology (2012a)	-	1.30	-	-	-	-	√	√	√	na	None	CSL exceedance; buried wood pulp.
	WPAH015	WP-05-SD	59	Malcolm Pirnie (2007)	na	na	na	na	-	na	na	√	na	√	SMS Chemicals Except PCBs ^d	Buried wood pulp.
	WPAH016	N/A	47	New Station	na	na	na	na	na	na	na	na	na	na	SMS Chemicals	PCB SQS exceedances at adjacent Stations WP-01-SD and WP-03-SD. Results will represent this area.
	WPAH017	MA03A	44	Ecology (2012a)	-	-	-	610	-	-	√	√	√	√	None ^d	SQS exceedance.
	WPAH018	MA04A	36	Ecology (2012a)	-	-	-	740	-	670	√	√	√	√	None	SQS exceedance.
	WPAH019	N/A	~40 ^e	New Station	na	na	na	na	na	na	na	na	na	na	None	Area of wood debris accumulation offshore of Ediz Hook. ^f
	WPAH020	N/A	~40 ^e	New Station	na	na	na	na	na	na	na	na	na	na	None	Area of wood debris accumulation offshore of Ediz Hook. ^f

Notes:

Exceeds SQS criteria.
Exceeds CSL criteria.

- = concentration less than SMS criteria
√ = existing chemistry present (since 2002)
2LAET = second lowest apparent effects threshold
CSL = cleanup screening level
LAET = lowest apparent effects threshold
MLLW = mean lower low water
na = not analyzed
N/A = not applicable
OC = organic carbon
PCB = polychlorinated biphenyl
SMS = sediment management standards
SQS = sediment quality standards

^a Depths are based on visual review of digital bathymetric contours, which were derived from NOAA (1990).

^b An aliquot of sediment from each sampling location will be archived for possible future chemical analysis.

^c Sediment conventional parameters, grain size, black carbon and porewater ammonia and sulfides will be analyzed at all locations.

^d PCB congeners and dioxins/furans will also be analyzed at these stations to support bioaccumulation testing.

^e Due to slope in this area of the harbor, the final station location will be based on obtaining an approximate water depth of 40 ft MLLW.

^f Lawson (2013a, pers. comm.).

Table 3-3. Proposed SPI Stations

RI/FS Station Number	Historical Station Identifier	Reference for Existing Data	SPI or Sediment Grab Wood Debris Observations
SPI and Full Suite Bioassay			
WPAH003	N/A	--	--
WPAH004	NPI-PA8	Exponent (2008)	Wood fragments
WPAH005	NPI-PA9	Exponent (2008)	Large wood piece, pulp, some wood fragments, fibers
WPAH006	WP-11-SD	Malcolm Pirnie (2007)	Large wood chunks
WPAH007	NPI-PA10	Exponent (2008)	Bark chips, wood
WPAH008	WP-06-SD	Malcolm Pirnie (2007)	Wood bark
WPAH009	NPI-PA3	Exponent (2008)	Approximately 1–2 mm wood mat, substantial wood fiber
WPAH010	NPI-PA4	Exponent (2008)	Few wood fragments
WPAH011	NPI-PA6	Exponent (2008)	Wood chips
WPAH012	IE13A	Ecology (2012a)	Red rock and sawdust; approximately 75% wood debris
WPAH013	WP-07-SD	Malcolm Pirnie (2007)	None
WPAH014	IE16A	Ecology (2012a)	70% sawdust present
WPAH015	WP-05-SD	Malcolm Pirnie (2007)	None
WPAH016	N/A	--	--
WPAH017	MA03A	Ecology (2012a)	None
WPAH018	MA04A	Ecology (2012a)	Significant wood debris (approximately 90%)
WPAH019	N/A ^a	--	--
WPAH020	N/A ^a	--	--
SPI and Larval Bioassay Re-test			
WPAH022	IH02A	Ecology (2012a)	10% wood debris
WPAH023	IH03A	Ecology (2012a)	Wood chips and wood debris up to 90%
WPAH024	IH06A	Ecology (2012a)	None
WPAH025	MA01A	Ecology (2012a)	None
WPAH026	IE09A	Ecology (2012a)	Trace wood debris
WPAH027	IE07A	Ecology (2012a)	95% wood debris
WPAH028	IE06A	Ecology (2012a)	Approximately 75% wood
WPAH029	IE15A	Ecology (2012a)	Approximately 5% wood debris
WPAH030	MA06A	Ecology (2012a)	Approximately 5% wood
WPAH031	MA05A	Ecology (2012a)	None
WPAH032	MA02A	Ecology (2012a)	Approximately 80% wood debris
WPAH033	BL01A	Ecology (2012a)	Approximately 30% wood debris
WPAH034	BL03A	Ecology (2012a)	Trace amount of wood debris
WPAH035	BL04A	Ecology (2012a)	None
WPAH036	KP01A	Ecology (2012a)	None
WPAH037	KP02A	Ecology (2012a)	20% wood debris
WPAH038	CSO-006	--	--
WPAH039	IE04A	Ecology (2012a)	Significant (up to 50%) wood
WPAH040	IE14A	Ecology (2012a)	None
WPAH041	BL06A	Ecology (2012a)	None
WPAH042	KP05A	Ecology (2012a)	Trace wood debris
WPAH043	IE03A	Ecology (2012a)	Wood debris (bark) on sediment surface
WPAH044	BA01A	Ecology (2012a)	None
WPAH045	KP06A	Ecology (2012a)	None
WPAH046	FP01A	Ecology (2012a)	Approximately 1% wood debris
WPAH047	EH02A	Ecology (2012a)	None

Table 3-3. Proposed SPI Stations

RI/FS Station Number	Historical Station Identifier	Reference for Existing Data	SPI or Sediment Grab Wood Debris Observations
SPI Re-occupation			
WPAH053	13	SAIC (1999)	Wood chips mixed in wood pulp
WPAH054	92	SAIC (1999)	Trace pulp mixed in > 20 cm
WPAH055	43	SAIC (1999)	Trace pulp mixed in > 8.6 cm
WPAH056	63	SAIC (1999)	Sparse pulp mixed in > 16.8 cm
WPAH057	91	SAIC (1999)	Pulp
WPAH058	38	SAIC (1999)	Pulp/bacterial mat
WPAH059	14	SAIC (1999)	Trace pulp mixed in top 5 cm
WPAH060	15	SAIC (1999)	Moderate pulp mixed with sediment
WPAH061	12	SAIC (1999)	Pulp/bacterial mat
WPAH062	39	SAIC (1999)	Pulp/bacterial mat
WPAH063	11	SAIC (1999)	Moderate pulp mixed with sediment
WPAH064	44	SAIC (1999)	Sparse pulp mixed in top 4.8 cm
WPAH065	51	SAIC (1999)	Buried pulp layer
WPAH066	95	SAIC (1999)	Trace pulp mixed in top 7 cm
WPAH067	16	SAIC (1999)	Trace pulp mixed in top 3 cm
WPAH068	67	SAIC (1999)	Trace pulp mixed in 0.5 cm
WPAH069	17	SAIC (1999)	None
WPAH070	72	SAIC (1999)	None
WPAH071	82	SAIC (1999)	None
WPAH072	84	SAIC (1999)	None
WPAH073	18	SAIC (1999)	None
WPAH074	41	SAIC (1999)	Sparse wood chips mixed in trace pulp > 6.5 cm
WPAH075	45	SAIC (1999)	Buried pulp layer
WPAH076	30	SAIC (1999)	Buried pulp layer
WPAH077	57	SAIC (1999)	Buried pulp layer
WPAH078	40	SAIC (1999)	Trace pulp mixed in top 5 cm
WPAH079	10	SAIC (1999)	None
WPAH080	46	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH081	52	SAIC (1999)	Buried pulp layer
WPAH082	58	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH083	42	SAIC (1999)	Trace pulp/bacterial mat
WPAH084	47	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH085	9	SAIC (1999)	Pulp/bacterial mat
WPAH086	59	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH087	8	SAIC (1999)	Large wood piece on surface
WPAH088	48	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH089	7	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH090	61	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH091	6	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH092	50	SAIC (1999)	Sparse pulp and wood pieces in top 3 cm
WPAH093	5	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH094	3	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH095	2	SAIC (1999)	Sparse, scattered wood pieces on surface
WPAH096	77	SAIC (1999)	Sparse, scattered wood pieces on surface

Table 3-3. Proposed SPI Stations

RI/FS Station Number	Historical Station Identifier	Reference for Existing Data	SPI or Sediment Grab Wood Debris Observations
New SPI Stations Near Ediz Hook			
WPAH097	N/A ^a	--	--
WPAH098	N/A ^a	--	--
WPAH099	N/A ^a	--	--
WPAH100	N/A ^a	--	--

Notes:

-- = not available

N/A = not applicable

RI/FS = remedial investigation and feasibility study

SPI = sediment profile imaging

^a Stations WPAH019, WPAH020, WPAH097, WPAH098, WPAH099, and WPAH100 are previously unsampled SPI stations located in nearshore water south of Ediz Hook.

Table 3-4. Proposed Bioaccumulation Stations

Region	RI/FS Station Number	Historical Station Identifier	Reference for Existing Data	Existing Chemistry			Bioaccumulation and SPME Analyses ^b	Activated Carbon Treatability Testing ^c
				PCBs (Aroclors or congeners)	Dioxins and Furans (congeners)	Sediment Chemical Analyses ^a		
Lagoon	WPAH048	LA01A	Exponent (2008)	√	√	X	X	
	WPAH051	LA03A	Exponent (2008)	√	√	X	X	X
Inner Harbor	WPAH004	NPI-PA8	Exponent (2008)	√	√	X	X	
	WPAH009	NPI-PA3	Exponent (2008)	√	√	X	X	
	WPAH010	NPI-PA4	Exponent (2008)	√	√	X	X	
	WPAH011	NPI-PA6	Exponent (2008)	√	√	X	X	
	WPAH013	WP-07-SD	Malcolm Pirnie (2007)	√	√	X	X	
	WPAH015	WP-05-SD	Malcolm Pirnie (2007)	√	√	X	X	
	WPAH017	MA03A	Ecology (2012a)	√	√	X	X	
	WPAH024	IH06A	Ecology (2012a)	√	√	X	X	
	WPAH025	MA01A	Ecology (2012a)	√	√	X	X	
	WPAH027	IE07A	Ecology (2012a)	√	√	X	X	
	WPAH049	NPI-PA1	Exponent (2008)	√	√	X	X	
	WPAH050	IH01A	Ecology (2012a)	√	√	X	X	X
	WPAH052	IE12A	Ecology (2012a)	√	√	X	X	

Notes:

√ = existing chemistry available (since 2002)

X = proposed 2013 sample analyses

PCB = polychlorinated biphenyl

RI/FS = remedial investigation and feasibility study

SPME = solid-phase microextraction

^a Black carbon, other conventionals, PCB congeners, and dioxin/furan congeners will be analyzed, and an aliquot will be archived for possible future analyses.

^b PCB congeners and dioxin/furan congeners will be measured in tissue through laboratory bioaccumulation testing and in porewater via SPME devices.

^c Concurrent with the bioaccumulation and SPME testing, activated carbon treatability testing will also be performed.

Table 4-1. Geographic Coordinates of Proposed Sampling Locations for the Field Investigation^a

Station Type	RI/FS Station Number	Historical Station Number	Coordinates	
			Latitude ^b	Longitude ^b
Full-Suite Bioassay Stations				
	WPAH001	LA02A-01	48.132939	-123.468263
	WPAH002	NPI-L1	48.132592	-123.468590
	WPAH003	N/A	48.134658	-123.463310
	WPAH004	NPI-PA8	48.133334	-123.461202
	WPAH005	NPI-PA9	48.132918	-123.460678
	WPAH006	WP-11-SD	48.132750	-123.460939
	WPAH007	NPI-PA10	48.131906	-123.459843
	WPAH008	WP-06-SD	48.130328	-123.458439
	WPAH009	NPI-PA3	48.136649	-123.460825
	WPAH010	NPI-PA4	48.135141	-123.459738
	WPAH011	NPI-PA6	48.133603	-123.459584
	WPAH012	IE13A	48.135709	-123.456178
	WPAH013	WP-07-SD	48.133114	-123.456600
	WPAH014	IE16A	48.133152	-123.453096
	WPAH015	WP-05-SD	48.131539	-123.453075
	WPAH016	N/A	48.129352	-123.453833
	WPAH017	MA03A	48.128303	-123.452084
	WPAH018	MA04A	48.126915	-123.449558
	WPAH019	N/A	48.139422	-123.450024
	WPAH020	N/A	48.140149	-123.445087
Larval Bioassay Re-Test Stations				
	WPAH021	LA02A	48.132173	-123.469094
	WPAH022	IH02A	48.133014	-123.460281
	WPAH023	IH03A	48.131300	-123.459723
	WPAH024	IH06A	48.128623	-123.456647
	WPAH025	MA01A	48.126259	-123.453399
	WPAH026	IE09A	48.136321	-123.460497
	WPAH027	IE07A	48.138345	-123.453492
	WPAH028	IE06A	48.138876	-123.451200
	WPAH029	IE15A	48.132936	-123.448991
	WPAH030	MA06A	48.131062	-123.446108
	WPAH031	MA05A	48.128494	-123.449240
	WPAH032	MA02A	48.127136	-123.450105
	WPAH033	BL01A	48.125220	-123.447204
	WPAH034	BL03A	48.125406	-123.443360
	WPAH035	BL04A	48.125521	-123.441378
	WPAH036	KP01A	48.124282	-123.440155
	WPAH037	KP02A	48.123768	-123.438817
	WPAH038	CSO-006	48.122125	-123.433917

Table 4-1. Geographic Coordinates of Proposed Sampling Locations for the Field Investigation^a

Station Type	RI/FS Station Number	Historical Station Number	Coordinates	
			Latitude ^b	Longitude ^b
	WPAH039	IE04A	48.139202	-123.444684
	WPAH040	IE14A	48.136733	-123.443761
	WPAH041	BL06A	48.130859	-123.440998
	WPAH042	KP05A	48.125634	-123.435501
	WPAH043	IE03A	48.140490	-123.438992
	WPAH044	BA01A	48.135992	-123.434942
	WPAH045	KP06A	48.130375	-123.431300
	WPAH046	FP01A	48.139691	-123.416683
	WPAH047	EH02A	48.137533	-123.404756
Bioaccumulation Stations				
	WPAH027	IE07A	48.138345	-123.453492
	WPAH048	LA01A	48.133122	-123.469693
	WPAH049	NPI-PA1	48.135206	-123.463663
	WPAH004	NPI-PA8	48.133334	-123.461202
	WPAH024	IH06A	48.128623	-123.456647
	WPAH025	MA01A	48.126259	-123.453399
	WPAH009	NPI-PA3	48.136649	-123.460825
	WPAH010	NPI-PA4	48.135141	-123.459738
	WPAH011	NPI-PA6	48.133603	-123.459584
	WPAH013	WP-07-SD	48.133114	-123.456600
	WPAH015	WP-05-SD	48.131539	-123.453075
	WPAH017	MA03A	48.128303	-123.452084
	WPAH052	IE12A	48.136368	-123.452047
Bioaccumulation and Treatability Testing Stations				
	WPAH051	LA03A	48.132940	-123.468262
	WPAH050	IH01A	48.134032	-123.461338
Sediment Profile Imaging (SPI)				
<i>SPI at Full Suite Bioassay Stations</i>				
	WPAH003	N/A	48.134658	-123.463310
	WPAH004	NPI-PA8	48.133334	-123.461202
	WPAH005	NPI-PA9	48.132918	-123.460678
	WPAH006	WP-11-SD	48.132750	-123.460939
	WPAH007	NPI-PA10	48.131906	-123.459843
	WPAH008	WP-06-SD	48.130328	-123.458439
	WPAH009	NPI-PA3	48.136649	-123.460825
	WPAH010	NPI-PA4	48.135141	-123.459738
	WPAH011	NPI-PA6	48.133603	-123.459584
	WPAH012	IE13A	48.135709	-123.456178
	WPAH013	WP-07-SD	48.133114	-123.456600

Table 4-1. Geographic Coordinates of Proposed Sampling Locations for the Field Investigation^a

Station Type	RI/FS Station Number	Historical Station Number	Coordinates	
			Latitude ^b	Longitude ^b
	WPAH014	IE16A	48.133152	-123.453096
	WPAH015	WP-05-SD	48.131539	-123.453075
	WPAH016	N/A	48.129352	-123.453833
	WPAH017	MA03A	48.128303	-123.452084
	WPAH018	MA04A	48.126915	-123.449558
<i>SPI at Larval Bioassay Re-test Stations</i>				
	WPAH022	IH02A	48.133014	-123.460281
	WPAH023	IH03A	48.131300	-123.459723
	WPAH024	IH06A	48.128623	-123.456647
	WPAH025	MA01A	48.126259	-123.453399
	WPAH026	IE09A	48.136321	-123.460497
	WPAH027	IE07A	48.138345	-123.453492
	WPAH028	IE06A	48.138876	-123.451200
	WPAH029	IE15A	48.132936	-123.448991
	WPAH030	MA06A	48.131062	-123.446108
	WPAH031	MA05A	48.128494	-123.449240
	WPAH032	MA02A	48.127136	-123.450105
	WPAH033	BL01A	48.125220	-123.447204
	WPAH034	BL03A	48.125406	-123.443360
	WPAH035	BL04A	48.125521	-123.441378
	WPAH036	KP01A	48.124282	-123.440155
	WPAH037	KP02A	48.123768	-123.438817
	WPAH038	CSO-006	48.122125	-123.433917
	WPAH039	IE04A	48.139202	-123.444684
	WPAH040	IE14A	48.136733	-123.443761
	WPAH041	BL06A	48.130859	-123.440998
	WPAH042	KP05A	48.125634	-123.435501
	WPAH043	IE03A	48.140490	-123.438992
	WPAH044	BA01A	48.135992	-123.434942
	WPAH045	KP06A	48.130375	-123.431300
	WPAH046	FP01A	48.139691	-123.416683
	WPAH047	EH02A	48.137533	-123.404756
<i>Re-occupation SPI Stations</i>				
	WPAH053	13	48.134691	-123.461998
	WPAH054	92	48.133172	-123.460028
	WPAH055	43	48.130842	-123.457658
	WPAH056	63	48.129351	-123.456370
	WPAH057	91	48.135851	-123.460860
	WPAH058	38	48.134163	-123.459333
	WPAH059	14	48.132847	-123.458128

Table 4-1. Geographic Coordinates of Proposed Sampling Locations for the Field Investigation^a

Station Type	RI/FS Station Number	Historical Station Number	Coordinates	
			Latitude ^b	Longitude ^b
	WPAH060	15	48.129833	-123.455161
	WPAH061	12	48.136680	-123.459077
	WPAH062	39	48.135498	-123.459000
	WPAH063	11	48.134677	-123.455993
	WPAH064	44	48.131993	-123.455535
	WPAH065	51	48.130865	-123.453995
	WPAH066	95	48.127372	-123.450267
	WPAH067	16	48.127829	-123.449498
	WPAH068	67	48.126806	-123.446987
	WPAH069	17	48.126336	-123.444547
	WPAH070	72	48.128307	-123.440306
	WPAH071	82	48.126163	-123.439797
	WPAH072	84	48.124694	-123.439322
	WPAH073	18	48.125002	-123.437654
	WPAH074	41	48.135292	-123.454345
	WPAH075	45	48.133821	-123.453984
	WPAH076	30	48.132009	-123.452466
	WPAH077	57	48.130999	-123.450688
	WPAH078	40	48.137502	-123.454713
	WPAH079	10	48.136498	-123.452299
	WPAH080	46	48.134998	-123.451844
	WPAH081	52	48.133657	-123.450648
	WPAH082	58	48.132331	-123.449511
	WPAH083	42	48.137666	-123.452029
	WPAH084	47	48.136670	-123.449999
	WPAH085	9	48.135465	-123.448745
	WPAH086	59	48.133829	-123.447310
	WPAH087	8	48.138667	-123.449664
	WPAH088	48	48.137667	-123.447666
	WPAH089	7	48.137705	-123.445346
	WPAH090	61	48.136810	-123.443329
	WPAH091	6	48.135988	-123.440401
	WPAH092	50	48.139329	-123.444012
	WPAH093	5	48.139665	-123.440793
	WPAH094	3	48.138503	-123.433803
	WPAH095	2	48.137668	-123.431664
	WPAH096	77	48.138329	-123.425334

Table 4-1. Geographic Coordinates of Proposed Sampling Locations for the Field Investigation^a

Station Type	RI/FS Station Number	Historical Station Number	Coordinates	
			Latitude ^b	Longitude ^b
<i>New SPI Stations Near Ediz Hook</i>				
	WPAH097	N/A	48.137481	-123.459663
	WPAH098	N/A	48.138548	-123.454954
	WPAH019	N/A	48.139422	-123.450024
	WPAH020	N/A	48.140149	-123.445087
	WPAH099	N/A	48.141005	-123.440238
	WPAH0100	N/A	48.141033	-123.434688
Reference Stations^c				
	CR02	N/A	47.3347209	-122.6641694
	CR-12	N/A	47.30015703	-122.6825862
	CR23W	N/A	47.33321583	-122.6751122

Notes:

N/A = not applicable

RI/FS = remedial investigation and feasibility study

^a These proposed station coordinates are approximate and may be adjusted in the field based on field conditions at the time of sampling.

^b World Geodetic System 1984 (WGS 84).

^c Reference station locations may be changed in the field based on gross field grain size determination.

Table 4-2. Sample Analyses Summary

Analytical Parameters	Analytical Lab	Analytical Method	Sample Preservation	Technical Holding Time	Minimum Sample Size	Sample Container(s)
Sediment						
Total organic carbon Black carbon	Alpha	SW-846 9060 Gustafson et al. (1997)	Cool to 4°C ± 2°C	28 days	10 g	Two 4 oz. WMG jars w/ Teflon-lined lid
Total volatile solids	ALS-Kelso	EPA 160.4	Cool to 4°C ± 2°C (no headspace)	7 days	5 g	
Grain size Total solids	ALS-Kelso	PSEP EPA 160.3 Modified	Cool to 4°C ± 2°C	6 months 6 months	100 g 10 g	Three 8 oz. WMG jars w/ Teflon-lined lid
Metals	ALS-Kelso	SW-846 6020A/7471B	Cool to 4°C ± 2°C	6 months 28 days (Mercury only)	2.5 g	
PAHs SVOCs	ALS-Kelso	SW-846 8270D SIM SW-846 8270D	Cool to 4°C ± 2°C	Extract w/in 14 days of collection; analyze w/in 40 days of extraction	20 g dry wt.	
PCB congeners PCDD/Fs	AXYS AXYS	EPA 1668A EPA 1613B	Cool to 4°C ± 2°C Cool to 4°C ± 2°C	1 year 1 year	10 g	
Porewater						
Ammonia	ALS-Kelso	SM 4500 NH ₃ -E	Cool to 4°C ± 2°C; H ₂ SO ₄ to pH<2	28 days	50 mL	One 16 oz. WMG jar w/ Teflon-lined lid (field); two 250 mL HDPE bottle (lab generated porewater)
Sulfides	ALS-Kelso	EPA 9030 Modified	Cool to 4°C ± 2°C; Zn(OAc) ₂ /NaOH to pH>9	7 days	50 mL	
Bioassays						
10-Day amphipod	NewFields	PSEP	Cool to 4°C ± 2°C	56 days	4 L	One 1-gallon bucket with Teflon bag
Larval development with resuspension	NewFields	PSEP	Cool to 4°C ± 2°C	56 days	1 L	One 1-L WMG
20-Day juvenile polychaete	NewFields	PSEP	Cool to 4°C ± 2°C	56 days	4 L	One 1-gallon bucket with Teflon bag
Bioaccumulation/SPME Test						
45-Day adult bivalve and adult polychaete	NewFields	Corps (2013), Lee et al. (1989)	Cool to 4°C ± 2°C	56 days	35 L	Two 1-gallon buckets with Teflon bags
Treatability Test						
45-Day adult bivalve and adult polychaete	NewFields	Corps (2013), Lee et al. (1989)	Cool to 4°C ± 2°C	56 days	35 L	Two 1-gallon buckets with Teflon bags
Tissue						
PCB congeners	SGS	EPA 1668A	Frozen	1 year	10 g	Foil wrapped in Ziploc bag
PCDD/Fs	SGS	EPA 1613B	Frozen	1 year	10 g	Foil wrapped in Ziploc bag
SPMEs						
PCB congeners	SGS	EPA 1668A	Cool to 4°C ± 2°C	1 year	10 g	N/A
PCDD/Fs	SGS	EPA 1613B	Cool to 4°C ± 2°C	1 year	10 g	N/A

Notes:

Alpha = Alpha Analytical
ALS-Kelso = ALS Environmental (Kelso, WA)
AXYS = Axy's Analytical Services Ltd.
EPA = U.S. Environmental Protection Agency
HDPE = high density polyethylene
N/A = not applicable
NaOH = sodium hydroxide
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl

PCDD/F = polychlorinated dibenzo-*p*-dioxin and dibenzofuran
PSEP = Puget Sound Estuary Program
SGS = SGS Analytical Perspectives
SIM = selective ion monitoring
SM = Standard Methods for the Examination of Water and Wastewater
SPME = solid-phase microextraction
SVOC = semivolatile organic compound
SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
WMG = wide mouth glass
Zn(OAc)₂ = zinc acetate

Table 4-3. Field Sample Collection Matrix

Station Number	Sample Number	Sample Type	Sediment Chemistry Samples							Bioassay Samples			Bioaccumulation Samples	Treatability Test Samples	Filter Wipe Blanks and Filter Paper Blanks				
									Archive	Sediment					Ghost Wipes	Whatman Filter Papers			
			TOC, Black Carbon	TS, Grain size	TVS (No headspace)	Metals, SVOCs, PAHs	PCB congeners, Dioxin and Furans	Ammonia and Sulfides (Porewater to be analyzed at lab)	TBD	10-day amphipod (<i>Eohaustorius estuarius</i>)	Larval development (<i>Mytilus galloprovincialis</i>) with resuspension	20-day <i>Neanthes</i> sp.	Bioaccumulation Test -- 45-day adult bivalve [<i>Macoma nasuta</i>] and adult polychaete [<i>Nephtys caecoides</i>]	Treatability Study -- 45-day adult bivalve [<i>Macoma nasuta</i>] and adult polychaete [<i>Nephtys caecoides</i>]	Metals	Mercury	SVOCs	PCB Congeners	Dioxins and Furans
			4 oz WMG ^a	8 oz WMG ^a	4 oz WMG ^a	8 oz WMG ^a	8 oz WMG ^a	16 oz WMG ^a	8 oz WMG ^a	1-gallon bucket with Teflon bag ^a	1, 1-L WMG ^a	1-gallon bucket with Teflon bag ^a	2, 1-gallon buckets with Teflon bags ^{a,e}	2, 1-gallon buckets with Teflon bags ^{a,e}	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a
			10 g Refrigerated	110 g Refrigerated	5 g Refrigerated	22.5 g Refrigerated	10 g Refrigerated	100 mL (porewater) Refrigerated	NA Frozen	4 L Refrigerated	1 L Refrigerated	4 L Refrigerated	6 L Refrigerated	6 L Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated
Site																			
WPAH001	SD0001	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH002	SD0002	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH003	SD0003	Normal	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH004	SD0004	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
		Laboratory Triplicate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4 additional gallons of sediment for laboratory triplicate analysis at WPAH004	NA	NA	NA	NA	NA	NA
WPAH005	SD0005	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH006	SD0006	Normal	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH007	SD0007	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH008	SD0008	Normal	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH009	SD0009	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH010	SD0010	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH011	SD0011	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH012	SD0012	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH013	SD0013	Normal	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH014	SD0014	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH015	SD0015	Normal	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH015	SD0016	Field Split ^b	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FW Blank	FW0001	Equipment filter wipe blank ^c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____
WPAH016	SD0017	Normal	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH017	SD0018	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH018	SD0019	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH019	SD0020	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH020	SD0021	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
WPAH021	SD0022	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA

