

UPDATED FINAL

Surface Water and Sediment Trap Field Sampling Plan

**Portland Harbor Pre-Remedial Design
Investigation and Baseline Sampling
Portland Harbor Superfund Site**

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September 27, 2018

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
μm	micrometer
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzodioxin
ADCP	acoustic Doppler current profiler
AECOM	AECOM Technical Services
ALS	ALS Environmental
ARARs	applicable or relevant and appropriate requirements
ASAO	Administrative Settlement Agreement and Order on Consent
BEHP	bis-(2-ethylhexyl) phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
COCs	contaminants of concern
CRD	Columbia River Datum
CSM	Conceptual Site Model
D/F	dioxins/furans
DDx	dichlorodiphenyltrichloroethane (DDT) and its derivatives
DGPS	differential global positioning system
DI	deionized water
DOC	dissolved organic carbon
DQMP	Data Quality Management Plan
DQOs	data quality objectives
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
FC	Field Coordinator
FS	feasibility study
FSP	Field Sampling Plan
Geosyntec	Geosyntec Consultants, Inc.
GFF	glass fiber flat
Global	Global Diving & Salvage, Inc.
Gravity	Gravity Marine Services
ID	identification number

Integral	Integral Consulting
L	liters
LISST	Laser <i>In Situ</i> Scattering and Transmissometry
LWG	Lower Willamette Group
MCP	methylchlorophenoxypropionic acid
MDL	method detection limit
min	minute
NAD	North American Datum
NAVD88	North American Vertical Datum of 1988
NTU	Nephelometric Turbidity Unit
NWIS	National Weather Information System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	Pre-Remedial Design Investigation
pg	Particulate Phase
PHSS	Portland Harbor Superfund Site
PP	peristaltic pump
PQL	practical quantitation limits
Pre-RD AOC Group	Pre-Remedial Design Agreement and Order on Consent Group
PSEP	Puget Sound Estuary Program
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI	remedial investigation
RM	river mile
ROD	Record of Decision
Site	Portland Harbor Superfund Site
SOP	standard operating procedure
SOW	Statement of Work
ST	sediment trap
SVOC	semi-volatile organic compound
SW	surface water
TDS	total dissolved solids

TestAmerica	TestAmerica Laboratories
TOC	total organic carbon
TSS	total suspended solids
USGS	United States Geological Survey
VOC	volatile organic compound

1. INTRODUCTION

The Record of Decision (ROD) described a post-ROD sampling effort for the Portland Harbor Superfund Site (Site or PHSS; Figure 1) located in Portland, Oregon, to delineate and better refine the sediment management area footprints, refine the Conceptual Site Model (CSM), determine baseline conditions, and support remedial design (United States Environmental Protection Agency [EPA] 2017a). Geosyntec Consultants, Inc. (Geosyntec), and AECOM Technical Services (AECOM) have submitted a detailed Work Plan for Pre-Remedial Design Investigations (PDI) on behalf of a group of industrial parties called the Pre-Remedial Design Agreement and Order on Consent Group (Pre-RD AOC Group). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-RD AOC Group to conduct the PDI studies at the Site (EPA 2017b). The ASAOC includes the Statement of Work (SOW) and the PDI Work Plan (an attachment to the SOW), which generally describe the field investigation activities, data analyses, schedule, and deliverables for the PDI.

These PDI studies are a foundational step in what will be a multi-phase effort to update current conditions from the collection of data during the remedial investigation (RI)/feasibility study (FS). The RI/FS was initiated by a group of potentially responsible parties known as the Lower Willamette Group (LWG) and completed by EPA in 2016 (EPA 2016a, 2016b). The RI consisted of three rounds of data collection, including surface and subsurface sediment, bank soils, surface water, sediment traps, porewater, fish tissue, and other media from 2001 through 2007.

This Field Sampling Plan (FSP) was prepared to support the surface water and sediment trap sampling efforts outlined in the PDI Work Plan (Geosyntec 2017) and the project Quality Assurance Project Plan (QAPP) (AECOM and Geosyntec 2018a). To the extent practicable, previously approved FSPs and standard operating procedures (SOPs) from the RI will be referenced.

1.1 Project Setting

The PHSS is located in Portland, Oregon, on the lower Willamette River immediately downstream of the urban downtown. The Site extends from river mile (RM) 1.9 upstream to RM 11.8 and covers 2,190 acres (Figure 1). There are two reaches located immediately upstream of the Site. The Downtown Reach, which includes the urbanized area of downtown Portland, is defined by EPA as extending from RM 11.8 to RM 16.6. EPA defines the Upriver Reach as extending from RM 16.6 to RM 28.4.

1.2 Project Overview

In the RI (EPA 2016a), surface water samples were collected using two primary methods: 1) a peristaltic pump (PP) method; and 2) a high-volume method using either an Infiltrax 300,

Infiltrax-L, or Gravity PR2900 system with XAD-2 resin columns (Amberlite® XAD®-2 polymeric adsorbent is a hydrophobic crosslinked polystyrene copolymer resin) to collect hydrophobic organic compounds for analysis by ultra-low detection analytical methods (XAD method). The PP method was used to collect samples for total concentrations of constituents (particulate and dissolved combined; whole water samples) and dissolved metals (i.e., as the filtrate of water passed through a 0.45-micrometer [μm] in-line cartridge filter in the field). The XAD method was used to collect samples consisting of a particulate phase (solids captured on a series of filters) and a dissolved phase (consisting of the fraction of dissolved organic constituents binding to the XAD-2 resin), which were summed to a total concentration (calculated).

To support the PDI studies, surface water data will be collected consistent with the RI approach. Surface water samples for analysis of hydrophobic organic compounds by ultra-low detection limit analytical methods will be collected using a high-volume pumping system (Gravity PR2900) connected to an in-line vortex separator, followed by a 0.5 μm glass fiber flat (GFF) filter and a XAD-2 resin column. Surface water samples will also be collected using a PP for the analysis of specific semi-volatile organic compounds (SVOCs), other organics, and metals (including total and dissolved metals via field filtering of samples as described above), and non-chemical parameters (e.g., total suspended solids [TSS]).

Sediment traps were also used in the RI to characterize waterborne sediment contamination that enters the study area from upstream sources (Integral 2006). For the PDI studies, sediment traps will again be deployed to collect sediment settling from the surface water column. The data will provide a line of evidence for incoming sediment load to the Site. The sediment traps will target fine-grained, more mobile suspended sediment, and material higher in total organic carbon (TOC) that is more likely to move downstream and be deposited within the Site. Sediments captured in the sediment traps will be analyzed for the full ROD suite of contaminants of concern (COCs) for sediment (see ROD Table 17, relisted in Table 3 of the PDI Work Plan), TOC, and grain size.

1.3 Data Quality Objectives

Data quality objectives (DQOs) for surface water and sediment trap sampling are detailed in the QAPP Table 3 (AECOM and Geosyntec 2018a). The objectives of PDI surface water and sediment trap sampling are to 1) baseline the river conditions in 2018 with synoptic data (sediment and fish tissue), 2) investigate current surface water conditions and changes over time, and 3) update study area conditions to refine the CSM for future remedial design purposes, as described in the PDI Work Plan (Geosyntec 2017). In addition, sediment trap sampling will provide data regarding upstream conditions and contaminant loading into the Site.

2. SAMPLING DESIGN AND APPROACH

This FSP provides the additional details necessary to ensure that the execution of the study will achieve the project-specific DQOs and data use objectives set out in Section 1.3 of this FSP and Section 3.2 of the QAPP (AECOM and Geosyntec 2018a). This section of the FSP presents the details of the study design including the methods, locations, and approach of sampling.

The purpose of surface water sampling is to characterize the flow and quality of surface water passing through the river's cross section at each location and evaluate chemical concentrations immediately upstream of the Site that could be contributing to incoming contaminant loads. One cross-sectional composited sample will be collected per transect (similar to the RI Round 2A approach).¹ The sample design will be vertically composited and horizontally composited along the transect, with equal volume across the cross-sectional area of the segment. Surface water sampling will be conducted over three events targeting different months and flow conditions to capture seasonal and flow-dependent variability of surface water conditions (high-flow, low-flow and a stormwater event; Section 2.4).

Sediment traps will be placed along two of the upstream transects to evaluate incoming sediment loads (settling particulate matter). These sediment traps will also be deployed over similar seasonal conditions as the surface water sampling to capture high-flow, low-flow, and stormwater events (three events). However, sediment traps will be deployed over a period of 3 months, compared to a 1-week sampling schedule for surface water. The goal of sediment trap sampling is to overlap with the surface water sampling sometime during each seasonal event, but the interval/collection durations are not the same. Please refer to Section 2.4 for further details of the sampling schedule.

Methods for surface water and sediment trap sampling are generally consistent with the following:

- EPA-approved sampling plans from the RI (Integral Consulting [Integral] 2004a, 2004b, 2006b, and 2006c)
- San Francisco Estuary Institute's *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001)
- *Interagency Field Manual for the Collection of Water-Quality Data* (United States Geologic Survey [USGS] 2000)
- EPA Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996)

¹ Ethylbenzene samples will be collected as a series of discrete samples from the three near-bottom locations across each transect and will not be composited.

- EPA guidance on collecting and evaluating sediment data (EPA 2014)
- Puget Sound Estuary Program (PSEP) protocols (PSEP 1986)

Previous study designs are briefly discussed below. Variation in sample design or collection from the site-specific RI documents is provided in Section 2.5.

2.1 Surface Water

2.1.1 Surface Water Sampling Method Selection and Rationale

Surface water samples will be collected by two methods: 1) a PP, and 2) a high-volume pumping system (Gravity PR2900) consisting of a series of filtration (vortex separator and GFF filter) to capture the particulate phase and an XAD-2 resin column to capture the dissolved fraction of target constituents. The PP method is appropriate for non-organic chemicals and those that do not require ultra-low detection limits. The PP method will be used to collect samples for total concentrations of constituents (particulate and dissolved combined; whole water samples) and dissolved metals (i.e., as the filtrate of water passed through a 0.45 µm in-line cartridge filter in the field). The high-volume surface water sampling method (herein referred to as the high-volume method) will be used to collect samples for analysis of hydrophobic organic compounds by ultra-low detection limit analytical methods (Table 1). Analysis of surface water samples collected via the high-volume method is more likely to detect lower concentrations of focused COCs resulting in method detection limits (MDLs) that are at or below applicable or relevant and appropriate requirement-based cleanup levels (ARAR-based cleanup levels) provided in the ROD (Table 17 of ROD and Table 3 of the PDI Work Plan).

Based on the RI dataset, the high-volume method consistently obtained 99% or greater detection frequency for focused COCs and resulted in MDLs that were consistently lower than PP samples (Table 1). The high end of the range of MDLs for PP samples was above the ARAR-based cleanup levels for all focused COCs. High-volume samples resulted in MDLs that were below ARAR-based cleanup levels for dichlorodiphenyltrichloroethane (DDT) and its derivatives (DDx) and total polychlorinated biphenyls (PCBs). The ARAR-based cleanup level for total polycyclic aromatic hydrocarbons (PAHs) is based on benzo(a)pyrene equivalents, which do not have a specified MDL for high-volume samples; however, individual PAH MDLs² were below ARAR-based cleanup levels for all PAHs with the exception of benzo(a)pyrene and dibenz(a,h)anthracene. The ARAR-based cleanup level for the dioxin 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD) toxic equivalency is unachievable for MDLs under the PP method and achievable using high-volume sample methods only if 1,000 liters (L) or more of surface water is pumped in the field.

² PAHs will be analyzed using the isotopic dilution method, which is characterized by sample-specific Estimated Detection Limits rather than MDLs.

The PDI target volume is 400 L per composite sample, to be collected within a 12-hour field day. A sampling volume of approximately 1,000 L was collected during the first sampling events of the RI to achieve ultra-low detection limits. However, the testing laboratory (AXYS) indicated that the background interferences in the XAD-2 resin when sampling such large volumes during the RI forced a dilution series that essentially negated the positive effect of the larger volume. In addition to the interferences, at a flow rate of 1.5 liters per minute (L/min) (maximum rate), the sampling would take over 12 hours of pumping. Combined with transit time to the transect locations, set-up time at each location across the transect, and filter changes, monitoring, etc., there is not adequate daylight to safely perform a larger volume effort. Based on the detection limits for the XAD resin provided by AXYS for the PDI work, a 400 L composite sample, with the extract split 75% for dioxin/furan (D/F), PCBs, and pesticides, and 25% for PAHs, meets the ARAR-based cleanup levels for all COCs with the exception of D/F.

2.1.2 Chemistry and Rationale for Sampling Locations

Surface water will be collected from seven transect locations over three sampling rounds to provide spatial coverage across the study area and evaluate a range of river dynamics (high-flow, low-flow, storm events). Approximate transect locations are depicted on Figure 2 and listed on Table 2 as follows:

- Transect 1: RM 1.8 at the downstream boundary (within the Site)
- Transect 2: Downstream boundary of the Multnomah Channel; entrance to channel is near RM 3
- Transect 3: RM 4
- Transect 4: RM 7
- Transect 5: RM 8.8
- Transect 6: RM 11.8, just upstream of the Site, near the Downtown Reach boundary
- Transect 7: RM 16.2, further upstream, near the boundary between the Downtown Reach and the Upriver Reach

These transect locations were selected to provide representative coverage from each of the four segments of the Site: RMs 1.9 to 5 (Segment 4); RMs 5 to 7.5 (Segment 3); RMs 7.5 to 9 (Segment 2); and RMs 9 to 11.8 (Segment 1).

Composite surface water samples will be analyzed in the laboratory for conventional parameters and chemical testing for the ROD COCs presented in Table 3a, with the exception of ethylbenzene, which will be collected as a series of discreet samples. Concentrations of organic compounds with low detection limits will be collected with the Gravity PR2900 using a vortex solids separator and GFF filter to capture the particulate phase, and an XAD-2 resin column to capture the dissolved fraction. These constituents (PCB congeners, select pesticides, PAHs, and D/F) will be reported by the laboratory as concentrations in the particulate phase (from the solids

collected by the vortex solids separation system and a laboratory grade 0.5 µm GFF filter) and the dissolved phase (from the XAD-2 resin column); total surface water concentrations will be calculated from these fractions, consistent with RI methods. Filtered PP samples in the field will be analyzed for select dissolved metals, hardness as calcium carbonate, and dissolved organic carbon (DOC). Unfiltered PP samples will be analyzed for select total metals, ethylbenzene, MCPP, select SVOCs, tributyltin, and conventional analytes including TSS, total dissolved solids (TDS), and TOC. The COCs to be analyzed under each collection method are outlined in Table 3a and compared in Table 3b.

Field parameters of the river will include temperature, pH, dissolved oxygen, turbidity, conductivity using a multi-probe YSI, flow rate velocity using a hand-held acoustic Doppler current profiler (ADCP), and particle size distribution and particle concentrations using a Laser *In Situ* Scattering and Transmissometry (LISST). LISST is a submersible multi-parameter system for *in-situ* measurements of particle size distribution and concentration and will be used during surface water sampling. The ADCP measures water flow rates, and hand-held instruments will be used during surface water sampling. At a minimum, data from both instruments will be recorded in the field at three water depths per station (see next section). The SOPs for 1) measuring water quality parameters including particle size distribution and particle concentrations using LISST measurements and 2) performing the handheld acoustical Doppler current profiler measurements are provided in Appendices B-1 and B-2, respectively.

2.1.3 Sample Types, Locations, Depths

One composited sample will be collected per surface water transect (similar to the RI approach during RI Round 2A). The sample will be vertically composited and horizontally composited along the transect. Composite samples will be collected by sampling nine equal volumes from three locations along each transect (east shore, middle of the navigation channel, and west shore) and at three depths per location: upper depth (3 feet below water surface), near bottom (3 feet above sediment surface), and middle (equal distance between upper and bottom). The objective of the composite sample design is to collect a sample volume that is representative of the cross-sectional area of the transect.

Prior to sampling, the depths across the river at each location will be measured and recorded. If the nearshore subsample locations have shallow water depths (i.e., less than 10 feet), fewer subsamples may be collected and more volume collected per subsample. If fewer subsamples are collected, volumes will be adjusted such that equal volume of surface water is collected from the east shore, navigation channel, and west shore. Target water depths based on 2009 bathymetry are listed in Table 2.

As shown on Table 3a, four types of samples will be collected per event and per transect (one at each of the seven transects):

- High-volume surface water samples as the particulate phase collected using a vortex separation system and 0.5 µm GFF filter

- High-volume surface water samples as the dissolved phase in XAD-2 resin beads that adsorb hydrophobic compounds
- PP-filtered using 0.45 µm in-line cartridge filter (dissolved phase) surface water samples
- PP-unfiltered (total) surface water samples

A total of 21 of each of the four sample types listed above will be collected for the PDI study.

2.2 Sediment Trap

2.2.1 Selection and Rationale for Sampling Locations and Chemistry

A total of four discrete traps will be deployed per event, and all will be placed at upriver locations to assess incoming contaminant loads to the Site. Two sediment traps will be deployed at upriver transect RM 11.8 (the target placement is actually at RM 11.81 just above the boundary of the Site), and two additional traps will be placed at upriver transect RM 16.5 (Figure 2, Table 2). Sediment traps will be sampled in coordination with the surface water sampling program (three events over 1 year, concurrent with the surface water sampling program); the traps and surface water sampling events will temporally overlap.

A total of 12 samples will be collected for the PDI study (four samples, three events). Retained sediments (settled particulate matter) will be analyzed for the full ROD suite of sediment COCs, TOC, and grain size (Table 3a).

2.2.2 Sediment Trap Design, Sample Types, Locations, Depths

The sediment trap dimensions, ratio and cluster design, and deployment methods are consistent with methods used in the RI (EPA 2016a). Sediment traps will consist of four glass tubes sized 15 centimeters in diameter and 80 centimeters long (Figure 3).³ Baffles will not be used. Each tube will contain approximately 1 L of high salinity water (dense salt) and sodium azide or formalin preservative to help maintain the integrity of the samples and confirm that the cylinder has remained upright during deployment (i.e., check the salinity of the water). The top of the trap is oriented perpendicular to the direction of the flow, so that the surface water will pass over the opening of the tube, lose energy, and settle inside the tube. Sediment traps are designed with a 5:1 height-to-diameter ratio consistent with PSEP methods (PSEP 1997). The sediment trap is secured above the mudline with the open top of the cylinders 3 feet above the mudline. This height was determined to ensure sediments are collected settling from the water column and not from re-suspension of bedded sediments and has been used effectively at other sites (Norton

³ The currently planned design for sediment traps may be reconsidered during project planning should additional information regarding hydrodynamics and sediment transport at the Site indicate a wider diameter sediment trap may be needed; a 5:1 height-to-width ratio will be maintained.

2001). Glass tubes will be placed inside protective polyvinyl chloride rings; the rings will be fastened together and secured to a rebar post driven into the sediment floor by divers, consistent with RI methods.

The traps will be deployed for a period of approximately 3 months, then repeated for two additional 3-month deployments to reflect the same targeted flow patterns for surface water sampling. Traps will be installed and retrieved by commercial divers, consistent with methods described in the RI. The material from each of the four tubes (four subsamples per station) will be composited together into one sample per location and per event for chemical analyses.

2.3 Sample Nomenclature

Sample identification will be performed in a manner similar to the RI Round 1 FSP (Integral 2002, Section 4.2) and described in the QAPP. All samples will have a unique identifying sample identification number (ID), including the following:

- Project phase (PDI)
- Sample matrix (surface water [WS]; sediment trap [ST])
- Unique, sequential transect number or station number (T01 to T07 for surface water transect; ST-XXX to ST-XXX for sediment trap)
- For ethylbenzene, the transect number will be followed by “E,” N,” or “W” to indicate location along the transect where E = east, N = navigation channel, and W = west.
- Sampling Round Identifier using YYMM designation (1803 for 2018 event in March)

For example, a surface water sample collected from the first transect will be assigned the sample ID of PDI-WS-T01-1807 during the low-flow summer season in July 2018 from Transect #01. The ethylbenzene sample collected from the navigation channel at that transect would be identified as PDI-WS-T01N-1807. As another example, a sediment trap sample from the first upriver transect (Transect 06) during the first sampling round in March 2018 will be assigned the sample ID of PDI-ST-T06a-1803 from station “a” along that transect. See Section 4.2.1 of the QAPP for nomenclature associated with field duplicates and other quality assurance (QA)/quality control (QC) samples.