Table 4-3. Field Sample Collection Matrix

Station Number	Sample Number	Sample Type	Sediment Chemistry Samples							Bioassay Samples			Bioaccumulation Samples	Treatability Test Samples	Filter Wipe Blanks and Filter Paper Blanks				
									Archive	Sediment					Ghost Wipes	Whatman Filter Papers			
			TOC, Black Carbon	TS, Grain size	TVS (No headspace)	Metals, SVOCs, PAHs	PCB congeners, Dioxin and Furans	Ammonia and Sulfides (Porewater to be analyzed at lab)	TBD	10-day amphipod (<i>Eohaustorius estuarius</i>)	Larval development (<i>Mytilus galloprovincialis</i>) with resuspension	20-day <i>Neanthes</i> sp.	Bioaccumulation Test -- 45-day adult bivalve [<i>Macoma nasuta</i>] and adult polychaete [<i>Nephtys caecoides</i>]	Treatability Study -- 45-day adult bivalve [<i>Macoma nasuta</i>] and adult polychaete [<i>Nephtys caecoides</i>]	Metals	Mercury	SVOCs	PCB Congeners	Dioxins and Furans
			4 oz WMG ^a	8 oz WMG ^a	4 oz WMG ^a	8 oz WMG ^a	8 oz WMG ^a	16 oz WMG ^a	8 oz WMG ^a	1-gallon bucket with Teflon bag ^a	1, 1-L WMG ^a	1-gallon bucket with Teflon bag ^a	2, 1-gallon buckets with Teflon bags ^{a,e}	2, 1-gallon buckets with Teflon bags ^{a,e}	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a
			10 g Refrigerated	110 g Refrigerated	5 g Refrigerated	22.5 g Refrigerated	10 g Refrigerated	100 mL (porewater) Refrigerated	NA Frozen	4 L Refrigerated	1 L Refrigerated	4 L Refrigerated	6 L Refrigerated	6 L Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated
WPAH022	SD0023	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH023	SD0024	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH024	SD0025	Normal	Tag #_____	Tag #_____	Tag #_____	NA	Tag #_____	Tag #_____	Tag #_____	NA	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA
WPAH025	SD0026	Normal	Tag #_____	Tag #_____	Tag #_____	NA	Tag #_____	Tag #_____	Tag #_____	NA	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA
WPAH026	SD0027	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH027	SD0028	Normal	Tag #_____	Tag #_____	Tag #_____	NA	Tag #_____	Tag #_____	Tag #_____	NA	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA
WPAH028	SD0029	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH029	SD0030	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH030	SD0031	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH031	SD0032	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH032	SD0033	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH033	SD0034	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH034	SD0035	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH035	SD0036	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH036	SD0037	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH037	SD0038	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH038	SD0039	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH039	SD0040	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH039	SD0041	Field Split ^b	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FW Blank	FW0002	Equipment filter wipe blank ^c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Tag #_____	Tag #_____	Tag #_____	Tag #_____	Tag #_____
WPAH040	SD0042	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH041	SD0043	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH042	SD0044	Normal	Tag #_____	Tag #_____	Tag #_____	NA	NA	Tag #_____	Tag #_____	NA	Tag #_____	NA	NA	NA	NA	NA	NA	NA	NA

Table 4-3. Field Sample Collection Matrix

Station Number	Sample Number	Sample Type	Sediment Chemistry Samples							Bioassay Samples			Bioaccumulation Samples	Treatability Test Samples	Filter Wipe Blanks and Filter Paper Blanks				
									Archive	Sediment					Ghost Wipes	Whatman Filter Papers			
			TOC, Black Carbon	TS, Grain size	TVS (No headspace)	Metals, SVOCs, PAHs	PCB congeners, Dioxin and Furans	Ammonia and Sulfides (Porewater to be analyzed at lab)	TBD	10-day amphipod (<i>Eohaustorius estuarius</i>)	Larval development (<i>Mytilus galloprovincialis</i>) with resuspension	20-day <i>Neanthes</i> sp.	Bioaccumulation Test -- 45-day adult bivalve [<i>Macoma nasuta</i>] and adult polychaete [<i>Nephtys caecoides</i>]	Treatability Study -- 45-day adult bivalve [<i>Macoma nasuta</i>] and adult polychaete [<i>Nephtys caecoides</i>]	Metals	Mercury	SVOCs	PCB Congeners	Dioxins and Furans
			4 oz WMG ^a	8 oz WMG ^a	4 oz WMG ^a	8 oz WMG ^a	8 oz WMG ^a	16 oz WMG ^a	8 oz WMG ^a	1-gallon bucket with Teflon bag ^a	1, 1-L WMG ^a	1-gallon bucket with Teflon bag ^a	2, 1-gallon buckets with Teflon bags ^{a,e}	2, 1-gallon buckets with Teflon bags ^{a,e}	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a	4 oz WMG ^a
			10 g Refrigerated	110 g Refrigerated	5 g Refrigerated	22.5 g Refrigerated	10 g Refrigerated	100 mL (porewater) Refrigerated	NA Frozen	4 L Refrigerated	1 L Refrigerated	4 L Refrigerated	6 L Refrigerated	6 L Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated	NA Refrigerated
WPAH043	SD0045	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH044	SD0046	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH045	SD0047	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH046	SD0048	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH047	SD0049	Normal	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	Tag # _____	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA
WPAH047	SD0050	Field Split ^b	Tag # _____	Tag # _____	Tag # _____	NA	NA	Tag # _____	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FW Blank	FW0003	Equipment filter wipe blank ^c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____
Filter Paper	FB0001	Filter Paper Blank ^d	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	Tag # _____
WPAH048	SD0051	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	NA	Tag # _____	NA	NA	NA	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH049	SD0052	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	NA	Tag # _____	NA	NA	NA	Tag # _____	NA	NA	NA	NA	NA	NA
WPAH050	SD0053	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	NA	Tag # _____	NA	NA	NA	Tag # _____	Tag # _____	NA	NA	NA	NA	NA
		Laboratory Triplicate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4 additional gallons of sediment for laboratory triplicate analysis at WPAH050	NA	NA	NA	NA	NA	NA
WPAH051	SD0054	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	NA	Tag # _____	NA	NA	NA	Tag # _____	Tag # _____	NA	NA	NA	NA	NA
WPAH052	SD0055	Normal	Tag # _____	Tag # _____	Tag # _____	NA	Tag # _____	NA	Tag # _____	NA	NA	NA	Tag # _____	NA	NA	NA	NA	NA	NA
Reference Area																			
CR02	SD0056	Normal	Tag # _____	Tag # _____	NA	NA	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
CR-12	SD0057	Normal	Tag # _____	Tag # _____	NA	NA	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA
CR23W	SD0058	Normal	Tag # _____	Tag # _____	NA	NA	NA	NA	Tag # _____	Tag # _____	Tag # _____	Tag # _____	NA	NA	NA	NA	NA	NA	NA

Notes:

NA = not applicable
 PAH = polycyclic aromatic hydrocarbon
 PCB = polychlorinated biphenyl
 SVOC = semivolatile organic compound
 TBD = to be determined
 TOC = total organic carbon
 TS = total solids
 TVS = total volatile solids
 WMG = wide mouth glass

^a The size and number of containers may be modified.
^b Blind field split samples will be collected at a minimum frequency of 1 field split sample per 20 sediment samples.
^c A filter wipe blank sample will be collected at a minimum frequency of 1 per 20 sediment samples.
^d Filter paper blanks are prepared in the field to evaluate potential background concentration present in filter paper used for the equipment filter wipe blank. Filter paper blanks will be collected at a minimum frequency of one for each lot number of filter papers used for collecting the equipment wipe blank. The filter lot number will be clearly noted in the field logbook.
^e The sediment at bioaccumulation replicate stations, treatability stations and in combination with full suite bioassay stations may be combined into 5-gallon bucket rather than 5, 1-gallon buckets.

PCBs only
 TOC only

Table 5-1. Sediment Analyte List Summary

Analyte	Analytical Method	Laboratory			ACG		
		Units	MDL	MRL	Units	Value	Source
Metals							
Arsenic	SW-846 6020A	mg/kg dry wt.	0.06	0.5	mg/kg dry wt.	7	NewFields (2012b)
Cadmium	SW-846 6020A	mg/kg dry wt.	0.004	0.02	mg/kg dry wt.	0.49	NewFields (2012b)
Chromium	SW-846 6020A	mg/kg dry wt.	0.03	0.2	mg/kg dry wt.	260	Puget Sound LAET
Copper	SW-846 6020A	mg/kg dry wt.	0.08	0.1	mg/kg dry wt.	30	NewFields (2012b)
Lead	SW-846 6020A	mg/kg dry wt.	0.009	0.05	mg/kg dry wt.	450	Puget Sound LAET
Mercury	SW-846 7471B	mg/kg dry wt.	0.002	0.02	mg/kg dry wt.	0.079	NewFields (2012b)
Silver	SW-846 6020A	mg/kg dry wt.	0.008	0.02	mg/kg dry wt.	6.1	Puget Sound LAET
Zinc	SW-846 6020A	mg/kg dry wt.	0.2	0.5	mg/kg dry wt.	70	NewFields (2012b)
SVOCs							
Chlorinated Hydrocarbons							
1,2,4-Trichlorobenzene	SW-846 8270D	mg/kg dry wt.	0.011	0.33	mg/kg dry wt.	0.031	Puget Sound LAET
1,2-Dichlorobenzene		mg/kg dry wt.	0.018	0.33	mg/kg dry wt.	0.035	Puget Sound LAET
1,4-Dichlorobenzene		mg/kg dry wt.	0.018	0.33	mg/kg dry wt.	0.11	Puget Sound LAET
Hexachlorobenzene		mg/kg dry wt.	0.015	0.33	mg/kg dry wt.	0.022	Puget Sound LAET
Phthalate Esters							
Bis(2-ethylhexyl) phthalate	SW-846 8270D	mg/kg dry wt.	0.019	0.33	mg/kg OC ^a	1,300	NewFields (2012b)
Butylbenzyl phthalate		mg/kg dry wt.	0.016	0.33	mg/kg OC ^a	63	NewFields (2012b)
Dibutyl phthalate		mg/kg dry wt.	0.012	0.33	mg/kg dry wt.	1.4	Puget Sound LAET
Diethyl phthalate		mg/kg dry wt.	0.014	0.33	mg/kg dry wt.	0.2	Puget Sound LAET
Dimethyl phthalate		mg/kg dry wt.	0.016	0.33	mg/kg dry wt.	0.071	Puget Sound LAET
Di-n-octyl phthalate		mg/kg dry wt.	0.024	0.33	mg/kg dry wt.	6.2	Puget Sound LAET
Phenols							
2,4-Dimethylphenol	SW-846 8270D	mg/kg dry wt.	0.015	0.33	mg/kg dry wt.	0.029	NewFields (2012b)
2-Methylphenol		mg/kg dry wt.	0.017	0.33	mg/kg dry wt.	0.063	NewFields (2012b)
4-Methylphenol		mg/kg dry wt.	0.017	0.33	mg/kg dry wt.	0.670	NewFields (2012b)
Pentachlorophenol ^b		mg/kg dry wt.	0.006	0.2	mg/kg dry wt.	0.36	Puget Sound LAET
Phenol		mg/kg dry wt.	0.019	0.33	mg/kg dry wt.	0.420	NewFields (2012b)
Miscellaneous Extractables							
Benzoic acid	SW-846 8270D	mg/kg dry wt.	0.14	2	mg/kg dry wt.	0.65	Puget Sound LAET
Benzyl alcohol		mg/kg dry wt.	0.017	0.33	mg/kg dry wt.	0.057	Puget Sound LAET
Dibenzofuran		mg/kg dry wt.	0.012	0.33	mg/kg dry wt.	0.540	NewFields (2012b)
Hexachlorobutadiene ^c		mg/kg dry wt.	0.014	0.33	mg/kg dry wt.	0.011	Puget Sound LAET
N-Nitrosodiphenylamine		mg/kg dry wt.	0.018	0.33	mg/kg dry wt.	0.028	Puget Sound LAET
PAHs							
HPAHs							
	SW-846 8270 SIM						
Benz(a)anthracene		µg/kg dry wt.	0.72	5	µg/kg dry wt.	1,300	Puget Sound LAET
Benzo(a)pyrene		µg/kg dry wt.	0.76	5	µg/kg dry wt.	1,600	Puget Sound LAET
Benzo(b)fluoranthene		µg/kg dry wt.	0.92	5	µg/kg dry wt.	3,200	Puget Sound LAET
Benzo(k)fluoranthene		µg/kg dry wt.	0.87	5	µg/kg dry wt.	3,200	Puget Sound LAET
Benzo(g,h,i)perylene		µg/kg dry wt.	0.85	5	µg/kg dry wt.	670	Puget Sound LAET
Chrysene		µg/kg dry wt.	0.8	5	µg/kg dry wt.	1,400	Puget Sound LAET
Dibenz(a,h)anthracene		µg/kg dry wt.	0.8	5	µg/kg dry wt.	230	Puget Sound LAET
Fluoranthene		µg/kg dry wt.	0.98	5	µg/kg OC ^a	1,700,000	NewFields (2012b)
Indeno(1,2,3-cd)pyrene		µg/kg dry wt.	0.87	5	µg/kg dry wt.	600	Puget Sound LAET
Pyrene		µg/kg dry wt.	0.76	5	µg/kg dry wt.	2,600	Puget Sound LAET
Total HPAHs		µg/kg dry wt.	--	5	µg/kg dry wt.	12,000	Puget Sound LAET
LPAHs							
	SW-846 8270 SIM						
2-Methylnaphthalene		µg/kg dry wt.	0.39	5	µg/kg OC ^a	670,000	NewFields (2012b)
Acenaphthene		µg/kg dry wt.	0.5	5	µg/kg dry wt.	500	Puget Sound LAET
Acenaphthylene		µg/kg dry wt.	0.56	5	µg/kg dry wt.	1,300	Puget Sound LAET
Anthracene		µg/kg dry wt.	0.55	5	µg/kg dry wt.	960	Puget Sound LAET
Fluorene		µg/kg dry wt.	0.61	5	µg/kg OC ^a	540,000	NewFields (2012b)
Naphthalene		µg/kg dry wt.	0.6	5	µg/kg OC ^a	2,100,000	NewFields (2012b)
Phenanthrene		µg/kg dry wt.	1.4	5	µg/kg OC ^a	1,500,000	NewFields (2012b)
Total LPAHs		µg/kg dry wt.	--	5	µg/kg OC ^a	5,200,000	NewFields (2012b)
cPAH TEQ		--	--	--	µg/kg OC ^a	9,200	NewFields (2012b)

Table 5-1. Sediment Analyte List Summary

Analyte	Analytical Method	Laboratory			ACG		
		Units	MDL	MRL	Units	Value	Source
PCDD/Fs	EPA 1613B		EDL	MRL			
2,3,7,8-TCDD		ng/kg dry wt.	0.05	0.2	--	--	--
1,2,3,7,8-PeCDD		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,4,7,8-HxCDD		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,6,7,8-HxCDD		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,7,8,9-HxCDD		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,4,6,7,8-HpCDD		ng/kg dry wt.	0.10	1	--	--	--
OCDD		ng/kg dry wt.	0.50	2	--	--	--
2,3,7,8-TCDF		ng/kg dry wt.	0.05	0.2	--	--	--
1,2,3,7,8-PeCDF		ng/kg dry wt.	0.10	1	--	--	--
2,3,4,7,8-PeCDF		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,4,7,8-HxCDF		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,6,7,8-HxCDF		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,7,8,9-HxCDF		ng/kg dry wt.	0.10	1	--	--	--
2,3,4,6,7,8-HxCDF		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,4,6,7,8-HpCDF		ng/kg dry wt.	0.10	1	--	--	--
1,2,3,4,7,8,9-HpCDF		ng/kg dry wt.	0.10	1	--	--	--
OCDF		ng/kg dry wt.	0.50	2	--	--	--
Total TCDD		ng/kg dry wt.	NA	NA	--	--	--
Total PeCDD		ng/kg dry wt.	NA	NA	--	--	--
Total HxCDD		ng/kg dry wt.	NA	NA	--	--	--
Total HpCDD		ng/kg dry wt.	NA	NA	--	--	--
Total TCDF		ng/kg dry wt.	NA	NA	--	--	--
Total PeCDF		ng/kg dry wt.	NA	NA	--	--	--
Total HxCDF		ng/kg dry wt.	NA	NA	--	--	--
Total HpCDF		ng/kg dry wt.	NA	NA	--	--	--
Total TEQ		ng/kg dry wt.	NA	NA	--	--	--
Dioxin TEQ		--	--		ng/kg dry wt.	5.70	NewFields (2012b)
PCB congeners	EPA 1668A		EDL	MRL			
PCB-1		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-2		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-3		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-4		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-5		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-6		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-7		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-8		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-9		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-10		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-11		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-12/13		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-14		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-15		ng/kg dry wt.	0.2	0.4	--	--	--
PCB-16		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-17		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-19		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-21/33		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-22		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-23		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-24		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-25		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-26/29		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-27		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-28/20		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-30/18		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-31		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-32		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-34		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-35		ng/kg dry wt.	0.1	0.4	--	--	--

Table 5-1. Sediment Analyte List Summary

Analyte	Analytical Method	Laboratory			ACG		
		Units	MDL	MRL	Units	Value	Source
PCB-36		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-37		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-38		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-39		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-41/40/71		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-42		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-43		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-44/47/65		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-45/51		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-46		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-48		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-50/53		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-52		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-54		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-55		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-56		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-57		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-58		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-59/62/75		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-60		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-61/70/74/76		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-63		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-64		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-66		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-67		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-68		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-69/49		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-72		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-73		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-77		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-78		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-79		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-80		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-81		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-82		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-83/99		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-84		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-88/91		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-89		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-92		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-94		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-95/100/93/102/98		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-96		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-103		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-104		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-105		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-106		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-107/124		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-108/119/86/97/125/87		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-109		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-110/115		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-111		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-112		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-113/90/101		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-114		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-117/116/85		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-118		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-120		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-121		ng/kg dry wt.	0.1	0.4	--	--	--

Table 5-1. Sediment Analyte List Summary

Analyte	Analytical Method	Laboratory			ACG		
		Units	MDL	MRL	Units	Value	Source
PCB-122		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-123		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-126		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-127		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-128/166		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-130		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-131		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-132		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-133		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-134/143		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-136		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-137		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-138/163/129/160		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-139/140		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-141		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-142		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-144		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-145		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-146		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-147/149		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-148		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-150		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-151/135/154		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-152		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-153/168		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-155		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-156/157		ng/kg dry wt.	0.1	0.8	--	--	--
PCB-158		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-159		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-161		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-162		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-164		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-165		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-167		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-169		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-170		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-171/173		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-172		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-174		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-175		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-176		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-177		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-178		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-179		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-180/193		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-181		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-182		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-183/185		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-184		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-186		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-187		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-188		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-189		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-190		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-191		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-192		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-194		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-195		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-196		ng/kg dry wt.	0.1	0.4	--	--	--

Table 5-1. Sediment Analyte List Summary

Analyte	Analytical Method	Laboratory			ACG		
		Units	MDL	MRL	Units	Value	Source
PCB-197/200		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-198/199		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-201		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-202		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-203		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-204		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-205		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-206		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-207		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-208		ng/kg dry wt.	0.1	0.4	--	--	--
PCB-209		ng/kg dry wt.	0.1	0.4	--	--	--
Monochlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Dichlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Trichlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Tetrachlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Pentachlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Hexachlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Heptachlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Octachlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Nonachlorobiphenyls, Total		ng/kg dry wt.	--	--	--	--	--
Decachlorobiphenyl		ng/kg dry wt.	--	--	--	--	--
PCBs, Total		ng/kg dry wt.	--	--	--	--	--
PCB Congener TEQ		--	--	--	ng/kg dry wt.	1.37	NewFields (2012b)
Conventional Parameters							
Grain size	PSEP	--	--	--	--	--	--
Total solids (%)	EPA 160.3 Modified	%	--	--	--	--	--
Total organic carbon (%)	SW-846 9060	%	0.018	0.01	--	--	--
Black carbon	Gustafson et al. (1997)	--	0.018	0.01	--	--	--
Total volatile solids (%)	EPA 160.4	%	--	--	--	--	--

Notes:

ACG = analytical concentration goal	OC = organic carbon normalized
cPAH = carcinogenic polycyclic aromatic hydrocarbon	PAH = polycyclic aromatic hydrocarbon
dry wt. = dry weight	PCB = polychlorinated biphenyl
EDL = estimated detection limit	PCDD/F = polychlorinated dibenzo- <i>p</i> -dioxin and dibenzofuran
EPA = U.S. Environmental Protection Agency	PSEP = Puget Sound Estuary Program Methods
HPAH = high molecular weight polycyclic aromatic hydrocarbon	SIM = selective ion monitoring
LAET = lowest apparent effects threshold	SVOC = semivolatile organic compound
LPAH = low molecular weight polycyclic aromatic hydrocarbon	SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
MDL = method detection limit	TEQ = toxic equivalence
MRL = method reporting limit	

^a The listed chemical parameter criteria represent concentrations "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon of the sediment.

^b Pentachlorophenol analyzed by SW-846 8270D SIM.

^c Hexachlorobutadiene analyzed by SW-846 8270D (low level) (Lawson 2013b, pers. comm.).

Table 5-2. Porewater, SPME, and Tissue Analyte List Summary

Analyte	Analytical Method	Laboratory	
		MDL	MRL
Porewater (mg/L)			
Ammonia as Nitrogen	SM 4500 NH ₃ -E	0.009	0.005
Sulfides	EPA 9030 Modified	0.03	0.1
Tissues (pg/g)			
PCB congeners	EPA 1668A	0.02-0.13	1
PCDD/Fs	EPA 1613B		
2,3,7,8-TCDD		0.15	0.5
1,2,3,7,8-PeCDD		0.22	2.5
1,2,3,4,7,8-HxCDD		0.28	2.5
1,2,3,6,7,8-HxCDD		0.29	2.5
1,2,3,7,8,9-HxCDD		0.32	2.5
1,2,3,4,6,7,8-HpCDD		0.34	2.5
OCDD		0.41	5
2,3,7,8-TCDF		0.12	0.5
1,2,3,7,8-PeCDF		0.19	2.5
2,3,4,7,8-PeCDF		0.18	2.5
1,2,3,4,7,8-HxCDF		0.26	2.5
1,2,3,6,7,8-HxCDF		0.25	2.5
1,2,3,7,8,9-HxCDF		0.26	2.5
2,3,4,6,7,8-HxCDF		0.31	2.5
1,2,3,4,6,7,8-HpCDF		0.21	2.5
1,2,3,4,7,8,9-HpCDF		0.3	2.5
OCDF		0.34	5
SPMEs (pg/g)			
PCB congeners	EPA 1668A	0.02-0.13	1
PCDD/Fs	EPA 1613B		
2,3,7,8-TCDD		0.15	0.5
1,2,3,7,8-PeCDD		0.22	2.5
1,2,3,4,7,8-HxCDD		0.28	2.5
1,2,3,6,7,8-HxCDD		0.29	2.5
1,2,3,7,8,9-HxCDD		0.32	2.5
1,2,3,4,6,7,8-HpCDD		0.34	2.5
OCDD		0.41	5
2,3,7,8-TCDF		0.12	0.5
1,2,3,7,8-PeCDF		0.19	2.5
2,3,4,7,8-PeCDF		0.18	2.5
1,2,3,4,7,8-HxCDF		0.26	2.5
1,2,3,6,7,8-HxCDF		0.25	2.5
1,2,3,7,8,9-HxCDF		0.26	2.5
2,3,4,6,7,8-HxCDF		0.31	2.5
1,2,3,4,6,7,8-HpCDF		0.21	2.5
1,2,3,4,7,8,9-HpCDF		0.3	2.5
OCDF		0.34	5

Notes:

- EPA = U.S. Environmental Protection Agency
- MDL = method detection limit
- MRL = method reporting limit
- PCB = polychlorinated biphenyl
- PCDD/F = polychlorinated dibenzo-*p*-dioxin and dibenzofuran
- SM = Standard Methods for the Examination of Water and Wastewater
- SPME = solid-phase microextraction

Table 6-1. Laboratory Quality Control Limits - Sediment

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
Metals				
Arsenic	SW-846 6020A	78-122	75-125	20
Cadmium	SW-846 6020A	81-119	75-125	20
Chromium	SW-846 6020A	80-119	75-125	20
Copper	SW-846 6020A	83-116	75-125	20
Lead	SW-846 6020A	79-121	75-125	20
Mercury	SW-846 7471B	71-128	75-125	20
Silver	SW-846 6020A	66-134	75-125	20
Zinc	SW-846 6020A	73-121	75-125	20
SVOCs				
Chlorinated Hydrocarbons				
	SW-846 8270D			
1,2,4-Trichlorobenzene		42-91	35-105	40
1,2-Dichlorobenzene		40-96	36-96	40
1,4-Dichlorobenzene		40-95	28-95	40
Hexachlorobenzene		50-109	37-119	40
Phthalate Esters				
	SW-846 8270D			
Bis(2-ethylhexyl) phthalate		51-115	35-126	40
Butylbenzyl phthalate		53-114	36-129	40
Dibutyl phthalate		52-117	28-144	30
Diethyl phthalate		45-121	23-131	40
Dimethyl phthalate		48-113	28-124	40
Di-n-octyl phthalate		51-121	36-136	40
Phenols				
	SW-846 8270D			
2,4-Dimethylphenol		29-93	10-117	40
2-Methylphenol		44-96	14-103	40
4-Methylphenol		38-94	26-97	40
Pentachlorophenol ^a		44-109	10-135	40
Phenol		40-87	18-106	40
Miscellaneous Extractables				
	SW-846 8270D			
Benzoic acid		10-104	10-85	40
Benzyl alcohol		47-99	40-96	40
Dibenzofuran		47-101	35-112	40
Hexachlorobutadiene		42-99	27-107	40
N-Nitrosodiphenylamine		44-113	35-112	40
PAHs				
HPAHs				
	SW-846 8270 SIM			
Benz(a)anthracene		46-120	35-122	40
Benzo(a)pyrene		49-122	37-123	40
Benzo(b)fluoranthene		51-121	35-124	40
Benzo(k)fluoranthene		55-120	38-124	40
Benzo(g,h,i)perylene		49-122	33-128	40
Chrysene		49-120	36-126	40
Dibenz(a,h)anthracene		43-125	32-125	40
Fluoranthene		39-135	35-139	40
Indeno(1,2,3-cd)pyrene		40-128	28-133	40
Pyrene		39-134	27-134	40
Total HPAHs		--	--	--

Table 6-1. Laboratory Quality Control Limits - Sediment

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
LPAHs	SW-846 8270 SIM			
2-Methylnaphthalene		27-126	24-115	40
Acenaphthene		39-124	33-118	40
Acenaphthylene		38-126	32-117	40
Anthracene		38-130	30-127	40
Fluorene		39-129	33-125	40
Naphthalene		32-124	23-114	40
Phenanthrene		39-123	29-125	40
Total LPAHs		--	--	--
cPAH TEQ		--	--	--
PCDD/Fs	EPA 1613B			
2,3,7,8-TCDD		70-130	NA	NA
1,2,3,7,8-PeCDD		70-130	NA	NA
1,2,3,4,7,8-HxCDD		70-130	NA	NA
1,2,3,6,7,8-HxCDD		76-130	NA	NA
1,2,3,7,8,9-HxCDD		70-130	NA	NA
1,2,3,4,6,7,8-HpCDD		76-130	NA	NA
OCDD		78-130	NA	NA
2,3,7,8-TCDF		75-130	NA	NA
1,2,3,7,8-PeCDF		80-130	NA	NA
2,3,4,7,8-PeCDF		70-130	NA	NA
1,2,3,4,7,8-HxCDF		72-130	NA	NA
1,2,3,6,7,8-HxCDF		84-130	NA	NA
1,2,3,7,8,9-HxCDF		78-130	NA	NA
2,3,4,6,7,8-HxCDF		70-130	NA	NA
1,2,3,4,6,7,8-HpCDF		82-122	NA	NA
1,2,3,4,7,8,9-HpCDF		78-130	NA	NA
OCDF		70-130	NA	NA
Total TCDD		NA	NA	NA
Total PeCDD		NA	NA	NA
Total HxCDD		NA	NA	NA
Total HpCDD		NA	NA	NA
Total TCDF		NA	NA	NA
Total PeCDF		NA	NA	NA
Total HxCDF		NA	NA	NA
Total HpCDF		NA	NA	NA
Total TEQ		--	--	--
Dioxin TEQ		--	--	--
PCB congeners	EPA 1668A			
PCB-1		50-150	NA	NA
PCB-2		NA	NA	NA
PCB-3		50-150	NA	NA
PCB-4		50-150	NA	NA
PCB-5		NA	NA	NA
PCB-6		NA	NA	NA
PCB-7		NA	NA	NA
PCB-8		NA	NA	NA

Table 6-1. Laboratory Quality Control Limits - Sediment

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
PCB-9		NA	NA	NA
PCB-10		NA	NA	NA
PCB-11		NA	NA	NA
PCB-12/13		NA	NA	NA
PCB-14		NA	NA	NA
PCB-15		50-150	NA	NA
PCB-16		NA	NA	NA
PCB-17		NA	NA	NA
PCB-19		50-150	NA	NA
PCB-21/33		NA	NA	NA
PCB-22		NA	NA	NA
PCB-23		NA	NA	NA
PCB-24		NA	NA	NA
PCB-25		NA	NA	NA
PCB-26/29		NA	NA	NA
PCB-27		NA	NA	NA
PCB-28/20		NA	NA	NA
PCB-30/18		NA	NA	NA
PCB-31		NA	NA	NA
PCB-32		NA	NA	NA
PCB-34		NA	NA	NA
PCB-35		NA	NA	NA
PCB-36		NA	NA	NA
PCB-37		50-150	NA	NA
PCB-38		NA	NA	NA
PCB-39		NA	NA	NA
PCB-41/40/71		NA	NA	NA
PCB-42		NA	NA	NA
PCB-43		NA	NA	NA
PCB-44/47/65		NA	NA	NA
PCB-45/51		NA	NA	NA
PCB-46		NA	NA	NA
PCB-48		NA	NA	NA
PCB-50/53		NA	NA	NA
PCB-52		NA	NA	NA
PCB-54		50-150	NA	NA
PCB-55		NA	NA	NA
PCB-56		NA	NA	NA
PCB-57		NA	NA	NA
PCB-58		NA	NA	NA
PCB-59/62/75		NA	NA	NA
PCB-60		NA	NA	NA
PCB-61/70/74/76		NA	NA	NA
PCB-63		NA	NA	NA
PCB-64		NA	NA	NA
PCB-66		NA	NA	NA
PCB-67		NA	NA	NA
PCB-68		NA	NA	NA
PCB-69/49		NA	NA	NA

Table 6-1. Laboratory Quality Control Limits - Sediment

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
PCB-72		NA	NA	NA
PCB-73		NA	NA	NA
PCB-77		50-150	NA	NA
PCB-78		NA	NA	NA
PCB-79		NA	NA	NA
PCB-80		NA	NA	NA
PCB-81		50-150	NA	NA
PCB-82		NA	NA	NA
PCB-83/99		NA	NA	NA
PCB-84		NA	NA	NA
PCB-88/91		NA	NA	NA
PCB-89		NA	NA	NA
PCB-92		NA	NA	NA
PCB-94		NA	NA	NA
PCB-95/100/93/102/98		NA	NA	NA
PCB-96		NA	NA	NA
PCB-103		NA	NA	NA
PCB-104		50-150	NA	NA
PCB-105		50-150	NA	NA
PCB-106		NA	NA	NA
PCB-107/124		NA	NA	NA
PCB-108/119/86/97/125/87		NA	NA	NA
PCB-109		NA	NA	NA
PCB-110/115		NA	NA	NA
PCB-111		NA	NA	NA
PCB-112		NA	NA	NA
PCB-113/90/101		NA	NA	NA
PCB-114		50-150	NA	NA
PCB-117/116/85		NA	NA	NA
PCB-118		50-150	NA	NA
PCB-120		NA	NA	NA
PCB-121		NA	NA	NA
PCB-122		NA	NA	NA
PCB-123		50-150	NA	NA
PCB-126		50-150	NA	NA
PCB-127		NA	NA	NA
PCB-128/166		NA	NA	NA
PCB-130		NA	NA	NA
PCB-131		NA	NA	NA
PCB-132		NA	NA	NA
PCB-133		NA	NA	NA
PCB-134/143		NA	NA	NA
PCB-136		NA	NA	NA
PCB-137		NA	NA	NA
PCB-138/163/129/160		NA	NA	NA
PCB-139/140		NA	NA	NA
PCB-141		NA	NA	NA
PCB-142		NA	NA	NA
PCB-144		NA	NA	NA

Table 6-1. Laboratory Quality Control Limits - Sediment

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
PCB-145		NA	NA	NA
PCB-146		NA	NA	NA
PCB-147/149		NA	NA	NA
PCB-148		NA	NA	NA
PCB-150		NA	NA	NA
PCB-151/135/154		NA	NA	NA
PCB-152		NA	NA	NA
PCB-153/168		NA	NA	NA
PCB-155		50-150	NA	NA
PCB-156/157		50-150	NA	NA
PCB-158		NA	NA	NA
PCB-159		NA	NA	NA
PCB-161		NA	NA	NA
PCB-162		NA	NA	NA
PCB-164		NA	NA	NA
PCB-165		NA	NA	NA
PCB-167		50-150	NA	NA
PCB-169		50-150	NA	NA
PCB-170		NA	NA	NA
PCB-171/173		NA	NA	NA
PCB-172		NA	NA	NA
PCB-174		NA	NA	NA
PCB-175		NA	NA	NA
PCB-176		NA	NA	NA
PCB-177		NA	NA	NA
PCB-178		NA	NA	NA
PCB-179		NA	NA	NA
PCB-180/193		NA	NA	NA
PCB-181		NA	NA	NA
PCB-182		NA	NA	NA
PCB-183/185		NA	NA	NA
PCB-184		NA	NA	NA
PCB-186		NA	NA	NA
PCB-187		NA	NA	NA
PCB-188		50-150	NA	NA
PCB-189		50-150	NA	NA
PCB-190		NA	NA	NA
PCB-191		NA	NA	NA
PCB-192		NA	NA	NA
PCB-194		NA	NA	NA
PCB-195		NA	NA	NA
PCB-196		NA	NA	NA
PCB-197/200		NA	NA	NA
PCB-198/199		NA	NA	NA
PCB-201		NA	NA	NA
PCB-202		50-150	NA	NA
PCB-203		NA	NA	NA
PCB-204		NA	NA	NA
PCB-205		50-150	NA	NA

Table 6-1. Laboratory Quality Control Limits - Sediment

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
PCB-206		50-150	NA	NA
PCB-207		NA	NA	NA
PCB-208		50-150	NA	NA
PCB-209		50-150	NA	NA
Monochlorobiphenyls, Total		NA	NA	NA
Dichlorobiphenyls, Total		NA	NA	NA
Trichlorobiphenyls, Total		NA	NA	NA
Tetrachlorobiphenyls, Total		NA	NA	NA
Pentachlorobiphenyls, Total		NA	NA	NA
Hexachlorobiphenyls, Total		NA	NA	NA
Heptachlorobiphenyls, Total		NA	NA	NA
Octachlorobiphenyls, Total		NA	NA	NA
Nonachlorobiphenyls, Total		NA	NA	NA
Decachlorobiphenyl		NA	NA	NA
PCBs, Total		NA	NA	NA
PCB Congener TEQ		--	--	--
Conventional Parameters				
Grain size	PSEP	--	--	--
Total solids (%)	EPA 160.3 Modified	--	--	20
Total organic carbon (%)	SW-846 9060	75-125	75-125	25
Black carbon	Gustafson et al. (1997)	75-125	75-125	25
Total volatile solids (%)	EPA 160.4	85-115	--	20

Notes:

- EPA = U.S. Environmental Protection Agency
- HPAH = high molecular weight polycyclic aromatic hydrocarbon
- LCS = laboratory control sample
- LPAH = low molecular weight polycyclic aromatic hydrocarbon
- PAH = polycyclic aromatic hydrocarbon
- PCB = polychlorinated biphenyl
- PCDD/F = polychlorinated dibenzo-*p*-dioxin and dibenzofuran
- PSEP = Puget Sound Estuary Program Methods
- RPD = relative percent difference
- SIM = selective ion monitoring
- SVOC = semivolatile organic compound
- SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
- TEQ = toxic equivalence

^a Pentachlorophenol analyzed by SW-846 8270D SIM.

Table 6-2. Laboratory Quality Control Limits - Porewater, SPMEs, and Tissue

Analyte	Analytical Method	Accuracy LCS %R	Matrix Spike %R	Precision RPD
Porewater				
Ammonia as Nitrogen	SM 4500 NH ₃ -E	90-110	90-110	20
Sulfides	EPA 9030 Modified	55-130	34-166	20
SPMEs				
PCB congeners	EPA 1668A	70-130	70-130	20
PCDD/Fs	EPA 1613B	70-130	70-130	20
2,3,7,8-TCDD		70-130	70-130	20
1,2,3,7,8-PeCDD		70-130	70-130	20
1,2,3,4,7,8-HxCDD		70-130	70-130	20
1,2,3,6,7,8-HxCDD		70-130	70-130	20
1,2,3,7,8,9-HxCDD		70-130	70-130	20
1,2,3,4,6,7,8-HpCDD		70-130	70-130	20
OCDD		70-130	70-130	20
2,3,7,8-TCDF		70-130	70-130	20
1,2,3,7,8-PeCDF		70-130	70-130	20
2,3,4,7,8-PeCDF		70-130	70-130	20
1,2,3,4,7,8-HxCDF		70-130	70-130	20
1,2,3,6,7,8-HxCDF		70-130	70-130	20
1,2,3,7,8,9-HxCDF		70-130	70-130	20
2,3,4,6,7,8-HxCDF		70-130	70-130	20
1,2,3,4,6,7,8-HpCDF		70-130	70-130	20
1,2,3,4,7,8,9-HpCDF		70-130	70-130	20
OCDF		70-130	70-130	20
Tissues				
PCB congeners	EPA 1668A	70-130	70-130	20
PCDD/Fs	EPA 1613B	70-130	70-130	20
2,3,7,8-TCDD		70-130	70-130	20
1,2,3,7,8-PeCDD		70-130	70-130	20
1,2,3,4,7,8-HxCDD		70-130	70-130	20
1,2,3,6,7,8-HxCDD		70-130	70-130	20
1,2,3,7,8,9-HxCDD		70-130	70-130	20
1,2,3,4,6,7,8-HpCDD		70-130	70-130	20
OCDD		70-130	70-130	20
2,3,7,8-TCDF		70-130	70-130	20
1,2,3,7,8-PeCDF		70-130	70-130	20
2,3,4,7,8-PeCDF		70-130	70-130	20
1,2,3,4,7,8-HxCDF		70-130	70-130	20
1,2,3,6,7,8-HxCDF		70-130	70-130	20
1,2,3,7,8,9-HxCDF		70-130	70-130	20
2,3,4,6,7,8-HxCDF		70-130	70-130	20
1,2,3,4,6,7,8-HpCDF		70-130	70-130	20
1,2,3,4,7,8,9-HpCDF		70-130	70-130	20
OCDF		70-130	70-130	20

Notes:

- EPA = U.S. Environmental Protection Agency
- LCS = laboratory control sample
- PCB = polychlorinated biphenyl
- PCDD/F = polychlorinated dibenzo-*p*-dioxin and dibenzofuran
- RPD = relative percent difference
- SM = Standard Methods for the Examination of Water and Wastewater

APPENDIX A

HEALTH AND SAFETY PLAN

SITE HEALTH AND SAFETY PLAN

Western Port Angeles Harbor RI/FS

Prepared for

Western Port Angeles Harbor Group
City of Port Angeles
Georgia Pacific LLC
Merrill & Ring
Nippon Paper Industries USA Co., Ltd.
Port of Port Angeles

Prepared by



411 1st Avenue S.
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Seattle, WA 98104

June 13, 2013

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LIST OF ATTACHMENTS

Attachment 1. Site Map and Hospital Route

Site Map

Hospital Route Map

Attachment 2. Regulatory Notices

Federal OSHA Right to Know Poster

Attachment 3. Safety Procedures

Cold Stress

Heat Stress

Attachment 4. Material Safety Data Sheets

Heptane

Attachment 5. Employee Exposure/Injury Incident Report


Attachment 6. Near-Miss Incident Report

ACRONYMS AND ABBREVIATIONS

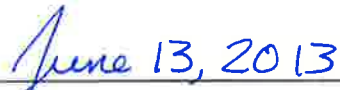
CFR	Code of Federal Regulations
CHSM	Corporate Health and Safety Manager
CPR	cardiopulmonary resuscitation
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high-efficiency particulate air
IDLH	immediately dangerous to life and health
Integral	Integral Consulting Inc.
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PFD	personal flotation device
PID	photoionization detector
PPE	personal protective equipment
RI/FS	remedial investigation and feasibility study
SHSP	site health and safety plan
SPI	sediment profile imaging
SSO	site safety officer
STEL	short-term exposure limit
USCG	U.S. Coast Guard
WISHA	Washington Industrial Safety and Health Act

SITE HEALTH AND SAFETY PLAN APPROVAL

This site health and safety plan has been reviewed and approved for surface sediment sampling at Port Angeles Harbor, Port Angeles, Washington.



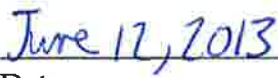
Project Manager



Date



Corporate Health and Safety Manager



Date

SITE HEALTH AND SAFETY PLAN ACKNOWLEDGMENT

In the absence of an appropriate subcontractor or consultant health and safety plan, and with the written approval of Integral Consulting Inc. (Integral) corporate health and safety manager, the subcontractor or consultant may utilize the Integral site health and safety plan (SHSP), provided there is written concurrence from the subcontractor or consultant that they will directly administer the plan for their employees and assume all risks associated with any possible errors or omissions in the plan. This SHSP does not cover any construction activities. The Integral SHSP is a minimum standard for the site and will be strictly enforced for all Integral personnel, or its subcontractors or consultants where applicable.

I have reviewed the SHSP prepared by Integral, dated June 13, 2013, for the Port Angeles Harbor fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of Integral, or its subcontractors or consultants. I have had an opportunity to ask questions regarding this plan, which have been answered satisfactorily by Integral.

_____ Employee signature	_____ Company	_____ Date
_____ Employee signature	_____ Company	_____ Date
_____ Employee signature	_____ Company	_____ Date
_____ Employee signature	_____ Company	_____ Date
_____ Employee signature	_____ Company	_____ Date
_____ Employee signature	_____ Company	_____ Date
_____ Employee signature	_____ Company	_____ Date

1 INTRODUCTION

It is the policy of Integral Consulting Inc. (Integral) to provide a safe and healthful work environment that is compliant with applicable regulations. No aspect of the work is more important than protecting the health and safety of all workers.

This site health and safety plan (SHSP) provides general health and safety provisions to protect workers from potential hazards during field activities at Port Angeles Harbor located in Port Angeles, Washington. This SHSP has been prepared in accordance with the Washington Industrial Safety and Health Act (WISHA) and federal Occupational Safety and Health Administration (OSHA) safety regulations (29 CFR [Code of Federal Regulations] 1910 and 29 CFR 1926).

WISHA (Chapter 49.17 of the Revised Code of Washington) requires employers to provide safe and healthful workplaces for all employees. All work that Integral conducts in the State of Washington must conform to the WISHA core rules presented in Title 296, Chapter 296-800 of the Washington Administrative Code. The Division of Safety and Health of the Washington State Department of Labor and Industries administers WISHA. WISHA is the state equivalent of the federal government's Occupational Safety and Health Act, which is administered by OSHA. This SHSP follows both WISHA and OSHA hazardous waste operations and emergency response and applicable regulations in 29CFR1910 and 29CFR1926.

Attachments to the SHSP provide a site-specific map and specific routes to the hospital from the site (Attachment 1), regulatory notices (Attachment 2), safety procedures (Attachment 3), material safety data sheets (Attachment 4), an employee exposure/injury incident report (Attachment 5), and a near-miss incident report (Attachment 6).

This SHSP has been prepared to identify potential site hazards to the extent possible based on information available to Integral. Integral cannot guarantee the health or safety of any person entering this site. Because of the potentially hazardous nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at this site. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior evaluation by trained health and safety personnel.

A copy of this SHSP must be in the custody of the field crew during field activities. All individuals performing fieldwork must read, understand, and comply with this plan before undertaking field activities. Once the information has been read and understood, the individual must sign the Site Health and Safety Plan Acknowledgment form provided as part of this plan. The signed form will become part of the project file.

This plan may be modified at any time based on the judgment of the Integral site safety officer (SSO) in consultation with the project manager and Integral corporate health and safety manager (CHSM) or designee. Any modification will be presented to the onsite team during a safety briefing and will be recorded in the field logbook.

1.1 OBJECTIVES AND METHODS

The primary objective of the field investigation is to fill data gaps for the remedial investigation (RI) and provide additional information for the feasibility study (FS). To meet this objective, field activities will comprise surface sediment sampling and sediment profile imaging (SPI; not included in this SHSP, but in subcontractor's task-specific health and safety plan and only subcontractor personnel will be used for this task in the field). A grab sampler (e.g., power grab, van Veen, modified petite-Ponar [or similar equipment]) will be positioned on a sampling vessel. If accessible during low tide, surface sediment samples from the lagoon may be collected directly with stainless-steel spoons and bowls. Samples will be collected from the 0–10 cm (0–4 in.) interval.

Additional details on the objectives and methods are presented in the main text of the sampling and analysis plan.

1.2 ORGANIZATION

This SHSP covers one field activity: surface sediment sampling. Chemical and physical hazard evaluations are presented in Sections 2 and 3, respectively. Specific health and safety guidelines associated with each task, including a brief description of the work, are discussed in Section 11, "Task-Specific Safety Procedures."

1.3 ROLES AND RESPONSIBILITIES

All Integral personnel, subcontractors, or consultants and visitors on this site for surface sediment sampling must comply with the requirements of this SHSP. The specific responsibilities and authority of management, safety and health, and other personnel on this site are detailed in the following paragraphs.

1.3.1 Site Safety Officer

The SSO has full responsibility and authority to implement this SHSP and to verify compliance. The SSO reports to the project manager and is onsite or readily accessible to the site during all work operations. The SSO is responsible for assessing site conditions and directing and controlling emergency response activities. The specific responsibilities of the SSO include:

- Managing the safety and health functions on this site
- Serving as the onsite point of contact for safety and health concerns
- Assessing site conditions for unsafe acts and conditions and ensuring corrective action
- Ensuring that all Integral employees and subcontractors understand and follow the SHSP
- Ensuring that daily work schedules and tasks are reasonable for the required levels of effort and weather conditions
- Confirming local emergency response phone numbers and locations
- Conducting and documenting the initial and daily or periodic health and safety briefings
- Evaluating and modifying the level of protective apparel and safety equipment, based on site conditions
- Ensuring that the field team observes all necessary decontamination procedures.

If the SSO determines that site conditions are unsafe, he or she has the authority to suspend field operations until the problem is corrected. The SSO can modify SHSP procedures in the field. Any changes must be documented in the field logbook, and field staff must be immediately informed of the change. The project manager and Integral's CHSM must be notified by phone or e-mail within 24 hours of any major changes to the SHSP.

1.3.2 Project Manager

The project manager has overall responsibility to ensure that personnel working onsite are safe. The specific responsibilities of the project manager include:

- Ensuring that the SHSP is developed prior to the field work or site visit
- Reviewing and approving the SHSP prior to the field work or site visit
- Ensuring employee understanding of and compliance with the SHSP.

1.3.3 Corporate Health and Safety Manager

The CHSM provides guidance to the project manager and SSO on SHSP preparation and reviews and approves the SHSP. The CHSM also serves as an arbitrator if there is a conflict between the project manager, SSO, and field personnel. In addition, the CHSM¹ conducts periodic unannounced audits of Integral field operations to ensure compliance with the SHSP.

¹ The audit task may be delegated to an office health and safety representative by the CHSM.

1.3.4 Field Personnel

All Integral personnel and subcontractors on this site participating in surface sediment sampling are responsible for reading and complying with this SHSP, using the proper personal protective equipment (PPE), reporting unsafe acts and conditions, and following the work and safety and health instructions of the project manager and SSO. All Integral personnel, subcontractors, or consultants can and are encouraged to suspend field operations if they feel conditions have become unsafe.

1.4 SITE DESCRIPTION

Port Angeles Harbor lies in the shelter of Ediz Hook, located on the Washington shoreline of the Strait of Juan de Fuca. The study area is Western port Angeles Harbor.

- **Owner/tenant:** NA
- **Site history:** Port Angeles Harbor's industrial development began with sawmills and fish packing operation in the late 1800s. Typical operations within the harbor included sawmills, fish packing, bulk fuel facilities, pulp and paper mills, and other wood processing-related operations. Other uses include the U.S. Coast Guard Station located at the tip of Ediz Hook, aquaculture, and marine shipping.
- **Current site use:** Active harbor
- **Hazardous waste site:** No
- **Industrial waste site:** No
- **Topography (if applicable):** NA
- **Site access:** Via sampling vessel
- **Nearest drinking water/sanitary facilities:** Onboard sampling vessel
- **Nearest telephone:** Cell phones onboard sampling vessel
- **Size of site:** This field investigation addresses sediments located below mean higher high water within the western Port Angeles Harbor study area, located west of the Rayonier study area and south of the Ediz Hook spit except in areas where this tidal level is covered by riprap or bulkheads.
- **Pathways for hazardous substance dispersion:** Water currents and sediment deposition

A detailed site map is provided in Attachment 1 to this SHSP.

1.5 PROJECT MANAGER AND OTHER KEY CONTACTS

	Name (Affiliation)	Work Telephone	Cell Phone
Project manager	Betsy Day (Integral)	(206) 957-0346	(206) 769-4672
Site safety officer	Jane Sexton (Integral)	(206) 957-0342	(206) 999-5793
Corporate health and safety manager	Eron Dodak (Integral)	(503) 943-3614	(503) 407-2933
Facility contact	NA	NA	NA
Western Port Angeles Harbor Group contact	Allison Geiselbrecht (Floyd Snider)	(206) 292-2078	(206) 722-2460

2 CHEMICAL HAZARD EVALUATION

Potentially hazardous chemicals known to exist at the site are primarily metals and organic compounds. The chemicals of concern, applicable chemical properties, and potential exposure routes are presented in the following sections.

The following table lists the historical site maximum constituent concentrations for constituents in Port Angeles Harbor sediments. In addition, the table lists the properties of sample preservatives and decontamination chemicals that may be used at the site (i.e., heptane). The table also lists the chemical properties and OSHA permissible exposure limit (PEL), short-term exposure limit (STEL), and immediately dangerous to life and health (IDLH) level. Some chemicals used during equipment decontamination or sample preservation may volatilize and enter the field crew's breathing zone and be inhaled. Breathing zone air can be monitored to ensure that the chemicals do not exceed the PEL. If any of the chemicals exceed the PEL, immediate action is required (e.g., don respirators, leave site) as designated in the "Air Monitoring" section (Section 5) of this SHSP.

Chemical Properties

Chemical of Concern	Concentration (site maximum or range expected)	Medium	OSHA PEL	OSHA STEL	OSHA IDLH	IP (eV)	Carcinogen or Other Hazard
PCBs	240–2,930 µg/kg	Sediment	--	--	--	--	Ca
Mercury	0.6–2.65 mg/kg	Sediment	TWA 0.01 mg/m ³	--	10 mg/m ³ (as Hg)	--	CNS, PNS
Cadmium	6.0–8.1 mg/kg	Sediment	--	--	--	--	--
Zinc	411–1,660 mg/kg	Sediment	--	--	--	--	--
Heptane	Product	Decon	50 ppm	--	1,100 ppm	10.18	Flammable

- Notes:**
- = none established
 - Ca = carcinogen
 - CNS = central nervous system
 - IDLH = immediately dangerous to life and health
 - IP (eV) = ionization potential (electron volts)
 - mg/kg = milligrams per kilogram
 - PEL = permissible exposure limit
 - PNS = peripheral nervous system
 - ppm = parts per million
 - STEL = short-term exposure limit
 - TWA = time weighted average
 - µg/g = micrograms per gram

The table below summarizes the chemical characteristics and potential chemical exposure routes at the site.

	Likely	Possible	Unlikely
Potential Chemical Exposure Routes at the Site:			
Inhalation		X ^a	X ^b
Ingestion			X
Skin absorption		X ^a	
Skin contact		X ^a	
Eye contact		X ^a	
Chemical Characteristics:			
Corrosive			X
Flammable	X ^a		X ^b
Ignitable	X ^a		X ^b
Reactive			X
Volatile	X ^a		X ^b
Radioactive			X
Explosive			X
Biological agent			X
Particulates or fibers			X
If likely, describe:	Heptane is volatile, and field personnel will stand upwind when using this chemical. This chemical will not be used unless area is well ventilated. Keep heptane away from ignition sources at all times.		