Additional data fields will be populated in the database with unique features associated with each sample or subsample, such as sampling depth of equipment, sampling equipment, subsample locations, RM, etc. The sample IDs will not be different for the specific fractions of surface water (i.e., whole water, filtered water, particulate phase or XAD-2 adsorbed dissolved phase). Rather, the matrix field within the database will be used to identify the specific fraction (for example, “XAD” to represent the dissolved phase of the organic constituents collected using the PR2900 or “F” for field-filtered samples collected using the PP). See the QAPP (AECOM and Geosyntec 2018a) for details.

2.4 Sampling Schedule

The overall project schedule is outlined in the PDI Work Plan. The anticipated schedule for the surface water and sediment trap sampling is mid-summer (July/August) through early spring (February/March 2019). Surface water and sediment trap sampling will be conducted over three events targeting different months and flow conditions to capture seasonal and flow-dependent variability of surface water conditions. Sediment traps will not be deployed or retrieved on the same days as surface water sampling to avoid disturbance of bedded sediment during surface water sampling.

2.4.1 Surface Water Sampling Schedule

The scheduling of sampling events will be based on two criteria 1) actual flow and storm conditions (primary) based on the conditions described below, and 2) target months (secondary) based on consistency with historical data. The target months reflect the most likely timing for sampling and provide the laboratories and vessel support with a target schedule for preparation of field equipment. However, if desired conditions are not met during anticipated sampling months, then alternate options will be discussed with EPA (e.g., relaxation of target criteria or sampling in a later month). Ideally, PDI sampling would be in the same months as historical data for seasonal comparability, since seasonal differences in the river system may affect study area conditions and concentrations.

During the RI, three sets of surface water sampling events occurred: Round 1, Round 2A, and Round 3A (EPA 2016a). Each set of sampling events targeted low-flow, high-flow, and/or stormwater-influenced conditions (Table 4a). The flow and storm conditions targeted for sampling are provided in the RI Round 3A FSP:

- **Low-flow events** are characterized by sustained⁴ daily average flows less than 20,000 cubic feet per second (cfs) for the PDI sampling. These conditions can occur throughout the year. During the RI, Round 2 low-flow events occurred in November 2004, March 2005, and July 2005; the Round 3 low-flow event occurred in September 2006. Historically, low-flow conditions are reliable in the summer during the months of July, August, and mid-September, but can occur as early as March and as late as November. For Round 2, the lowest low-flow event was in July, with an average flow of 8,604 cfs (range of 20,519 to 8,604 cfs monthly average among low-flow sampling events [Integral 2006a]). Based on historical average flows (Figure 4), the months of July to October typically have average flows of < 20,000 cfs. The PDI target sampling schedule for low-flow conditions is mid-summer (e.g., July/August 2018).
- **High-flow events** are characterized by sustained, non-storm-induced flow of greater than 50,000 cfs for the PDI sampling. For safety considerations, sampling should not occur if

⁴ Sustained flow conditions are considered to be flow conditions lasting greater than 24 hours.

flows exceed 100,000 cfs. During the RI, high-flow events occurred in January 2006 and January 2007. The January 2006 high-flow event occurred during average flows of 168,000 cfs (Integral 2006b). During the January 2007 event, sampling was done in two phases. Sampling occurred from January 15 to 18, 2007, and was halted due to reduced flows < 50,000 cfs. Sampling resumed from February 21 to March 10 when flows were elevated again (Integral 2007). Based on historical average flows (Figure 4), the months of January to April typically have average flows > 50,000 cfs. However, this is highly variable by year, with some years (e.g., 2013) not having any high-flow events and other years (e.g., 2015) only having high flows in early winter (November/December). Because of schedule constraints, the PDI target sampling schedule for high-flow conditions is November 2018 to February 2019.

- **A stormwater event** is characterized for the PDI sampling as an event where sustained flows are ideally less than the low-flow trigger (i.e., 20,000 cfs) averaged over the month, and the presence of a substantial rain event causes an increase in river flow up to (and possibly greater than) 40,000 cfs to capture solids that may be mobilized during these episodic events. The RI Round 3A FSP characterized a target storm event when a rainfall of greater than 0.2 inches for more than 3 hours occurred with, ideally, a period of rain lasting 2-3 days. The goal of the stormwater event is to collect surface water samples from a period with substantial flow contributions from major outfalls located within the study area. Achieving this scenario requires consideration of both appropriate rainfall and flow rates. During the RI, one stormwater-influenced sampling event occurred in November 2006, during which average flow was 19,750 cfs and rainfall averaged 0.77 inches per day over the 4-day sampling event (Integral 2007). The flow rate for this stormwater event was lower than average flow rates of the November 2006 low-flow event. Stormwater events were particularly difficult to capture in the RI, as the single stormwater event failed to meet the flow criteria. The PDI target sampling schedule for stormwater winter high-flow conditions is October to December 2018.

Flow conditions will be monitored relative to the USGS Real Time National Weather Information System (NWIS) Database for the Morrison Bridge station 14211720 located at RM 12.7. Surface water average monthly discharge, velocity, height, and rainfall from this station are shown in Figure 4 for 2010 through the most recent data available in 2016.

The sampling for each surface water sampling event is anticipated to occur over a 1-week period. Two vessels will be deployed during each event to minimize collection times and improve the concurrency of the data. Each team (vessel) will collect a minimum of one transect per day. During summer months with extended daylight hours, the field team may be able to collect two transects per day, if time and health and safety considerations allow.

2.4.2 Sediment Trap Sampling Schedule

Sediment trap deployment will overlap with surface water sampling, conditional on sediment traps being deployed for approximately 3 months. The goal for sediment trap scheduling is to

reflect seasonal conditions and capture the same low-flow, high-flow, and stormwater events as the surface water sampling program. The surface water sampling will overlap with trap deployment (samples collected at some time during trap deployment) to the extent practicable. Sediment traps will be deployed initially during the low-flow surface water sampling event (targeting August) and left in place for 3 months. Sediment traps deployed in late August will represent summer low-flow conditions and will be concurrent with the low-flow surface water sampling event (also targeting August).

Sediment traps will be collected in October, cleaned at the field processing lab, and prepared for re-deployment. After decontamination, sediment traps will be re-deployed from early October to December to represent storm-flow winter events. Sediment traps will be sampled and removed in December concurrent with the stormwater surface water sampling event (targeting November/December but dependent on flow conditions). Sediment traps will be collected, cleaned, and prepared for re-deployment in December/January targeting winter flows. Traps will be re-deployed for 3 months and retrieved in February/March, depending on flow conditions. Based on historical average velocity (Figure 4), these months should capture the remaining winter high flows.

Based on reported sediment accumulation during the RI, less than 20 centimeters (~8 inches) of solids is expected per trap for each 3-month deployment. The Round 3 sampling events retrieved sediment traps at the end of January 2007 (Q1), end of April (Q2), mid-August (Q3), and mid-November (Q4) (Integral 2008). In some of the late fall sampling events (October/January), some of the traps contained insufficient volume (only a few centimeters) for the full suite of chemical testing (Table 4b). Each sediment trap deployment and retrieval field event is expected to take 1 to 2 days of field work.

2.5 Key Changes from Previously Approved RI FSPs

Surface water sampling and sediment trap sampling during the RI was performed in accordance with EPA-approved project plans (Integral 2004a, 2004b, 2006c). During the RI Round 1 sampling event, the PP method was used, but many of the MDLs were elevated compared to the ARAR-based cleanup levels. During the RI Round 2 and Round 3 sampling events, the high-volume method was used for ultra-low detection limit samples for selected COCs. PDI sampling will be conducted in accordance with those plans (both PP and high-volume methods) except where noted.

Key PDI changes from the *Round 2A FSP – Surface Water* (Integral 2004b) and the *Round 3A FSP – Surface Water* (Integral 2006d) include the following:

- Previous RI sample events collected horizontally composited samples (but unique depths) or vertically composited samples (but unique locations). During another RI event, transect-composited samples were collected (horizontally and vertically). Differences in methods occurred throughout the RI based on changing specific data use objectives for

each sampling event and per specific requests from EPA at that time. For the PDI study, only cross-sectional river transect samples will be collected. These samples will each consist of a single composite across the horizontal and vertical sampling points.

- Discrete sample locations will be collected for ethylbenzene only. Ethylbenzene will be collected from the near-bottom depth at each of three locations along each transect (i.e., east bank, west bank, and mid-channel). For all other analytes, only transect composite samples will be used for chemical testing.
- Samples will be analyzed for the analytes listed in Table 3a of this FSP.
- During the RI data collection, surface water samples were collected using a modified equal discharge increment sampling approach (USGS 2000; see Appendix B of the RI Round 2 FSP [Integral 2004a] and Appendix A of the RI Round 3A FSP [Integral 2006d]) where samples were collected from two depths, with volumes rated to the flow at each depth (near surface and near bottom). As a modification to this approach, the PDI samples will be collected using an equally weighted volume from each of three spatially distinct locations along each transect, from three depths. For the PDI study, composite samples will be collected by sampling equal volumes from three stations along each transect. At each station, three vertical depth positions will be sampled (targeting 3 feet below surface, mid-depth, 3 feet above mudline). The total number of sampling positions for each transect should be nine. At stations with less than 10 feet of water depth, only two vertical positions will be sampled (see Table 2). The total volume of water to be collected for each sample (peri-pump filtered/unfiltered and high-volume) will be divided by the total sampling positions per transect to determine the volume of water per vertical position at each location on a transect.
- The SOP for surface water sampling calls for vertical integration of samples by raising and lowering the pump at each equal-discharge-increment zone and compositing into one cross-sectional sample. For the PDI study, samples will be collected from two to three discrete depths and composited into one cross-sectional sample as described above.
- The RI high-volume method during Round 2A was performed with an Infiltrex 300 sampling unit. The RI high-volume method during Round 3A was performed using a PR2900 sampling unit. For the PDI study, a PR2900 unit will be used to collect all samples, with slight modification from the RI sampling event. Surface water will be pumped through Teflon-lined polypropylene tubing, vortex separator (instead of a 140 μm stainless steel pre-filter used during the RI), 0.5 μm GFF filters, and XAD-2 resin beads packed inside stainless steel canisters. To address concerns with accumulated water during sampling, water retention on the GFF filters will be minimized; should any “perched” water be noted during filter changes or at the end of sampling, the 0.5 μm GFF filter will be covered with a new clean lab-weighed and numbered filter to sandwich the solids and absorb any perched water. The amount of water used to “purge” the vortex will be minimized.

- The SOP for the Multi-probe YSI reflects an older model. A newer model of the YSI will be used during the PDI study (see new SOP in Appendix B-1).
- The PP surface water sampling method used glass and polycarbonate carboy containers for the composite sample; all PP water will be pumped to a single Teflon-lined polycarbonate carboy for this FSP. The material should be acceptable for both organic and inorganic samples.
- Consistent with the RI, AXYS Laboratory will prepare and analyze all of the GFF filters and XAD-2 resin columns. A static spike (carbon-labeled target compounds) will be added to the XAD-2 resin at the laboratory prior to shipping to the field facility for sampling. The static spike recoveries will be reported for informational purposes (i.e., no qualification of results during validation based on the recovery) to monitor analyte retention and potential desorption from the XAD-2 resin during sampling. For other COCs and conventional parameters, the selected labs will be ALS Environmental (ALS) and TestAmerica Laboratories (TestAmerica). Analytical laboratories are included as described in Section 5.
- Particle size in the water column will be measured *in situ* using a LISST (model 100x). The LISST uses a laser and an annular ring detector that records scattering at 32 angles (bins). These measurements are mathematically inverted to obtain size distribution and scaled to obtain the volume scattering function. The size distribution is presented as concentration with units of microliters per liter in each of the 32 log-spaced size bins (see SOP in Appendix B-1).

Key PDI changes from the RI *Round 3 FSP – Sediment Traps* (Integral 2006c) include the following:

- The RI used divers for deployment of traps at 12 locations throughout the river, including downstream locations. The PDI will also use divers, but traps will only be placed at four upriver stations (to capture what is entering the Site) at two transects.
- For the RI, sediment traps were deployed for approximately 1 year (four events, 3 months each). They were recovered quarterly, and the accumulated sediment collected for analysis. The PDI study will deploy traps over an approximate 1-year period but will target seasonal river flows (high, low, storm) in parallel with surface water sampling.
- Sediment traps were not placed along surface water transects during the RI. The PDI will place traps along the transects.
- Sediment trap samples will be analyzed for the analytes listed in Table 3a of this FSP. Analytical laboratories are included as described in Section 5.

3. PROJECT ORGANIZATION/FIELD TEAM

3.1 Team Organization and Responsibilities

Team organization is presented in Section 2.2 of the QAPP (AECOM and Geosyntec 2018a). As it relates to this FSP, AECOM and Geosyntec are coordinating activities including management of all subcontractors, field sampling, analysis, and reporting scoping tasks.

The PDI Project Coordinator, Mr. Ken Tyrrell, and PDI Project Manager, Dr. Jennifer Pretare, Ph.D., (AECOM) will be responsible for overall project coordination and providing oversight on planning and coordination, work plans, all project deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the project. Ms. Anne Fitzpatrick (Geosyntec) will serve as the project's senior technical lead for this study and will audit the field events.

Ms. Nicky Moody (AECOM) and Mr. Keith Kroeger (Geosyntec) will be the Project Field Coordinators (FCs) responsible for managing field activities and general field QA/QC oversight. They will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and oversee delivery of environmental samples to the designated laboratory for chemical analyses. This task will be led by Ms. Kristen Durocher (AECOM), who conducted similar sampling on the Lower Passaic River. Project Chemists include Ms. Julia Klens-Caprio (Geosyntec) and Ms. Amy Dahl (AECOM). The Project Chemists are responsible for coordination with labs regarding sample receipt, requested analyses and turn-around times. The Project Chemists will also answer technical and logistical questions related to the analyses requested, including issues related to limited sample availability which impacts detection limits and matrix interferences.

Gravity Marine Services (Gravity), of Fall City, Washington, will provide the XAD samplers, vessel platforms, sampling equipment, and experienced field staff for the project, with Mr. Shawn Hinz acting as a point of contact. Gravity will also build the sediment traps. Analytical laboratories include ALS in Kelso, Washington; AXYS in British Columbia, Canada; and TestAmerica in Fife, Washington, Sacramento, California, and Knoxville, Tennessee (see Section 5 for details). Diving support for sediment trap deployment and retrieval will be provided by Global Diving & Salvage, Inc. (Global), Portland, Oregon.

3.2 Communication/Information Flow

The communication strategy is outlined in Section 2 of the QAPP (AECOM and Geosyntec 2018a). The FCs will be the points of contact for field staff during the implementation of this FSP. Deviations from this FSP or the project-specific QAPP will be reported to the PDI Project Manager for consultation. Significant deviations from the FSP/QAPP will be further reported to representatives of the Pre-RD AOC Group and EPA.

3.3 Coordination with EPA

The PDI Project Coordinator will notify the EPA Project Manager 1 to 2 weeks prior to beginning any field activities so that EPA can schedule any oversight activities required. EPA should provide an indication of the number of split samples and reasonable notification (24 hours) for collection of samples to allow field staff to accommodate the request with minimal disturbance to the field schedule. The PDI Project Coordinator will also notify the EPA Project Manager once field activities have been completed.

Split whole water samples for chemical analyses can be provided to EPA upon their request. EPA's Project Manager should contact the PDI Project Coordinator to coordinate this activity and determine appropriate logistics. Split samples for high-volume samples require advanced notice and discussion due to additional required preparation to ensure extracts can be split by the lab. Currently, it is anticipated that the entire extract will be used during analysis. If EPA elects to collect split samples on high-volume samples, a second PR2900 sampler may need to be deployed simultaneously to ensure adequate extract can be generated. Typically, this is done so that EPA's comparison samples are evaluated relative to the field and analytical variability measured by the project team; however, given the nature of the high-volume sampling, it is logistically very challenging to take two samples at a single location.

4. SAMPLE COLLECTION PROCEDURES

The following sections describe the procedures and methods that will be used during surface water and sediment trap sampling. These procedures include sampling methods; recordkeeping; sample handling, storage, and shipping; and field quality control procedures. Field forms are provided in Appendix A. Project-specific SOPs for peristaltic-pump sampling and high-volume sampling are provided in Appendix B-3 and B-4, respectively. All work will be performed in accordance with the project Health and Safety Plan (AECOM and Geosyntec 2018b). A task hazard analysis specific to surface water sampling and sediment trap sampling will be attached as an addendum to the project Health and Safety Plan.

4.1 Sampling Vessels and Equipment

Surface water sampling will be conducted concurrently per event from two sampling vessels, R/V *Cayuse* and R/V *Tieton*, provided by Gravity. The R/V *Cayuse* is a 24-foot research vessel with landing craft design, crew cabin, and forward working area. The R/V *Tieton* is a 32-foot research vessel with landing craft design and crew cabin, pilot house, and forward working area. Both vessels have an A-frame assembly with a custom winch for deployment and retrieval of sampling equipment, and dynamic positioning system. Each vessel is equipped with a virtual anchoring system, which incorporates an autopilot and two small motors to keep the vessel on station without needing to set fixed anchors. Supplemental vessels are available if additional or backup support for in-water sampling is needed. All vessels will be mobilized from Swan Island Launch.

For sediment trap sampling, divers will be used for deployment and retrieval. Diving support will be provided by Global. Global is a commercial marine services provider founded in 1979 with extensive experience working on complex technical projects in and around the Columbia River and in Portland. Global stages its vessel, the 36-foot DSV *LOON*, in the Swan Island Basin for rapid response in and around Portland and has local personnel available to staff projects in the area.

Equipment and supplies will include all equipment for positioning, sampling, processing, recording, and shipping samples. Equipment lists are included in the SOPs for sampling. Sample containers and preservatives, as well as coolers and packing material, will be supplied by the analytical laboratory.

4.2 Station Positioning and Vertical Control

Station positioning and vertical control will be performed as outlined in the SOP provided in Appendix B-5 and the PDI Data Quality Management Plan (DQMP; AECOM and Geosyntec 2018c). A differential global positioning system (DGPS) unit will be used to confirm the horizontal sampling locations to an accuracy of 1 to 2 meters, per the RI. The DGPS accuracy will be confirmed each morning and evening to a known land-based survey point. Confirmed station locations will be recorded to the nearest whole foot in North American Datum (NAD) 1983 Oregon State Plane North horizontal datum.

Vertical control will be established using an on-board fathometer or lead line to measure depth to mudline at sampling locations. Water depths will be converted to elevations in North American Vertical Datum of 1988 (NAVD88) based on the river stage at the time of sampling as recorded at the Morrison Street Bridge located at RM 12.7. Elevations in the local Columbia River Datum (CRD) will also be calculated in the project database. Water levels will be recorded to the nearest one tenth of a foot in the datum specified in the DQMP and the RI. See Section 5.2 of Integral (2002) for further details.

4.3 Sample Collection and Processing

In general, sample collection will be performed as described in the RI Round 1 FSP (Integral 2002), RI Round 2A FSP for Surface Water Sampling (Integral 2004b), and RI Round 3 FSP for Sediment Traps (Integral 2006c) with modifications as described in Section 2.5 of this FSP.

Methods for surface water sampling using PP and clean hand-dirty hand sampling (EPA 1996) are described in the SOP for Surface Water Sampling (Integral 2004b and 2006c) provided in Appendix B-3. The SOPs include lists of needed supplies and equipment and methods for equipment decontamination. As the SOP for high-volume surface water sampling from the RI was focused on the Infiltrax 300 system and this sampling effort will be using the PR2900 system, a new SOP for this sampling method is provided (Appendix B-4). The Gravity PR2900 system was selected for this sampling effort because of its mechanical simplicity, ease of use,

lower rate of malfunction in the field, and lower operational costs. Additional details on sampling and recordkeeping are provided in the PDI QAPP.