Notes:

^a Decontamination chemical (heptane)

^b Sediment

3 PHYSICAL HAZARD EVALUATION AND GUIDELINES

The following sections present general physical hazards and overwater work guidelines.

3.1 GENERAL PHYSICAL HAZARDS

The following table presents physical hazards that are expected to be present during field activities.

Possible Hazard	Yes	No	Proposed Safety Procedure
Heavy equipment	X		Stay back from operating equipment; wear safety vests and hard hats; coordinate and maintain eye contact with equipment operator.
Material handling	X		Lift properly; seek assistance if necessary; do not overfill coolers or boxes. Seek assistance if drums must be moved.
Adverse weather	X		Seek shelter during electrical storms; work in adverse weather conditions only with proper training and equipment.
Uneven terrain/tripping	X		Use caution, wear properly fitting shoes or boots, and keep work area orderly.
Cold/hypothermia	X		Keep warm and dry; bring changes of clothes; do not work in extreme conditions without proper equipment and training. Follow cold stress information (Attachment 3). <i>Note:</i> potential for cold/hypothermia will depend on season and location of the site.
Falling objects	X		Wear hard hats near overhead hazards (i.e., winch).

Summary of potential physical hazards posed by proposed site activities:

Activity	Potential Hazard
Sediment sampling	Uneven terrain/tripping, cold/hypothermia, drowning, falling objects, heavy equipment, material handling, adverse weather, vessel operations
Sample handling/mobilization	Material handling

3.2 OVERWATER WORK GUIDELINES

3.2.1 General Overwater Safety Guidelines

The overwater safety program requires the following:

- U.S. Coast Guard (USCG)-approved personal flotation device (PFD) must be worn at all times when working over water greater than 6 in. deep. PFDs must be inspected prior to use and defective PFDs must not be used.
- The boat operator must have training in the safe operation of the boat (Section 6.1).
- No smoking is allowed on boats or near refueling activities.
- Sampling equipment on boats must be kept organized at all times.
- Boats are required to be equipped with a throwable life ring, fire extinguisher, first aid kit, eyewash bottle and water (if acids are taken on the boat), drinking water (for long trips), alternate propulsion mechanism (e.g., paddles), rope, and warning horn; each field member will be briefed on the storage location of this equipment on the first day of the field event.
- All equipment must be used in accordance with the manufacturers' recommendations.

The following table summarizes possible physical hazards that are expected to be present during overwater work field activities.

Possible Hazard	Yes	No	Proposed Safety Procedure
Water hazards	X		Wear a USCG-approved PFD at all times when working over water greater than 6 in. deep. Inspect the PFDs prior to use and do not use defective PFDs. Keep sampling equipment on boats organized at all times. Boats are required to be equipped with a throwable life ring, fire extinguisher, and warning horn, and each field member will be briefed on the storage location of these safety items on the first day of the field event.
Vessel operations	X		Exercise prudent overwater safety.

3.2.2 Sampling Vessel Operations

The physical hazards associated with the deployment and retrieval of sampling equipment from a sampling vessel result from the equipment's weight and the method of deployment. Only trained personnel will deploy and retrieve sampling gear. Under circumstances of potentially dangerous waves or winds, the vessel pilot and field team leader will employ best professional judgment to ensure safe field operations.

To avoid injuries from heavy equipment, personnel will wear steel-toe boots when working on the work deck or loading/unloading heavy equipment from the vessel. Hard hats will be worn by personnel when present on the work deck due to the proximity of overhead gear. Sample handling equipment, containers, deck lines, hydraulic cables, and water hoses not in immediate use will be kept clear of walkways and work areas until needed. Each time sampling operations at a given location have been completed, excess sediment on the deck will be washed from the deck over the sampling location or, if specified in the field sampling plan (depending on the anticipated level of contamination) will be containerized in U.S. Department of Transportation-approved 55-gallon drums to 1) prevent personnel from slipping, 2) minimize personnel exposure to potentially contaminated sediment, and 3) limit cross-contamination between sample locations.

USCG-approved PFDs will be provided for and worn by all personnel working on the deck, or as directed by the Integral SSO or vessel operator. As mentioned above, the vessel must also be equipped with throwable life rings, fire extinguishers, and warning horns, and each crew member will be briefed on the location of this equipment prior to initiation of the sampling event.

3.2.3 Small Craft Operation

Safety procedures on small boats (i.e., length 20 ft or less) may necessitate an increased level of protection, depending on boat size, and location on the water body. Small-boat procedures will include all the requirements listed above, except that a fire extinguisher is not necessary for a row boat and a throwable seat cushion may be used in place of a life ring. In addition, all personnel onboard will be required to wear USCG-approved PFDs at all times. Any Integral personnel or subcontractors operating small boats must have completed a Coast Guard Auxiliary *Boating Safely* course and have a demonstrated knowledge of the safe handling of these craft.

3.2.4 U.S. Coast Guard Notification

USCG will be notified of the schedule and scope of the overwater sampling work. If USCG deems a notice to other mariners to be necessary, then information will be provided by Integral to USCG to make barge and other river traffic aware of their sampling activities.

4 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

The following sections address PPE and safety equipment required for completing the field activities.

4.1 PERSONAL PROTECTIVE EQUIPMENT

Based on the hazards identified above in Sections 2 and 3, the following table identifies the PPE required for site activities.

Site Activity	Level of Protection	
	Initial	Contingency ^a
Sediment sampling	MD*	Leave site
Sample handling	D	MD
Decon	MD	C

Notes:

^a Based on unexpected change in site conditions

Each level of protection will incorporate the following PPE:

- Level D Long pants and work coveralls, hard hat, latex or nitrile gloves under work gloves, eye protection, and steel-toe and steel-shank boots are required. Hearing protection is required as needed.
- Level MD Same as Level D with addition of rain gear.
- Level MD* Same as Level MD with addition of a PFD.
- Level C Same as Level D with chemical protective coveralls (coated Tyvek[®]) and half-face or full-face air purifying respirator with high-efficiency particulate air (HEPA) filter and organic vapor sorbent combination cartridge.

Respirator and Respirator Cartridge Information

Is there potential for a respirator to be donned during fieldwork?

Yes _____ No X

4.2 SAFETY EQUIPMENT

The following safety equipment will be onsite during the proposed field activities.

Air Monitoring (check the items required for this project)

- | | |
|---|--|
| <input type="checkbox"/> OVM | <input type="checkbox"/> Air sampling pumps |
| <input type="checkbox"/> LEL/O ₂ meter | <input type="checkbox"/> Miniram (particle monitors) |
| <input type="checkbox"/> H ₂ S meter | <input type="checkbox"/> Radiation meter |
| <input type="checkbox"/> Detector pump and tubes
(e.g., benzene) | <input type="checkbox"/> Other: |

First Aid Kit Mandatory, including absorbent compress, adhesive bandages, adhesive tape, antiseptic, burn treatment, medical exam gloves, sterile pad, cardiopulmonary resuscitation (CPR) shield, triangle bandage, scissors—for cutting off the PPE from an injured person (check additional items required for the site)

- | | |
|---|---|
| <input checked="" type="checkbox"/> Emergency blanket | <input checked="" type="checkbox"/> Sunscreen |
| <input type="checkbox"/> Insect repellent | <input type="checkbox"/> Other: _____ |

Other (check the items required for this project)

- | | |
|--|--|
| <input checked="" type="checkbox"/> Eyewash | <input type="checkbox"/> Fit test supplies |
| <input checked="" type="checkbox"/> Drinking water | <input checked="" type="checkbox"/> Fire extinguisher (drill rigs and onboard larger sampling vessels) |
| <input type="checkbox"/> Stopwatch for monitoring heart rate for heat stress monitoring ² | <input type="checkbox"/> Windsock |
| <input type="checkbox"/> Thermoscan [®] thermometer for heat stress monitoring | <input checked="" type="checkbox"/> Cellular phone |
| <input type="checkbox"/> Survival kit ³ | <input type="checkbox"/> Radio sets |
| <input checked="" type="checkbox"/> Personal flotation device | <input checked="" type="checkbox"/> Global positioning system |
| <input type="checkbox"/> Cool vests | <input type="checkbox"/> Other: _____ |

² Heart rate monitoring requires special training.

³ Consult the CHSM for guidance for site-specific survival kits.

5 HEALTH AND SAFETY TRAINING AND MEDICAL MONITORING

The following sections present requirements for health and safety training and medical monitoring.

5.1 HEALTH AND SAFETY TRAINING AND MEDICAL MONITORING

State and federal laws establish training requirements for workers at uncontrolled hazardous waste sites (including areas where accumulations of hazardous waste create a threat to the health and safety of an individual, the environment, or both). Integral and subcontractor personnel are required to complete the following training requirements prior to working at the site.

5.1.1 Training Requirements

Task	No Training	24-Hour	40-Hour ^a	Supervisor ^b	First Aid/CPR ^c	Medical Monitoring
Integral Field Personnel						
Jane Sexton			X	X	X	X
Stefan Wodzicki			X		X	X
Zachary Estela			X		X	X
Other Integral Subcontractors						
Vessel operator / deckhands ^d	X					

Notes:

^a Must have current OSHA 8-hour refresher if it has been more than a year since the OSHA 40-hour training.

^b At least one person onsite must be OSHA HAZWOPER supervisor trained if this is a hazardous waste site.

^c At least one member of each team of two or more people onsite must be first aid/CPR trained.

^d The vessel operator and deck hand will not be required to have 40-hour training. The vessel operator will stay out of the exclusion and contamination reduction zones during sample collection and decontamination activities. The vessel operator and deckhands are required to have USCG training.

5.1.2 Site Safety Meetings

Site safety meetings must be held before beginning new tasks or when new staff enters the site. Site safety meetings should be held at a minimum of once a week and should be held daily on complex or high hazard projects. Tailgate safety meetings must occur every morning during review of the day's work plan, covering specific hazards that may be encountered. Additional

meetings will be held at any time health and safety concerns are raised by any of the personnel. Attendance and topics covered are to be documented in the field logbook.

5.2 MEDICAL MONITORING

OSHA requires medical monitoring for personnel potentially exposed to chemical hazards in concentrations in excess of the PEL for more than 30 days per year and for personnel who must use respiratory protection for more than 30 days per year. Integral requires medical monitoring for all employees potentially exposed to chemical hazards.

Will personnel working at this site be enrolled in a medical monitoring program?

Yes X No

6 EMERGENCY RESPONSE PLAN

The following sections discuss emergency recognition and prevention, emergency response and notification, emergency decontamination, site communications, and use of the buddy system.

6.1 EMERGENCY RECOGNITION AND PREVENTION

It is the responsibility of all personnel to monitor work at the site for potential safety hazards. All personnel are required to immediately report any unsafe conditions to the SSO. The SSO is responsible to immediately take steps to remedy any unsafe conditions observed at the work site.

The following are examples of some emergency situations that could occur during the Port Angeles Harbor supplemental investigation field activities:

- Slips, trips, and falls (wet deck surfaces, piers, open hatches, etc.)
- Entrainment of clothes or objects in moving equipment or parts
- A person falls overboard
- Serious injury or illness (e.g., physical injury, heart attack)
- Severe thunderstorm with lightning.

Immediate actions will be taken by the field team under the leadership of the SSO in response to these emergencies.

6.2 EMERGENCY RESPONSE AND NOTIFICATION

If an emergency at the site warrants it, all personnel must immediately evacuate the affected work area and report to the SSO at the predetermined emergency assembly location:

Sampling Vessel Cabin or Field Vehicle

In case of injury, field personnel should take precautions to protect the victim from further harm and notify local or facility emergency services. The victim may require decontamination prior to treatment if practicable—requirements will vary based on site conditions.

Emergency medical care will be provided by:

- Local emergency medical provider (i.e., fire department)
- Facility emergency medical provider
- First aid-trained field staff (for remote areas only)

Local Resources	Name	Telephone	Notified Prior to Work (Yes/No)?
Fire	City of Port Angeles Fire Department	911	No
Police	City of Port Angeles Police Department	911	No
Ambulance	Medic 1	911	No
Hospital	Olympic Medical Center	(360) 417-7000	No
Directions to the hospital:	Consult attached map.		

The SSO must confirm that the hospital listed is still in operation and that it has an emergency room. **It is required that the SSO drive to the hospital so that the directions are practiced and understood prior to initiating fieldwork.**

Corporate Resource	Name	Work Telephone	Cell Phone
Integral CHSM ^a	Eron Dodak	Office: (503) 943-3614	(503) 407-2933
Integral President	Lucinda Jacobs	Office: (206) 957-0328	(206) 999-3061
Integral Human Resources Manager	Amy Logan	Office: (720) 465-3312	NA
Medical consultant	Dr. Calvin Jones (HealthForce Partners)	Office: (425) 806-5700	NA

Notes:

^a If the CHSM cannot be reached, call Ian Stupakoff [Office: (360)705-3534, ext. 20; Cell: (360)259-2518]. If Ian Stupakoff cannot be reached, call David Livermore [Office: (503)943-3613; Cell: (503)806-4665]. If David Livermore cannot be reached, call Barbara Trenary [Office: (206) 248-9645; Cell: (206) 849-0882].

In case of serious injuries, death, or other emergency, the Integral CHSM must be notified immediately at the phone numbers listed above. The Integral CHSM will notify the project manager and Integral's President. The project manager will notify the client.

6.3 EMERGENCY DECONTAMINATION PROCEDURES

In case of an emergency, if possible, gross decontamination procedures will be promptly implemented. If a life-threatening injury occurs and the injured person cannot undergo decontamination procedures onsite, then the medical facility will be informed that the injured

person has not been decontaminated and given information regarding the most probable chemicals of concern.

Decontamination procedures will be used only if practical and if they will not further injure the person or delay treatment. Decontamination procedures should not be implemented if there is not a reasonable possibility that the injured party requires such intervention. The SSO will make the determination whether or not to decontaminate the injured person. The following steps will be followed for decontaminating injured personnel while onsite:

- If it will not injure the person further, cut off PPE using scissors or scrub the gross contamination from the injured person's PPE (e.g., Tyvek® coveralls, work boots) with a Liquinox® or Alconox® solution followed by a rinse with tap or deionized/distilled water
- Remove PPE if feasible without further injuring the person.

6.4 SITE COMMUNICATIONS

Each field team will carry a cell phone that is in good working order. If there is any type of emergency that requires the site to be evacuated (e.g., severe thunderstorm with lightning, chemical release), the field team leader will rally the field team to the sampling vessel cabin or field vehicle. All other emergency notifications that do not require evacuation (e.g., a person falling overboard) will be conducted using a cell phone. Emergency phone numbers are listed above in Section 6.2.

6.5 BUDDY SYSTEM

The buddy system will be used at the site at all times. The buddy system is a system of organizing employees into field teams in such a manner that each employee of the field team is designated to be observed by at least one other employee in the field team. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

7 WORK ZONES

Work zones are defined as follows:

Exclusion zone	Any area of the site where hazardous substances are present, or are reasonably suspected to be present, and pose an exposure hazard to personnel
Contamination reduction zone	Area between the exclusion and support zones that provides a transition between contaminated and clean zones
Support zone	Any area of the site, so designated, that is outside the exclusion and contamination reduction zones

Site control measures in work zones are described below for each type of field activities.

Exclusion zone: The aft deck of the sampling vessel will be considered to be the exclusion zone. Sample collection and processing will occur in this area. Only properly equipped and trained personnel (i.e., wearing modified D protective clothing) will be allowed in this area. The area will be washed with water between sample stations.

Contamination reduction zone: After sampling is completed at a station, the exclusion zone will become the contamination reduction zone. Chemical decontamination will occur away from other personnel and in a downwind portion of the deck to minimize exposure to volatile decontamination chemicals.

Support zone: The pilot house will be the support zone. No chemical or sample handling activities will occur in this area. Personnel will be required to wash chemicals and sediment from raingear or Tyvek® coveralls before entering this area.

Controls to be used to prevent entry by unauthorized persons: No unauthorized personnel will be allowed into the exclusion/contaminant reduction zones.

8 EQUIPMENT DECONTAMINATION AND PERSONAL HYGIENE

8.1 EQUIPMENT DECONTAMINATION PROCEDURES

After sampling is completed, the exclusion zone will be used as the contaminant reduction zone for decontamination activities, provided there is no contamination remaining after the sampling is completed. To minimize or prevent personal exposure to hazardous materials, all personnel working in the exclusion zone and contaminant reduction zone will comply with the following decontamination procedures:

- All personnel will wash sediment and chemicals from their rain gear or Tyvek® coveralls before leaving the exclusion zone.
- All gloves, Tyvek®, rain gear, and rubber boots will be removed prior to entering the field vehicle.

Decontamination equipment required at the site includes the following:

- Buckets or tubs
- Laboratory grade distilled/deionized water
- Site water
- Scrub brushes (long-handled)
- Liquinox® or Alconox® detergent
- Heptane
- Plastic bags
- Foil
- Paper towels
- Garbage bags.

All nondisposable components of the sampling equipment (e.g., stainless steel spoons and bowls used for sample compositing) that contact the sediment will be decontaminated using the following steps:

1. Rinse with site water/tap water
2. Wash with Alconox® or Liquinox® detergent
3. Rinse with site water/tap water

4. Rinse with solvent (heptane)
5. Rinse with site water (grab sampler) or distilled/deionized water using a garden sprayer (compositing equipment only)
6. Allow to air dry
7. Wrap up compositing equipment in aluminum foil.

Decontamination wastewater containing solvent rinsate will be collected in plastic tubs and allowed to evaporate in an area downwind of the field crew during the course of the decontamination activity. Any solvent rinsate that has not evaporated by the end of the decontamination activity will be containerized and disposed of in accordance with applicable regulations.⁴

8.2 PERSONAL HYGIENE

The following personal hygiene practices will be used at the site to reduce exposure to chemicals.

- Long hair will be secured away from the face so it does not interfere with any activities.
- All personnel leaving potentially contaminated areas will wash their hands, forearms, and faces in the contaminant reduction zone prior to entering any clean areas or eating areas.
- Personnel leaving potentially contaminated areas will shower (including washing hair) and change to clean clothing as soon as possible after leaving the site.
- No person will eat, drink, or chew gum or tobacco in potentially contaminated areas. Single portion drink containers and drinking of replacement fluids for heat stress control will be permitted only in support areas.
- Smoking is prohibited by Integral personnel and subcontractors in all areas of the site because of the potential for contaminating samples and for the health of the field team.

⁴ Integral personnel are not allowed to sign hazardous waste manifests. Hazardous waste manifests must be signed by the client or client's attorney.

9 VEHICLE SAFETY, SPILL CONTAINMENT, AND SHIPPING INSTRUCTIONS

9.1 VEHICLE SAFETY

Integral's vehicle safety program requires the following:

- Cell phone usage while driving is not allowed, including the use of hands-free devices. If it not feasible to wait to use the cell phone until arriving at the destination, pull off the road and park in a safe location to use the cell phone. Do not pull to the side of the road to use a cell phone because this significantly increases the risk of a rear-end collision.
- All vehicles are to be operated in a safe manner and in compliance with local traffic regulations and ordinances.
- Drivers are to practice defensive driving and drive in a courteous manner.
- Drivers are required to have a valid driver's license and liability insurance (per local state laws).
- Seat belts are to be worn by the driver and all passengers.
- No persons are allowed to ride in the back of any trucks or vans, unless equipped with seatbelts.
- Vehicles are to be driven in conformance with local speed limits.
- Personnel who are impaired by fatigue, illness, alcohol, illegal or prescription drugs, or who are otherwise physically unfit, are not allowed to drive or work on Integral field sites.
- Personnel are to avoid engaging in other distractions such as changing radio stations while driving.
- Motor vehicle accidents are to be reported to the responsible law enforcement agency, the Integral human resources manager, and the Integral CHSM on the same day of occurrence. Documentation of damage should be photographed.
- Personnel who have experienced work-related vehicle accidents or citations may be required to complete a defensive driving program.

9.2 SPILL CONTAINMENT

All decontamination chemicals will be dispensed from the manufacturers' capped containers directly into laboratory safety squirt bottles that have been permanently marked with the name of the chemical and that have screw caps. Decontamination chemicals will be poured into the

prelabeled squirt bottles while they are over shallow Rubbermaid® tubs to capture any possible overflow or spills. Any spills will be cleaned up and disposed of in accordance with applicable regulations.

9.3 SHIPPING INFORMATION

Federal laws and international guidelines place restrictions on what materials may be shipped by passenger and cargo aircraft. In addition, 49 CFR regulates labeling, manifesting, and shipment of all packages containing potentially hazardous materials. In the course of this field investigation, the following items will be shipped to and from the site as shown below:

Item	Hazardous Constituent	Quantity	Packaging	How Shipped
Samples	None	Solid matrix samples from 61 sampling locations	Coolers	Field vehicle
Solvents (name)	Heptane	1 gal each	Glass bottles protected against breakage in manufacturers' shipping containers or plastic bottle jackets	Field vehicle
Calibration gas (name)	None			
Other	None			

A 24-hour emergency response number (on any shipping documents such as a Uniform Hazardous Waste Manifest, Shipper's Declaration of Dangerous Goods, etc.) is required for shipments of all dangerous or hazardous goods. Integral does not have a 24-hour emergency contact number for dangerous or hazardous goods shipment. No dangerous or hazardous goods may be shipped by Integral until an account is set up with a 24-hour emergency response service such as CHEM-TEL (1-813-248-0573). If any hazardous or dangerous goods need to be shipped for a project, they must be shipped directly to the site by the supplier. Any hazardous or dangerous goods that are not used in the course of the field effort must remain at the site.

The samples will be prepared and labeled for shipment in accordance with the sampling and analysis plan developed for the site.

Air shipment of equipment with lithium batteries is required to note the presence of these batteries. Warning labels are available from the equipment rental agency and can be copied.

10 TASK-SPECIFIC SAFETY PROCEDURE SUMMARY FOR SEDIMENT SAMPLING

Always wear a USCG-approved PFD when doing any work on the sampling vessel or dock. A hard hat, safety glasses, steel-toe boots, and nitrile gloves are required at all times without exception. Use hearing protection as needed.

Exercise caution when working on a boat deck. Always be aware of the surroundings and river wave action that can rock the sampling vessel without notice. Keep sampling equipment on boats organized at all times. Boats are required to be equipped with a throwable life ring, fire extinguisher, and warning horn, and each field member will be briefed on the storage location for this equipment.

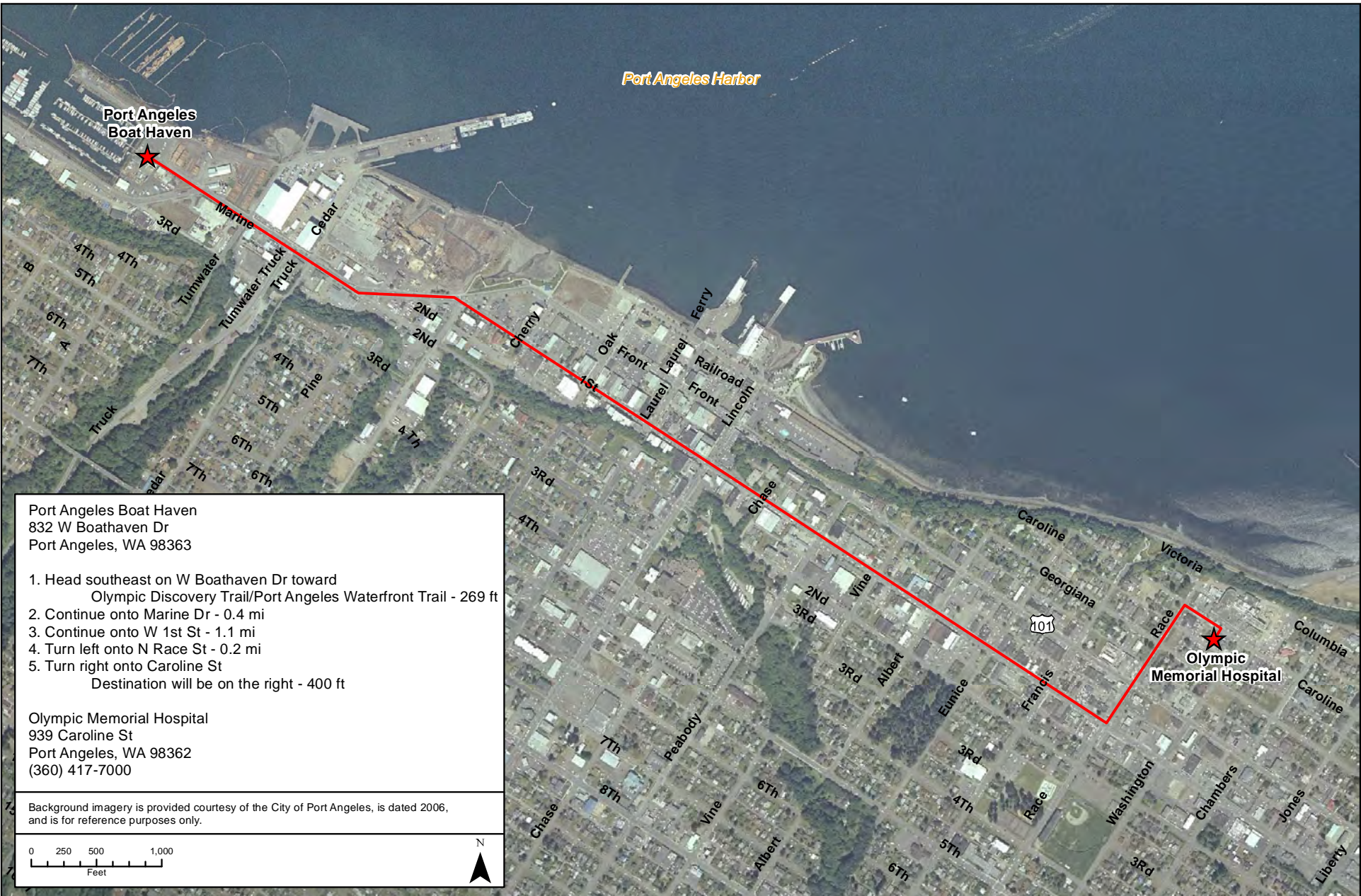
Avoid getting sediment or decontamination chemicals on clothes or skin. Exercise care when lifting, assembling, and decontaminating grab samplers. Always stay clear of the winch line and be aware of its location.

If it is necessary for personnel to enter restricted areas of the upland facility during the sampling event, then they will comply with the client's safety requirements for the site (e.g., wear hard hats and safety glasses).