4.3.1 Surface Water – High-Volume Method (Low Detection Limit)

Surface water samples will be collected using a PR2900 high-volume pumping system connected to a vortex solids separation system and 0.5 µm GFF filter and XAD-2 resin column to collect hydrophobic organic compounds for analysis by ultra-low detection limit analytical methods (consistent with RI approaches and methods).

Details of the high-volume field sampling methods are provided in the High-Volume Surface Water Sampling SOP (Appendix B-4). The PR2900 uses a peristaltic pump with Teflon-lined dedicated tubing to draw water through a vortex solids separation system with a laboratory grade 0.5 µm GFF filter to capture remaining solids. The solids captured in the vortex separation system and the solids on the GFF filter(s) are combined to represent a single total particulate solids sample for subsequent extraction and analysis. The water is then passed through the XAD-2 sorption media columns to capture organic analytes from the dissolved phase. Dissolved-phase hydrophobic organic compounds diffuse into the XAD-2 resin and are retained for subsequent solvent extraction and analysis. Each column is its own sample, representing the dissolved phase of constituents in the transect sample. The resin columns from the high-volume sampling are not being composited per laboratory instructions for XAD. The GFF filters and sediments from the vortex separator will be placed into one sample container and shipped to the laboratory. The laboratory will handle this as one sample representing the separated solids phase of constituents in the transect sample.

The high-volume samples will be generated as the particulate phase fraction (i.e., vortex + GFF filter) and the dissolved phase fraction (i.e., the XAD-2 resin). Each fraction will be analyzed for chlorinated pesticides + hexachlorobenzene, PCB congeners, PAHs, and D/F. The concentration data from the particulate and the dissolved fractions will be used to mathematically calculate whole water concentrations. Whole water concentrations will be calculated using the following equation:

$$\text{COC pg/L} = \{ [\text{Particulate Phase (pg)}] + [\text{XAD-2 (pg)}] \} / \text{Sample Volume (L)}$$

Where:

- Particulate phase is the analytical sample consisting of the solids from the vortex and GFF filters (pg/sample);
- XAD-2 is the dissolved fraction of the sample (pg/sample); and
- Sample volume is the total amount of water passed through the PR2900 during sample collection.

A target volume of approximately 400 L of water will be pumped through the system. Flow rates will be low (approximately 1.5 L/ min) to allow for adsorption of dissolved phase COCs to the

XAD-2 resin column. To meet the ultra-low detection limits required for the target COCs (see Table 2c in the QAPP), it is necessary to sample large volumes of water over several hours. The target volume (400 L) will be collected equally from up to nine points at each transect (i.e., if a shallow depth at one location along a transect may preclude collection from three depths). Each composite sample will consist of equal volumes collected from the subsample locations (i.e., equal across all depths and locations across each transect). For example, assuming a 400 L composite sample, equal volumes of approximately 45 L will be collected at each distinct vertical/transect subsample location assuming nine subsample locations. Specifically, the water depths at each location will be measured in the field with an onboard fathometer and lead line as a backup measure.

At locations with greater than 10 feet of water depth, three vertical positions will be sampled (3 feet below surface, mid-depth, 3 feet above mudline); at locations with less than 10 feet of water depth, only two vertical positions will be sampled (see Table 2). The number of vertical positions at each of the three transect locations will be determined first, and the total number of sampling positions for the transect summed. The total volume of water to be collected for each sample (400 L for high-volume sampling) will be divided by the total sampling positions per transect to determine the volume of water per vertical position at each location on a transect.

The target volume was selected based on an evaluation of the RI data collected using high-volume methods, and the practical quantitation limits (PQLs) provided by AXYS for the XAD-2 resin. Based on the sample specific (ng/sample) PQL, a sample volume of 400 L is estimated to be adequate to meet the ROD cleanup numbers for all constituents, with the noted exception of 2,3,7,8-TCDD toxic equivalency. An estimated 1,000 L would be required to achieve the ROD cleanup number for 2,3,7,8-TCDD, which is not feasible due to time and analytical constraints as discussed in Section 2.1.2. The MDLs based on the sampling of 400 L are provided in the PDI QAPP.

During the stormwater sampling event, consistent with the RI efforts, volumes should be decreased to 100 – 150 L per sample.

Vessel traffic and turbidity will be monitored, and the pump will be shut off should a passing vessel or other disturbance cause an increase in turbidity (estimate of > 50 Nephelometric Turbidity Units [NTUs] above ambient background based on best professional judgement and recent experience), indicated by the YSI Multiprobe turbidity monitor. As total system pressure approaches 15 pounds per square inch, the PR2900 system will be shut down and the 0.5 µm GFF filter will be changed. Each 0.5 µm GFF filter that is used during the sampling will be added to the labeled sampling jar for the particulate phase.

4.3.2 Surface Water – Peristaltic Pump Method (Standard Detection Limit)

Surface water samples will also be collected via the PP method in accordance with RI procedures for the analysis of specific SVOCs, specific VOCs, MCP, tributyltin, specific metals, and non-chemical conventional parameters (e.g., TSS and TOC). Surface water will be drawn through

pre-cleaned acid-washed Teflon tubing, following purging of at least five times the required sample volume. The PP will run side-by-side and at the same time as the high-volume sampler. Surface water from each vertically integrated location will be combined into a single sample for analysis.

The sampling for VOC analysis, however, will be a series of three discrete samples to avoid loss of VOCs (ethylbenzene) during compositing. Samples for VOC analysis (ethylbenzene) will be sampled from the near-bottom depth at each location (east shore, navigation channel, west shore) for all transects (total of 21 samples). For VOC analysis, surface water will be collected directly into the sampling container and will not be composited. The samples will be collected using the PP and will be sampled at approximately the mid-point of the time pumping at that depth for the other parameters.

The whole water sample for these parameters will be collected at each transect by pumping approximately 15 L of water into a Teflon-lined high-density polycarbonate carboy at a rate that will ensure the carboy is filled in the same amount of time (pumped during the same time period) as the XAD sample. Total volume to be collected per substation will be determined as described above for the high-volume sampling, which depends on the number of substation points that will comprise a composite.

Flow rates for the PP will be estimated based on the total volume and flow rate for the XAD.⁵ Flow rates will be calibrated at the beginning of sampling and will be monitored in the carboy every 15 minutes using a graduated cylinder and stop watch.

Once all locations on a single transect have been sampled (up to nine equal volume subsamples), surface water in the carboy will be homogenized using a 3-inch Teflon-coated stir bar and stir plate on the sampling vessel. Water from the carboy will be sub-sampled (divided) to individual laboratory-provided sample containers using a PP and sent to the laboratory for analysis. Both filtered (dissolved) and unfiltered (total) surface water samples will be analyzed for metals at all locations. As needed, samples will be pre-filtered for dissolved metals from the carboy using an in-line 0.45 µm cartridge filter. To allow filters to be purged prior to collection of the sample for DOC analysis, containers for dissolved metals will be filled first and the sample bottle for DOC will be filled last.

PP samples are expected to reach MDLs at or below ARAR-based cleanup levels for all metals with the exception of arsenic. Select organics measured via PP are expected to achieve MDLs similar to those in the RI; however, some remain above ARAR-based cleanup levels. The specific SVOCs will not be analyzed via high-volume sampling due to analytical interferences

⁵ For example, flow rate would be calculated by dividing 15 L (target fill volume of water in 20 L carboy) by the volume of water to be sampled using the PR2900 (e.g., 400 L) and multiplying the result by 1.5 L (the maximum desired flow rate of the PR2900). In this example, the flow rate would be 5% of 1.5 L/min, or 0.05 L/min for the PP.

and to remain consistent with RI methods. However, lower MDLs than those listed in the QAPP may be achievable in coordination with the selected laboratory.

Samples will be placed in the appropriate laboratory-provided sampling containers (Table 5a) and stored in a cooler to maintain the samples at a temperature of 0 to less than 6 degrees Celsius (°C) until transport to the laboratory.

4.3.3 Surface Water – Field Parameters

During field sampling, continuous *in-situ* monitoring of dissolved oxygen, pH, specific conductivity, temperature, turbidity, salinity, and oxidation reduction potential of the water column will be recorded at all sampling stations using a multi-parameter water quality meter connected to a datasonde array consisting of water quality probes, depth sensor, and turbidity sensor (YSI 6820 V2 or equivalent) per the SOP provided in Appendix B-1. These measurements will be made by lowering the datasonde into the water at the appropriate depth. At each station, an anchor-type weight will be attached to the two lengths of Teflon-lined tubing (for the PR2900 and the PP) and the water quality meters (a YSI datasonde and LISST sensing unit) with zip ties, to help keep the instruments “on station.” The meter will be co-deployed with the intakes of the water sampling equipment, but will be kept separate (i.e., tubing will be approximately 6 inches lower than the sonde housing to avoid potential contamination of the surface water sample).

At the station of interest, the datasonde (and sampling tubing) will be lowered through the water column until it is approximately 3 feet off the mudline bottom as determined by the shipboard fathometer. If the operator “feels” the bottom with the weight,⁶ the instrument should be raised and data collection delayed to allow any resuspended sediment to dissipate as determined by monitoring real-time turbidity readings. The anchor weight should be kept suspended above the bottom sediment. Based on the water depth provided by the datasonde, field technicians will determine the water column structure and define the desired depths for data and sample collection. The datasonde should be allowed to equilibrate at bottom depth for at least 1 minute (or until readings for all parameters stabilize) before beginning water column profiling. River flow measurements will be conducted in a similar manner using a hand-held mechanical flow meter or ADCP device; a minimum of three measurements will be recorded per location—upper, lower, and mid-point of the water column.

Field technicians will then create a new logging file for that station/profile and initiate data logging. The datasonde will then be slowly retrieved by hand at a rate of approximately 1 foot

⁶ The type of weight used will be a lead weight housed in an aluminum cylinder that has been covered in a rubber coating. The rubber coating minimizes contact with metals. In addition, the tubing will be positioned to sample up-current of the weight and sensor set allowing it to pump water that has not come in contact with any of the sensor/weight array.

per second, per the manufacturer's specifications for the response time of the sensors, as indicated by the real-time display. Once the initial profile is complete, field technicians will return the instrument package to the sampling point and conduct water sampling according to the appropriate SOP. Prior to initiating the sample collection and upon completion at a depth, water quality measurements will be recorded on appropriate Field Logs (Appendix A). The datasonde will continue to log data throughout the sampling activity. After the conclusion of all sampling at a station, a second profile will be collected in the same manner as the first (full water column profile) in order to document any changes in the water column.

4.3.4 Sediment Trap

Sediment traps will consist of four glass tubes per station, with settling particulate material collected in each glass tube (as described in Section 2.2.2). For deployment, the vessel will maneuver to the proposed location then deploy the sediment trap assembly using an A-frame winch with diver assistance. The diver will drive rebar into the sediment then affix the sediment trap assembly to the rebar so that the open tops of the cylinders are 3 feet above the mudline elevation and perpendicular to the direction of flow. Sediment traps will be placed with the bottom of the sediment trap approximately 1.5 feet (45 centimeters) above the mudline. An anchor will be connected to the rebar with approximately 30 meters of anchor line. The sediment trap set up is shown in Figure 3 and is consistent with RI methods excerpted and provided here in Appendix B-6.

For recovery (3 months later), a diver will cover the tops of each glass tube with foil, detach the trap assembly from the rebar, and the trap will be raised to the surface using the vessel's winch. The glass tubes will be removed from the assembly, kept upright, and allowed to resettle, if needed. The thickness of accumulated sediment will be measured at multiple points around each tube to account for sloping of sediment within the tube and recorded on the Field Logs (Appendix A). Overlying water will then be siphoned or pumped off from each glass tube. Sediments from each tube will be characterized and described on the Field Logs (Appendix A) prior to composting. Once characterized, sediments will be collected in a stainless-steel mixing container and homogenized until uniform color and consistency is achieved via mixing with a stainless-steel spoon. Once homogenized, sediments will be placed in the appropriate laboratory-provided sampling containers (Table 5b) and stored in a cooler at 0 to 6°C until transported to the laboratory.

4.4 Sample Handling and Transport

Since samples collected under this FSP will be used in support of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities, the processes described in the QAPP and previously approved plans will be followed to ensure samples are traceable from their collection through data delivery.

Chain-of-custody procedures, storage, transport, packaging, and shipping details will be followed as detailed in the PDI QAPP (AECOM and Geosyntec 2018a). Samples will be stored on ice at

4°C in a field cooler and shipped to appropriate laboratories. These methods are generally consistent with Sections 5.8.1, 5.8.2, and 5.8.3 of the RI Round 1 FSP and associated SOPs. Additional details are provided in Section 4.3 of the PDI QAPP (AECOM and Geosyntec 2018a).

4.5 Field Logbook and Forms

All field activities will be recorded in a field logbook as detailed in the PDI QAPP (AECOM and Geosyntec 2018a). The information recorded will be consistent with the RI Round 1 FSP (Integral 2002); see Section 5.3 for details. Project-specific PDI field forms are provided in Appendix A and will be completed as described in the PDI QAPP (AECOM and Geosyntec 2018a).

4.6 Decontamination Procedures

All equipment decontamination procedures will be performed as detailed in the RI Round 2A FSP Appendix C Surface Water Sampling SOP (Integral 2004b) provided as Appendix B-3 of this FSP, and the RI Round 3 Sediment Traps FSP (Integral 2006c) excerpted as Appendix B-7 of this FSP. Decontamination procedures specific to the high-volume sampling equipment proposed for this PDI study are provided in Appendix B-4 of this FSP. Disposable equipment used in the high-volume sampling (e.g., tubing, GFF filters) will be decontaminated by the laboratory. Decontamination of field sampling equipment will occur between stations.

4.7 Waste Disposal

Waste disposal will follow procedures described in the Investigation-Derived Waste SOP (Appendix B-7). In general, any excess water or sediment remaining after processing will be returned to the vicinity of the collection site. Any water or sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection site before proceeding to the next station. Phosphate-free detergent-bearing liquid wastes from decontamination of the sampling equipment will be washed overboard or disposed into the sanitary sewer system.

Tyvek, gloves, paper towels, plastic sheeting, and other waste material generated during sampling will be placed in heavyweight garbage bags or other appropriate containers and placed in a normal refuse container for disposal at a solid waste landfill.

4.8 Field Quality Control

All QA/QC procedures are detailed in the QAPP (AECOM and Geosyntec 2018a).

Blind field duplicates are additional samples collected at the same location to characterize variability in sampling results. Field duplicates for PP samples will be collected as described in Section 4.6.1 of the QAPP. Field duplicates of high-volume samples and sediment traps are not planned.

Other field QC samples, such as trip blanks, temperature blanks, and rinsate blanks, will be collected as outlined in Section 4.6.1 of the QAPP. Split samples for EPA will be determined at the time of sampling. Rinsate blanks will be conducted once per event for sediment trap and high-volume samplers. Sediment trap rinsate blanks will be collected using deionized water (DI) poured over the sediment trap equipment after field decontamination. Rinsate blanks for the high-volume sampling equipment (PR2900) will be collected as described in the surface water sampling SOP (Appendix B) and QAPP. Three blank samples will be collected per surface water event: 1) run DI water through the PR2900 equipment with tubing, vortex separator, 0.5 µm GFF filter, and XAD-2 cartridge and collect a “particulate phase” blank and an XAD-2 resin blank; and 2) run DI water through PP into carboy, and using PP from the carboy, collect a total water sample (Table 6).

5. LABORATORY ANALYSIS

All physical and chemical analysis of surface water samples will be performed by the following laboratories:

- AXYS in British Columbia, Canada, will analyze the high-volume samples (both particulate phase as solids collected by the vortex solids separator and 0.5 µm GFF filter and XAD-2 resin column samples) for chlorinated pesticides + hexachlorobenzene, PCB congeners, PAHs, and D/F.
- AXYS is also responsible for the preparation and decontamination of all disposable high-volume sampling equipment including preparation of XAD-2 resin cartridges, decontamination of GFF filters, and decontamination of sample tubing (PP sampling does not require laboratory decontaminated tubing).
- ALS in Kelso, Washington, will analyze the PP samples for bis-(2-ethylhexyl) phthalate (BEHP), pentachlorophenol, and tributyltin.
- TestAmerica in Fife, Washington, will analyze the PP samples for ethylbenzene, MCP, and metals (total and dissolved). At all stations, unfiltered surface water samples will be analyzed for conventional parameters including TDS, TSS, and TOC. Unfiltered samples for TDS and TSS will be filtered at the analytical laboratory, consistent with the Round 3 RI sampling (Integral 2006c). Filtered samples will be analyzed for conventionals, including DOC and hardness, consistent with the RI.

All physical and chemical analysis of sediment trap samples will be performed by the following laboratories.

- ALS in Kelso, Washington, will analyze for chlorinated pesticides, PAHs, BEHP, tributyltin, and total solids.
- TestAmerica in:

- Fife, Washington, will analyze total petroleum hydrocarbons as diesel range organics, metals, TOC, grain size, and total solids
- Sacramento, California, will analyze D/F
- Knoxville, Tennessee, will analyze PCB congeners

Approximately 1,000 grams (wet weight) of sediment are required for the full ROD Table 17 Sediment COC analyte list. If the recovered volume of sediment in sediment traps is insufficient for all analytes, the prioritization of analyses will be focused on COCs (PCBs, D/F PAHs, and DDx), then metals, then other SVOCs, then conventionals (grain size and TOC). Additional details on the analytical methods, QA/QC requirements and procedures, and laboratory-specific QA/QC requirements are detailed in Section 4.6 of the QAPP (AECOM and Geosyntec 2018a). All samples will be placed in laboratory-supplied sample containers and preserved according to analytical protocols. Sample containers, preservation requirements, holding times, and sample sizes are provided for all analyses in Table 5a for surface water samples and Table 5b for sediment trap samples.

6. DATA MANAGEMENT AND REPORTING

6.1 Field Data Management

The procedures and activities outlined in this FSP and the QAPP are designed to ensure DQOs are met, consistent with previous RI studies. Field record-keeping details can be found in the QAPP (AECOM and Geosyntec 2018a). A bound field logbook will be assigned to and maintained by field team members for the duration of sampling and will be kept as permanent records. A series of QA/QC steps described in the QAPP will be implemented to ensure data integrity. Data quality management procedures performed in the field will include the following:

- All samples will be given a unique identifier (Section 2.3 of this FSP).
- All samples will be collected and transported under chain-of-custody control (Section 4.4 of this FSP).
- Field logbooks and data sheets will be maintained (Section 4.5 of this FSP).
- Field QA/QC samples will be collected according to the QAPP and SOPs provided in Appendix B to this FSP.

6.2 Post-Analysis Data Management and Reporting

Analytical laboratories will be required to adhere to all QA/QC procedures outlined in the QAPP. Laboratories will provide all data for field investigations in electronic format and QA/QC reports, including a narrative of the standard QA/QC protocols. Data validation and data management will be performed according to the QAPP and DQMP; see the QAPP for details on data validation procedures. Following data validation, all data, supplementary information, and

validator qualifiers associated with samples will be compiled into an SQL Server database for the project. Tabular data files will be provided to EPA as they become available after data validation and database management.

Data summaries will be included in the PDI Evaluation Report as attachments. Attachments will include a summary of field sampling activities, including sampling locations, analyses, sample collection methods, and any deviations from the FSP. Methods, analysis, and results for all testing procedures will be documented and presented in standard scientific reporting format. An electronic data deliverable (EDD) of the project database will accompany the PDI Evaluation Report.

7. REFERENCES

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TABLES

Table 1. Comparison of Peristaltic Pump and XAD Methods for Measuring Focused COCs at the Site

Focused COC Contaminant	Method	RI Sample Number	# Detected	% Detected	MDL (µg/L)	Surface Water ARAR-based Cleanup Level
Total PAHs	Peristaltic	174	101	58%	0.0065 - 0.043	0.00012 (as carcinogenic PAHs)
	XAD - Total	174	174	100%	0.00029 - 0.00141	
PCB Aroclor	Peristaltic	53	6	11%	0.0025 - 0.0027	0.000006
PCB Congeners	XAD - Total	53	53	100%	0.000000024 - 0.0000007	
2,3,7,8-TCDD TEQs	Peristaltic	Not analyzed by this method				0.0000000005 (as TEQ)
	XAD - Total	121	121	100%	0.000000011	
Total DDx	Peristaltic	84	29	35%	0.000472 - 0.0016	0.001
	XAD - Total	84	83	99%	0.000012 - 0.000015	

General Notes:

1. Peristaltic Pump MDLs are reported as achieved based on description in the RI Section 5.4.
2. XAD-2 MDLs are based on 100 L of surface water pumped. During the R3 sampling, 100 L was pumped during the stormwater event and 500 L was pumped during the low-flow and high-flow events for stations with the full suite of analyses. MDLs are shown for XAD filtrate and particulate; MDLs for total concentrations are calculated as the sum of XAD filtrate and particulate. MDLs are from Integral (2006) Round 3A Field Sampling Plan.
3. XAD MDL for 2,3,7,8-TCDD shown for TCDD TEQs.
4. XAD MDL for PAHs and DDx are minimum and maximum MDL for individual constituents.

Acronyms:

µg/L = microgram per liter

2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzodioxin

ARAR = applicable or relevant and appropriate requirements

COC = contaminant of concern

DDx = dichlorodiphenyltrichloroethane and its derivatives

L = liter

MDL = method detection limit

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

RI = remedial investigation

TEQ = toxic equivalency

Table 2. Station Location Coordinates, Target Depth, and Identification Scheme

Sample Type	Composite Sample ID	Transect	Transect Location	Sequential Sub Location ID	Expected Mudline Elevation (CRD - Feet) ^a	Target Surface Water Sampling Depths	Proposed Location Coordinates (NAD 1983; Intl Feet) ^b	
							Easting	Northing
Surface Water	PDI-WS-T01-MMY	1	RM 1.8	1E	N/A	-- ^c	7618001	725315
				1Nav	-52.5	-3 ft., -25 ft., -49 ft.	7617290	725842
				1W	-14.7	-3 ft., -6 ft., -12 ft.	7616474	726447
	PDI-WS-T02-MMY	2	Multnomah Channel	2E	-21.6	-3 ft., -9 ft., -19 ft.	7613370	720591
				2Nav	-28.0	-3 ft., -13 ft., -25 ft.	7613404	720321
				2W	-6.5	-2 ft., -4 ft.	7613436	720067
	PDI-WS-T03-MMY	3	RM 4	3E	N/A	-- ^c	7618348	715910
				3Nav	-54.0	-3 ft., -26 ft., -51 ft.	7617650	715649
				3W	N/A	-- ^c	7616809	715322
	PDI-WS-T04-MMY	4	RM 7	4E	-12.9	-3 ft., -5 ft., -10 ft.	7627723	704523
				4Nav	-44.1	-3 ft., -21 ft., -41 ft.	7627307	704108
				4W	N/A	-- ^c	7626717	703493
	PDI-WS-T05-MMY	5	RM 8.8	5E	-16.8	-3 ft., -7 ft., -14 ft.	7634506	698140
				5Nav	-34.2	-3 ft., -16 ft., -31 ft.	7633857	697446
				5W	N/A	-- ^c	7633267	696814
	PDI-WS-T06-MMY	6	RM 11.81 (upriver)	6E	-59.1	-3 ft., -28 ft., -56 ft.	7645633	687094
				6Nav	-61.0	-3 ft., -29 ft., -58 ft.	7645425	686928
				6W	-17.6	-3 ft., -7 ft., -15 ft.	7645200	686750
	PDI-WS-T07-MMY	7	RM 16.2 (upriver)	7E	N/A	-- ^c	7646788	665117
				7Nav	-90.3	-3 ft., -44 ft., -87 ft.	7646285	665150
				7W	N/A	-- ^c	7645696	665190
Sediment Trap	PDI-ST-T06a-MMY	6	RM 11.81 (upriver)	ST6a	-63.3	Not Applicable	7645543	687022
	PDI-ST-T06b-MMY			ST6b	-56.5		7645320	686845
	PDI-ST-T07a-MMY	7	RM 16.2 (upriver)	ST7a	-66.9		7646544	665133
	PDI-ST-T07b-MMY			ST7b	-44.7		7645995	665170

General Notes:

Conversion from CRD to NAVD88: Elevation(CRD)+5.38=NAVD88

Footnotes:

a) Vertical Datum: CRD (ft.); based on 2009 NOAA bathymetry. Target sampling depths may be revised/included following updated bathymetry survey.

b) Horizontal Projection: NAD 1983 Oregon State Plane North (Intl Feet)

c) For locations where current mudline elevations are not available, targeting depths will be determined in the field following measurement of water depth.

Acronyms:

CRD = Columbia River Datum; ft. = foot/feet; ID = identification number; N/A = not available; NAD = North American Datum; NAVD 88 = North American Vertical Datum of 1988; NOAA = National Oceanic and Atmospheric Administration; RM = river mile

Table 3a. Summary of Sample Types, Numbers, and Analytes

Sample Type	Number of Samples	Sampling Events	Total Number of Samples	Analyses
High-Volume Surface Water - Separated Solids ^a	7	3	21	PCB Congeners, Pesticides (Aldrin, chlordanes, Hexachlorobenzene and DDX), PAHs, and PCDD/Fs
High-Volume Surface Water - XAD-2 ^a	7	3	21	PCB Congeners, Pesticides (Aldrin, chlordanes, Hexachlorobenzene and DDX), PAHs, and PCDD/Fs
Surface Water - Peristaltic Pump - Filtered - Dissolved	7	3	21	Dissolved Metals (As, Ca, Cr, Cu, Mg, Zn), Hardness as CaCO ₃ , and Dissolved Organic Carbon
Surface Water - Peristaltic Pump - Unfiltered - Total	7	3	21	Total Metals (As, Cr, Cu, Zn), BEHP, Ethylbenzene, MCP, PCP, Tributyltin, Total Suspended Solids, TOC, and Total Dissolved Solids
Sediment Trap	4	3	12	All ROD Table 17 Sediment COCs + TOC and Grain Size
Total Count			96	

General Notes:

1. Surface water samples for each transect will be equal-volume cross sectional composites. Vertically composited multi-depth (2 or 3 depths) samples from each of three sub-stations along a transect will be composited. One exception is ethylbenzene which will be sampled as discrete samples from near-bottom depths at all stations.
2. Since ethylbenzene will be sampled at the near-bottom depth at each sub-station along the transect there will be a total of 21 samples for VOC analysis per round, for a total of 63 samples for VOC analysis.
3. Field parameters and grain size will be measured *in situ*.

Footnotes:

a) High volume surface water samples will be reported as dissolved phase from the XAD, separated solids (particulate phase), and total (calculated) concentrations.

Acronyms:

As = arsenic; BEHP = bis(2-ethylhexyl)phthalate; CA = calcium; CaCO₃ = calcium carbonate; COC = contaminant of concern; Cr = chromium; Cu = copper; DDX = sum of dichlorodiphenyltrichloroethane and its derivatives; Mg = magnesium; PAHs = polycyclic aromatic hydrocarbon; PCBs = polychlorinated biphenyls; PCP = pentachlorophenol; PCDD/Fs = polychlorinated dibenzo-p-dioxins and furans; MCP = meta-chlorophenylpiperazine; ROD = Record of Decision; TOC = total organic carbon; Zn = zinc

Table 3b. Selected Analytes Sorted by Surface Water Sample Collection Method

Analyte	High-Volume Surface Water			Surface Water - Peristaltic Pump	
	Separated Solids	XAD-2	Total	Filtered (Dissolved)	Unfiltered (Total)
Aldrin	X	X	X		
Arsenic				X	X
BEHP					X
Chlordanes	X	X	X		
Chromium				X	X
Copper				X	X
DDx	X	X	X		
Dissolved Organic Carbon				X	
Ethylbenzene					X
Hardness				X	
Hexachlorobenzene	X	X	X		
MCPP					X
PAHs	X	X	X		
PCB congeners	X	X	X		
PCDD/Fs	X	X	X		
Pentachlorophenol					X
Tributyltin					X
Total Suspended Solids ^a					X
Total Dissolved Solids ^a					X
Total Organic Carbon					X
Zinc				X	X
Field Parameters	Measured continuously with YSI Water Quality Meter				
Grain Size	Measured <i>in situ</i> with LISST				

Footnotes:

a) Filtered by analytical laboratory

Acronyms:

BEHP = bis(2-ethylhexyl)phthalate

COC = contaminant of concern

DDx = sum of dichlorodiphenyltrichloroethane and its derivatives

LISST = Laser In-Situ Scattering and Transmissometry

MCPP = meta-chlorophenylpiperazine

PAHs = polycyclic aromatic hydrocarbon

PCBs = polychlorinated biphenyls

PCDD/Fs = polychlorinated dibenzo-p-dioxins and furans

Table 4a. Summary of Historical RI Surface Water Sampling Events

RI Sampling Round	Method	Number of Transects	Surface Water Sampling Scheme	Target Time of Year for Sampling	Actual Time of Year Sampled	Actual Sample Volume	References
Round 1	PP	3	Two stations per transect, two sampling depths--surface and near-bottom; plus discrete nearshore samples	Low flow (late summer to early fall) and high flow (late fall to early winter) ¹	N/A	~ 40 L for PP samples (target)	Striplin et al. 2002. Round 1 FSP, Portland Harbor RI/FS.
Round 2A	PP and Infiltrix 300 (XAD-2)	3	(1) cross-section river transect composite sample, spatially integrated across entire width and depth of channel based on a flow-weighted methods (USGS 2000) ² and (2) discrete near-bottom (within 1 meter), and (3) single point vertically integrated samples	Nov 2004 (high-flow, winter, target); July 2005 (low-flow, summer), March 2005 (selected by EPA); a first flush stormwater runoff fall event was also targeted	Nov to Dec 2004; March 2005; July 2005	~ 1,000 L pumped for XAD samples	Integral 2004. Integral 2005a, 2005b, 2005c.
Round 3A	PP and Infiltrix 300 (XAD-2)	5	Three stations per transect, divided into east, west, and Navigation Channel samples; vertically integrated but horizontally discrete; near-bottom and near surface samples (10-foot minimum water depth); 12 point samples	Jan 2006 (winter, flooding, high-flow); Sept 2006 (summer, low-flow); Nov 2006 (storm event); Jan/Feb/March 2007 (winter, high-flow)	Jan 2006; Sept 2006; Nov 2006; Jan 2007, and Feb through March 2007 ³	~ 100L (storm event); ~ 500L (high-flow and low-flow events) pumped for XAD samples	Integral 2006 and 2006b. Integral 2007a and 2007b.

Notes:
General water quality measurements of ambient surface water were taken at all sampling locations including conductivity, pH, temperature, dissolved oxygen, and redox potential of the water column.

Footnotes:
(1) Low flow and high flow conditions, as determined by USGS field gauge readings at the Morrison Bridge.
(2) Vertically integrated sample from 0.3 meters below water surface to within 1 meter of the river bottom in each sub-area, samples combined into river cross-section composite sample.
(3) The first phase took place January 15-18, 2007. On January 18, 2007, the high-flow surface water collection program was cancelled due to the flow of the Willamette River dipping below 50,000 cfs. The second phase resumed on February 21 through March 10, 2007.

Acronyms:
cfs = cubic feet per second; EPA = U.S. Environmental Protection Agency; FS = feasibility study; FSP = Field Sampling Plan; FSR = Field Sampling Report; Integral = Integral Consulting; L = liter; N/A = not available; PP = peristaltic pump; RI = remedial investigation; USGS = U.S. Geological Survey

References:
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Integral 2005c. Round 2A Summer 2005 Surface Water FSR, Portland Harbor RI/FS. Sept 19, 2005.
Integral 2006a. Round 3A Field Sampling Plan Surface Water Sampling, Portland Harbor RI/FS. Sept 18, 2006.
Integral 2006b. Round 3A Summer 2006 Low-Flow Surface Water Event FSR. Dec 8, 2006.
Integral 2007a. Round 3A Fall 2006 Stormwater Surface Water Event FSR. Jan 15, 2007.
Integral 2007b. Round 3A Winter 2007 High-Flow Surface Water Event FSR. April 30, 2007.

Table 4b. Summary of Sediment Accumulated in Round 3A Sediment Traps at RM 11 and RM 16

Trap # ⁽¹⁾	Average Sediment Height (cm) in Glass Tubes ⁽⁴⁾				SPM Material Description (4 events)
	Jan 2007 ⁽⁶⁾	July 2007	Oct 2007	Jan 2008	
ST007	37	10.0	7.1	7.9	Gray silty sand; gray silty sand; gray silt; silty sand
ST008	69 ⁽⁵⁾	16.0	2.9 ⁽³⁾	12.5	Organic litter; mostly woody debris; light gray silt; grayish green silt
ST009	6.3	10.7	4.9 ⁽²⁾	1.7 ⁽²⁾	Organic litter with gray silt; brownish silt with significant grass litter; light gray silt; gray silt
ST010	52	9.7 ⁽²⁾	1.4 ⁽³⁾	6.0	Brownish gray sandy silt; light gray silt; grayish brown silt

Notes:

- (1) Sediment Traps ST007 and ST008 are located near RM 11.8. Sediment traps ST009 and ST010 are located near RM 16.0.
- (2) Insufficient volume to fill all sample jars for testing.
- (3) Insufficient volume, traps redeployed without sample collection.
- (4) Individual tube measurements were generally within +/- 2 cm from each other.
- (5) Tube glass tube height at ST008 during Jan 2007 event was about 78 cm tall.
- (6) Individual tube measurements in the Q1 Jan 2007 event compared baffle/no baffle design; results were less than 1 to 2 cm difference at 3 of 4 locations: ST007 (37.3, 37.4); ST008 (70.1, 68.0); ST009 (6.5, 6.1) and ST010 (49.1, 55.5).

Acronyms: cm = centimeter; RM = river mile; SPM = settled particulate matter

Table 5a. Sample Containers, Preservation, Holding Times, and Sample Volume - Surface Water

Surface Water Parameter	Analytical Method	Container	Preservation	Holding Time	Minimum Volume Needed
High-Volume Surface Water Samples					
PCB Congeners	EPA 1668A ^a	XAD-2 Column (1 gallon Ziplock bag and bubble wrap) + Separated Solid (8-oz jar)	Cool to 0-6°C store in the dark	1 year from collection to preparation; 1 year from extraction to analysis	400 liters (pumped through XAD)
Dioxins/Furans	EPA 1613B ^a	XAD-2 Column (1 gallon Ziplock bag and bubble wrap) + Separated Solid (8-oz jar)	Cool to 0-6°C store in the dark	1 year from collection to preparation; 1 year from extraction to analysis	400 liters (pumped through XAD)
PAHs	EPA 8270D SIM ^a	XAD-2 Column (1 gallon Ziplock bag and bubble wrap) + Separated Solid (8-oz jar)	Cool to 0-6°C	7 days from collection to preparation; 40 days from extraction to analysis	400 liters (pumped through XAD)
Chlorinated Pesticides + Hexachlorobenzene	MLA-028/EPA 1699 ^a	XAD-2 Column (1 gallon Ziplock bag and bubble wrap) + Separated Solid (8-oz jar)	Cool to 0-6°C	7 days from collection to prep; 40 days (1 year for HCB) from extraction to analysis	400 liters (pumped through XAD)
Surface Water - Peristaltic Pump Samples					
BEHP	EPA 8270D-LL	2x 1-L AG	Cool to 0-6°C	7 days from collection to preparation; 40 days from extraction to analysis	2 L
Ethylbenzene	EPA 8260C	3x 40-mL VOA vials	HCL to pH <2, Cool to 0-6°C, no headspace	14 days from collection to analysis	120 mL
MCPP	EPA Method 8151A	2x 1-L AG	Cool to 0-6°C	7 days from collection to preparation; 40 days from extraction to analysis	2 L
Pentachlorophenol	EPA Method 8041A and EPA 8270D-LL	2x 1-L AG	Cool to 0-6°C	7 days from collection to preparation; 40 days from extraction to analysis	2 L
Metals (Total)	EPA Method 6020B	1x 100-mL HDPE	HNO ₃ to pH <2	180 days from collection to analysis	100 mL
Metals (Dissolved) + Hardness as CaCO ₃	EPA Method 6020B	1x 100-mL HDPE	HNO ₃ to pH <2	180 days from collection to analysis	100 mL
Tributyltin	Unger et al.	1-L AG	Cool to 0-6°C	7 days from collection to preparation; 40 days from extraction to analysis	2 L
Total Suspended Solids	Standard Method 2540D	1x 1-L HDPE	Cool to 0-6°C	7 days from collection to analysis	1 L
Total Dissolved Solids	EPA Method 160.1	1 x 500-mL HDPE	Cool to 0-6°C	7 days from collection to analysis	500 ml
Total Organic Carbon	EPA 9060	1 x 250-mL HDPE	H ₂ SO ₄ to pH <2, Cool to 0-6°C	28 days from collection to analysis	250 ml
Dissolved Organic Carbon	EPA 9060	1 x 500-mL AG	H ₂ SO ₄ to pH <2, Cool to 0-6°C	28 days from collection to analysis	500 mL
Field Parameters					
Temperature, pH, DO, turbidity, flow rate velocity, and conductivity	YSI™ 6820 (V2 or equivalent)	Measured <i>in situ</i>			
Particle Size Distribution	LISST	Measured <i>in situ</i>			

Table 5a. Sample Containers, Preservation, Holding Times, and Sample Volume - Surface Water

Notes:

1. Refrigerate preservation times consistent with PSEP protocols for Washington State.
2. Method detection limits presented in the project QAPP.
3. Concentration data from solids and dissolved fractions will be used to mathematically calculate whole water concentrations.
4. Whole water concentrations for XAD samples will be calculated using the following equation:
$$\text{COC pg/L} = \{[\text{separated solids (pg)}] + [\text{XAD (pg)}]\} / \text{Sample Volume (L)}.$$

Footnotes:

- a) Analysis can be performed by splitting the extract from a single XAD column collected per sample.

Acronyms:

AG = amber glass	HDPE = high density polyethylene
BEHP = Bis(2-ethylhexyl) phthalate	L = liter
CaCO ₃ = calcium carbonate	LISST = Laser In-Situ Scattering and Transmissometry
COC = contaminant of concern	MCPP = meta-chlorophenylpiperazine
DO = dissolved oxygen	mL = milliliter
EPA = United States Environmental Protection Agency	PAHs = polycyclic aromatic hydrocarbons
H ₂ SO ₄ = sulfuric acid	PCB = polychlorinated biphenyls
HCB = hexachlorobenzene	PSEP = Puget Sound Estuary Program
HCL = hydrochloric acid	QAPP = Quality Assurance Project Plan

Table 5b. Sample Containers, Preservation, Holding Times, and Sample Volume - Sediment Trap

Sediment Trap Parameter	Container		Preservation	Holding Time	Minimum Sample Size (wet weight grams)
	Type	Size			
PCB Congeners	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	1 year, 1 year	100
PCDD/Fs	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	1 year, 1 year ^a	100
Pesticides	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 1 year	100
PAHs	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 1 year	100
BEHP	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 1 year	100
Metals	G or P	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	6 months, 2 years	50
Mercury	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	28 days, 28 days	50
TPH Diesel	G	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 40 days	50
Tributyltin	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 1 year	100
Grain size	G or P	16 oz	Refrigerate, 4 ± 2°C	6 months	100 to 150
Total organic carbon	WMG	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 1 year	25
Total solids	G or P	8 oz	Refrigerate, 4°C Deep Frozen (-20°C)	14 days, 6 months	50

Notes:

1. Refrigerate preservation times consistent with PSEP protocols for Washington State.
2. Frozen preservation times provided from PESP 1996.
3. Method detection limits presented in the project QAPP.
4. Parameters are listed in general order of priority of analysis.

Footnotes:

a) stored in darkness.