ATTACHMENT 1

SITE MAP AND
HOSPITAL ROUTE

S:\se\C1102_PAHarbor_WPAHG\Production_MXD\SAP_OAPP\Fig1_HospitalRoute_05222013.mxd 5/22/2013 10:11:30 AM



Port Angeles Boat Haven
832 W Boathaven Dr
Port Angeles, WA 98363

1. Head southeast on W Boathaven Dr toward Olympic Discovery Trail/Port Angeles Waterfront Trail - 269 ft
2. Continue onto Marine Dr - 0.4 mi
3. Continue onto W 1st St - 1.1 mi
4. Turn left onto N Race St - 0.2 mi
5. Turn right onto Caroline St
Destination will be on the right - 400 ft

Olympic Memorial Hospital
939 Caroline St
Port Angeles, WA 98362
(360) 417-7000

Background imagery is provided courtesy of the City of Port Angeles, is dated 2006, and is for reference purposes only.

0 250 500 1,000
Feet

N

Figure 1.
Emergency Hospital Route to Olympic Memorial Hospital
939 Caroline St, Port Angeles, WA 98362
Western Port Angeles Harbor SAP



ATTACHMENT 2

REGULATORY NOTICES

You Have a Right to a Safe and Healthful Workplace. **IT'S THE LAW!**

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in the inspection.
- You can file a complaint with OSHA within 30 days of discrimination by your employer for making safety and health complaints or for exercising your rights under the *OSH Act*.
- You have a right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violation.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records or records of your exposure to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.



The *Occupational Safety and Health Act of 1970 (OSH Act)*, P.L. 91-596, assures safe and healthful working conditions for working men and women throughout the Nation. The Occupational Safety and Health Administration, in the U.S. Department of Labor, has the primary responsibility for administering the *OSH Act*. The rights listed here may vary depending on the particular circumstances. To file a complaint, report an emergency, or seek OSHA advice, assistance, or products, call 1-800-321-OSHA or your nearest OSHA office: • Atlanta (404) 562-2300 • Boston (617) 565-9860 • Chicago (312) 353-2220 • Dallas (214) 767-4731 • Denver (303) 844-1600 • Kansas City (816) 426-5861 • New York (212) 337-2378 • Philadelphia (215) 861-4900 • San Francisco (415) 975-4310 • Seattle (206) 553-5930. Teletypewriter (TTY) number is 1-877-889-5627. To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website at www.osha.gov. If your workplace is in a state operating under an OSHA-approved plan, your employer must post the required state equivalent of this poster.

1-800-321-OSHA
www.osha.gov

ATTACHMENT 3

SAFETY PROCEDURES

FROSTBITE

What happens to the body:

Freezing in deep layers of skin and tissue; pale, waxy-white skin color; skin becomes hard and numb; usually affects fingers, hands, toes, feet, ears, and nose.

What to do: (land temperatures)

- Move the person to a warm, dry area. Don't leave the person alone.
- Remove wet or tight clothing that may cut off blood flow to the affected area.
- **Do not** rub the affected area because rubbing damaged the skin and tissue.
- Gently place the affected area in a warm water bath (105°) and monitor the water temperature to **slowly** warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast, causing tissue damage. Warming takes 25-40 minutes.
- After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm.
Note: If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
- Seek medical attention as soon as possible.

How to Protect Workers

- Recognize the environmental and workplace conditions that lead to potential cold-induced illnesses and injuries.
- Learn the signs and symptoms of cold-induced illnesses/injuries and what to do to help the worker.
- Train workers about cold-induced illnesses and injuries.
- Select proper clothing for cold, wet, and windy conditions. Layer clothing to adjust to changing environmental temperatures. Wear a hat and gloves, in addition to underwear that will keep water away from the skin (polypropylene.)
- Take frequent short breaks in warm, dry shelters to allow the body to warm up.
- Perform work during the warmest part of the day.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Use the buddy system (work in pairs.)
- Drink warm, sweet beverages (sugar water, sports-type drinks.)
Avoid drinks with caffeine (coffee, tea, or hot chocolate) **or alcohol**.
- Eat warm, high-calorie foods like hot pasta dishes.

Workers are at increased risk when...

- They have predisposing health conditions such as cardiovascular disease, diabetes, and hypertension.
- They take certain medications. Check with your doctor, nurse, or pharmacy and ask if medicines you take affect you while working in cold environments.
- They are in poor physical condition, have a poor diet, or are older.

HYPOTHERMIA - (Medical Emergency)

What happens to the body:

Normal body temperature (98.6°F/37°C) drops to or below 95°F/35°C; fatigue or drowsiness; uncontrolled shivering; cool, bluish skin; slurred speech; clumsy movements; irritable, irrational, or confused behavior.

What to do: (land temperatures)

- Call for emergency help (i.e., ambulance or 911).
- Move the person to a warm, dry area. Don't leave the person alone.
- Remove wet clothing and replace with warm, dry clothing or wrap the person in blankets.
- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if he is alert. **Avoid drinks with caffeine** (coffee, tea, or hot chocolate) **or alcohol**.
- Have the person move his arms and legs to create muscle heat. If he is unable to do this, place warm bottles or hot packs in the armpits, groin, neck, and head areas. **Do not** rub the person's body or place him in a warm water bath. This may stop his heart.

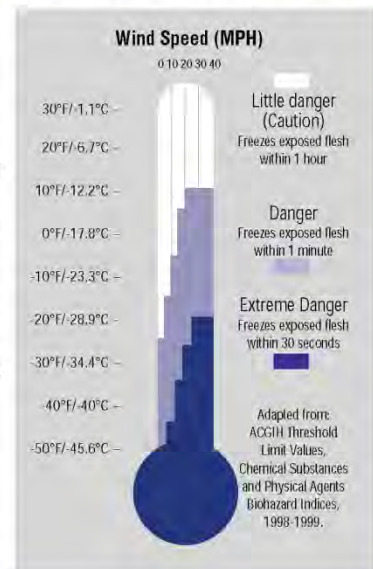
What to do: (water temperatures)

- Call for emergency help (i.e., ambulance or 911). Body heat is lost up to 25 times faster in water.
- **Do not** remove any clothing. Button, buckle, zip, and tighten any collars, cuffs, shoes, and hoods because the layer of trapped water closest to the body provides a layer of insulation that slows the loss of heat. Keep the head out of the water and put on a hat or hood.
- Get out of the water as quickly as possible or climb on anything floating. **Do not** attempt to swim unless a floating object or another person can be reached because swimming or other physical activity uses body heat and reduces survival time by about 50 percent.
- If getting out of the water is not possible, wait quietly and conserve body heat by folding arms across the chest, keeping thighs together, bending knees, and crossing ankles. If another person is in the water, huddle together with chests held closely.

THE COLD STRESS EQUATION

LOW TEMPERATURE + WIND SPEED + WETNESS = INJURIES & ILLNESS

When the body is unable to warm itself, serious cold-related illnesses and injuries may occur, and permanent tissue damage and death may result. **Hypothermia** can occur when *land temperatures* are above freezing or *water temperatures* are below 98.6°F/37°C. Cold-related illnesses can slowly overcome a person who has been chilled by low temperatures, brisk winds, or wet clothing.



HEAT EXHAUSTION

What happens to the body:

Headaches, dizziness, or light-headedness, weakness, mood changes, irritability or confusion, feeling sick to your stomach, vomiting, fainting, decreased and dark-colored urine, and pale, clammy skin.

What should be done:

- Move the person to a cool shaded area. Don't leave the person alone. If the person is dizzy or light-headed, lay him on his back and raise his legs about 6-8 inches. If the person is sick to his stomach, lay him on his side.
- Loosen and remove heavy clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if he is not feeling sick to his stomach.
- Try to cool the person by fanning him. Cool the skin with a cool spray mist of water or wet cloth.
- If the person does not feel better in a few minutes call for emergency help (ambulance or call 911.)

(If heat exhaustion is not treated, the illness may advance to heat stroke.)

How to Protect Workers

- Learn the signs and symptoms of heat-induced illnesses and what to do to help the worker.
- Train workers about heat-induced illnesses.
- Perform the heaviest work during the coolest part of the day.
- Slowly build up tolerance to the heat and the work activity (usually takes up to 2 weeks.)
- Use the buddy system (work in pairs.)
- Drink plenty of cool water (one small cup every 15-20 minutes.)
- Wear light, loose-fitting, breathable (like cotton) clothing.
- Take frequent short breaks in cool, shaded areas (allow your body to cool down.)
- Avoid eating large meals before working in hot environments.
- Avoid caffeine and alcoholic beverages (these beverages make the body lose water and increase the risk of heat illnesses.)

Workers are at increased risk when...

- They take certain medications. Check with your doctor, nurse, or pharmacy to see if medicines you take affect you when working in hot environments.
- They have had a heat-induced illness in the past.
- They wear personal protective equipment.

HEAT STROKE - A Medical Emergency

What happens to the body:

Dry, pale skin (no sweating); hot red skin (looks like a sunburn); mood changes; irritability, confusion, and not making any sense; seizures or fits, and collapse (will not respond).

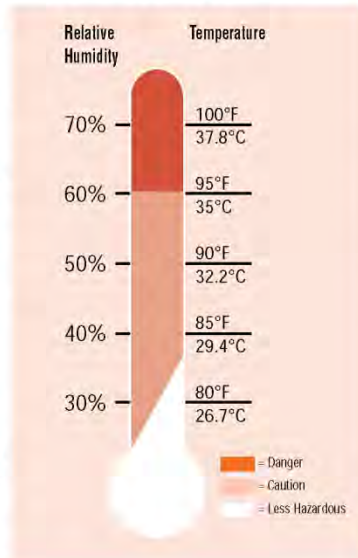
What should be done:

- Call for emergency help (i.e., ambulance or 911.)
- Move the person to a cool, shaded area. Don't leave the person alone. Lay him on his back and if the person is having seizures, remove objects close to him so he won't hit them. If the person is sick to his stomach, lay him on his side.
- Remove heavy and outer clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if he is alert enough to drink anything and not feeling sick to his stomach.
- Try to cool the person by fanning him or her. Cool the skin with a cool spray mist of water, wet cloth, or wet sheet.
- If ice is available, place ice packs in armpits and groin area.

THE HEAT EQUATION

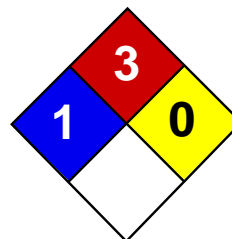
HIGH TEMPERATURE + HIGH HUMIDITY + PHYSICAL WORK = HEAT ILLNESS

When the body is unable to cool itself through sweating, **serious** heat illnesses may occur. The most severe heat-induced illnesses are **heat exhaustion** and **heat stroke**. If actions are not taken to treat heat exhaustion, the illness could progress to heat stroke and **death**.



ATTACHMENT 4

MATERIAL SAFETY DATA SHEETS



Health	1
Fire	3
Reactivity	0
Personal Protection	G

Material Safety Data Sheet n-heptane MSDS

Section 1: Chemical Product and Company Identification

Product Name: n-heptane

Catalog Codes: SLH2152, SLH2998, SLH1675, SLH1948

CAS#: 142-82-5

RTECS: MI7700000

TSCA: TSCA 8(b) inventory: n-heptane

CI#: Not available.

Synonym: Dipropyl methane; Heptyl hydride

Chemical Name: Heptane

Chemical Formula: C₇H₁₆

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{n-}heptane	142-82-5	100

Toxicological Data on Ingredients: n-heptane: VAPOR (LC50): Acute: 103000 mg/m 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:

If swallowed, do NOT induce vomiting. Never give anything by mouth to an unconscious person. Aspiration hazard if swallowed- can enter lungs and cause damage. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 203.89°C (399°F) - 223 C (433 F)

Flash Points: CLOSED CUP: -4°C (24.8°F). (TAG) OPEN CUP: -1.1111°C (30°F).

Flammable Limits: LOWER: 1.05% UPPER: 6.7%

Products of Combustion: These products are carbon oxides (CO, CO₂).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:

Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards:

Flaming occurs when liquid chlorine in n-Heptane is added to added to red phosphorous. Vapors may form explosive mixtures with air. Vapor may travel considerable distance to source of ignition and flash back.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:

Flammable liquid, insoluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 500 (ppm) from OSHA (PEL) [United States] TWA: 2000 (mg/m³) from OSHA (PEL) [United States] TWA: 350 CEIL: 1800 (mg/m³) from NIOSH [United States] TWA: 85 CEIL: 440 (ppm) from NIOSH [United States] TWA: 400 STEL: 500 (ppm) from ACGIH (TLV) [United States] TWA: 500 (ppm) [United Kingdom (UK)] TWA: 400 STEL: 500 (ppm) [Canada] TWA: 1640 STEL: 2049 (mg/m³) [Canada] TWA: 400 STEL: 500 (ppm) [Belgium] TWA: 200 (ppm) [Norway] TWA: 300 STEL: 500 (ppm) [Finland] TWA: 500 (ppm) [Austria] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Hydrocarbon. Gasoline-like

Taste: Not available.

Molecular Weight: 100.21 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 98.4 (209.1°F)

Melting Point: -90.7°C (-131.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.6838 (Water = 1)

Vapor Pressure: 5.3 kPa (@ 20°C)

Vapor Density: 3.5 (Air = 1)

Volatility: Not available.

Odor Threshold: 150 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 4.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:

Soluble in diethyl ether, acetone. Insoluble in cold water. Soluble in alcohol. Solubility in Chloroform, Petroleum Ether, Ether, Acetone: >10% Floats on water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute toxicity of the vapor (LC50): 103000 mg/m³ 4 hours [Rat].

Chronic Effects on Humans:

May cause damage to the following organs: lungs, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through the skin. Eyes: Contact with liquid may cause eye irritation. Contact with vapors is not expected to cause eye irritation. Inhalation: Inhalation of vapor or mist causes respiratory tract and mucous membrane irritation. It can affect behavior/central nervous system and cause central nervous system effects (mild excitement followed CNS depression which is characterized by headache, nausea, dizziness, hilarity, hallucinations, lightheadness, distorted perceptions, convulsions, weakness, loss of judgement and coordination, narcosis, semi-consciousness, coma and death at higher doses). It may cause cardiac effects (irregular heartbeat/cardiac arrhythmias, or heart to stop beating), and pulmonary edema. It is readily absorbed by the inhalation route. Ingestion: Causes gastrointestinal tract irritation with nausea, vomiting, swelling of the abdomen. Aspiration into the lungs can produce chemical pneumonitis. It can also affect behavior/central nervous system with symptoms paralleling those of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact can defat the skin and product irritation and dermatitis. Inhalation: Repeated or prolonged inhalation may affect behavior/central nervous system (symptoms similar to acute inhalation) and may produce minimal peripheral nerve damage (polyneuropathy) with numbness and tingling of the extremities in a stocking-and -glove pattern. Reversible of polyneuropathy as been reversible by a year following removal from exposure. It may also affect the brain, blood (anemia), and hearing (mild change in auditory threshold), and may also cause weight loss, Ingestion: Prolonged or repeated ingestion may affect the liver, urinary system, blood (changes in blood serum composition).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Heptane UNNA: 1206 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: n-heptane Illinois toxic substances disclosure to employee act: n-heptane Rhode Island RTK hazardous substances: n-heptane Pennsylvania RTK: n-heptane Minnesota: n-heptane Massachusetts RTK: n-heptane Massachusetts spill list: n-heptane New Jersey: n-heptane California Director's List of Hazardous Substances: n-heptane TSCA 8(b) inventory: n-heptane TSCA 4(a) proposed test rules: n-heptane TSCA 8(d) H and S data reporting: n-heptane: Effective date: 1/26/94; Sunset date: 6/30/98

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 3

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 05:42 PM

Last Updated: 06/09/2012 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

ATTACHMENT 5

EMPLOYEE EXPOSURE/INJURY

INCIDENT REPORT

Employee Exposure/Injury Incident Report

(completed by the CHSM or designee)

Employee: _____

Office or field location: _____

Incident:

Potential or known exposure (describe): _____

Physical injury or illness (describe): _____

Location (city and state): _____ Project and Contract No. _____

Date of incident: _____ Time of incident: _____

Date incident reported: _____ Person to whom incident was reported: _____

Weather condition during incident: Temperature: _____ Precipitation: _____

Wind speed and direction: _____ Cloud cover: _____

Name of materials potentially encountered (chemical exposure):

Chemical and phase (i.e., liquid, solid, gas, vapor, fume, mist), radiological, etc.: _____

Describe the exposure/injury in detail and the parts of the body affected (attach extra sheets if necessary):

Describe exact onsite or offsite location where the incident occurred:

What was the employee doing when the exposure/injury occurred? (Describe briefly as site reconnaissance, soil sampling, etc.):

How did the incident occur? Describe fully the factors that led to or contributed to the incident:

Was medical treatment given? Yes No If yes, when? _____

By whom? Name of paramedic: _____

Name of physician: _____

Other: _____

Where? Onsite _____ Offsite _____

If offsite, name of hospital or clinic: _____

Length of inpatient stay (dates): _____

Was Integral Consulting management notified? Yes No If yes, when? _____

Name and title of manager(s) notified: _____

Did the exposure/injury result in permanent disability or death? Yes No

If yes, explain: _____

Number of days away from work _____ Number of days of restricted work activity: _____

Has the employee returned to work? (Yes / No) If yes, date: _____

Names of other persons affected during the incident:

Names of persons who witnessed the incident:

Name and title of field team leader or immediate supervisor at the site:

Was the operation being conducted under an established safety plan? Yes No

If yes, attach a copy. If no, explain: _____

Was personal protective equipment (PPE) used by the employee? Yes No

If yes, list items: _____

Did any limitations in safety equipment or PPE affect or contribute to exposure? Yes No

If yes, explain: _____

Attachments to this report: _____ Medical report(s) (if not confidential) _____ Site safety plan
_____ Other relevant information

Employee's signature Date

Site safety officer's signature Date

Project manager's signature Date

Corporate health and safety manager review and comments

Corrective action/procedure changes carried out on the project:

Corrective actions to be taken to prevent similar incidents at other sites:

Corporate Health and Safety Manager's signature Date

ATTACHMENT 6

NEAR-MISS INCIDENT REPORT

Near-Miss Incident Report

(completed by field staff)

Employee: _____

Office or site location: _____

Near-Miss Incident (check one or more): Exposure Physical injury Property damage

Location (city and state): _____ Project and Contract No. _____

Date of incident: _____ Time of incident: _____

Fully describe the incident, including how it happened, persons involved, if chemicals were involved in the incident, etc.:

Was the operation being conducted under an established safety plan? Yes No

If yes, attach a copy. If no, explain: _____

Employee's signature

Date

Project Manager's signature

Date

Site safety officer's signature

Date

Corporate health and safety manager review and comments

Corrective action/procedure changes carried out at the site:

Corrective actions to be taken to prevent similar incidents at other sites:

Corporate Health and Safety Manager's signature

Date

APPENDIX B

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE (SOP) AP-01

SAMPLE PACKAGING AND SHIPPING

SCOPE AND APPLICATION

This SOP describes specific requirements for sample packaging and shipping to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein. This SOP also presents the method to be used when packing samples that will either be hand delivered or shipped by commercial carrier to the laboratory.

EQUIPMENT AND SUPPLIES REQUIRED

Make sure that you have the equipment and supplies necessary to properly pack and ship environmental samples, including the following:

- Project-specific sampling and analysis plan (SAP)
- Project-specific field logbook
- Sealable airtight bags in assorted sizes (e.g., Ziploc[®])
- Wet ice in doubled, sealed bags; frozen Blue Ice[®]; or dry ice
- Cooler(s)
- Bubble wrap
- Fiber-reinforced packing tape, clear plastic packing tape, and duct tape
- Scissors or knife
- Chain-of-custody (COC) forms
- COC seals
- Large plastic garbage bags (preferably 3 mil [0.003 in.] thick)
- Paper towels
- “Fragile,” “This End Up,” or “Handle With Care” labels
- Mailing labels
- Air bills for overnight shipment

PROCEDURE

Customize the logistics for sample packaging and shipping to each study. If necessary, transfer samples from the field to a local storage facility where they can be frozen or refrigerated. Depending on the logistics of the operation, field personnel may transport samples to the laboratory or use a commercial courier or shipping service. In the latter case, Integral field personnel must be aware of any potentially limiting factors to timely shipping, such as availability of overnight service and weekend deliveries to specific areas, and shipping regulations regarding “restricted articles” (e.g., dry ice, formalin) prior to shipping the samples.

SAMPLE PREPARATION

Take the following steps to ensure the proper transfer of samples from the field to the laboratories:

At the sample collection site:

1. Document all samples using the proper logbooks or field forms (see SOP AP-02), required sample container identification (i.e., sample labels with tag numbers), and COC form (example provided in SOP AP-03). Fill out the COC form as described in SOP AP-03, and use the sample labeling techniques provided in SOP AP-04.
2. Make all applicable laboratory quality control sample designations on the COC forms. Clearly identify samples that will be archived for future possible analysis. Label these samples as follows: “Do Not Analyze: Hold and archive for possible future analysis.” Some laboratories interpret “archive” to mean that they should continue holding the residual sample after analysis.
3. Notify the laboratory contact and the Integral project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all COC forms to Integral’s project QA/QC coordinator or project manager, as appropriate.
4. Keep the samples in the possession of the sampling personnel at all times. Lock and secure any temporary onsite sample storage areas to maintain sample integrity and COC requirements.
5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
6. Complete the COC form as described in SOP AP-03, and retain the back (pink) copy for project records prior to sealing the cooler. Check sample containers against the COC form to ensure all the samples that were collected are in the cooler.

7. Store each sample container in a sealed plastic bag that allows the sample label (example provided in SOP AP-03) to be read. Before sealing the bags, ensure that volatile organic analyte (VOA) vials are encased in a foam sleeve or in bubble wrap.
8. If the samples require storage at a specific temperature, place enough ice in the sample cooler to maintain the temperature (e.g., 4°C) throughout the sampling day.

At the sample processing area (immediately after sample collection) take the following steps:

1. If the samples require a specific storage temperature, then cool the samples and maintain the temperature prior to shipping. For example, place enough ice in each sample cooler to maintain the temperature at 4°C until processing begins at the testing laboratory.
2. Be aware of holding time requirements for project-specific analytes and arrange the sample shipping schedule accordingly.
3. Place samples in secure storage (i.e., locked room or vehicle) or keep them in the possession of Integral sampling personnel before shipment. Lock and secure any sample storage areas to maintain sample integrity and COC requirements.
4. Store samples in the dark (e.g., keep coolers shut).

At the sample processing area (just prior to shipping), do the following:

1. Check sample containers against the COC form to account for all samples intended for shipment.
2. Choose cooler(s) of appropriate size and make sure they are clean of gross contamination inside and out. If the cooler has a drain, close the drain and secure it with duct tape.
3. Line the cooler with bubble wrap and place a large plastic bag (preferably with a thickness of 3 mil), open, inside the cooler.
4. Individually wrap each glass container (which was sealed in a plastic bag at the collection site) in bubble wrap and secure with tape or a rubber band. Place the wrapped samples in the large plastic bag in the cooler, leaving room for ice to keep the samples cold (i.e., 4°C).
5. If temperature blanks have been provided by the testing laboratory, place one temperature blank in each sample cooler.
6. If the samples require a specific storage temperature, add enough wet ice or Blue Ice[®] to maintain that temperature during overnight shipping (i.e., 4°C). Always overestimate the amount of ice that will be required. Keep ice in a sealed plastic bag, which is placed in a second sealed plastic bag to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it may insulate the samples from the ice. After adding all samples and ice to the cooler, use bubble wrap (or other

available clean packing material) to fill any empty space and prevent the samples from shifting during transport.

7. If possible, consolidate all VOA samples in a single cooler and ship them with (a) trip blank(s) if the project-specific QA project plan calls for them.
8. Sign, date, and include any tracking numbers provided by the shipper on the COC form. Remove the back (pink) copy of the original COC form and retain this copy for the project records.
9. Seal the rest of the signed COC form in a bag and tape the bag to the inside of the cooler lid. Each cooler should contain an individual COC form for the samples contained inside it. If time is short and it becomes necessary to combine all the samples onto a single set of COC forms and ship multiple coolers together, then indicate on the outside of the appropriate cooler, "Chain-of-Custody Inside."
10. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it with fiber-reinforced packing tape. Tape the cooler around the opening, joining the lid to the bottom, and around the circumference of the cooler at both hinges.
11. As security against unauthorized handling of the samples, apply two COC seals across the opening of the cooler lid (provided with example field forms). Place one seal on the front right portion of the cooler and one on the back left. Be sure the seals are properly affixed to the cooler to prevent removal during shipment. Additional tape across the seal may be necessary if the outside of the cooler is wet.

SAMPLE SHIPPING

Hand Delivery to the Testing Laboratory

1. Notify the laboratory contact and the Integral project QA/QC coordinator that samples will be delivered to the laboratory and the estimated arrival time.
2. When hand-delivering environmental samples, make sure the testing laboratory receives them on the same day that they were packed in the coolers.
3. Fax or scan and e-mail copies of all COC forms to the Integral project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after it has been faxed. Never leave the original COC form in the custody of non-Integral staff.

Shipped by Commercial Carrier to the Laboratory

1. Apply a mailing label to the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care." If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the cooler and to protect it from the weather. This is a secondary label in case the air bill is lost during shipment.
2. Fill out the air bill and fasten it to the handle tags provided by the shipper (or the top of the cooler if handle tags are not available).
3. If samples must be frozen (-20°C) during shipping, make sure that dry ice has been placed in the sample cooler. Be aware of any additional shipping, handling, and special labeling requirements that the shipper may require.
4. Make sure that benthic infauna samples have been preserved with formalin in the field prior to shipping. Be aware of any additional shipping, handling, and special labeling requirements that the shipper may require for these samples.
5. Notify the laboratory contact and the Integral project QA/QC coordinator that samples will be shipped and the estimated arrival date and time. If environmental samples must be shipped at 4°C or -20°C , choose overnight shipping for delivery next morning. Fax or scan and e-mail copies of all COC forms to the Integral project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after faxing. Never leave the original COC form in the custody of non-Integral staff.

STANDARD OPERATING PROCEDURE (SOP) AP-02

FIELD DOCUMENTATION

SCOPE AND APPLICATION

This SOP describes the Integral procedure for accurate record-keeping in the field for the purposes of ensuring that samples can be traced from collection to final disposition.

Document all information relevant to field operations properly to ensure that activities are accounted for in written records to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. Several types of field documents are used for this purpose and should be consistently used by field personnel. Field documentation should include only a factual description of site-related activities and observations. Field personnel should not include superfluous comments or speculation regarding the field activities or observations.

FIELD LOGBOOKS

During field sampling events, field logbooks must be used to record all daily activities. The purpose of the field logbook is to document events and record data measured in the field to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. The project manager (or designee) should issue a field logbook to the appropriate site personnel for the direction of onsite activities (e.g., reconnaissance survey team leader, sampling team leader). It is this designee's responsibility to maintain the site logbook while it is in his or her possession and return it to the project manager or turn it over to another field team.

Make entries in the field logbook as follows:

1. Document all daily field activities in indelible ink in the logbook and make no erasures. Make corrections with a single line-out deletion, followed by the author's initials and the date. The author must initial and date each page of the field logbook. The author must sign and date the last page at the end of each day, and draw a line through any blank space remaining on the page below the last entry.