Acronyms:

BEHP = Bis(2-ethylhexyl) phthalate; G = glass; oz. = ounce; P = plastic; PAHs = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyls; PCDD/Fs = polychlorinated dibenzo-p-dioxins and furans; PSEP = Puget Sound Estuary Protocol; QAPP = Quality Assurance Project Plan; WMG = wide mouth glass; TPH = total petroleum hydrocarbons

Table 6. Summary of QA/QC Sample Types, Numbers, and Analytes

Sample Type		Frequency	Number of Samples	Analyses
Blind Field Duplicates (Surface Water - Peristaltic Pump)	Filtered - Dissolved	1 per 20 samples (1 per event)	3	Dissolved Metals (As, Ca, Cr, Cu, Mg, Zn), Hardness as CaCO ₃ , and Dissolved Organic Carbon
	Unfiltered - Total	1 per 20 samples (1 per event)	3	Total Metals (As, Cr, Cu, Zn), BEHP, Ethylbenzene, MCP, PCP, Tributyltin, Total Suspended Solids, TOC, and Total Dissolved Solids
Rinsate Blank (Surface Water - High-Volume Method)	Separated Solids	1 per event	3	PCB Congeners, Pesticides (Aldrin, Chlordanes, Hexachlorobenzene, and DDX), PAHs, and PCDD/Fs
	XAD-2	1 per event	3	PCB Congeners, Pesticides (Aldrin, Chlordanes, Hexachlorobenzene, and DDX), PAHs, and PCDD/Fs
Filter Blank (Surface Water - Peristaltic Pump Method)	Filtered - Dissolved	1 per 20 samples (1 per event)	3	Dissolved Organic Carbon, Dissolved Metals (As, Ca, Cr, Cu, Mg, Zn), Hardness as CaCO ₃
Rinsate Blank (Surface Water - Peristaltic Pump Method)	Tubing, Carboy, and Stir Bar	1 per event	3	Total Metals (As, Cr, Cu, Zn), BEHP, TOC, Ethylbenzene, MCP, PCP, and Tributyltin
Rinsate Blank (Sediment Trap Equipment)		1 per 20 samples (1 per event)	3	ROD Table 17 Sediment COCs
Trip Blank		One per cooler	21	Ethylbenzene (VOC)
Total Count			42	

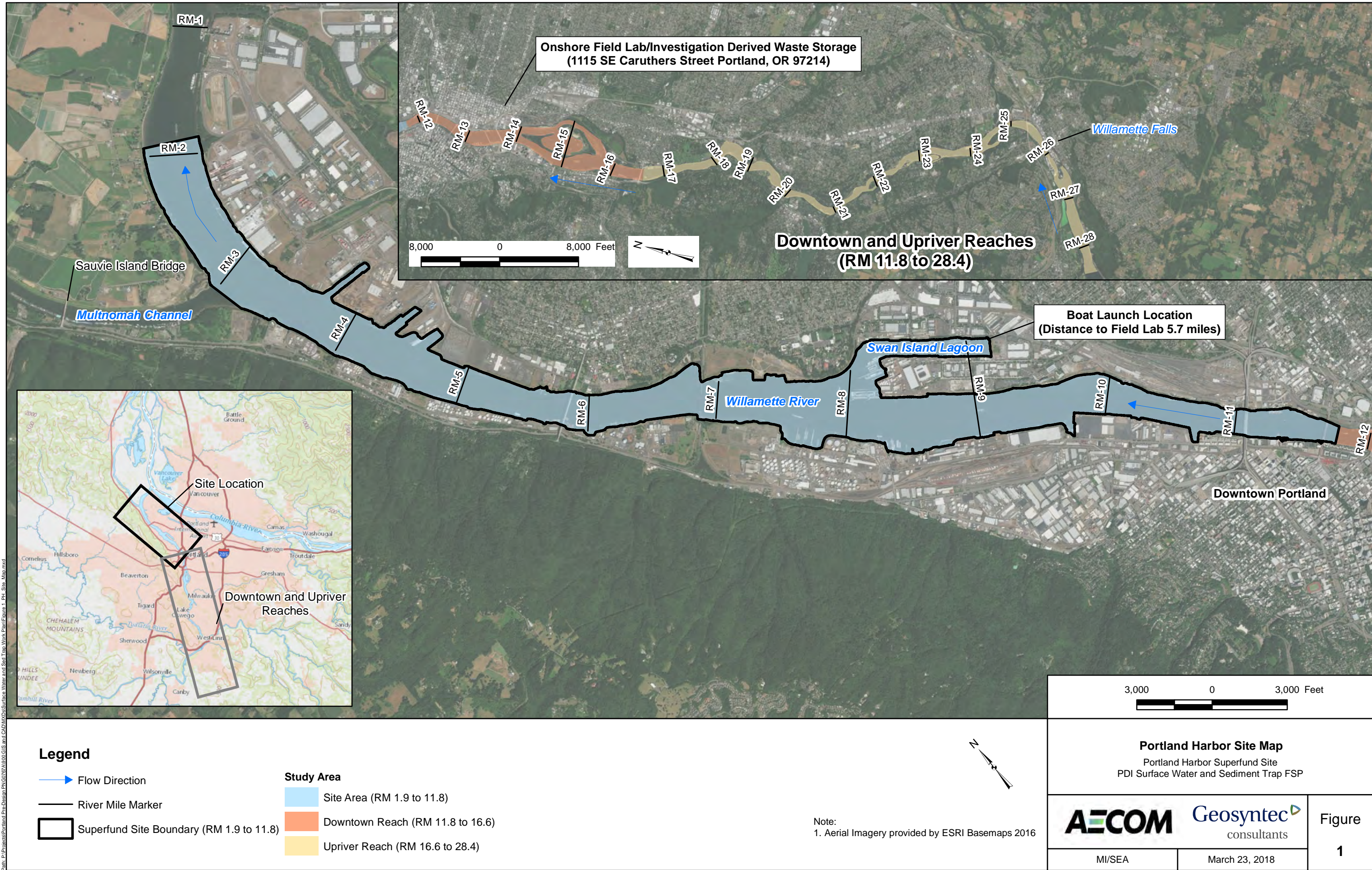
Footnotes:

a) High-Volume Surface water and sediment trap samples will not be analyzed for field duplicates.

Acronyms:

As = arsenic, BEHP = bis(2-ethylhexyl)phthalate; COC = contaminant of concern; CaCO₃ = calcium carbonate; Ca = calcium; Cr = chromium; Cu = copper; DDX = sum of dichlorodiphenyltrichloroethane and its derivatives; MCP = meta-chlorophenylpiperazine; Mg = magnesium; PAHs = polycyclic aromatic hydrocarbon; PCBs = polychlorinated biphenyls; PCP = pentachlorophenol; QA/QC = quality assurance/quality control; ROD = Record of Decision; TOC = total organic carbon; VOC = volatile organic compound; Zn = zinc

FIGURES





Path: P:\Projects\Portland Pre-Design\FIG072\A100 GIS and CAD\MapDocs\Surface Water and Sed Trap Work Plan\Figure 2 Surface Water Sample Locs.mxd

Legend

- Proposed Surface Water Sample Location (n = 21)
- Proposed Sediment Trap Sample Location (n = 4)
- Proposed Surface Water Transect
- Capped Area (Existing)
- 6E

 Surface Water Station Location ID
- ST6a

 Sediment Trap Station Location ID

Note:
1. Aerial Imagery provided by ESRI Basemaps 2016
2. One composite surface water and sediment trap sample will be collected per transect.
3. Surface water samples will be both vertically and horizontally composited.

2,00002,000 Feet

Surface Water and Sediment Trap Sampling Locations

Portland Harbor Superfund Site

PDI Surface Water and Sediment Trap FSP

AECOM

Geosyntec consultants

MI/SEA

March 2018

Figure 2



Sediment Trap Photos

Portland Harbor Superfund Site
PDI Surface Water and Sediment Trap FSP

Geosyntec
consultants

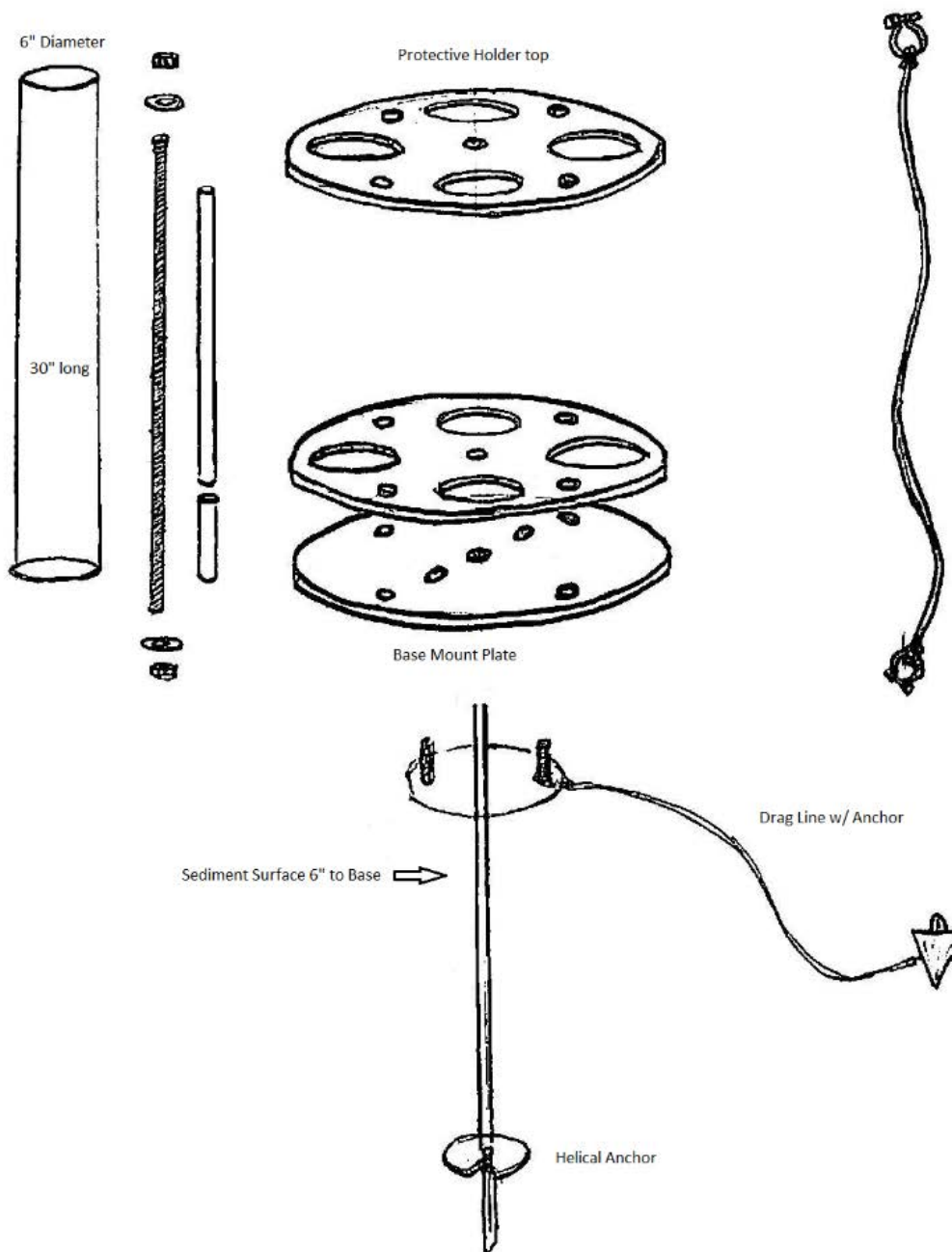
AECOM

Portland, Oregon

March 2018

Figure
3a

Notes:
1. Source: Gravity Marine



Notes:
1. Source: Gravity Marine

Sediment Trap Schematic - Unassembled

Portland Harbor Superfund Site
PDI Surface Water and Sediment Trap FSP

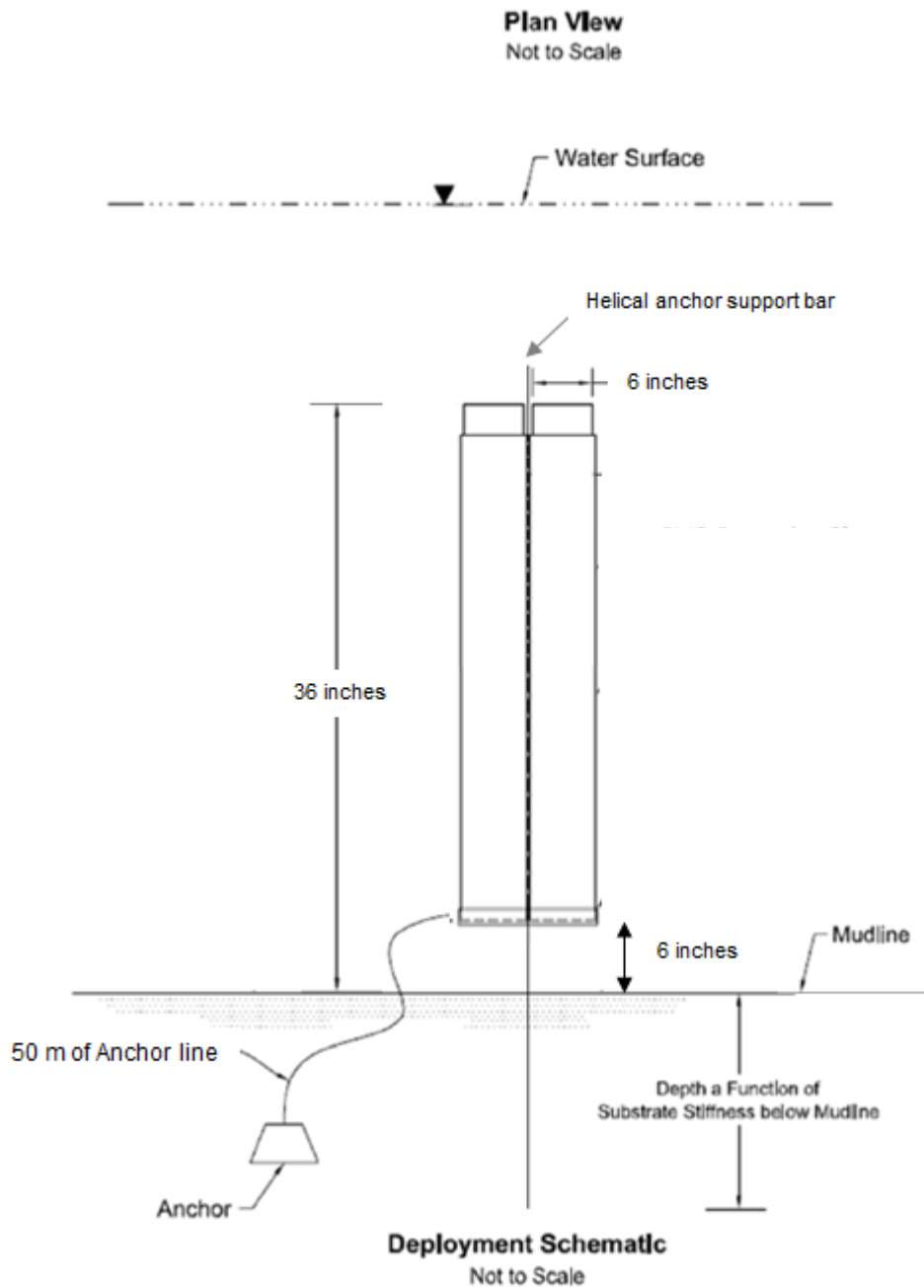
Geosyntec
consultants

AECOM

Portland, Oregon

March 2018

Figure
3b



Sediment Trap Schematic - Deployment

Portland Harbor Superfund Site
PDI Surface Water and Sediment Trap FSP

Geosyntec
consultants

AECOM

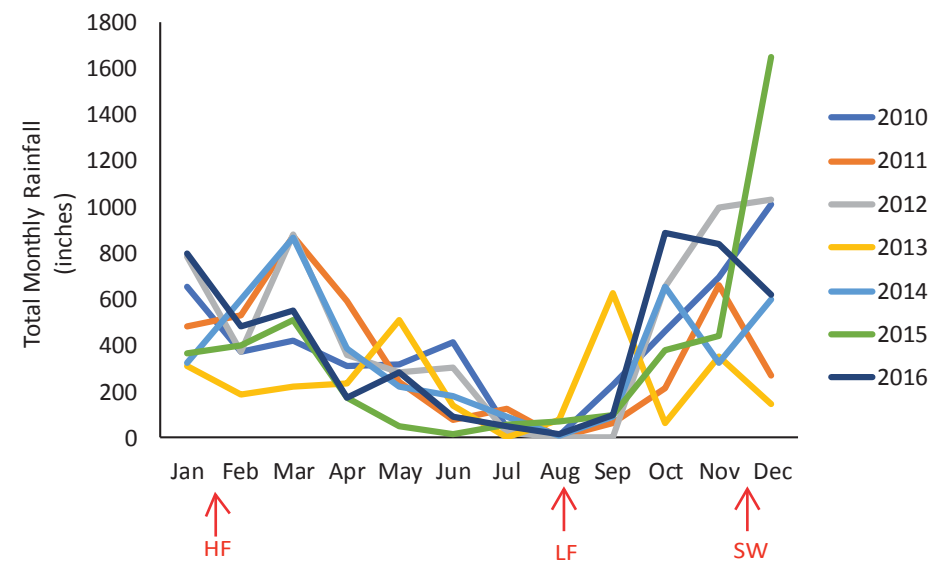
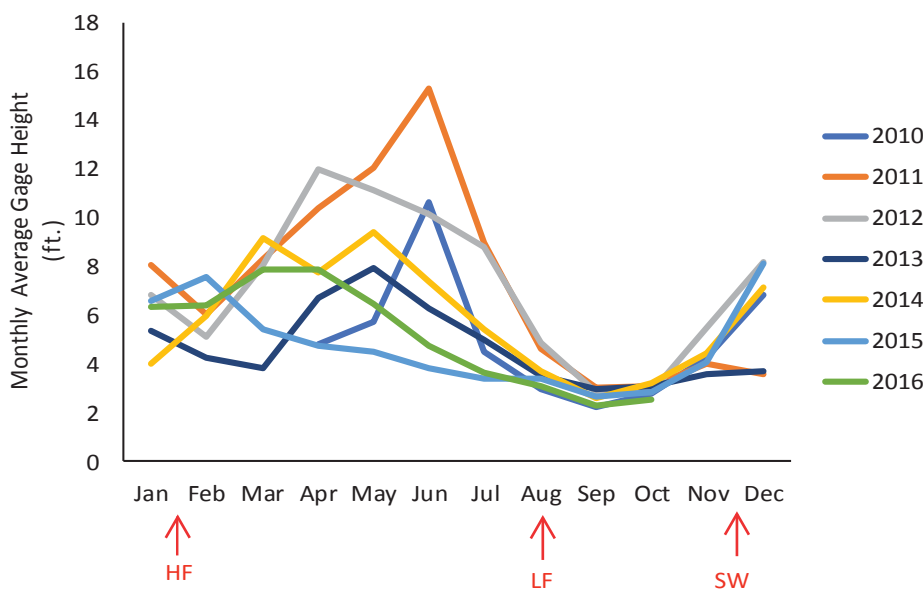
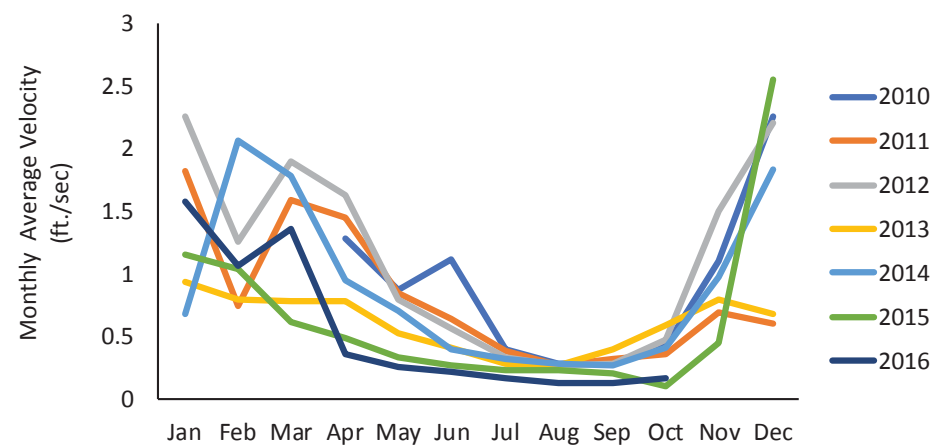
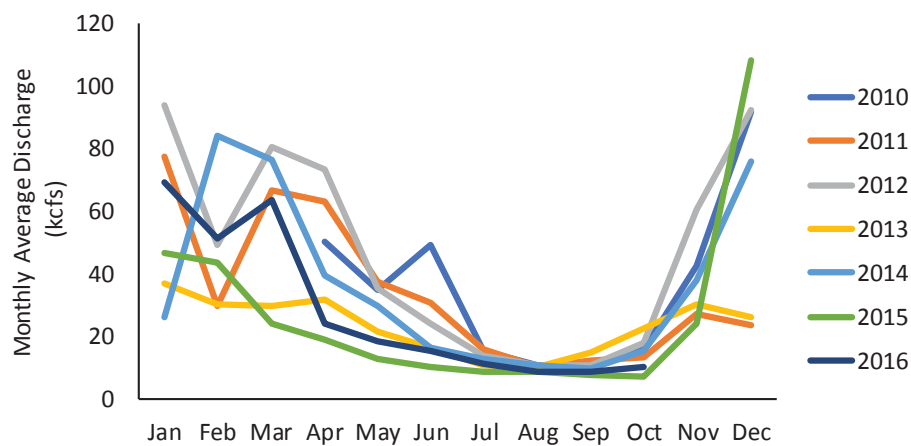
Portland, Oregon

March 2018

Figure
3c

Notes:

- Source: Adapted from Figure 3-1, Portland Harbor RI/FS, Round 3 Field Sampling Plan; Sediment Trap Construction and Deployment Schematic; Anchor Environmental, LLC.