2. Write the project name, dates of the field work, site name and location (city and state), and Integral job number on the cover of the field logbook. If more than one logbook is used during a single sampling event, then annotate the upper right-hand corner of the logbook (e.g., Volume 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Secure all field logbooks when not in use in the field. The following is a list of the types of information that is appropriate for entry in the field notebook:
 - Project start date and end date
 - Date and time of entry (24-hour clock)
 - Time and duration of daily sampling activities
 - Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, rain, thunder, wave action, current, tide, vessel traffic, air and water temperature, thickness of ice if present)
 - Name and affiliation of person making entries and other field personnel and their duties, including what times they are present
 - The location and description of the work area, including sketches, map references, and photograph log, if appropriate
 - Level of personal protection being used
 - Onsite visitors (names and affiliations), if any, including what times they are present
 - The name, agency, and telephone number of any field contacts
 - Notation of the coordinate system used to determine the station location
 - The sample identifier and analysis code for each sample to be submitted for laboratory analysis, if not included on separate field data sheets
 - All field measurements made (or reference to specific field data sheets used for this purpose), including the time of collection and the date of calibration, if appropriate
 - The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates, if not included on separate field data sheets
 - For aquatic sampling, the type of vessel used (e.g., size, power, type of engine)
 - Specific information on each type of sampling activity
 - The sample type (e.g., groundwater, soil, surface sediment), sample number, sample tag number, and any preservatives used, if not included on separate field data sheets
 - Sample storage methods

- Cross-references of numbers for duplicate samples
 - A description of the sample (source and appearance, such as soil or sediment type, color, texture, consistency, presence of biota or debris, presence of oily sheen, changes in sample characteristics with depth, presence/location/thickness of the redox potential discontinuity [RPD] layer, and odor) and penetration depth, if not included on separate field data sheets
 - Estimate of length and appearance of recovered cores, if not included on separate field data sheets
 - Photographs (uniquely identified) taken at the sampling location, if any
 - Details of the work performed
 - Variations, if any, from the project-specific sampling and analysis plan (SAP) or standard operating protocols and reasons for deviation
 - Details pertaining to unusual events that might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity, control of vertical descent of the sampling equipment)
 - References to other logbooks or field forms used to record information (e.g., field data sheets, health and safety log)
 - Any field results not appearing on the field data sheets (if used), including station identification and location, date, and time of measurement
 - Sample shipment information (e.g., shipping manifests, chain-of-custody (COC) form numbers, carrier, air bill numbers, time addresses)
 - A record of quantity of investigation-derived wastes (if any) and storage and handling procedures.
3. During the field day, as listed above, record in the logbook a summary of all site activities. Provide a date and time for each entry. The information need not duplicate anything recorded in other field logbooks or field forms (e.g., site health and safety officer's logbook, calibration logbook, field data sheets), but should summarize the contents of the other logbooks and refer to the pages in these logbooks for detailed information.
4. If measurements are made at any location, record the measurements and equipment used, or refer to the logbook and page number(s) or field forms on which they are recorded. All maintenance and calibration records for equipment should be traceable through field records to the person using the instrument and to the specific piece of instrumentation itself.

5. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., groundwater monitoring form, sediment core profile form, water quality measurement form) to record the relevant sample information collected. For instructions regarding the proper identification of field data forms, sampling personnel should consult the project-specific SAP.

Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

PHOTOGRAPHS

In certain cases, photographs (print or digital) of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Ensure that photographs include a measured scale in the image, when practical. If you take photographs of sample characteristics and routine sampling activities, avoid using telephoto or wide-angle shots, because they cannot be used in enforcement proceedings. Record the following items in the field logbook for each photograph taken:

1. The photographer's name or initials, the date, the time of the photograph, and the general direction faced (orientation)
2. A brief description of the subject and the field work shown in the picture
3. For print photographs, the sequential number of the photograph and the roll number on which it is contained
4. For digital photographs, the sequential number of the photograph, the file name, the file location, and back-up disk number (if applicable).

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all photographic materials to be developed (prints) or copied (disks). Place the prints or disks and associated negatives in the project files (at the Integral project manager's location). Make photocopies of photo logs and any supporting documentation from the field logbooks, and place them in the project files with the prints or disks.

EQUIPMENT CALIBRATION RECORDS

Record in the field logbook all equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration. Calibrate all equipment used during the investigation daily, at a minimum, in accordance with the manufacturers' recommendations.

DISTRIBUTION OF COPIES

When the field team has returned from the sampling event, the field team leader is responsible for making sure that the field documentation is 1) scanned and placed into the project file on the portal (in a subfolder named Field under Working_Files), and 2) a copy of all field logbooks and additional field data forms is made and placed into the project file. Both the scanned copy and the hard copy will be available for general staff use.

The original field logbooks and forms will be placed in a locked file cabinet for safekeeping. One file cabinet at each Integral office will contain the original field documentation for multiple projects. The original field documentation will be filed at the Integral office where the project manager is located.

SET-UP OF LOCKING FILE CABINET

Place each project in its own file folder in a locking file cabinet. On the folder label, include the project name and contract number. Each project folder will include up to six kinds of files:

- Field logbook(s)
- Additional field data forms
- Photographs
- COC forms
- Acknowledgment of Sample Receipt forms
- Archive Record form (to be completed only if samples are archived at an Integral field storage facility or Integral laboratory).

STANDARD OPERATING PROCEDURE (SOP) AP-03

SAMPLE CUSTODY

SCOPE AND APPLICATION

This SOP describes Integral procedures for custody management of environmental samples.

A stringent, established program of sample chain-of-custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with SOP AP-01, which covers sample packaging and shipping; SOP AP-02, which covers the use of field logbooks and other types of field documentation; and SOP AP-04, which covers sample labeling. Chain-of-custody (COC) forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in his or her possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

At no time is it acceptable for samples to be outside of Integral personnel's custody unless the samples have been transferred to a secure area (i.e., locked up). If the samples cannot be placed in a secure area, then an Integral field team member must physically remain with the samples (e.g., at lunch time one team member must remain with the samples).

CHAIN-OF-CUSTODY FORMS

The COC form is critical because it documents sample possession from the time of collection through final disposition. The form also provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

Complete the COC form after each field collection activity and before shipping the samples to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. The individuals relinquishing and receiving the samples must sign the

COC form(s), indicating the time and date of the transfer, when transferring possession of the samples.

A COC form consists of three-part carbonless paper with white, yellow, and pink copies. The sampling team leader keeps the pink copy. The white and yellow sheets are placed in a sealed plastic bag and secured inside the top of each transfer container (e.g., cooler). Field staff retain the pink sheet for filing at the Integral project manager's location. Each COC form has a unique four-digit number. This number and the samples on the form must be recorded in the field logbook. Integral also uses computer-generated COC forms. If computer-generated forms are used, then the forms must be printed in triplicate and all three sheets signed so that two sheets can accompany the shipment to the laboratory and one sheet can be retained on file. Alternatively, if sufficient time is available, the computer-generated forms will be printed on three-part carbonless paper.

Record on the COC form the project-assigned sample number and the unique tag number at the bottom of each sample label. The COC form also identifies the sample collection date and time, type of sample, project name, and sampling personnel. In addition, the COC form provides information on the preservative or other sample pretreatment applied in the field and the analyses to be conducted by referencing a list of specific analyses or the statement of work for the laboratory. The COC form is sent to the laboratory along with the sample(s).

PROCEDURES

Use the following guidelines to ensure the integrity of the samples:

1. Sign and date each COC form. Have the person who relinquishes custody of the samples also sign this form.
2. At the end of each sampling day and prior to shipping or storage, make COC entries for all samples. Check the information on the labels and tags against field logbook entries.
3. Do not sign the COC form until the team leader has checked the information for inaccuracies. Make corrections by drawing a single line through any incorrect entry, and then initial and date it. Make revised entries in the space below the entries. After making corrections, mark out any blank lines remaining on the COC form, using single lines that are initialed and dated. This procedure will prevent any unauthorized additions.

At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date of the transfer. The time the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as FedEx or United Parcel Service (UPS), record the name of the carrier on the COC form. Also enter on the COC form any tracking numbers supplied by the carrier. The time of transfer should be as close to the actual drop-off time as possible. After signing the COC forms and removing the pink copy, seal them inside the transfer container.
5. If errors are found after the shipment has left the custody of sampling personnel, make a corrected version of the forms and send it to all relevant parties. Fix minor errors by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.
6. Provide a COC form and an Archive Record form for any samples that are archived internally at Integral.

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all COC forms to be copied. A discussion of copy distribution is provided in SOP AP-02.

CUSTODY SEAL

As security against unauthorized handling of the samples during shipping, affix two custody seals to each sample cooler. Place the custody seals across the opening of the cooler (front right and back left) prior to shipping. Be sure the seals are properly affixed to the cooler so they cannot be removed during shipping. Additional tape across the seal may be prudent.

SHIPPING AIR BILLS

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., FedEx, UPS), the shipper provides an air bill or receipt. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting the sender's copy of all shipping air bills to be copied at an Integral office. A discussion of copy distribution is provided in SOP AP-02. Note the air bill number (or tracking number) on the applicable COC forms or, alternatively, note the applicable COC form number on the air bill to enable the tracking of samples if a cooler becomes lost.

ACKNOWLEDGMENT OF SAMPLE RECEIPT FORMS

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is faxed to the project QA/QC coordinator the day the samples are received by the laboratory. The person receiving this form is responsible for reviewing it, making sure that the laboratory has received all the samples that were sent, and verifying that the correct analyses were requested. If an error is found, call the laboratory immediately, and document

any decisions made during the telephone conversation, in writing, on the Acknowledgment of Sample Receipt form. In addition, correct the COC form and fax the corrected version to the laboratory.

Submit the Acknowledgment of Sample Receipt form (and any modified COC forms) to be copied. A discussion of copy distribution is provided in SOP AP-02.

ARCHIVE RECORD FORMS

On the rare occasion that samples are archived at an Integral office, it is the responsibility of the project manager to complete an Archive Record form. This form is to be accompanied by a copy of the COC form for the samples, and will be placed in a locked file cabinet. The original COC form remains with the samples in a sealed Ziploc® bag.

STANDARD OPERATING PROCEDURE (SOP) AP-04

SAMPLE LABELING

SCOPE AND APPLICATION

This SOP describes the general Integral procedures for labeling samples, and the three kinds of labels that can be used on a project (i.e., sample labels, sample tags, and internal sample labels). Consult the project-specific sampling and analysis plan (SAP) to determine the exact sample identifiers and sample labels that are required for a given project. If they are not specified in the SAP, then follow the designations below.

SAMPLE IDENTIFIERS

Before field sampling begins, establish sample identifiers to be assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., replicates) to ensure proper data analysis and interpretation, 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples, and 3) to track individual sample containers to ensure that the laboratory receives all material associated with a single sample. To accomplish these purposes, each container may have three different codes associated with it: the sample identifier, the sample number, and the sample tag number. These codes and their use are described as follows:

- **Sample Identification Code**—The sample identification code (Sample ID) is a unique designation that identifies where and how the sample was collected. The sample identifier is recorded in the field logbook *only* and is not provided on the sample label or chain-of-custody (COC) form. The sample identifier is a multiple-part code. The first component begins with the letter abbreviation; for example, “SWNS” or “SWNB” to designate the surface water sample was collected from the near-surface or near-bottom of the water column. The second part could identify the sampling event; for example, “1” to designate Round 1 sampling. The third part could contain an abbreviation for whether the station is a single point (SP), a transect (TR), a composite (CO), or a vertically integrated station (VI). The station number would be the final component of the sample identifier. Use leading zeros for stations with numbers below 100 for ease of data management and correct data sorting.

If appropriate, add a supplemental component to the sample identifier to code field

duplicate samples and splits. Use a single letter (i.e., a suffix of “A” and “B”) to indicate field duplicates or splits in the final component of the sample identifiers. For equipment decontamination blanks, assign sequential numbers starting at 900 instead of station numbers. Use a sample type code that corresponds to the sample type for which the decontamination blank was collected. Additional codes may be adopted, if necessary, to reflect sampling equipment requirements (see project-specific SAP).

Examples of sample IDs are as follows:

- SWNS-1-SP-002: Surface water sample collected from the near-surface at a single point during Round 1 from Station 2.
- SWNB-1-TR-010-A: Duplicate surface water sample from the near-bottom transect during Round 1 from Station 10.
- **Sample Number**—The sample number is an arbitrary number assigned to each distinct sample or split that is shipped to the laboratory for separate analysis. The sample number appears on the sample containers and the COC forms. Each sample will be assigned a unique sample number. All aliquots of a composited field sample will have the same sample number. In cases where samples consist of multiple bottles from the same location, assign each bottle the same sample number and time. However, assign replicates from the same location different sample numbers and times. Sample numbers of related field replicates will not necessarily have any shared content.

Each field split of a single sample will also have a different sample number and time. The sample number is generally a unique six-digit number that includes a two-digit media code and a four-digit number. The media code may be site-specific, but the Integral default codes are as follows:

- SS—Surface soil
- BH—Subsurface soil or rock (typically from borehole)
- GW—Groundwater
- SW—Surface water
- PW—Pore water
- SD—Sediment
- BT—Biota or biological tissue

The exact sample numbering scheme may vary from project to project. Variances in the sample numbering scheme will be described in the project-specific SAP for the field event. Example sample numbers are PW0001, PW0002, PW0003, etc.

- **Tag Number**—Attach a different tag number to each sample container. If the amount of material (i.e., everything associated with a single sample number) is too large for a single container, assign each container the same sample number and a different sample tag. A sample will also be split between containers if a different preservation technique is used for each container (i.e., because different analyses will be conducted).

The sample tag number is a unique five- or six-digit number assigned to each sample label (or “tag”) for multiple bottles per sample. Integral sample labels come with a preprinted sample tag number. The tag number provides a unique tracking number to a specific sample bottle. This allows for greater flexibility in tracking sample bottles and assists in field quality control when filling out documentation and shipping. Sample tags are not used by many other consultants, and there may be resistance from such firms during teaming situations. However, experience has shown that tags can be very valuable, both in the field and while processing data from field efforts.

Record tag numbers on the COC form. Laboratories use tag numbers only to confirm that they have received all of the containers that were filled and shipped. Data are reported by sample number.

Assign sample numbers sequentially in the field; sample labels are preprinted with sequential tag numbers.

SAMPLE LABELS

Integral sample labels are designed to uniquely identify each individual sample container that is collected during a sampling event. Field sampling teams are provided with preprinted sample labels, which must be affixed to each sample container used. Fill out the labels at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- A unique number (commonly referred to as the “Tag Number”) that is preprinted on the label consisting of five or six digits; used to identify individual containers.

SAMPLE TAGS

Integral sample tags are designed to be affixed to each container that is used for a sample. Sample tags are required only for environmental samples collected in certain U.S.

Environmental Protection Agency (EPA) regions (e.g., EPA Region 5). Field crews are provided with preprinted sample tags. Attach sample tags to each individual sample container with a rubber band or wire through a reinforced hole in the tag. Mark all sample tag entries with indelible ink. Fill out the tags at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- Type of analysis.

A space for the laboratory sample number (provided by the laboratory at log-in) will also be provided on the sample tag.

INTERNAL SAMPLE LABELS

For benthic infaunal samples, wash away the sediment from the sample and collect the remaining benthic infauna into a sample container. Affix sample label (as discussed above) to the outside of the sample container. In addition, place an internal sample label inside the sample container. This internal sample label is made of waterproof paper; be sure to make all internal sample label entries with pencil. Fill out the internal sample labels at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservative used (e.g., formalin).

STANDARD OPERATING PROCEDURE (SOP) AP-05

INVESTIGATION-DERIVED WASTE HANDLING

SCOPE AND APPLICATION

This SOP presents the method to be used for handling wastes generated during field sampling activities that could be hazardous. These wastes are referred to as investigation-derived waste and are subject to specific regulations.

All disposable materials used for sample collection and processing, such as paper towels and gloves, are not considered investigation-derived wastes and 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 normal refuse container for disposal at a solid waste landfill.

EQUIPMENT AND REAGENTS REQUIRED

- 55-gallon drums (or appropriately sized waste container)
- Paint markers
- Tools (to open and close drum)
- Ziploc® bags
- Drum labels.

PROCEDURES

1. Place solid wastes that need to be containerized in properly labeled, DOT- approved, 55-gallon drums.
2. Properly close, seal, label, and stage all filled or partially filled drums before demobilization. Properly profile full drums and have them shipped off site to a RCRA Subtitle C facility.

3. Sampling activities generate personal protective equipment and miscellaneous debris that require disposal. Remove gross contamination from these items, and place the items in plastic bags. It is acceptable to store these items in plastic bags as an interim measure. At the end of each day, dispose of the bags at an appropriate solid waste facility dumpster.

STANDARD OPERATING PROCEDURE (SOP) SD-02

PREPARATION OF FIELD QUALITY CONTROL SAMPLES FOR SEDIMENTS

SCOPE AND APPLICATION

This SOP describes the purpose, preparation, and collection frequency of field duplicate samples, field replicate samples, matrix spike/matrix spike duplicates, equipment rinsate blanks, bottle blanks, trip blanks, temperature blanks, environmental blanks, and reference materials (i.e., a standard reference material, a certified reference material, or other reference material; for the purposes herein, all types of reference materials are referred to as standard reference material, or SRM) for sediment sampling efforts. Not all of the field quality control samples discussed in this SOP may be required for a given project. The specific field quality control samples will be identified in the project-specific field sampling plan (FSP) and quality assurance project plan (QAPP). For most projects, Integral's recommended field quality control samples are an equipment rinsate blank, a field duplicate, and trip blanks if samples are to be analyzed for volatile organic compounds (VOCs). Definitions of all potential quality control samples are described below.

As part of the quality assurance/quality control (QA/QC) program, all field quality control samples will be sent to the laboratories "blind." To accomplish this, field quality control samples will be prepared and labeled in the same manner as regular samples, with each quality control sample being assigned a unique sample number that is consistent with the numbering for regular samples. All of the containers with preservatives that are required to complete the field quality control sample for the applicable analyte list shall be labeled with the same sample number. The sample ID for field quality control samples should allow data management and data validation staff to identify them as such and should be recorded only in the field logbook. Under no circumstances should the laboratory be allowed to use reference materials, rinsate blanks, or trip blanks for laboratory quality control analysis (i.e., duplicates, matrix spike, and matrix spike duplicates). To prevent such an occurrence, regular samples should be selected and marked on the chain-of-custody/sampling analysis request (COC/SAR) form or the laboratory should be instructed to contact the project QA/QC coordinator to select appropriate samples for each sample group.

Field quality control samples will be prepared at least once per sampling event, and certain types will be prepared more often at predetermined frequencies. If the number of samples taken does not equal an integer multiple of the intervals specified in this SOP, the number of

field quality control samples is specified by the next higher multiple. For example, if a frequency of 1 quality control sample per 20 is indicated and 28 samples are collected, 2 quality control samples will be prepared. Field quality control samples for sediment sampling activities should be prepared consistent with the requirements discussed below and at the frequency indicated unless different frequency requirements are listed in the FSP and QAPP.

The following table lists the quality control sample types and suggested frequencies for sediment sampling programs. Because sediment quality control sampling may require assessment of site cross-contamination, additional blanks may be required. A detailed explanation of each quality control sample type with the required preparation follows.

Table 1. Field Quality Control Sample Requirements

Quality Control Sample Name	Abbreviation	Preparation		Frequency ^a
		Location	Method	
Duplicate	DUP	Sampling site	Additional natural sample	One per 20 samples. May not be applicable if REP is being collected.
Replicate	REP	Sampling site	Additional natural sample	One replicate per 20 samples. May not be applicable if DUP is being collected.
Matrix spike/matrix spike duplicate	MS/MSD	Sampling site	Additional sample bottles filled for laboratory quality control requirements	One per 20 samples.
Equipment rinsate blank	ER	Sampling site	Deionized water collected after pouring through and over decontaminated equipment	Minimum of one per sampling event per type of sampling equipment used and then 1 per 20 thereafter.
Filter wipe	FW	Sampling site	Whatman filter papers (organic analysis) and Ghost Wipes (metals/mercury analysis) will be wiped over decontaminated equipment	Minimum of one per sampling event per type of sampling equipment used and then 1 per 20 thereafter.
Filter paper blank	FB	Sampling site	Clean, unused Whatman filter papers (organic analysis) and Ghost Wipes (metals/mercury analysis) will be sent to the analytical laboratory	Minimum of one for each lot number of filter papers used.
Bottle blank	BB	Field	Unopened bottle	One per sample episode or one per bottle type.
Trip blank	TB	Laboratory	Deionized water with preservative	One pair per each VOC sample cooler shipment.

Quality Control Sample Name	Abbreviation	Preparation		
		Location	Method	Frequency ^a
Temperature blank	TMB	Laboratory	Deionized water	One per sample cooler.
Environmental blank	EB	Field	Bottle filled at sample site with deionized water	One per 20 samples.
Standard reference material	SRM	Field laboratory or sampling site	SRM ampules or other containers for each analyte group	One set per 50 samples or one per episode.

^a Frequencies provided here are general recommendations; specific frequencies should be provided in the project-specific FSP or QAPP.

FIELD DUPLICATE SAMPLES

Field duplicate (or split) samples are collected to assess the homogeneity of the samples collected in the field and the precision of the sampling process. Field duplicates will be prepared by collecting two aliquots for the sample and submitting them for analysis as separate samples. Field duplicates will be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. The actual number of field duplicate samples collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field duplicate collection may vary by EPA region or state).

FIELD REPLICATE SAMPLES

Field replicate samples are co-located samples collected in an identical manner over a minimum period of time to provide a measure of the field and laboratory variance, including variance resulting from sample heterogeneity. Field replicates will be prepared by collecting two completely separate samples from the same station and submitting them for analysis as separate samples. Field replicates will be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. If field duplicate samples are collected, then it is unlikely that field replicate samples will also be collected during a sampling event. The actual number of field replicate samples collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field duplicate collection may vary by EPA region or state).

MATRIX SPIKE/MATRIX SPIKE DUPLICATES

The matrix spike/matrix spike duplicate (MS/MSD) analyses provide information about the effect of the sample matrix on the design and measurement methodology used by the laboratory. To account for the additional volume needed by the laboratory to perform the analyses, extra sample volumes may be required to be collected from designated sediment stations. MS/MSDs may be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. The actual number of extra bottles collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements may vary by analyte group).

EQUIPMENT RINSATE BLANKS

Equipment rinsate blanks will be used to help identify possible contamination from the sampling environment and/or from decontaminated sampling equipment. Equipment rinsate blanks will be prepared by pouring laboratory distilled/deionized water through, over, and into the decontaminated sample collection equipment, and then transferring the water to the appropriate sample containers and adding any necessary preservatives. Equipment rinsate blanks will be prepared for all inorganic, organic, and conventional analytes at least once per sampling event per the type of sampling equipment used. The actual number of equipment rinsate blanks prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of equipment rinsate blank collection may vary by EPA region or state).

FILTER WIPES

Filter wipe samples will be used to help identify possible contamination from the sampling environment or from the decontaminated sediment sampling equipment (e.g., sediment grab sampler, stainless-steel bowls and spoons, shovel, trowel).

Filter wipe samples will be prepared by grasping a piece of clean, ashless filter wipe/paper with decontaminated tongs and/or tweezers and wiping down all surfaces of dry, decontaminated equipment that comes into contact with the sediment sample (e.g., stainless-steel spoon, inside of sediment grab sampler). Whatman filter papers will be used for organic analysis and Ghost Wipes will be used for metals/mercury analysis. The filter wipes/papers will be from the same lot used to prepare the filter paper blanks (see below), and the filter lot number will be clearly noted in the field logbook. One filter wipe/paper will be used for each equipment type, solid matrix type, and analysis type. For example, if two pieces of equipment were used for sediment sampling (trowel and stainless-steel spoon) and both metals and

organic compounds were being analyzed, then a total of four filter wipes/papers would be sent to the analytical laboratory.

Tongs and/or tweezers will be used to handle the filter wipe/paper, and all sediment sample-exposed surfaces will be thoroughly wiped down using one piece of filter wipe/paper (per equipment type and for each analysis). The filter wipe sample will then be placed into a labeled certified pre-cleaned sample jar provided by the analytical laboratory. The filter wipe/paper box will be stored in a clean glass container and must NOT be stored in a plastic bag. In moist environments, the filters should be wrapped thoroughly in aluminum foil to protect them from moisture.

Filter wipe samples will be prepared for all inorganic and organic analytes at least once per sampling event per the type of sampling equipment used. The actual number of filter wipe samples prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of filter wipe sample collection may vary by EPA region or state).

FILTER PAPER BLANKS

Whenever a filter wipe sample is prepared in the field, a filter paper blank will also be prepared in the field to evaluate potential background concentrations present in the filter paper used for the equipment filter wipe sample.

Filter paper blanks will be prepared by using tongs and/or tweezers to remove the clean ashless filter paper from its box. Whatman filter papers will be used for organic analysis and Ghost Wipes will be used for metals/mercury analysis. The filter papers will be from the same lot used to prepare the filter wipe samples (see above), and the filter lot number will be clearly noted in the field logbook. One filter wipe/paper will be sent to the analytical laboratory for each type of analysis to be performed (i.e., inorganic or organic analytes). The filter paper blank will be placed into a labeled certified pre-cleaned sample jar provided by the analytical laboratory.

Filter paper blanks will be collected at a minimum frequency of one for each filter lot number. The actual number of filter paper blanks prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of filter paper blank collection may vary by EPA region or state).

BOTTLE BLANKS

The bottle blank is an unopened sample bottle. Bottle blanks are submitted along with sediment samples to ensure that contaminants are not originating from the bottles themselves because of improper preparation, handling, or cleaning techniques. If required, one bottle

blank per lot of prepared bottles will be submitted for analysis. If more than one type of bottle will be used in the sampling (e.g., high-density polyethylene or glass), then a bottle blank should be submitted for each type of bottle and preservative. The actual number of bottle blanks analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP as the requirements on frequency of bottle blank analysis may vary by EPA region or state).

To prepare a bottle blank in the field, set aside one unopened sample bottle from each bottle lot sent from the testing laboratory. Label the bottle as "Bottle Blank" on the sample label (and in the "Remarks" column on the COC/SAR form), and send the empty bottle to the laboratory with the field samples.

TRIP BLANKS

Trip blanks will be used to help identify whether contaminants may have been introduced during the shipment of the sediment samples from the field to the laboratory for VOC analyses only. Trip blanks are prepared at the testing laboratory by pouring distilled/deionized water into two 40-mL VOC vials and tightly closing the lids. Each vial will be inverted and tapped lightly to ensure no air bubbles exist.

The trip blanks will be transported unopened to and from the field in the cooler with the VOC samples. A trip blank is labeled and placed inside the cooler that contains newly collected VOC samples and it remains in the cooler at all times. A trip blank must accompany samples at all times in the field. One trip blank (consisting of a pair of VOC vials) will be sent with each cooler of samples shipped to the testing laboratory for VOC analysis.

TEMPERATURE BLANKS

Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. A temperature blank shall be included with each sample cooler shipped to the testing laboratory.

ENVIRONMENTAL BLANKS

The environmental (field) blank is prepared in the field to evaluate potential background concentrations present in the air and in the distilled/deionized water used for the final decontamination rinse. If unpreserved bottles are to be used, then the appropriate preservative (i.e., for metals samples use a 10 percent nitric acid solution to bring sample pH

to 2 or less) must be added, as may be required. Environmental blanks should be collected at a minimum frequency of 1 in 20 samples. The actual number of environmental blanks analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of environmental blank analysis may vary by EPA region or state).

To prepare an environmental blank in the field, open the laboratory-prepared sample bottle while at a sample collection site, fill the sample bottle with distilled/deionized water, and then seal it. Assign the environmental blank a unique sample number, label the bottle, and then send the bottle to the laboratory with the field samples.

REFERENCE MATERIALS

SRMs are samples containing known analytes at known concentrations that have been prepared by and obtained from EPA-approved sources. The SRMs have undergone multi-laboratory analyses using a standard method that provides certified concentrations. When available for a specific analyte, SRMs provide a measure of analytical performance and/or analytical method bias (i.e., accuracy) of the laboratory. Several SRMs may be required to cover all analytical parameters. For all analytes where available, one SRM will be analyzed at a frequency of one per 50 samples. The actual number of SRMs analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of SRM analysis may vary by EPA region or state).

STANDARD OPERATING PROCEDURE (SOP) SD-04

SURFACE SEDIMENT SAMPLING

SCOPE AND APPLICATION

This SOP defines and standardizes the methods for collecting surface sediment samples from freshwater or marine environments. Surface sediments are defined as those from 0 to at most 10 cm below the sediment-water interface. The actual definition of surface sediments is typically program-specific and depends on the purpose of the study and the regulatory criteria (if any) to which the data will be compared.

This SOP utilizes and augments the procedures outlined in USEPA (1996) and ASTM (2003) guidelines. A goal of this SOP is to ensure that the highest quality, most representative data are collected, and that these data are comparable to data collected by different programs that follow the USEPA (1996) guidelines.

SUMMARY OF METHOD

Sediment samples for chemical and toxicity analysis are collected using a surface sediment sampling device (e.g., grab sampler) or hand implements (i.e., spoons, scoops, shovels, or trowels). If a sample meets acceptability guidelines, overlying water is carefully siphoned off the surface in a grab sampler, and the sediment is described in the field logbook. Depending upon the type of analysis to be performed, sediment samples for chemical analysis may be collected directly from an undisturbed surface (e.g., volatile organic compounds and sulfides), or may be homogenized using decontaminated, stainless-steel containers and utensils prior to being placed in sample jars. Sediment from several sampler casts or exposed sediment locations may also be composited and homogenized prior to being placed in sample jars.

SUPPLIES AND EQUIPMENT

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device
 - Grab sampler or box corer (see examples below in procedures for “Sediment Sample Collection”)

- Stainless-steel spoon, scoop, shovel, or trowel
- Field equipment
 - Siphoning hose
 - Stainless-steel bowls or containers
 - Stainless-steel spoons, spatulas, and/or mixer
 - Stainless-steel ruler
 - Project-specific decontamination supplies (e.g., Alconox™ detergent, 0.1 N nitric acid, methanol, hexane, distilled/deionized water)
 - Personal protective equipment for field team (e.g., rain gear, safety goggles, hard hats, nitrile gloves)
 - First aid kit
 - Cell phone
 - Camera
 - Sample containers
 - Ziploc® bags
 - Bubble wrap
 - Sample jar labels
 - Clear tape
 - Permanent markers
 - Indelible black-ink pens
 - Pencils
 - Coolers
 - Ice
- Documentation
 - Waterproof field logbook
 - Field sampling plan
 - Health and safety plan
 - Correction forms
 - Request for change forms
 - Waterproof sample description forms.

PROCEDURES

Sediment Sample Collection with a Grab Sampler

Use a sampler that obtains a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical and biological analyses. The sampler should be composed of a material such as stainless steel or aluminum, or have a noncontaminating coating such as Teflon™. Samplers capable of providing high-quality sediment samples include grab-type samplers (e.g., van Veen, Ekman, Smith-McIntyre, Young grab, Power Grab and modified-ponar grab) and box cores (Soutar, mini-Soutar, Gray-O'Hara, spade core). Some programs require a sampler that collects from a specific area (e.g., 0.1 m²). Most sampling devices are typically a standard size; however, some non-standard sizes are available to meet the requirements of specific programs. Grab samplers, especially van Veen grab and Ekman grab, are the most commonly used samplers to collect surface sediment. Power Grab samplers are often used for programs requiring collection of sediment deeper than 10 cm (4 in.) or in areas with debris.

Depending on grab weight and water depth, use a hydraulic winch system to deploy the heavier samplers at a rate not exceeding 1 m/second to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, close the jaws slowly and bring the sampler to the deck of the vessel at a rate not exceeding 1 m/second to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, record the time, water depth, and location of sample acquisition in the field logbook.

Retrieve and secure the sampler, and carefully siphon off any overlying water. Inspect the sample to determine acceptability using the criteria detailed in USEPA (1996), except when noted in the project-specific field sampling plan. These criteria include but are not limited to the following:

- There is minimal or no excessive water leakage from the jaws of the sampler
- There is no excessive turbidity in the water overlying the sample
- The sampler is not over-penetrated
- The sediment surface appears to be intact with minimal disturbance
- There is no anthropogenic (i.e., man-made) debris in the sampler
- The program-specified penetration depths are attained.

If the sample meets acceptability criteria, record the sample collection location using a global positioning system (GPS) and enter observations onto a sample collection form or the field logbook. Depending on programmatic goals, remove the sampling interval specified in the field sampling plan. Use a decontaminated stainless-steel ruler to measure the sample collection depth (0 to 10 cm) within the sampler. To prevent possible cross-contamination, do not use sediments touching the margins of the sampler.

Take a photograph of the sediment in the grab sampler and in the stainless-steel bowl in the field. Verify that the station number or sample ID, time, and date are shown in the photograph.

Typically, sediment from a minimum of three separate casts of the sampler is composited at each station (see project-specific field sampling plan). Once the sample has been characterized, subsample the sediment for chemical and biological analyses using a decontaminated stainless-steel spoon.

Sediment Sample Collection with Hand Implements

Obtain a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical and biological analyses. Hand implements (e.g., spoons, scoops, shovels, or trowels) must be composed of stainless steel.

Use GPS to locate the sampling site and approach the location carefully to avoid disturbing the area of sediment to be sampled. Prior to sample collection, describe and characterize the undisturbed surface sediment in the field logbook. If necessary, expose the sediment surface by clearing an approximately 1-ft² area at the sampling site of any rocks greater than approximately 5 in. Remove any anthropogenic (i.e., man-made) debris and organic material on the sediment surface. Note any material removed from the sampling site in the field logbook.

Using a decontaminated, stainless-steel hand implement (i.e., spoon, scoop, shovel, or trowel), excavate the sediment to 10 cm. Place the sediment in a decontaminated stainless-steel bowl and use a decontaminated stainless-steel ruler to confirm that the correct sampling interval has been collected. If the full sample collection interval (i.e., 10 cm) has not been reached, collect additional sediment, place it in the stainless-steel bowl, and reconfirm the sampling interval. Continue this process until the full sample collection interval (0 to 10 cm) has been reached.

Take a photograph of the excavated hole from where the sediment sample was removed. Verify that the station number or sample ID, time, and date are shown in the photograph.

Sample Processing

Complete all sample collection forms, labels, custody seals, and chain-of-custody forms, and record sample information in the field logbook.

Collect samples for volatile compounds (either organics or sulfides) using a decontaminated stainless-steel spoon while sediment is still in the grab sampler or, if the sample is collected using a hand implement, in the stainless-steel bowl. Sediments for volatile analysis are not homogenized. Tightly pack the volatile organics sample jar with sediment (to eliminate obvious air pockets) and fill it so that no headspace remains in the jar. Alternatively, if there is adequate water in the sediment, fill the container to overflowing so that a convex meniscus forms at the top, and then carefully place the cap on the jar. Once sealed, the jar should contain no air bubbles.

Place the remaining sediment in the grab sampler in a precleaned, stainless-steel bowl; sediment collected using hand implements are already in a stainless-steel bowl. Once a sufficient amount of sediment has been collected, mix the sediment using a decontaminated stainless-steel spoon until it is of uniform color and texture throughout.

If required for analysis, collect samples for grain-size tests before any large rocks are removed from the homogenized sediment. Identify any rocks that are greater than 0.5 in. in diameter. Determine their percentage contribution to the homogenized sediment volume, note it on the sediment field collection form or in the field logbook, and then discard the rocks.

Dispense the sediment into precleaned sample jars for the various chemical or biological analyses. For toxicity testing, fill sample jars to the top with sediment to minimize available headspace. This procedure will minimize any oxidation reactions within the sediment. For chemical analysis, sample containers may be frozen for storage. Leave enough headspace to allow for sediment expansion.

After dispensing the sediment, place the containers into coolers with ice and either ship them directly to the analytical laboratories or transport them to a storage facility.

REFERENCES

- ASTM. 2003. *Standard Practice for Collecting Benthic Macroinvertebrates with Ekman Grab Sampler*. ASTM Standards on Disc, Volume 11.05.
- USEPA. 1996. Puget Sound Estuary Program: Recommended protocols for measuring selected environmental variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, and Puget Sound Estuary Program, Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA.

APPENDIX C

EXAMPLE FIELD FORMS

CORRECTIVE ACTION RECORD

Page ____ of ____ Audit Report No.: _____ Date: _____

Report Originator: _____ Person Responsible for Response: _____

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: _____ By: _____	
Date of Actual Occurrence: _____ By: _____	
Analyte: _____	Analytical Method: _____
Cause of Problem:	

CORRECTIVE ACTION PLANNED:

Person Responsible for Corrective Action: _____	Date of Corrective Action: _____
Corrective Action Plan Approval: _____	Date: _____

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Person Responsible for Follow-up Activities: _____	Date of Follow-up Activity: _____
Final Corrective Action Approval: _____	Date: _____

CUSTODY SEAL



Date: _____

Time: _____

Sampler Signature: _____

APPENDIX D

SPI DATA COLLECTION METHODS

Appendix A.
SPI Quality Assurance Project Plan (QAPP)
Prepared by
Germano and Associates

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GERMANO & ASSOCIATES, INC. QUALITY ASSURANCE PROJECT PLAN

The purpose of this document is to describe the operation of the sediment profile imaging (SPI) system, the procedures used to collect SPI data, and the hazards associated with SPI camera deployment and operation.

SPI Camera Operation

The SPI camera system is attached to the hydrowire. The camera prism is mounted on an assembly that can be moved up and down by producing tension or slack on the winch wire. As the camera is lowered, tension on the wire keeps the prism' in the 'up' position. Once the camera frame contacts the bottom, slack on the wire allows the prism to vertically descend into the seafloor. The rate at which the optical prism penetrates into the sediments is controlled by a passive hydraulic piston. This allows the optical prism to descend at approximately 6 cm per second and minimizes disturbance to the sediment column. Once on the seafloor, the SPI camera is controlled by the descent of the prism assembly past a magnetic switch. When the magnetic switch is closed by contact with the prism assembly, two replicate photographs of the sediment column are taken, one taken 5 seconds after the camera contacts the seafloor and the other 15 seconds after the camera contacts the seafloor.

As the camera is raised off the bottom, a wiper blade automatically cleans any sediment off of the prism faceplate, the strobes are recharged, and the camera can be lowered for another replicate image.

When the camera is brought to the surface, the frame count is verified and the camera prism penetration is estimated from a penetration indicator that measures the distance the prism fell relative to the camera base. If penetration is minimal, weight packs can be loaded to give the assembly increased penetration. If penetration is too great, adjustable stops (which control the distance the prism descends) can be lowered, and "mud" doors can be attached to each side of the frame to increase the bearing surface.

Equipment

To conduct a SPI survey, the following equipment is needed:

SPI Camera Components

- Benthos Sediment Profile Camera
- 12 v Nicad Battery Packs
- 12 Kilogram Lead Weights (10 Sets)
- "Mud" Doors
- Nikon D7000 Camera & Spare body
- Tool Kit
- Shackles, swivels and hardware

Positioning System

Research Vessel with winch and hydrowire having a minimum lifting capability of 150 kilos

Navigation system

Field Collections

At the beginning of each survey day, the time on the data logger mounted on the SPI camera will be synchronized with the navigation system clock. A Nikon digital SLR camera and a charged battery are loaded in the camera housing. Test shots are fired on deck at the beginning of each day to verify all internal electronics systems are working according to specifications.

Each SPI station replicate will be identified by the time recorded in the image file and the corresponding time and position recorded by the navigation system. A position will be recorded for each of the three replicate images taken at each SPI station. Redundant sample logs will be kept by the field crew. Information recorded in the field log includes:

- Time
- Date
- Station Location
- Replicate ID
- Frame Count
- Water Depth
- Penetration
- Observations on weather conditions, environmental conditions, or other pertinent observations
- Sampling Crew
- Time of arrival at vessel
- Time of survey commencement
- Time of survey conclusion
- Time departing vessel

Three replicate images will be taken at each SPI station. At regular intervals during each survey day, the frame counter is checked to make sure that the desired number of replicates have been taken. If images have been missed or the penetration depth is insufficient, then proper adjustments are made (e.g., weight is added to the frame) and additional replicates are taken.

To collect SPI data, the research vessel will be piloted to the target sampling location. Once within the project-specified distance of the target location, the SPI camera will be deployed. It is lowered to the seafloor until it lands on the bottom. Once on the bottom,

an electronic trigger is activated signaling the camera to collect images 5 seconds after contact and 20 seconds after contact. Once the image set is acquired, the SPI camera is raised off the seafloor and lowered again to collect the remaining two replicate image sets.

The target production rate during the survey is approximately 50 stations per day or 12-hour shift, with three replicates per station and two images per each replicate being acquired. The rate of data acquisition will be affected by several variables including but not limited to: winch speed, efficiency of vessel positioning, weather conditions, water depth, and transit times.

Hazards Associated with SPI Surveying

The hazards associated with SPI data collections are primarily physical hazards. The SPI camera is large, heavy piece of equipment that is deployed from a research vessel or some other type of sampling platform. There are no chemical or environmental hazards associated with SPI data collection.

During assembly, mobilization and deployment of the SPI camera, the hazards are physical and mechanical in nature. The hazards include:

- Slips, Trips and Falls
- Pinching and crushing of body parts
- Strains and muscle pulls
- Exposure to the elements
- Falls overboard
- Drowning

Hazards Related to SPI Camera Assembly and Mobilization

Prior to field collections, the SPI camera is assembled and mobilized upon the research platform. The camera is shipped in large crates completely disassembled. Component parts are made of high-grade stainless steel, with individual pieces weighing between 2-50 kilos. These pieces are bolted together to construct a high-strength steel frame assembly. During assembly all pieces are typically resting on the ground or platform and there are no overhead hazards. Potential hazards or risks during assembly are related to:

- the pinching of body extremities while assembling the frame
- falls of component parts on fingers, hands, feet or toes
- slips, trips and falls of personnel, and
- back and muscle strain moving and lifting component parts.

Risks associated with these hazards are minimized by using safe and proper assembly techniques, hazard recognition, and workplace controls.

Hazards Related to SPI Camera Operation

As previously described, the SPI camera is deployed from a research platform and, once deployed, operates autonomously until retrieval.

In most operations, the SPI camera is lifted off the platform and articulated over the stern or side of the research vessel. The lifting and movement is typically accomplished using a winch system coupled with a davit, boom, or A-frame. The winch controls the raising and lowering of the SPI camera system and the A-frame or equivalent controls the articulation of the camera over the side of the platform. In some instances, the lifting point is fixed and the camera is manually guided to the water. The hazards inherent in this operation are the lifting and movement of the heavy SPI camera. Specifically hazards include:

- Falling or dropping of the SPI camera,
- Movement of the camera and trapping of personnel by the camera against a solid object such as a bulkhead, frame, or gunwhale
- Slipping while handling the camera
- Falling overboard while deploying the camera.

Furthermore, these factors can be exacerbated by weather and sea-state. The logistics of deploying the camera can be made more difficult by inclement weather such as wind and heavy rain along with platform motion caused by waves and sea-swell. These weather-related factors also cause the research platform to be less stable and increases the difficulty of conducting SPI operations. As the SPI camera must remain stationary on the seafloor for many seconds prior to retrieval, the ability of the platform to hold position influences both the success of the SPI sampling operation as well as the safety of the personnel conducting the SPI operations. If the vessel drifts while the SPI camera is on the seafloor, additional winch cable is paid out so that slack is continuously maintained until the camera is ready for retrieval.

During retrieval, the camera is winched upwards from the seafloor to the research vessel. The most hazardous portion of camera retrieval is the period of time from when the camera reaches the surface of the water until it is safely rested on the deck of the research platform. In calm seas and with an articulating lifting point, this is a safe and straightforward process. However, the difficulty of this maneuver increases with inclement weather conditions and heightened sea-state. In the event of heightened sea state, the camera is brought aboard using tag lines, with all personnel removed from the movements of the camera. Throughout the deployment and retrieval operations clear communication between the SPI camera operating personnel and personnel operating the winch/lifting device controls is maintained.

Physical Hazards

Gear deployment and retrieval present hazards because of the heavy weight of the sampling gear, its suspension above the deck, and the risk of accidental and premature closure. During typical field operations, several heavy pieces of equipment (hundreds of pounds) are used to collect field samples. This gear can include the Sediment Vertical Profile System (SVPS), as well as a Gray-O'Hara box corer (0.06m²), and a dual van Veen grab sampler (0.1 m²). Safety pins are required to be in place on all pieces of gear, as appropriate, whenever the gear is inboard of the vessel rail. The triggering mechanism is always performed when the equipment is resting on a stable surface. All sampling gear is equipped with a ring by which the pin may be grasped for removal during deployment. If the gear or winch slips while a person's finger is inserted through this ring, the finger could be severed. Consequently, personnel are required to remove the safety pin only by grasping the outer edge of the ring between finger and thumb. During retrieval, at least one crew member watches for the appearance of the sampling gear at the water surface and alerts the winch operator. Failure to monitor gear retrieval and slow the winch upon surfacing can break the cable, cause loss of or damage the gear, or injure a crew member if the gear should fall or the cable end should snap. Personnel will be positioned on deck to safely bring the equipment aboard.

After repeated sampling, individual strands from the winch cable may break and project from the cable. Sampling personnel are instructed to avoid contact with the moving cable unless protected by work gloves. Periodically throughout the sampling cruise, the chief scientist inspects the cable for wear, especially where the wire is attached to the sampling gear. The chief scientist and safety officer are also responsible for periodic inspection of all shackles, pins, mousing, swivels, and thimbles to ensure the integrity of all points along the hydrowire. Likewise, all on-deck crew members are encouraged to periodically inspect these linkages. The winch drum, the blocks, and the area between the gear and the rail, deck, or other large equipment all represent significant pinching and crushing hazards. Personnel are instructed to keep their hands, feet, and clothing clear of these points. Lines, hoses, hatch covers, and mud on the deck all present tripping, slipping, and falling hazards. Every crew member should make an effort to keep the working surfaces of the deck clear and clean by coiling hoses and periodically washing the deck down with seawater to remove any mud left on deck from sampling operations.

Analysis of Sediment Profile Images

Thorough measurements of all physical parameters and some biological parameters are subsequently measured directly from the digital image files using a computer-image analysis system. The full color image analysis system can discriminate up to 16.7 million different shades of color, so subtle features can be accurately digitized and measured. Our software allows the measurement and storage of data on 21 different variables for each SPI image obtained. All data stored on disks are printed out on data sheets for editing by the principal investigator and as a hard-copy backup. All measured data are edited and verified by a senior-level scientist before being approved for final data synthesis, statistical analyses, and interpretation. Automatic disk storage of all

parameters measured allows data from any variables of interest to be compiled, sorted, displayed graphically, contoured, or compared statistically. In addition, the integration of the SPI analysis software with our database and GIS software allows any SPI measurement to be plotted (and contoured if desired) on a basemap of the survey area.

Specific measurement techniques for the SPI parameters measured are presented in the sections that follow.

Depositional Layer Thickness: Because of the camera's unique design, SPI has proven invaluable in detecting depositional layers ranging from 20 cm (the height of the SPI optical window) to 1 mm in thickness. During image analysis, the thickness of the newly-deposited layers is determined by measuring the linear distance between the pre- and post-disposal sediment water interface. Recently-deposited material is usually evident because of its unique optical reflectance and/or color relative to the underlying material representing the pre-disposal surface. Also, in most cases, the point of contact between the two layers and a textural change in sediment composition in the new layer are clearly visible, facilitating measurement of the thickness of the newly-deposited layer.

Sediment Type Determination: The sediment grain-size major mode and range are visually estimated from the photographs by overlaying a grain-size comparator which is at the same scale. This comparator was prepared by photographing a series of Udden-Wentworth size classes (equal to or less than coarse silt up to granule and larger sizes) through the SPI camera. Seven grain-size classes are on this comparator: ≥ 4 phi, 4-3 phi, 3-2 phi, 2-1 phi, 1-0 phi, 0-(-)1 phi, < -1 phi. The lower limit of optical resolution of the photographic system is about 62 microns, allowing recognition of grain sizes equal to or greater than coarse silt. The accuracy of this method has been documented by comparing our SPI estimates with grain-size statistics determined from laboratory sieve analyses.

Prism Penetration Depth: The SPI prism penetration depth is determined by:

1. Digitizing the entire area of sediment and dividing by the calibrated width of the image to get the average penetration depth; and,
2. measuring both the largest and smallest linear distance between the sediment-water interface and the bottom of the image frame.

The SPI analysis software automatically subtracts maximum and minimum values to determine the small scale boundary roughness value. All three values, (maximum, minimum, and average penetration depth) are included on the data sheets. Prism penetration is potentially a noteworthy parameter; if the number of weights used in the camera is held constant throughout a survey, the camera functions as a static-load penetrometer. Comparative penetration values from sites of similar grain-size give an indication of the relative sediment water content.

Surface Boundary Roughness: Surface boundary roughness is determined by measuring the vertical distance (parallel to the image border) between the highest and

lowest points of the sediment-water interface. In addition, the origin of this small-scale topographic relief is indicated when it is evident (physical or biogenic). Boundary roughness is only accurately measured when the camera is level. In sandy sediments, boundary roughness can be a measure of sand wave height. On silt-clay bottoms, boundary roughness values often reflect biogenic features such as fecal mounds or surface burrows.

Mud Clasts: When fine-grained, cohesive sediments are disturbed, either by physical bottom scour or faunal activity (e.g., decapod foraging), intact clumps of sediment are often scattered about the seafloor. These mud clasts can be seen at the sediment-water interface in SPI images. During analysis, the number of clasts is counted, the diameter of a typical clast is measured, and their oxidation state is assessed. Depending on their place of origin and the depth of disturbance of the sediment column, mud clasts can be reduced or oxidized (in SPI images, the oxidation state is apparent from their reflectance value; see section on Apparent Redox Potential Discontinuity Depth below). Also, once at the sediment-water interface, these sediment clumps are subject to bottom-water oxygen levels and bottom currents. Based on laboratory microcosm observations of reduced sediments placed within an aerobic environment, oxidation of reduced surface layers by diffusion alone is quite rapid, occurring within 6-12 hours (Germano, 1983). Consequently, the detection of reduced mud clasts in an obviously aerobic setting suggests a recent origin. The size and shape of mud clasts, e.g. angular versus rounded, is also considered. Mud clasts may be moved about and broken by bottom currents and/or animals (macro- or meiofauna; Germano, 1983). Over time, large angular clasts become small and rounded. Overall, the abundance, distribution, oxidation state, and angularity of mud clasts are used to make inferences about the recent pattern of seafloor disturbance in an area.

Apparent Redox Potential Discontinuity (RPD) Depth: Aerobic near-surface marine sediments typically have higher reflectance values relative to underlying hypoxic or anoxic sediments. Surface sands washed free of mud also have higher optical reflectance than underlying muddy sands. These differences in optical reflectance are readily apparent in SPI images; the oxidized surface sediment contains particles coated with ferric hydroxide (an olive color when associated with particles), while reduced and muddy sediments below this oxygenated layer are darker, generally grey to black. The boundary between the colored ferric hydroxide surface sediment and underlying grey to black sediment is called the apparent redox potential discontinuity (abbreviated as the RPD).

The depth of the apparent RPD in the sediment column is an important time-integrator of dissolved oxygen conditions within sediment pore waters. In the absence of bioturbating organisms, this high reflectance layer (in muds) will typically reach a thickness of 2 mm (Rhoads, 1974). This depth is related to the supply rate of molecular oxygen by diffusion into the bottom and the consumption of that oxygen by the sediment and associated microflora. In sediments that have very high sediment-oxygen demand, the sediment may lack a high reflectance layer even when the overlying water column is aerobic.

In the presence of bioturbating macrofauna, the thickness of the high reflectance layer may be several centimeters. The relationship between the thickness of this high reflectance layer and the presence or absence of free molecular oxygen in the associated pore waters must be made with caution. The boundary (or horizon) which separates the positive Eh region of the sediment column from the underlying negative Eh region is called the Redox Potential Discontinuity or RPD. The exact location of this Eh=0 potential can only be determined accurately with microelectrodes; hence, the relationship between the change in optical reflectance, as imaged with the SPI camera, and the actual RPD can only be determined by making the appropriate *in-situ* Eh measurements. For this reason, we describe the optical reflectance boundary, as imaged, as the "apparent" RPD, and it is mapped as a mean value. In general, the depth of the actual Eh=0 horizon will be either equal or slightly shallower than the depth of the optical reflectance boundary. This is because bioturbating organisms can mix ferric hydroxide-coated particles downward into the bottom below the Eh=0 horizon. As a result, the apparent mean RPD depth can be used as an estimate of the depth of pore water exchange, usually through pore water irrigation (bioturbation).

The depression of the apparent RPD within the sediment is relatively slow in organic-rich muds (on the order of 200 to 300 micrometers per day); therefore this parameter has a long time constant (Germano and Rhoads, 1984). The rebound in the apparent RPD is also slow (Germano, 1983). Measurable changes in the apparent RPD depth using the SPI optical technique can be detected over periods of one or two months. This parameter is used effectively to document changes (or gradients) which develop over a seasonal or yearly cycle related to water temperature effects on bioturbation rates, seasonal hypoxia, sediment oxygen demand, and infaunal recruitment. In sediment-profile surveys of ocean disposal sites sampled seasonally or on an annual basis throughout the New England region performed under the DAMOS program for the U.S. Army Corps of Engineers, New England Division, SPI results have repeatedly documented a drastic reduction in apparent RPD depths at disposal sites immediately after dredged material disposal, followed by a progressive post-disposal apparent RPD deepening (barring further physical disturbance). Consequently, time series RPD measurements can be a critical diagnostic element in monitoring the degree of recolonization in an area by the ambient benthos.

The depth of the mean apparent RPD also can be affected by local erosion. The peaks of disposal mounds commonly are scoured by divergent flow over the mound. This can result in washing away of fines, development of shell or gravel lag deposits, and very thin apparent RPD depths. During storm periods, erosion may completely remove any evidence of the apparent RPD (Fredette *et al.*, 1988).