Notes:

kcfs – thousand cubic feet per second

ft./sec. – feet per second

ft. – feet

Red arrows indicate proposed PDI sampling events (HF = high-flow, LF = low-flow, SW = stormwater).

1. Data were obtained from USGS Oregon Water Science Center for Station ID 14211720 Willamette River at Portland, OR near the Morrison Bridge at River Mile 12.6 (<https://or.water.usgs.gov>); and provisional, uncorrected raw data obtained from the Swan Island Pump Station Rain Gauge for the City of Portland Hydra Network (https://or.water.usgs.gov/precip/swan_island_pump.rain).

Historical Surface Water Discharge Flow by Month

Portland Harbor Superfund Site
PDI Surface Water and Sediment Trap FSP

Geosyntec
consultants

AECOM

Figure
4

MI/AGF/SEA

August13, 2018

APPENDIX A

Field Forms and Checklists

A-1: Water Quality Parameter Log

A-2: ACDP Deployment Log

A-3: PR2900 Sampling Log

A-4: Sediment Trap Sampling Log

Surface Water Sampling - Water Quality Parameter and Sample Collection Log

Transect #: _____

Date: _____ Recorded by: _____

[illegible]

Notes:

1: Record at start, in 10 minute intervals, and stop times

2: Record total volume concentration & median particle size from LISST data

Surface Water Sampling - Water Quality Parameter and Sample Collection Log
Portland Harbor PDI Studies

Transect #: _____

Date: _____ Recorded by: _____

West Coordinates: _ Northing: _____ Easting: _____

NavChannel Coordinates: _ Northing: _____ Easting: _____

East Coordinates: _ Northing: _____ Easting: _____

High Volume Sample Collection:

Target Sample Volume: _____ Target Substation Volume: _____ Target Volume per Depth: _____

High Volume Sample

Position East/West/Nav	Depth	Tide	Sampling Depth (ft)	Pump Start Time	Pump Stop Time	Volume Sampled per Substation/Depth (L)	Notes	Total Volume Sampled (L)

Final High Volume Composite Sample ID: _____ Sample Date/Time: _____

Peri-pump Sample Collection:

Target Sample Volume: _____ Target Substation Volume: _____ Target Volume per Depth: _____

Peri-Pump Sample

Position East/West/Nav	Depth	Tide	Sampling Depth (ft)	Pump Start Time	Pump Stop Time	Volume Sampled per Substation/Depth (L)	Notes/Visual Description	Total Volume Sampled (L)

Final Peri-Pump Composite Sample ID: _____

Sample Date/Time: _____

East VOC Sample ID: _____


Sample Date/Time: _____

NavChannel VOC Sample ID: _____

Sample Date/Time: _____

West VOC Sample ID: _____

Sample Date/Time: _____

				Bottom Mounted Aquadopp Deployment & Recovery Log				
Project:				Technician:				
Deployment No.	Site Name	Planned Site Depth (m)	Location		UTC	Local	14:29	
In Water Date (mm/dd/yyyy)		In Water Time (24h)	Final Water Depth (m)	Anchor	Lat:			Lon:
					Lat:			Lon:
Frame, Buoy, & Recovery System								
Type of Bottom Mount		Length of Rope	Type of Rope Samson		Type of Buoys and flotation			
Sensor height from bottom of frame		Recovery System:	<input type="checkbox"/> Rope Packed?		<input type="checkbox"/> Ends of Rope Shackled & Attached?			
Acoustic Release								
Serial No.	Receive Frequency (kHz)	Transmit Frequency (kHz)	Enable Code	Enable Time (hrs)	Release Code			
Battery Fresh Date (mm/dd/yyyy)	Battery Voltage	<input type="checkbox"/> Rings cleaned <input type="checkbox"/> Rings greased	Zinc Anode Condition? Desiccant <input type="checkbox"/>	ARMED? <input type="checkbox"/>				
Nortek AQUADOPP								
Serial No.	Transmit Frequency (kHz)	<input type="checkbox"/> Pressure Port Clean?		<input type="checkbox"/> Bolts tight on current meter				
Battery Fresh Date (mm/dd/yyyy)	<input type="checkbox"/> Desiccant <input type="checkbox"/> External battery pack:	<input type="checkbox"/> Battery cable connected		<input type="checkbox"/> Bolts tight on External Battery				
Number:	Voltage:							
Aquadopp Pre-Deployment Functionality Tests								
<input type="checkbox"/> Communication>Serial port: make sure "hard break" is NOT checked				<input type="checkbox"/> Currents Tab: When pinging in air, amplitudes ~15-30				
<input type="checkbox"/> Communication>Terminal Emulator>Send Break				If placed in water YES / NO <input type="checkbox"/> Should be > 100 counts				
Did instrument wake with "Prodropp" firmware version, etc <input type="checkbox"/>				<input type="checkbox"/> Sensor Tab: Pitch/Roll <input type="checkbox"/> Heading <input type="checkbox"/> Pressure <input type="checkbox"/> Temp				
<input type="checkbox"/> If NO click stop data collection; then -communications>serial port: check search				Calibrate Temp and Pressure if necessary <input type="checkbox"/>				
<input type="checkbox"/> Communication>Terminal Emulator>Send Break				<input type="checkbox"/> Online>Temperature calibration <input type="checkbox"/> Online>Set Pressure Offset				
Did instrument wake with "Prodropp" firmware version, etc <input type="checkbox"/>				<input type="checkbox"/> Check Status Tab Error code should contain only Zeros (see page 63)				
Deployment>Planning>use existing				<input type="checkbox"/> Stop data collection <input type="checkbox"/> Click "start recorder data collecting" icon				
<input type="checkbox"/> Incheck "Waves" <input type="checkbox"/> Incheck "Use Advanced Settings"				<input type="checkbox"/> Collect data for a short period: click "stop data collection" icon				
<input type="checkbox"/> Set Profile Interval to 01 seconds <input type="checkbox"/> Click "Start Data Collection"				<input type="checkbox"/> Deployment>Recorder Data Retrieval (Confirm Data Collection)				
<input type="checkbox"/> Calibrated compass?								
Aquadopp deployment set up								
Existing deployment file:		File name:		<input type="checkbox"/> File Loaded: Deployment>planning>load from file				
Standard Tab		Deployment>planning>use existing		Advanced Tab				
Current profile		Instrument		Deployment Planning		Current profile		
Profile Interval(s)		Frequency: 1 mHz		Assumed Duration (days):		Average Interval (s):		
Number of cells:				Estimated Depth (m):		Blanking Dist. (m):		
Cell Size (m):				Battery Utilization (%):		Measurement load (%): <input type="checkbox"/> Auto		
<input type="checkbox"/> Waves				Memory required (MB):		<input type="checkbox"/> Coord. System		
Number of samples:				Vertical vel. Prec. (cm/sec):		ENU / XYZ / BEAM		
Sampling rate:				Horizont. Vel. Prec. (cm/sec):		<input type="checkbox"/> Measured		
Interval (s):				Compass update rate (s):		<input type="checkbox"/> Salinity (ppt)		
<input type="checkbox"/> SUV Data Collection				Compass update rate (s):		<input type="checkbox"/> Fixed (m/s):		
<input type="checkbox"/> Use Advanced Settings				Power level:		File Wrapping <input type="checkbox"/> (Usually No)		
<input type="checkbox"/> Deployment File Modified:		File>save as: .dep		<input type="checkbox"/> Start Deployment: Deployment>Start Recorder Deployment		Start date / time:		
<input type="checkbox"/> Compass Calibrated		<input type="checkbox"/> Heading Verified		Deployment Name (6-character name):				
Screen Capture of Calibration - File Name:				<input type="checkbox"/> Set Aquadopp Time to Laptop Time		<input type="checkbox"/> Install Dummy Plug		
<input type="checkbox"/> Laptop Synced to GMT				<input type="checkbox"/> Antifouling <input type="checkbox"/> Destin <input type="checkbox"/> Housing Wrapped		<input type="checkbox"/> Pinging Confirmed		
RECOVERY								
Recovery Date (mm/dd/yyyy)		Time off bottom (24h UTC and Local)		Time out of water (24h UTC and Local)		<input type="checkbox"/> Pinging		
Aquadopp Shut Down date / time		Lat: Same Lon: Same		Lat: Same Lon: Same		Fouling: <input type="checkbox"/>		
						Comments: heavy growth on mooring line, low growth on instrument/frame		
Data Recovery ***DO NOT DISCONNECT BATTERY*** until all data is downloaded and verified								
<input type="checkbox"/> Laptop Synced to GMT		<input type="checkbox"/> Communication>Serial Port: Upload Baud Rate Set to 115,200 kb						
<input type="checkbox"/> Computer Power management set to OFF		<input type="checkbox"/> Deployment>Recorder Data Retrieval: Select Files, Select "Retrieve"						
<input type="checkbox"/> Using AWAC AST: Deployment>Stop Recorder Deployment		File names:						
Computer Time		Instrument Time		<input type="checkbox"/> Open Data File in Storm Software		<input type="checkbox"/> Save Data File to a secondary Location		
		<input type="checkbox"/> Data is Verified						
Comments								

Gravity PR2900 - Water Sample Log

Transect_____

Crew_____

Date_____

[illegible]

Deployment Information				
Deployment Date:		Vessel Name:		
Start / End Time:		Weather:		
Sampler Personnel (AECOM/Geosyntec):		Global Dive Personnel:		Gravity Captain / Deckhand
Oversight Personnel:				
Tube Decontaminaton/Prep Method:				
Description of Location and Channel Bottom:				
Proposed Coordinates Easting: Northing:		Acutal Deployment Coordinates Easting: Northing:		Water Depth (ft): Method: <i>AirMar Echo Sounder (Bow Mounted)</i>
Checklist ("X"):	30" Anchor Rod Drive:	1 L Dense Salt Solution:	Sodium Azide:	Diver Confirmation Upright:
Glass Tube 1:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Glass Tube 2:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Glass Tube 3:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Glass Tube 4:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Additional Comments:				

Retrieval Information			
Retrieval Date:		Vessel Name:	
Start / End Time:		Weather:	
Sampler Personnel (AECOM/Geosyntec):		Global Dive Personnel:	
Oversight Personnel:		Gravity Captain / Deckhand	
Water Depth (ft): Method: <i>AirMar Echo Sounder (Bow Mounted)</i>		Analytical Suite: Full ROD Table 17 COCs	
Final Composited Sediment Trap Sample Description			
Color, Minor/Major Constiuent, Debris, Odor, and Sheen:			
Sample Information			
Sample ID	Sample Time	Sample Type (Primary, Duplicate, MS/MSD, EPA Split)	# of Containers

Glass Tube #1 Sediment Description					
Observations (biofouling, staining on tube, other):					
Sediment Mass:		Sediment Recovery Thickness (4 measurements in cm):			
		1)	2)	3)	4)
Color, Minor/Major Constituent %:					
Organics, Biota, and Other:					
Odor and Sheen:					
Glass Tube #2 Sediment Description					
Observations (biofouling, staining on tube, other):					
Sediment Mass:		Sediment Recovery Thickness (4 measurements in cm):			
		1)	2)	3)	4)
Color, Minor/Major Constituent %:					
Organics, Biota, and Other:					
Odor and Sheen:					
Glass Tube #3 Sediment Description					
Observations (biofouling, staining on tube, other):					
Sediment Mass:		Sediment Recovery Thickness (4 measurements in cm):			
		1)	2)	3)	4)
Color, Minor/Major Constituent %:					
Organics, Biota, and Other:					
Odor and Sheen:					
Glass Tube #4 Sediment Description					
Observations (biofouling, staining on tube):					
Sediment Mass:		Sediment Recovery Thickness (4 measurements in cm):			
		1)	2)	3)	4)
Color, Minor/Major Constituent %:					
Organics, Biota, and Other:					
Odor and Sheen:					

APPENDIX B

Standard Operating Procedures

- B-1: Water Quality Parameters SOP (LISST and YSI)
- B-2: Acoustic Doppler Current Profiler (ADCP) SOP
- B-3: Surface Water Sampling with Peristaltic Pump SOP (Integral 2004b)
- B-4: High-Volume Surface Water Sampling with PR2900 SOP
- B-5: Horizontal and Vertical Location Control SOP (August 2018)
- B-6: Excerpts from Round 3 Sediment Trap FSP (Integral 2006c)
- B-7: Investigation-Derived Waste SOP (March 2018)

APPENDIX B-1
STANDARD OPERATING PROCEDURE
WATER QUALITY PARAMETERS (LISST & YSI)

STANDARD OPERATING PROCEDURE (SOP)

LISST AND YSI FIELD PROBE MEASUREMENTS AND CALIBRATION

Scope and Application

This Standard Operating Procedure (SOP) describes the protocols for collecting *in situ* water quality data in the field with Laser *In Situ* Scattering and Transmissometry (LISST) Particle Analyzer and YSI multi-probe conductivity, temperature, turbidity and dissolved oxygen (CTD) sensors.

Definitions

pH: pH is the negative log₁₀ of the hydronium ion concentration.

Dissolved Oxygen (DO): The concentration of oxygen dissolved in water, expressed in milligrams per liter (mg/L) or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given barometric pressure and temperature.

Specific Conductivity (Cond): The measure of water's ability to conduct electricity, and therefore a measure of the water's ionic activity and content, normalized to a temperature of 25 degrees Celsius (°C).

NIST: National Institute of Standards and Technology.

Safety and Hazardous Materials Management

General Lab Safety – All general laboratory safety practices should be complied with, including wearing a laboratory coat, safety glasses, and gloves. Samples must be treated with regard to possible toxicity and microbiological potential.

This method may involve the use of corrosive and caustic reagents as well as chemicals that pose contact hazards. Care should be taken to avoid skin contact or inhalation of these chemicals.

Analysis – From a Vessel – Sampling personnel will follow standard safety procedures while onboard the sampling vessel. The vessel skipper has ultimate responsibility for safety while the vessel is underway. During deployment of equipment, the YSI sonde operator and the skipper must communicate with one another to avoid potential loss of the instrument due to propeller interface with the underwater field cable.

Analysis – Streams/Rivers – Sampling personnel will always enter streams/rivers cautiously and follow standard safety procedures when entering these flowing bodies of water. There are many hazards associated with streams and rivers sampling. Some of these hazards include traffic, fast moving or deep water, steep slopes to sampling sites, and hostile dogs or people. Use extreme caution when exiting sampling vehicles, walking along busy highways or sampling on bridges. Fast moving water can cause the sampling personnel to lose balance and fall into the water. This

can result in injury or drowning. Many of the sampling sites require personnel to walk over riprap or other extremely rough and slippery terrain. Again, extreme caution combined with slow movements can minimize potential injury. Be aware of your surroundings and potential presence of other people, especially under bridges or in culverts.

Equipment

Two instruments will be used for field measurements: a LISST Particle Analyzer and a YSI multiprobe.

The LISST 100X is a submersible multi-parameter system for *in situ* observations of particle size distribution and volume concentration. While *in situ*, LISST monitors particle size distribution, particle volume concentration, volume scattering function, optical transmission, depth, and temperature in both fresh and marine waters.

The YSI 6600 Sonde is an *in situ* detector of temperature, pH, dissolved oxygen, specific conductivity, turbidity, and depth in fresh and marine waters. The YSI 600XLM is a smaller version of the 6600 series and is identical in use and function. The YSI 6600 EDS is a 6600 sonde equipped with a rotating brush that periodically wipes the individual sensors to prevent biofouling during extended deployment periods.

Water Quality Measurements

Physical and chemical water parameters will be collected at surface water stations. Several physical and chemical water parameters are best measured in the field because of the unstable nature of the parameter or because the information is needed to direct further sampling. It is frequently preferable to perform these analyses in the field, especially if the samples will not be immediately transported to the analytical laboratory (pH, in particular, should be measured in the field if feasible).

It is best to place the instruments directly into the surface water body at the station location at the desired water depth instead of collecting a sample and measuring parameters in a container. However, if this is not possible, a flow through chamber may be most feasible for sample collection.

The sensors will run for the full duration of the sampling event to observe any potential changes in the physical parameters of the sample that may be caused by site changes or perturbations (such as vessel traffic, storm events, outflows, etc.).

Documentation of instrument information will include at a minimum the name(s) of the person(s) making the measurement and the field equipment used to make that measurement must be recorded in the field logbook and on any field forms used during the sampling event. Equipment maintenance and calibration records must be kept in logbooks and field records so that the procedures are traceable. Field records will be recorded in the project notebook.

The following sections provide protocols and calibration specific to each instrument.

LISST

Calibration

The LISST uses lasers for the measurement of particle volume and size; therefore, the calibration requirements are less substantial than for YSIs as degradation of the calibration does not occur; only the lens requires calibration. LISST calibration will be performed on the first and last day of field sampling at the AECOM Technical Services (AECOM) field laboratory. Calibration will be performed as a blank water calibration by submerging the sensors in only fresh distilled water to collect a background particle calibration.

The background scattering measurement is critical to good instrument performance. It is especially critical for clean water applications where the optical transmission is greater than 90% over the 5 cm path. The background scattering will also check the overall health of the instrument. It will verify that all of the systems are functioning and that the optics is still in alignment. To collect the background file, open the calibration function and collect 20 samples. After all 20 are collected the average will be displayed. If the values are acceptable the values can be saved to a file. All data collected in the field will be compared back to this new background file. If there is a problem with the instrument or if the water or windows are not clean, error messages will be displayed. Dirty water or windows will generally cause higher values across the middle rings. Large bubbles or particles in the water can cause higher values on the inner rings or left hand side of the display. High values on the inner rings combined with a lower Laser power value can also be an indication of optical misalignment.

Operation

1. At the start of sampling, log the LISST file name in your logbook.
2. Set the LISST to average 10 samples every 0.3 seconds and collect until shutoff with the magnetic strip.
3. Install LISST with other sensors at the targeted depth where the chemical samples will be collected and commence data collection in conjunction with the start of related sampling.
4. Stop sampling of the LISST at the conclusion of the sampling event.
5. Decontaminate LISST with Liquinox and DI water between stations.
6. Download LISST file to Trimble YUMA after each station is sampled.
7. Process files with daily background scatter calibration.

YSI MULTIPROBE

Calibration

Prior to start of sampling, conduct a calibration of the instrument:

1. Save with date of sampling.
2. See below for full calibration method and quality control (QC) requirements.
3. Collect and review calibration and verify acceptability.

Operation

1. At the start of sampling, log the YSI file name in your logbook.
2. Set the YSI to collect samples every 1 second.
3. Install YSI with other sensors at the targeted depth where the chemical samples will be collected and commence data collection in conjunction with the start of related sampling (see details below for Live Data Recording and Data Logging).
4. Stop sampling of the YSI at the conclusion of the sampling event.
5. Decontaminate YSI with Liquinox and DI water between stations.
6. Download YSI file to Trimble YUMA after each station is sampled.
7. Process files and save to USB backup.