Another important characteristic of the apparent RPD is the contrast in reflectance values at this boundary. This contrast is related to the interactions among the degree of organic-loading, bioturbational activity in the sediment, and the levels of bottom-water dissolved oxygen in an area. High inputs of labile organic material increase sediment oxygen demand and, subsequently, sulfate reduction rates (and the abundance of sulfide end-products). This results in more highly-reduced (lower-reflectance) sediments at depth

and higher RPD contrasts. In a region of generally low RPD contrasts, images with high RPD contrasts indicate localized sites of relatively high past inputs of organic-rich material (e.g., organic or phytoplankton detritus, dredged material, sewage sludge, etc.).

Sedimentary Methane: At extreme levels of organic-loading, pore-water sulphate is depleted, and methanogenesis occurs. The process of methanogenesis is detected by the appearance of methane bubbles in the sediment column. These gas-filled voids are readily discernible in SPI images because of their irregular, generally circular aspect and glassy texture (due to the reflection of the strobe off the gas). If present, the number and total area covered by all methane pockets is measured.

Infaunal Successional Stage: The mapping of successional stages is possible with SPI technology and is based on the theory that organism-sediment interactions follow a predictable sequence after a major seafloor perturbation. This theory states that primary succession results in "the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest..., our definition does not demand a sequential appearance of particular invertebrate species or genera" (Rhoads and Boyer, 1982). This theory is formally developed in Rhoads and Germano (1982) and Rhoads and Boyer (1982), with a brief overview presented below.

After an area of bottom is disturbed (whether from natural or anthropogenic events), the first invertebrate assemblage (referred to as a Stage I assemblage) that appears within days after the disturbance are dense assemblages of tiny, tube-dwelling marine polychaetes that reach population densities of 10^4 - 10^6 individuals m^2 . These animals feed at or near the sediment-water interface and have the effect of physically stabilizing or binding the sediment surface by the production of a mucous "glue" that they use to build their tubes. Sometimes deposited dredged material layers contain Stage I tubes still attached to mud clasts from their location of origin; these transported individuals are considered as part of the *in-situ* fauna in our assignment of successional stages.

If there are no repeated disturbances to the newly-colonized area, then these initial tube-dwelling suspension or surface-deposit feeding taxa are followed by burrowing, head-down deposit-feeders that rework the sediment deeper and deeper over time and mix oxygen from the overlying water into the sediment. The animals in these later-appearing communities (Stage II or III) are larger, have lower overall population densities (10 - 10^2 individuals m^2) and can rework the sediments to depths of 3-20 cm or more. These animals "loosen" the sedimentary fabric, increase the sediment water content (thereby lowering the sediment shear strength) and actively recycle nutrients because of the high exchange rate with the overlying waters due to their burrowing and feeding activities.

This continuum of change in animal communities after a disturbance (primary succession) has been divided arbitrarily into three stages: Stage I is the initial community of tiny, densely-populated polychaetes assemblages, Stage II is the start of the transition

to head-down deposit feeders, and Stage III is the mature, equilibrium community of deep-dwelling, head-down deposit feeders.

Infaunal successional stages are recognized in SPI images by the presence of dense assemblages of near-surface polychaetes and/or the presence of subsurface feeding voids; both types of assemblages may be present in the same image.

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APPENDIX E

INADVERTENT DISCOVERY OF ARCHAEOLOGICAL RESOURCES

Western Port Angeles Harbor Site SAP:

Inadvertent Discovery of Archaeological Resources

Derek S. Beery- City of Port Angeles Archaeologist

The Washington State Department of Ecology (Ecology) recently signed Agreed Order No. DE 9781 with Georgia-Pacific LLC, Nippon Paper Industries USA Co. Ltd., Merrill & Ring, the Port of Port Angeles and the City of Port Angeles (City) to prepare a remedial investigation and feasibility study of Western Port Angeles Harbor. These five potentially liable parties (PLPs) are required to prepare:

- A remedial investigation, which describes the nature and extent of contamination at the site.
- A feasibility study, which evaluates cleanup options.
- A remedial investigation/feasibility study (RI/FS) report.

During the public comment period for the Agreed Order (AO) and Sampling and Analysis Plan (SAP) the Washington State Department of Archaeology and Historic Preservation (DAHP) issued recommendations about their perceived potential that this project may inadvertently impact archaeological resources during the sample collection procedure (letter from Gretchen Kaehler to Ecology dated 04-18-2013). Derek Beery, the City's archaeologist, and Bill White, the Lower Elwha Klallam Tribe (LEKT) archaeologist, had also previously discussed this issue (personal communication 03-25-13). Mr. White and Mr. Beery noted the occurrence of landward archaeological sites around Port Angeles Harbor but also discussed that two recent underwater projects with archaeological components had not identified buried resources in the Western Harbor area (Ecology and Environment 2009 and Wessen 2009).

The City, LEKT, and Ecology held a brief conference call regarding archaeological resources on April 24th 2013, and discussed the application of an inadvertent discovery protocol for the sample collection process. Connie Groven with Ecology notified Gretchen Kaehler of DAHP of this

possibility and Ms. Kaehler agreed that with supervision of the project by the City and Tribal archaeologists she would consider implementation of proper inadvertent discovery protocols a sufficient response (email from Connie Grove on 04-26-13). As a result of these discussions, The City Archaeologist drafted this inadvertent discovery protocol for inclusion in the SAP as directed by Ecology. It should be noted that this is not a typical process for similar Ecology directed undertakings and special care is being directed toward the potential for the inadvertent discovery of archaeological resources from within Port Angeles Harbor for this project.

The current undertaking includes the collection of 47 samples of bulk sediment from the harbor floor by Integral Consulting Inc. under contract to the PLP group. The 47 sample stations are grouped into two types with two additional sets of analyses scheduled at 17 of those two types of stations:

- Larval retest stations (27): Approximately 1 gallon per station
- Full suite bioassay stations (20): Approximately 2.5 gallons per station
 - Bioaccumulation analysis (15): Additional 10 gallons of sediment per station
 - Treatability analysis (2): Additional 10 gallons of sediment per station

As such, 17 of the station locations will result in collection of 12.5 gallons of sediment per station and the remaining 30 will have less than 2.5 gallons collected. Integral has not yet finalized the apparatuses for collection at the time of this publication; however they assume to use standard techniques that include a winch-driven power grab, a dual van Veen, or a Young grab sampler for the open harbor sampling and a smaller hand-deployed grab sampler (like a modified petite-Ponar or small van Veen) for the samples inside the saltwater lagoon (personal communication with Jane Sexton of Integral on 05-10-13). The larger winch-driven samplers will require four or five grabs to collect the 12.5 gallons of sediment and there may be *misfires* where sediment is not collected due to logs or other large debris clogging the jaws. Target penetration depth is anticipated to be four inches (10 cm) deep but the samplers may take up to 16 inches of sediment due to their size and constraints upon precision under deep water. The sampling will be conducted from a boat.

The following pages review recent underwater archaeological studies for the harbor and then define the archaeological inadvertent discovery protocols for the collection of samples from 47 different stations in the western portion of Port Angeles Harbor as part of this SAP (see Figure 1).

Previous Investigations and Potential for Discovery

Two 2009 archaeological investigations contain somewhat differing opinions about the potential for submerged archaeological resources in Port Angeles Harbor; although both had negative results in the western harbor area (Ecology and Environment 2009 and Wessen 2009- see insets). To date, other than isolated recovery of burned shell and obsidian micro-flake fragments from disturbed areas near the Ennis Creek estuary, no submerged archaeological sites are reported in Port Angeles Harbor. There are, however, several known and studied archaeological sites in shoreline locations around the perimeter of the harbor that date to nearly 3000 years old (notably 45CA523 and 45CA415). Prior to then the natural sandspit, Ediz Hook, and the marine bluffs had not yet receded to the location that they currently (or for the past 3000 years) maintain.

The two summaries provided in the following insets suggest that there is little likelihood of intact underwater archaeological sites in the sediments of the western harbor. The Ecology and Environment (E&E 2009: 8-1) summary states that there *may* be such resources based on their archaeological monitoring findings but they report only two sets of resources (both from disturbed contexts) near Ennis Creek and the Rayonier Dock in the eastern harbor. Their samples from the western harbor area were negative for cultural resources. Wessen's 2009 report, which included underwater survey by a diver and geotechnical borings in the western harbor area, resulted in his assessment of a low potential for undetected archaeological deposits. It was the combination of E&E's lack of findings in the western harbor during a similar sampling project and Wessen's survey negative findings that led Mr. White and Mr. Beery to agree that inadvertent discovery protocols rather than full-time, onboard archaeological monitoring during sample collections was an adequate archaeological response to Ms. Kaehler's concerns.

FROM WESSEN 2009: ii

No potentially-significant archaeological deposits or materials were observed by the diver or encountered in sediments recovered from the geotechnical borings. Moreover, boring findings suggest that the potential for as yet undetected archaeological deposits in these areas is quite low.

There are no known shipwrecks, or other potentially significant historic features thought to be on the seabed near any of the terminals and we believe that prehistoric archaeological deposits were only likely to have formed when these areas were terrestrial surfaces near the shoreline. Environmental data indicates that there were only two intervals during the known human history of this region when this occurred: a relatively brief period ca. 12,000 years ago and for an unknown period sometime during the last ca. 3,000 to 5,000 years. The geotechnical borings clearly indicate that sediments from ca. 12,000 years ago are no longer present and that all of the Holocene sediments here represent marine deposits. Holocene marine deposits in Port Angeles Harbor may contain isolated archaeological objects, but such objects would be either re-deposited items which eroded out of archaeological deposits located closer to the historic shoreline or things that fell out of watercraft. We would expect such objects to be present in only very low densities. While the glacially consolidated sediments in the project areas probably include some representing terrestrial deposits, these are considerably older deposits which are very unlikely to contain cultural materials.

FROM ECOLOGY AND ENVIRONMENT 2009: 8-1

The recovery of burned shell from Area "A" is not unexpected since a well documented ethnographic village of P'e'nis is known to have existed in the area, and burned shell is one of the most common recoveries from coastal archaeological sites. It is unlikely that the artifacts recovered from Area "B" were from their primary point of deposition (since burned shell fragments were mixed with wood waste throughout the depth of the core). The disturbed nature of the finds makes their recovery of little scientific value. Additional archaeological deposits may be located in harbor and offshore contexts. The results of this monitoring project show that Port Angeles Harbor and shoreline developments may impact intact, buried cultural resources. There may be need for continued cultural resources monitoring of marine projects in nearshore and offshore areas demonstrated to have sensitivity for buried cultural resources. Criteria would be evidence that submerged sediments were deposited sometime after the terminal Pleistocene or throughout the Holocene, and that these sediments became submerged due to rising sea levels.

Archaeological Procedures

The City Archaeologist developed the following archaeological inadvertent discovery protocols through consultation with Ecology and LEKT. The City Archaeologist will serve as the project Principal Archaeologist. As stated above the consultations between the City, LEKT, and Ecology referenced the findings of previous archaeological investigations in and around Port

Angeles and took into account the recommendations and findings from the 2009 reports by Wessen for the Port of Port Angeles and E&E for Ecology. Based on these previously reported results the parties agreed that there is little likelihood that the four-inch deep penetrations for the grab samples will adversely affect submerged archaeological sites in Western Port Angeles Harbor. For this reason an archaeological monitor should not be required to be present on the boat during collection operations. DAHP, however, has issued their concerns that an inadvertent discovery protocol be attached to the SAP. The following paragraphs and sections address the protocols for archaeological oversight for the project.

Briefing

The City Archaeologist will provide a brief training on archaeological issues to scientific personnel at a pre-work meeting to ensure that they understand and comply with the archaeological protocols for inadvertent discoveries. Personnel involved in sample collection who have not received this training to the satisfaction of the City Archaeologist will not be allowed to perform sample collection. The briefings will be conducted by the City Archaeologist. The briefing will include background information about the roles of personnel, the legality of cultural resources compliance, and issues of respect and sensitivity of archaeological issues for modern Native American cultures of the Pacific Northwest. The briefing will also specifically focus on the procedures to be followed if a potential archaeological discovery is made during collection. Items of archaeological interest to be discussed will include such things as discarded shell, fire-altered rock, animal bone, lithic debitage, stone tools, heat-altered sediment, charcoal, ash, or other organic materials like cordage and fiber, or exotic materials not normally found in the region. Historic materials may also be encountered and typical historic period artifacts, in addition to many of the items discussed in the previous sentence, include items pre-dating 1950 A.D. such as milled lumber, masonry features, concrete, glass, ceramic, brick, wire, nails or other evidence of historic occupation and industry.

Qualifications

The City Archaeologist, acting as the Project Principal Archaeologist, meets the Secretary of the Interior's Professional Qualifications Standards for Archeology (48 CFR 44738). The City Archaeologist conducts regular business hours for the City and is reachable on his cell phone during non business hours. He will be in the City working on various archaeological projects during the sample collection and will be available to review any potential discoveries. He will

respond quickly to any questions or concerns about archaeological issues that arise during the sample collection. The City Archaeologist may also choose to conduct archaeological monitoring on board the sample collection boat.

Archaeological Monitoring

The primary goal of inadvertent discovery protocols will be documentation and proper handling of previously unknown items of archaeological interest collected inadvertently during the sampling process.

1. When the City Archaeologist is not present for sample collection, the Scientist in charge of the sampling process on board the boat will review the soils and other materials (biological or cultural) from each grab. If any items of archaeological interest are noted he or she will immediately protect the sample and notify the City Archaeologist. The City Archaeologist will inquire into the nature of the find and direct the next steps so that he may review the find and make determinations for proper contacts and protocols. At this point all work at that station must halt until the City Archaeologist has made a determination regarding the find. *Human Remains will be handled differently and are discussed later in this document in their own section.*
2. The City Archaeologist shall observe any items of archaeological interest within 24 hours of collection and will keep detailed notes on inadvertent discoveries including personnel present, location, time, and nature of the find. Screening of sample sediments will be to the discretion of the City Archaeologist. No soils accompanying a find of archaeological interest shall be disposed of until released by the City Archaeologist.
3. If the City Archaeologist determines that the items are not archaeological in nature work at that station may resume. If the City Archaeologist determines the find is a part of an archaeological *site* he will make the proper contacts and determine a course of action for that station. In this case work may resume only at other stations.

4. For purposes of this project a *site* is defined as two or more archaeological objects (artifacts or features) found on the same landform and within reasonable proximity to each other. An *isolate* is defined as any single artifact or single object broken into multiple pieces (such as a glass jar broken into multiple fragments). Any features such as fire hearths or other domestic features, refuse dumps/midden, concentrations of more than five prehistoric artifacts, or ten or more historic artifacts will require work stoppage and/or further investigation. If such finds are encountered supplemental investigations may be conducted to determine the significance of the archaeological resource.
5. The attached Chain of Communication (Appendix A) defines contacts for each interested party in the event of a notable discovery. If the find includes human remains, the City Archaeologist will also immediately notify the Clallam County Coroner and the Port Angeles Police as stipulated by State Law (see subsection on *Human Remains*). In the event of a confirmed inadvertent discovery the City Archaeologist will ensure that the Integral Project Manager, City Project Manager, and Ecology are notified of the discovery within one (1) day. The Principal Archaeologist will assemble all documentation and compose a preliminary assessment. The City Archaeologist will also notify the LEKT Archaeologist of any confirmed inadvertent discovery at the same time that he notifies Ecology. Ecology may be required to notify other interested tribes and parties of archaeological efforts or discoveries as part of their cultural resources responsibilities. Archaeological Monitoring of the sample collection is not required for this project. However; at any time during the project, the City Archaeologist may alter the protocols and request that he observe the collection of samples from the boat.
6. The City Archaeologist will ensure the proper documentation and assessment of any items of archaeological interest that are inadvertently encountered during the undertaking.

- (i) All archaeological materials discovered during the project will be recorded on a DAHP isolated find or site form.
- (ii) Inadvertent discoveries will be digitally photographed as applicable.
- (iii) Artifacts and archaeological samples inadvertently collected during the sampling will be documented and analyzed by the City Archaeologist (unless Human Remains are present requiring the conditions that follow under the *Human Remains* Section). Any samples or artifacts collected during such documentation and analysis will be held in secure storage until such a time as they can be conveyed to a repository or returned to their original location. The LEKT may provide this service.
- (iv) Stratigraphic profiles will not be possible for underwater grab-sampling. Soil descriptions of associated sediments in the sample will be part of the inadvertent discovery description.
- (v) Discovery locations will be documented on site maps and orthophotos.
- (vi) Inadvertent discovery locations will be plotted using professional grade GPS.

Inadvertent Collection

Collection of artifacts or other items of archaeological interest by contractor's employees, construction personnel, or others with access to the project as guests or employees of the PLPs are strictly prohibited except as discussed under the protocols above when professional archaeological analysis is required to make a determination of the significance of an inadvertent discovery or to better define research questions as part of future cleanup activities. If Native American human remains or associated or unassociated funerary objects are inadvertently collected during archaeological investigations then the reporting protocols discussed below under *Human Remains* shall take precedence.

Human Remains

If sampling activity unearths human remains such as isolated human teeth or bones or other mortuary items; then all activity to analyze the sample must cease that may cause further disturbance to those remains and they must be immediately secured and protected from further

disturbance. The finding of human skeletal remains must be reported to the Clallam County Coroner and the Port Angeles Police Department in the most expeditious manner possible. The City Archaeologist shall make the notification of human remains to the Clallam County Coroner and the Port Angeles Police Department. Concurrent with this notification the City Archaeologist will also notify the City Project Manager, the Integral Project Manager, and Ecology consistent with all other archaeological notification requirements. The remains should not be touched, moved, or further disturbed beyond bringing them to shore for professional review. The sample location must be marked with a professional grade GPS recorder. The Coroner will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic/archaeological. If the Coroner determines the remains are non-forensic, then they will report that finding to DAHP who will then take jurisdiction over the remains. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes. DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

Confidentiality

Archaeological properties are sensitive and archaeological sites are susceptible to vandalism and illegal removal activities. For this reason any information regarding discovered archaeological resources, their location, and other information should be held secure in order to protect the resources. To the extent allowed by law, all information concerning the discovery and/or location of archaeological resources, especially human remains, will be treated as CONFIDENTIAL and exempt from public disclosure under RCW 42.56.

1. The Contractor personnel shall not photocopy documents containing information on culturally sensitive findings. The Contractors may be required to keep a log identifying all persons who access the sensitive information and the date the access was permitted. Contractors and their representatives may be required to sign non-disclosure statements.
2. The Contractors may not release any information regarding archaeological discoveries to any media or third party or share information with the general public.

All requests for information regarding archaeological or cultural matters shall be submitted to the City Archaeologist.

3. Any disregard for these protocols on behalf of the Contractors or their subcontractors may constitute a Class C felony offense under RCW 27.44.040 or result in civil penalties and/or require compensation of the City and/or DAHP for all restoration costs under RCW 27.53.095.
4. All records resulting from archaeological investigations conducted under this inadvertent discovery protocol will be securely stored at an authorized curation facility with copies presented to consulting parties if requested in writing.

Reporting

In the event of one or more inadvertent archaeological discoveries, the City Archaeologist will prepare a final report for the project. This final report, if necessary, will be filed with DAHP in a form acceptable to DAHP and include site forms in a format acceptable to DAHP. The City Archaeologist will prepare this report and deliver it to Ecology within two (2) months after the completion of the ground disturbing construction components of the sampling project.

Schedule

The City will provide notice of *intent to proceed* for ground disturbing actions to the LEKT and DAHP by email two (2) working days prior to initiating sample collections. The Western Harbor Group currently forecasts that the project will be completed during June or July 2013. As stated above, the City Archaeologist will produce a final inadvertent discovery report, if inadvertent discovery is made during the project, and provide it to Ecology within 2 months after completion of the sample collections. The City will notify Ecology, LEKT, and DAHP of any changes to this schedule.

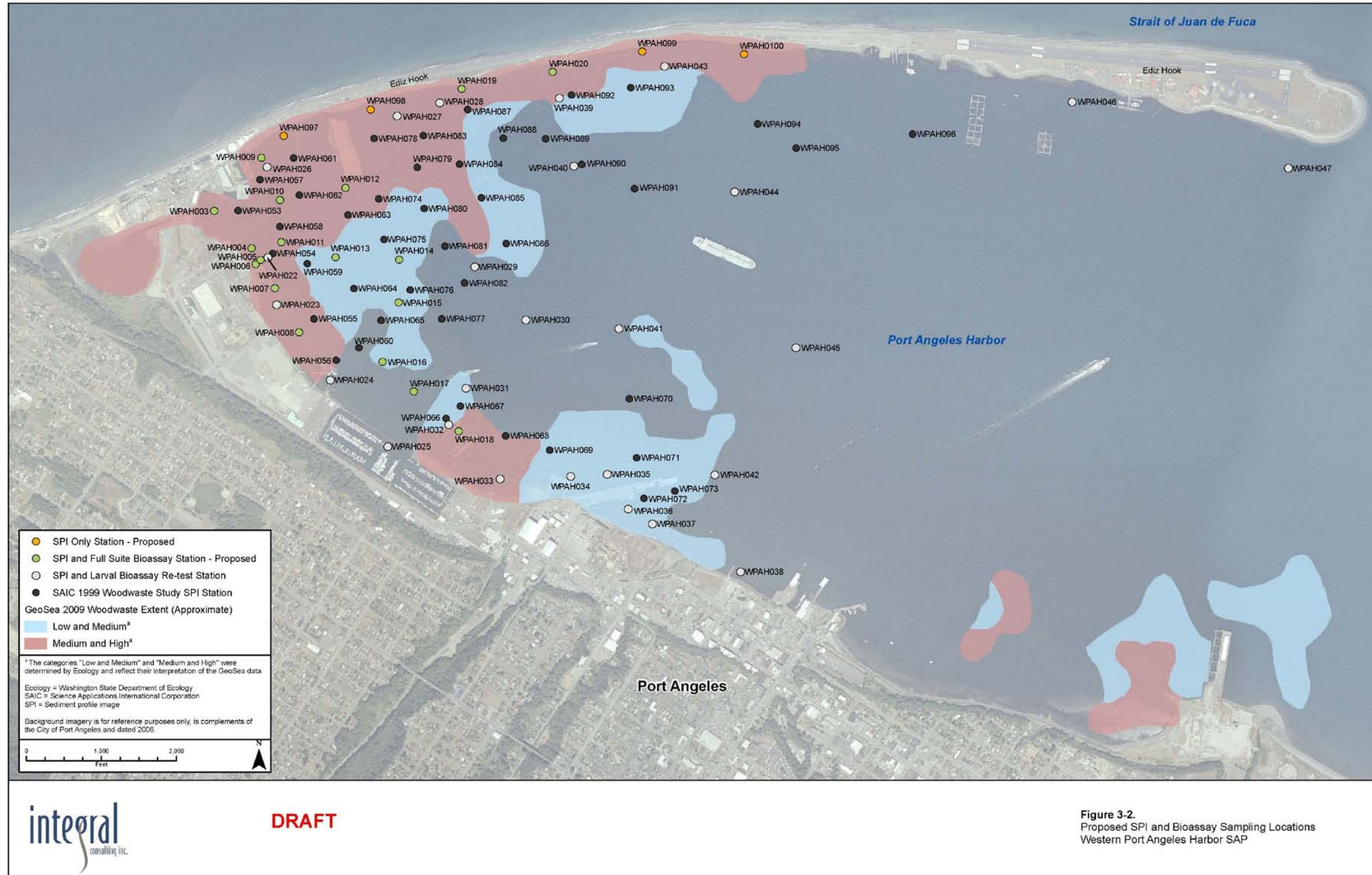


Figure 1. Overview of placement for Full Suite Bioassay and Larval Retest Stations, western Port Angeles Harbor.

References Cited

Ecology and Environment, Inc.

- 2009 *Cultural Resources Monitoring for Port Angeles Harbor Sediment Characterization Study*. Report prepared for Washington Department of Ecology Toxics Cleanup Program Southwest Regional Office: Lacey, Washington.

Wessen, Gary C. Phd.

- 2009 Archaeological Surveys of Selected Areas at Terminals 3, 5, and 7, Port Angeles Harbor, Port Angeles, Washington. Report prepared for the Port of Port Angeles: Washington.

Appendix A: Contact List

Washington State Department of Ecology
Mailing Address: Site Manager/Environmental Engineer Department of Ecology Southwest Regional Office/Toxics Cleanup Department
Phone: (360) 407-6254
Project Contact: Connie Groven
email: connie.groven@ecology.wa.gov

Washington State Dept. of Archaeology and Historic Preservation (DAHP)
Mailing Address: DAHP/SHPO PO Box 48343, Olympia, WA 98504-8343
Phone: (360) 586-3065
Fax: (360) 586-3067
Director/SHPO, Dr. Allyson Brooks, Allyson.Brooks@dahp.wa.gov (360) 586-3066
Physical Anthropologist, Dr. Guy Tasa Guy.tasa@dahp.wa.gov (360) 586-3534 (360) 790-1633 after hours cell phone
Project Contact: State Archaeologist, Gretchen Kaehler
Gretchen.Kaehler@dahp.wa.gov (360) 586-3088

City of Port Angeles
Address: 321 E 5 th St., Port Angeles, WA 98362
Project Contact: Derek S. Beery, City Archaeologist
Phone: 360-417-4704 (office) / 360-461-9131 (cell)
Email: dbeery@cityofpa.us
Director of Community and Economic Development, Nathan West
Email: nwest@cityofpa.us
Phone: 360- 417-4751

Lower Elwha Klallam Tribe
Address: 2851 Lower Elwha Road, Port Angeles, WA 98363
Project Contact Name: William White, Lower Elwha Klallam Archaeologist
Phone: 360- 452-8471 ext. 163 (office) / 360- 460-1617 (cell)
Email: Bill.white@elwha.nsn.us
Council Chair, Frances Charles
Email: francescharles@elwha.nsn.us
Phone: 360- 452-8471, ext. 106
CEO, Sonya Tetnowski
Email: Sonya.tetnowski@elwha.nsn.us
Phone: 360- 452-8471, ext. 115

Integral Consulting Inc.
Address: 411 1st Avenue S., Suite 550 Seattle, WA 98104
Project Contact Name: Jane E. Sexton, Managing Scientist
Phone: Direct: 206.957.0342 Cell: 206.999.5793
Email: jsexton@integral-corp.com
Integral Project Manager: Betsy Day
Email: bday@integral-corp.com
Phone: 206.957.0346

Local Law Enforcement (Human Remains Assistance)
City of Port Angeles Police Chief, Terry Gallagher (360) 417-4901
City of Port Angeles Deputy Police Chief, Brian Smith Bsmith@cityofpa.us (360) 417-4902 (360) 912-0184
Clallam County Sheriff, Bill Benedict (360) 417-2262 Admin: (360) 417-2262
Clallam County Coroner/ Prosecuting Attorney, Deborah S. Kelly dkelly@co.clallam.wa.us (360) 417-2368