The YSI multiprobe can be used for both attended discrete data collection (live data recording) and unattended longer-term data collection (data logging).

Live Data Recording

After calibration has been completed, completely rinse the probes with reverse osmosis (RO) water. Pour a small amount of tap water into the calibration cup to keep the sensors in a moist environment during transit to the first sampling locations. Be sure to bring check standards, RO water for rinsing, the probe guard and a 650 MDS datalogger with sufficient battery power to last for the sampling run. The YSI 650 MDS runs on four C cell batteries. Remaining battery life is always on display at the bottom right hand corner of each screen. See KCEL SOPs # 02-02-002, #02-02-004 and # 02-02-003 for measurements made in marine and freshwater systems.

Remove the calibration cup and install the slotted sensor guard. Place the YSI into the sampling environment; wait for parameters to equilibrate and record measurements, including time to the nearest minute, directly onto the field sheet.

Datalogging (Unattended Monitoring)

The YSI 6600 and 600XLM have onboard memory and power. These sondes can log readings to sonde memory for days or weeks at a time. If monitoring for DO, remember to re-enable the RS-232 sleep mode to conserve battery power and excess wear of the DO probe following the calibration of the sonde.

Setting Up Unattended Monitoring Using the 650 Datalogger

From the 650 main menu, select “Sonde Menu” then “Run” and then choose “Unattended”. The screen will show the Unattended Setup menu, which includes the following choices (use the arrow key to toggle down and highlight each selection for editing):

- Interval: Enter the desired sampling interval in hours, minutes, and/or seconds.
- Start date: Enter the sampling start date.
- Start time: Enter the sampling start time.
- Duration days: Enter the length of time, in days, that the sonde will be deployed.
- File: Enter a file name of no more than eight characters.
- Site: Enter the name of the location where the sonde will be deployed.
- Bat volts: This value is the voltage of the batteries inside the sonde (informational only).
- Bat life: This value is the number of days the sonde can log before the batteries will deplete (informational only).
- Free mem: The value is the number of days the sonde can log before the internal memory will be full (informational only).
- A - Tells the amount of time before the first sample will log.
- View Parameters: if selected, a list appears of what parameters will be logged.
- Start logging: When you have finished setting up for the unattended deployment you must select this. After you press enter, the screen will ask you if you really want to start logging. Enter yes and the screen will return to the Unattended Setup menu. Logging will begin at the next even multiple of your logging interval. The sonde can now be unconnected from the datalogger and is ready for unattended monitoring.

Setting Up Unattended Monitoring Using a PC Equipped with EcoWatch

From the main menu, select 1 – Run, then 2 – Unattended sample to bring up the Unattended Sample Menu. Select either the letter or number of the following options to edit:

- 1 – Interval: Enter the desired sampling interval in hours, minutes, and/or seconds.
- 2 – Start date: Enter the sampling start date.
- 3 – Start time: Enter the sampling start time.
- 4 – Duration days: Enter the length of time, in day, that the sonde will be deployed.
- 5 – File: Enter a file name of no more than eight characters.
- 6 – Site: Enter the name of the location where the sonde will be deployed.
- 7 – Bat volts: This value is the voltage of the batteries inside the sonde (informational only).
- 8 – Bat life: This value is the number of days the sonde can log before the batteries will deplete (informational only).
- 9 – Free mem: The value is the number of days the sonde can log before the internal memory will be full (informational only).
- A – Tells the amount of time before the first sample will log.

- B – Tells what parameters will be logging.
- C – Start logging – When you have finished setting up for the unattended deployment, you must select this. After you press the C key, the screen will ask you if you really want to start logging. Enter yes and the screen will return to the Unattended setup menu. Logging will begin at the next even multiple of your logging interval. The sonde may now be unattached from the PC and is ready for unattended monitoring.

The probe must be capped during the time between the last field measurement and arrival at the laboratory and must be stored with sufficient ambient water in the cap to maintain high humidity but not cover the individual probes. The sonde must be returned to the lab within 12 hours of the last field measurement so that post-deployment calibration checks can be performed.

Uploading Files from the Sonde to the PC

When the unattended monitoring period is over, the file stored in the YSI sonde may be transferred to a laptop PC loaded with EcoWatch software by following these steps:

- Connect the sonde to the PC and open the EcoWatch software. Use the Sonde button on the toolbar to communicate with the sondes software.
- Type “menu” after the prompt and select 1 – Run. If the sonde is still logging, select the option to stop logging and return to the main menu.
- From the main menu, select 3 – File menu and 3 – Quick upload. Choose to upload in PC6000 format. After the upload is complete, the data will be in a .DAT file on the PC.
- Open the .DAT file to view the data using the EcoWatch software.
- To export the file to an Excel spreadsheet, activate the File dropdown menu on the EcoWatch main toolbar and highlight Export. Save the file in .xls format.

YSI – Additional Calibration Information

Individual probes for the specific parameters of interest are calibrated before field use. The sondes are equipped with internal memory and programmable logging functions which allows unattended data collection for variable time frames. Post-deployment calibration verification checks are performed on each sonde returning from the field to help verify the accuracy of data collected. Records are kept on both pre-deployment calibration and post-deployment checks. In addition to these, notes are kept on probe electrical response, maintenance, and replacement. Calibration procedures are provided in Attachment 2 of this SOP.

The YSI model 650 data loggers are hand-held microcomputers that allow the user to display sonde readings, calibrate and configure sondes, store and recall data, and upload data from sondes.

EcoWatch for Windows is the PC software interface to YSI’s 6-Series environmental monitoring sondes. With EcoWatch, the user can program field equipment, upload data collected on the equipment, and format data into graphs, tables, and spreadsheets.

Attachment 1. Field Equipment List

- High volume peristaltic pump with vortex separator
- Teflon® tubing
- Surface water parameter multi-meter capable of measuring pH, reduction/oxidation (redox) potential, temperature, specific conductance, turbidity, and dissolved oxygen
- Teflon®-lined polyethylene sample tubing (length is site dependent)
- Platinum cured silicone tubing
- Plastic zip-ties
- Water Sampling Log forms
- Sample tags/labels and appropriate documentation (e.g., chain-of-custody forms)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample containers (PUF cartridges, vortex separator vials)
- Coolers
- Wet ice
- Nitrile gloves
- First aid kit
- Eye wash kit
- Duct tape
- Clear tape
- Packing tape dispenser
- Tool box
- Coated weights for water samplers
- Non-metallic wire for winch spool
- 2000-watt power generator or inverter
- Paper towels
- Dilute solution of Liquinox
- Deionized water
- Extension cord
- Power strip
- Resealable plastic bags (i.e., 1 gallon and 1 quart)
- Yuma Trimble
- IDW containers
- Hexane
- 0.45 micron in-line filters

Attachment 2.

1. YSI DETAILED PROCEDURES

1.1 CALIBRATION

Calibration for DO, Cond, turbidity and pH are to be done within 12 hours of deployment. Depth should be checked prior to deployment and calibrated to relative zero (local water surface) as needed. Temperature need only be checked annually since there is no means of calibrating the YSI thermistor, which is integral to the conductivity probe. If temperature values are found to be inaccurate beyond prescribed standards, the entire conductivity probe must be replaced

Pre-deployment calibration is done in the following order of increasing conductivity: DO, Cond, pH. This allows for an accurate calibration and control check for the very low conductivity standard used in this procedure (a standard that best reflects the actual conditions found in our fresh water sampling sites). In the calibration laboratory, the YSI Sonde should be properly supported on the bench so that solutions can be easily added to the calibration cup while also being able to properly rinse the sonde between calibration solutions.

1.1.1 Calibrating using the YSI 650 Datalogger

- Connect the YSI 650 datalogger to the sonde using the 8-foot 6090 field cable and press the green “power” button to activate the logger. The screen will automatically power to the “650 Main Menu” screen. Toggle down to “Sonde menu” and engage this menu by pressing the enter arrow key.
- Toggle down to the “Advanced” menu and press enter. In the “Advanced” menu, toggle down to “Setup” and press enter. To properly calibrate the DO probe, it is best to deactivate the “Autosleep RS232” protocol. This can be done by toggling down to this item on the “advanced setup” menu screen and pressing enter.
- You are now ready to begin calibration. Escape out twice from these menu layers and toggle up and enter “Calibrate” on the main Sonde menu.

1.1.1.1 Dissolved Oxygen

- With the sonde oriented so that the sensors are pointed upward, place enough RO or tap water in the calibration cup to raise the level to within approximately 3 millimeters (mm) (1/8th inch) of the o-ring on the DO probe. Make sure that the DO membrane is free of bubbles, tears, or creases and not immersed in water, and remove any water

droplets from the DO membrane surface with a kimwipe. Loosely cover the open top of the calibration cup with the lid.

- Select “Dissolved Oxygen” from the calibration menu. Select “% saturation” and enter the barometric pressure in mm Hg. This information is obtained using the digital barometer (7.4) in the calibration room.
- Wait approximately 10-20 minutes for the air in the calibration cup to become water-saturated and for the temperature to equilibrate. Record the pre-calibration value on the YSI calibration worksheet.
- Press “Enter” to calibrate and record the initial calibration check (post calibration value). This value should be within 1% of the calibration set point of 100%.
- Record the DO charge value to log a record of probe response and possible drift, which may indicate a need for probe maintenance. If the DO charge value falls outside of the 25-100 range, the electrodes need to be resurfaced and the membrane changed. See Section 5: Preventative Maintenance for the procedure to service the DO probe.
- Press the “Escape” key to return to the calibration menu

1.1.1.2 Conductivity

- Rinse and fill the calibration cup repeatedly with RO water until the conductivity reading is as close to zero as possible. This ensures that there are no lingering buffer salts on the probes or calibration cup that may contaminate the conductivity calibration standard.
- Rinse the chamber with reclaimed 73.9 $\mu\text{S}/\text{cm}$ solution and then fill the calibration cup (enough to cover the conductivity probe) with fresh 73.9 μS conductivity standard. Select “conductivity” from the calibration menu and then “spCond”. Enter the value in millisiemens (divide microsiemens by 1,000 and the result is 0.0739) and record the pre-calibration number (which will be reported in microsiemens).
- Press Enter to calibrate and record the post-calibration number. Discard the calibration solution and add the calibration check standard and record the response. The calibration check standard should be within 10% of the true value otherwise the sonde must be recalibrated with fresh standards and rechecked with fresh check standard solution.

1.1.1.3 pH

A two-point calibration procedure is most commonly used. First determine the approximate pH of the water body to be analyzed. If the majority of the water will be greater than 7.0, use the high range. If the pH values are expected to be below 7.0, use the low range.

1.1.1.3.1 High Range

- Rinse the sensors with a small portion of the pH 7.0 buffer and fill the cup to above the sensors with fresh pH 7.0 buffer and allow at least one minute for temperature equilibration and the response to stabilize before proceeding. Insure that there are no bubbles on the pH bulb or clinging to the bulb guard.
- Select ISEI pH from the calibration menu and select a two-point calibration.
- Enter the pH 7.0 buffer and record the pre-calibration value. Allow 2- 5 minutes for the reading to stabilize. Sometimes there will be a slow drift on the sensor readings, so be certain that the reading has equilibrated prior to calibration. Press Enter to calibrate and record the post-calibration number. Record the pH mV value to track the probe response and to help determine the need for maintenance and/or replacement. This value should be between 0 and +/- 50 mV.
- Escape once to enter the second point for the calibration curve, in this case using the pH 10.0 buffer. Rinse the probes and cup well with RO water and then with reclaimed pH 10 buffer. Fill the calibration cup with fresh pH 10.0 buffer. Repeat steps as above. For the pH 10 response, the pH mV constant should be -177 from the pH 7 mV value.
- Rinse well with RO water and reclaimed pH 6.86 check standard, and then pour in a pH 6.86 calibration check standard. The response of the check standard must be within +/- 0.2 pH units of the expected value, otherwise the sonde must be recalibrated with fresh standards and rechecked with fresh check standard solution.

1.1.1.3.2 Low Range

- Rinse the sensors with a small portion of the pH 7.0 buffer and fill the cup to above the sensors with fresh pH 4.0 buffer and

allow the response to stabilize. Select ISEI pH from the calibration menu and select a two-point calibration.

- Enter the pH 7.0 buffer, allow the readings to stabilize, and record the pre-calibration value. Press Enter to calibrate and record the post-calibration number and the pH mV value.
- Escape once to enter the second point in the calibration curve, in this case the pH 4.0 buffer. Rinse the probes and cup well with RO water and reclaimed pH 4 buffer, then pour in fresh pH 4.0 buffer. Repeat steps above and record the pH mV value. This value should be +177 from the pH 7 mV value.
- Rinse well and pour in a pH 6.86 calibration check standard. The response of the check standard must be within ± 0.2 pH units of the expected value, otherwise the sonde must be recalibrated with fresh standards and rechecked with fresh check standard solution.

1.1.1.4 Turbidity

- The first step is to confirm that the turbidity probe is functioning properly. Confirm that the wiper parks correctly. It should be positioned at approximately 180° opposite the optics. The wiper must reverse direction during the wipe cycle. The output of the probe must increase when you place your finger in front of the optics. If the wiper does not park correctly or reverse direction, then make sure that the underside of the wiper is clean and free of mud, sediment, or other fouling. Replace the wiper or pad with a spare if needed. If the probe does not show an increase in output or the wiper does not park correctly, then you must stop the calibration and determine the cause of the problem.
- Calibrating turbidity is best done in a lab environment; calibrations in the field can result in errors. It is better to post-calibrate a sonde back in the lab than to attempt the calibration of an optical probe in the field, especially if you are working out of a small boat or in less than clean conditions.
- Never use plastic or glass containers for your calibration unless the sensor guard is installed on the sonde. Use of the supplied calibration/storage cup with its black endcap is strongly recommended.

- Always ensure that the submerged parts of the sonde and wipers are clean before beginning any turbidity calibration. Remove any brush wipers and replace with a clean, standard (no brush) wiper. Sediment or other contaminants will compromise the standard if not removed prior to calibration. Make especially sure the optics are clean, no fingerprints!
- Always start with the zero (0) NTU standard first. Pour the 0 NTU cal standard into the calibration cup -- pour down the side so you do not aerate the sample. Secure the sonde into the calibration cup. Verify that there are no air bubbles on the probe face, run the wiper at least once, and wait out the probe's sampling period before accepting the first calibration point.
- Calibrate the second point, using 50 NTU. Again, wipe the probe at least once before pressing the enter button.

1.1.2 Calibrating Using a PC equipped with EcoWatch Software

- Connect the YSI to the PC using the 6067B calibration cable and attach the DB-9 connector of the cable to the Com port of the computer.
- Open the EcoWatch software program. Select the Sonde icon button from the EcoWatch toolbar and type "menu" at the # prompt on the terminal screen to bring up the main menu. Navigate through EcoWatch by typing in the number preceding each selection option at the prompt and pressing enter. Type in "0" or use the escape key to return to a previous menu.
- From the main menu, select the "Advanced" by typing in "8" at the prompt menu and press enter. In the "Advanced" menu, select 2- "Setup" and press enter. To properly calibrate the DO probe, it is necessary to deactivate the "Autosleep RS232" protocol. This can be done by selecting "5" in the "advanced setup" menu screen and pressing enter.
- You are now ready to begin calibration. Escape out twice from these menu layers to return to the main menu and select 2 – Calibrate to bring up the Calibration menu.
- Follow the steps outlined above in sections 1.1.1.1 through 1.1.1.3 to complete the calibration.

1.1.2.1 Temperature

Temperature probe calibration is factory-set and requires no daily re-calibration. Annually, the calibration must be verified as described in the QC section.

1.1.2.2 Depth

If data is to be collected at a particular depth and the YSI's depth reading is used to confirm the depth of the probe, the calibration of the depth sensor must be checked. The user should check that the reading above the water reads zero, and that immersion at one meter yields a correct reading. The sonde should be immersed such that the base of the probe is at one meter. A measuring device such as a marked Secchi disk line can be used to determine the accuracy. If the depth needs recalibration, remove the probe guard and re-attach the calibration cup so that the probes are in water saturated air. From the calibrate menu, select number 3-Pressure-Abs to access the depth calibration procedure. Input 0.00 and press Enter. Monitor the stabilization of depth readings with time. When no significant change occurs for approximately 30 seconds, press Enter to confirm the calibration.

2. QA/QC REQUIREMENTS

2.1 IN FIELD QC FOR ATTENDED MONITORING

When the YSI sonde is used for attended monitoring, both a field replicate (FREP) and field check standards (CS) for pH and conductivity are run at a frequency of 5% of field measurements or once per sampling run. A field replicate is defined as a separate in-situ measurement made immediately following all procedures done for an individual sample. The probe would typically be removed from the water body then returned to the same depth and position used in the original measurement. To meet project requirements, checks using calibration check standards may also be performed in the field. A pH calibration check standard and a conductivity calibration check standard may be taken into the field for each sampling run. The calibration checks should be analyzed at the same frequency as the field replicates (a minimum frequency of 5% of measurements or once per day).

The following table describes the acceptance limits for field replicates and calibration check standards.

Parameter	Replicate Samples	Field Calibration Check Standards
Dissolved Oxygen	RPD \leq 20%	Not applicable
Temperature	\pm 0.3 °C	Not applicable
Conductivity	RPD \leq 10%	\pm 10 %
pH	\pm 0.2 pH units	\pm 0.2 pH units

Notes:

RPD = Relative Percent Difference = $100 \times [(r_1 - r_2)] / ((r_1 + r_2)/2)$
where r1 = result 1 r2 = result 2

2.2 POST-DEPLOYMENT CALIBRATION CHECK

After either an attended or unattended monitoring period, sondes returned to the laboratory must have a calibration check performed within 12 hours of the last field measurement. The post-deployment checks must be done in the same order used for initial calibration and must be done before any maintenance or calibrations are performed.

2.2.1 DO Post-Deployment Check

Set up the sonde as described in the SOP. Measure the % DO in the saturated air and record the value and DO charge. Be sure to allow enough time (add an estimated time, i.e., 5 minutes) for the DO to truly equilibrate to the saturated air inside the calibration cup before recording the response.

2.2.2 Conductivity Post-Deployment Check

Immediately after the DO check, rinse the cup with reclaimed 73.9 $\mu\text{S}/\text{cm}$ solution, and then fill the calibration cup with the calibration check standard and record the measured value and the Conductivity Calibration Constant.

2.2.3 pH Post-Deployment Check

Immediately after the Conductivity check, fill the calibration cup with the calibration check standard and record the measured value and the pH mV value.

2.2.4 Time Post-Deployment Check

After an extended deployment, the internal YSI clock will be re-checked against the atomic clock to ensure the accuracy of the interval and actual time of logged samples.

If any parameter falls outside the acceptance limits shown below, the field data collected with the sonde may be qualified.

Attended Monitoring (or less than 24 hours from Calibration to End Check):

Parameter	Post-Deployment Calibration Check Acceptance Limits
Dissolved Oxygen	$\pm 4 \%$
Temperature	See below
Conductivity	$\pm 10 \%$
pH	± 0.2 pH units

Unattended Monitoring (more than 24 hours from Calibration to End Check):

Parameter	Post-Deployment Calibration Check Acceptance Limits
Dissolved Oxygen	±10 %
Temperature	See below
Conductivity	±10 %
pH	±0.3 pH units

Temperature probe calibration is confirmed annually with a side-by side comparison of the probe response to an NIST-traceable thermometer. The YSI probe and NIST-traceable thermometer are placed in an insulated beaker of RO water that was allowed to equilibrate for 1 hour at room temperature. Once the response has stabilized, the probe and thermometer readings are recorded in the calibration logbook. The temperature should also be checked at approximately 4°C by checking the temperature vs the NIST thermometer using the insulated beaker after allowing it to equilibrate overnight in the walk-in cooler. The probe responses must be within ± 0.2 °C of the measured response of the NIST thermometer. If not, the conductivity/temperature probe should be replaced and checked against the NIST traceable thermometer.

2.3 CORRECTIVE ACTION

If calibration verification or precision of duplicate field measurements do not meet specifications, these QC measurements should be immediately repeated. Calibration failures that are detected in the field may be corrected by re-calibrating then repeating the calibration verification. If this second verification or duplicate fails, the instrument should not be used for field measurements until the problem is fixed and acceptable performance has been verified. If QC failures are observed, lab analysis may also be used in place of field measurements. It may be necessary to flag the data or repeat the measurements with a properly functioning meter if other corrective actions cannot be performed.

Changing field conditions rather than a malfunction of the field meter may affect replicate field measurements. No corrective actions will be based on field replicates when acceptable field duplicates are observed. Significant changes in barometric pressure may affect the post-calibration values. This change should be documented.

DAF forms should be used when there is any failure of the QC requirements that could influence the data produced by the YSI, when there are unusual field conditions that may

affect the expected data, or if any described procedures were not able to be followed for whatever reason.

3. CONTAMINATION AND INTERFERENCES

Aside from algal growth, there are several factors that may cause inaccurate sensor readings. Calibration drift can occur on all sensors. Weekly maintenance and recalibration of sondes used for unattended deployments are required whenever starting a new project to ensure frequent validation of data collected. Time between maintenance may be increased depending on the environment being sampled. For example, the use of a YSI 6600 EDS in a static body of water stationed below the photic zone will experience much less biofouling than a sonde in a shallow stream during summer.

4. PREVENTATIVE MAINTENANCE

Multiprobes must be cleaned of algae and debris garnered during extended deployment. Use Kimwipes and RO water to gently remove buildup on probes and casings prior to storage and/or re-calibration. Sondes must be stored in a moist environment to prevent dehydration of the probes. After rinsing the sonde well with both RO water and tap water, pour a small amount of tap water into the calibration cup and hand tighten the cup onto the sonde. Storage caps and field connection guards appropriate for each sensor must be in place during storage and transport to and from the field.

4.1 DO SENSOR MAINTENANCE

The DO sensor membrane should be checked for air bubbles, tears or other imperfections and be replaced accordingly. To replace the membrane, remove the old membrane and rinse the electrodes with RO water. If either electrode shows signs of corrosion or buildup, dry the probe completely with a lens cleaning tissue.

Use the small sanding disc included in the 6035 DO probe conditioning kit to gently sand the electrodes in a motion similar to lighting a match. Always sand in a direction parallel to the gold electrode and continue until both electrodes are free of corrosion.

After completing the sanding procedure, rinse the probe face with RO water and then rinse with a small amount of the KCl solution included in the 6035 DO probe conditioning kit. Clamp the sonde so the probes are in a vertical position and apply KCl solution to the DO probe completely filling the moat around the electrodes and forming a positive meniscus on the tip of the sensor. Be sure no air bubbles are stuck to the face of the sensor and carefully place a Teflon® membrane over the sensor. Roll the o-ring over the end of the probe being

careful not to touch the membrane sensor surface with your fingers. There should be no wrinkles or trapped air bubbles under the membrane. Trim off excess membrane with scissors and rinse the sonde several times with RO water.

4.2 CONDUCTIVITY SENSOR MAINTENANCE

The openings that allow fluid access to the conductivity electrodes should be cleaned occasionally. Use the small cleaning brush included in the 6570 Maintenance Kit to scrub the inside of each hole 15-20 times. The temperature portion of the probe requires no maintenance.

4.3 PH PROBE MAINTENANCE

Cleaning of the pH probe is required whenever deposits or contaminants appear on the glass surface of the probe, or when the response of the probe becomes slow. Use a clean moistened cotton swab to remove all foreign material from the glass bulb. Carefully remove any material that may be blocking the reference electrode junction of the sensor.

4.4 DEPTH SENSOR MAINTENANCE

The depth sensor modules are factory installed options that are located between the bulkhead and the sonde tube. For the 600 XLM sonde, there is a circular protective cap with two small holes. The cap cannot be removed, but a syringe supplied in the maintenance kit can be used to clean the pressure port. For the 6600 sondes, the depth sensor is a through-hole on a module just above the sonde bulkhead that is also cleaned using the syringe. Fill the syringe with either tap or RO water, place the tip of the syringe into one of the holes and gently force water through the pressure port. Ensure that the water comes out of the other hole. Flush until the water comes out clean.

Slow or drifting responses during calibration or field measurements would indicate probe maintenance or replacement might be necessary. See the YSI instrument manual for more detailed troubleshooting and maintenance procedures. Post-deployment maintenance must be recorded on the calibration sheet and in the instrument log for each probe.

4.4.1 Training Outline

New technicians must successfully perform initial calibration, QC checks, file creation and download, and post-deployment checks under the direct supervision of an experienced analyst. New analysts will familiarize themselves with this SOP and the Sensor Operating Manuals before using the equipment.

4.4.2 References

USGS (United States Geologic Survey). Various dates. National field manual for the collection of water-quality data: U.S. Geological Survey techniques of water-resources investigations, Book 9, Chap. A1-A9. Available online at

<http://pubs.water.usgs.gov/twri9A>. U.S. Geological Survey. Accessed February 5, 2008, at <http://water.usgs.gov/owq/FieldManual/index.html#Citation>.

APPENDIX B-2
STANDARD OPERATING PROCEDURE
ADCP

STANDARD OPERATING PROCEDURE (SOP)

ACOUSTIC DOPPLER CURRENT PROFILER (ADCP) OPERATION AND DEPLOYMENT

Scope and Application

This document is was prepared by Gravity Consulting Inc. to describe the Standard Operating Procedure (SOP) for calibrating, preparing, deploying, and recovering fixed-point submerged (e.g., bottom-mounted) and vessel (surface-mounted) acoustic Doppler current profilers (ADCPs). ADCP current meters allow the direct measurement of water velocity that can be used to calculate fluxes of constituents of concern (i.e., suspended sediments) in aquatic environments.

The ADCP operates by transmitting bursts of sound (called pings) at fixed intervals and frequency into the water column. These “pings” are reflected from suspended particles in the water and the echoes produced from these reflections are received (“listened” to) by the ADCP. As the particles move with the water current, the echoes produce a Doppler shift or a change in the frequency between the transmitted sound and the sound reflected back to the ADCP. It is the Doppler shift, along with the timing of the returned echoes, from which the ADCP calculates water velocity, current direction, and the depth within the water column the velocity occurred. The ADCP also produces a longer-pulsed ping which is used to track the seafloor in the case of downward pointed vessel-mounted applications. This is used to determine the overall depth of the water column and to determine the relative speed and direction of the ADCP as it moves along a transect.

All of these data are calculated and recorded within the ADCP itself or transmitted via cable to a laptop computer. The data is stored in files and can be “played back” and post-processed, allowing the user to refine the data. The fixed-point (bottom) mounted and vessel (surface) mounted applications are somewhat different, and are subsequently treated separately below.

Vessel-mounted ADCP surveys are covered in this SOP. An ADCP will be mounted to the side of a survey vessel and transects will be driven near site transects.

This SOP should be followed for calibrating, preparing, deploying, and recovering ADCPs utilized in marine monitoring. It includes the approved methods for any of the following:

- Preparation for deployment with Teledyne RD Instrument’s Plan ADCP software so that battery life and data storage issues are properly addressed.
- Calibration to remove one- and two-cycle magnetic deviations from the internal magnetic fluxgate compass after adding a new battery. The ADCP has no moving parts, but it contains internal sensors that are sensitive to electromagnetic fields.

Fixed-mounted vs. Vessel-mounted

For dredge monitoring activities, both fixed-mounted and vessel-mounted ADCP surveys will be conducted. The following section describes the differences between the two current profiling techniques in greater detail.

Fixed-Mounted

A fixed-mounted ADCP includes any application consisting of an ADCP unit that is designed to sample below the water surface for an extended period at a fixed location. Typical sensors consist of four send-and-receive Doppler transducers – three for measuring velocity (u, v, and w) with one redundant transducer for error checking, a temperature cell, a tilt sensor, a fluxgate compass, and an optional pressure transducer. These units are typically mounted in a weighted cage, tethered with a lanyard, and outfitted with a multi-mode recovery system – acoustic releases.

Normal recovery is accomplished with the aid of an acoustic release, which can be tripped with a hydrophone from the surface to release a buoyant float with a line attached.

Vessel Mounted

A vessel mounted ADCP is any application consisting of an ADCP that is attached to a moving platform (i.e., a boat). The package consists of four Doppler transducers (send and receive) – three for measuring velocity (u, v, and w) and one for error checking, a temperature cell, a tilt sensor, and a fluxgate compass. The ADCP should have bottom-tracking engaged. The ADCP is secured to a mounting pole with two hose clamps and a back-up lanyard. In addition, the laptop collecting results from the ADCP via a powered cable can also receive GGA-mode (or GSA-mode) data sentences from a differential GPS.

Equipment and Personnel

This type of field servicing typically requires two technicians to safely perform the survey, in addition to the boat operator.

Training in the use of ADCP equipment and software as well as experience with water sampling are required. Personnel must have adequate experience using ADCP. Training in safety procedures for working on floating structures and near/over open water and on boats as well as experience working with hazardous chemicals (anti-foul paint on ADCP transducer heads).

For fixed-mount deployments, the following equipment is necessary:

- De-Gaussed ADCP battery pack
- Calibration equipment (lap top, cables, lazy Susan, and tilting block)
- Dedicated laptop, unless starting data acquisition beforehand after calibration

- Mounts, shackles, tackle, and recovery system
- Field Logs (see FSP Appendix A)
- Recovery line and tackle (station dependent)

For vessel-mount deployments:

- Dedicated laptop computer equipped with ADCP software
- Interface for DGPS from ship (if desired)
- ADCP communication cables, power cord
- Field Logs (see FSP Appendix A)

Calibration Procedures

The following section describes the calibration procedure for an ADCP. Typically, the ADCP should only need to be calibrated when battery packs are being exchanged. Calibration commands should be conducted using specific manufacturer software and commands.

The ADCP with the new battery must be calibrated away from stray magnetic fields (AX command). Required equipment includes a laptop with the software, the cables, and a non-magnetic lazy Susan. The ADCP must be set to Pacific Standard Time (PST).

The lazy Susan operator must:

- Brush the heads in order 1-2-3-4.
- Rotate flat, 360 degrees on primary axis.
- Rotate pitch/roll – lift by 10–20 degrees up on side 3 with a non-magnetic tilting.
- Block, rotate 360 degrees on primary axis.
- Rotate roll/pitch – lift by 10-20 degrees up on adjacent side, 360 degrees on primary axis.
- Final rotation – not as critical. Rotate somewhere between (and not as much), 360 degrees on primary axis.
- Erase the old data, use ErAsE.

ADCP Preparation, Deployment, and Recovery

The proposed deployment location must be free of marine cables, and if man-made electrical fields are present, the operator should consider collecting the data in beam coordinates rather than relying on the internal fluxgate magnetometer to rotate the results into east-west (u), north-south (v), and up-down (w) components.

Typically, data is collected at six-minute intervals, averaging 90 one-second pings, and then the ADCP should be shut down for 4.5 minutes to save on battery life. The duration, vertical resolution (bin size), and battery life can all be estimated using the PlanADCP software.

Prepare the ADCP as follows:

- Add a fresh battery pack. To change the batteries, open the back of the ADCP (away from the heads). Don't remove the back until you have identified beam 3 on the casing, and the position of the heads, so that you can put it back together the same way! Remove the bolts on the battery end of the unit; remove the old battery and desiccant pack. Take note of the position of the rubber band and the way it secures the desiccant away from the circuit boards. The seals on either side are the same; however, every time an end cap is opened, there is potential for negative pressure inside the ADCP which can cause a vacuum effect. This vacuum effect can pull moisture into the ADCP.
- Be sure to add new desiccant.
- Flip beam 3 so that it is to your right when you remove the back; mount the battery so that the white ponytail (and often the degauss sticker) is to your left. Feed the white ponytail through the rubber band on the battery pack so that it is tightened (and feeds through from the left).
- Add the backing plate, washers, and then wing nuts (to hand tight). Attach the desiccant with a rubber band wound around the wing nuts so that it does not get loose and touch the circuit board.
- Re-grease the o-ring with Dow Corning 111 valve lubricant and sealant (or equivalent) silicone grease. Be sparing and remove all particles of sand or dirt.
- Add the outside bolts so the nuts face the inside, and the bolt heads project toward the end(s). Put one washer under the head of each bolt and two under the nut.

Retrieval of Instrument

The preferred method to retrieve the ADCP gear is to trip the acoustic release by ensonifying the water column using the deck box. A hydrophone is included in the kit, and this must be plugged into the deck box by a knowledgeable operator. The hydrophone should be lowered into the water typically as deep as possible to get below the pycnocline, if present. Sound can easily be diffracted by density differences in the water column. In an extreme case (heavily stratified), one can be right over the release and not be able to get sound to it. Be aware that each release has a specific frequency (e.g., 10 kHz) and a release code (e.g., 'A') that have to be selected by the operator in order for the release to work. Try the procedure several times and keep watch for the float (it may come up under the boat, so don't have the propeller in gear).

If the acoustic release does not work, the grapple hook should be tried if weather conditions permit.

In the event this is unsuccessful, the next trip should be timed shortly after the time-release is set to go off. With luck the buoy will be waiting for you at the surface. If not, the grapple hook and possibly SCUBA or even submarine (ROV) assistance may be required.

Data Recovery and Processing

Data can either be download via the WinSC software with the powered data cable attached to the ADCP (memory is non-volatile, so this works with a dead ADCP battery) or by removing the ADCP transducer-side head (everything stated previously about re-packing o-rings applies here) and extracting the PCMIA data cards. These can be inserted in most laptops for a quick download. Serial downloads via the data cable may take an hour but has the advantage of not having to remove the beam heads.

Raw data from the instrument should be processed through the manufacturer's proprietary software (i.e., WinADCP, WinRIVER, etc.), which will extract internally logged data and convert to useful metrics such as current speed, direction, depth, etc. Processed data files should be saved as ASCII files for each specific location. File naming convention should include data type, monitoring location, and date of data recovery. The data file name should match the following template:

“LOCATION ID_INSTRUMENT_RECOVERYDATE (DDMMYYYY).xlsx”

For example, data from a bottom-mounted ADCP at station “B04” on July 4, 2014 should be saved as “B04_ADCP_04072014.xlsx”. If possible, data will be uploaded daily via the internet to survey manager on shore. Data will be backed up on a removable thumb-drive and transferred with crew shifts.

All gear should be hosed down with fresh water, decontaminated, and dried prior to storage. Biofouling may need to be scrubbed or even scraped off, but care should be taken with the ADCP, especially the beam heads.

For each site where fixed-mount ADCPs are installed, the standardized field log sheets provided in Appendix A should be used to record station information such as field conditions, location, serial numbers of equipment, and other relevant information that is considered necessary. For vessel-mounted applications, likewise use the field log sheets provided in Appendix A. Upon returning, gear must be cleaned and dried for long-term storage. Log sheets should be scanned and entered electronically into an ADCP database.

Data QA/QC

The fourth transducer head on the ADCP provides a built-in error estimate of the errors in measuring the three dimensions of water velocity: u, v, and w. Because the geometry of the transducer heads is fixed (e.g., 20 degree rotation out of the horizontal plane) the uncertainty

estimates of the upwelling/downwelling term (w), will be larger than for the horizontal components (u [east-west] and v [north-south]). Depending on the study design, multiple passes along a survey may be advisable for vessel-mounted applications. It is often better to make several passes along a single transect than a single pass along multiple transects.

Each log sheet that is entered into the database by one of the field staff is rechecked for errors by other staff after entry. Date and the technician who entered the data is written on the log sheet for reference after entry. Log sheets should be stored together in a project file.

Additionally, processed data should be reviewed to validate the instrument is reporting correct date and times, and values seem reasonable given the observed weather conditions and environment of deployment. Observance of unrealistic values (i.e., a velocity magnitude of -999) could indicate an electrical issue within the instrument or poor connection with data cable. Instrument should be inspected for any signs of wear or damage for each deployment and recovery.

Reporting

During ADCP survey activities, a brief daily summary report should be completed at the end of each day and submitted electronically to the onshore survey manager. Progress reports should include information on survey activities, locations of deployed/recovered ADCPs, locations of vessel mounted ADCP survey transects, and any issues encountered with survey progress or instrumentation.

Field log sheets should also be scanned and sent as PDF documents and/or entered electronically and submitted to onshore survey manager.

If possible, a brief overview of the data logged should also be included in progress reports. Information such as average velocity direction, magnitude, and any other notable observations should also be included.

References

Nortek ADCP Users Manual

APPENDIX B-3
STANDARD OPERATING PROCEDURE
SURFACE WATER SAMPLING
(Integral 2004b)

Note: Appendix C, Surface Water Sampling SOP, excerpted herein is from EPA-approved Round 2 Field Sampling Plan (August 2004); to the best of AECOM/Geosyntec knowledge, Integral did not release updated appendices following EPA approval. Therefore, SOP contains draft language (i.e., "Do Not Quote or Cite") that was retained in the source document.

APPENDIX C

SURFACE WATER SAMPLING SOP

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SURFACE WATER SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting surface water samples from freshwater or marine environments using a peristaltic pump and Teflon™ tubing. For this SOP, surface water is defined as water collected from 0.3 meter (1 foot) below the water surface and within 1 meter (3 feet) above the bottom. The actual definition of surface water is typically program-specific and is dependent 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 the San Francisco Estuary Institute's *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001), the *Interagency Field Manual for the Collection of Water-Quality Data* (USGS 2000), and U.S. Environmental Protection Agency (EPA) Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996). A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow EPA guidelines.

While sampling for trace metals, trace clean sampling techniques will be used for the collection of unfiltered organic compounds and conventionals, such as total suspended solids, dissolved organic carbon and dissolved suspended solids. By following this SOP, the collection of other samples besides trace metals guarantees a high level of sample integrity and minimizes contamination during sample handling.

SUMMARY OF METHOD

Surface water samples for standard chemical and conventional analyses will be collected using a peristaltic pump with an extended sampling tube lowered to the desired depth. These samples do not require the ultra-low detection units of other hydrophobic analytes.

Samples are collected using the two-person “clean hands – dirty hands” method (EPA 1996). The peristaltic pump's water intake is placed 15 feet away from the bow of the boat with a long pole. The outflow of the pump is directed through a Y-splitter into two composite mixing containers for sampling. Equal volumes will be pumped into two large, pre-cleaned 10-liter or 20-liter mixing containers equipped with magnetic stirring devices (Figure C-1). The first container, made of polycarbonate, will be used for compositing and mixing samples for subsequent analysis of trace metals, TBT, and conventionals. The second stainless-steel or glass container will be used for compositing and mixing samples for subsequent analysis of organic compounds.

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Following sample compositing in the mixing containers, appropriate sample bottles will be filled using a second peristaltic pump, with the outflow directed into the bottle. The sample jar is held near the pump outlet, and the sample container is rinsed several times and then filled. The sample containers are capped, labeled, and placed in clean, double Ziploc™ bags, and then placed inside a cooler.

Two types of surface water samples will be collected: unfiltered and filtered. For filtered samples, the 0.45-μm filter is placed inline near the tubing outlet to filter samples immediately before the water is discharged into the sample bottle.

Surface water collected at cross-sectional stations using the flow-weighted method (see Appendix B) will be composited by collecting water using the same technique described above. Integrated samples of the water column are collected by lowering and raising the sample tubing intake while pumping water from near surface to near bottom and back for a predetermined period at a predetermined rate.

SUPPLIES AND EQUIPMENT

The general types of equipment that are required are described in this section. A detailed supply and equipment list is provided in Table 1-1. Additional equipment may be required depending on the project.

Two peristaltic pumps will be used for collecting surface water samples. The first pump will fill the mixing containers, and the second pump will collect unfiltered and filtered split samples from the mixing container. A workbox made of PVC pipes and plastic sheeting will be used to house two stir plates and a small peristaltic pump. A polycarbonate and a glass or stainless steel 20-liter mixing containers will be placed over the two stir plates. Each mixing container will be equipped with a 5-inch-long Teflon™ coated stir-bar at the bottom and a lid containing an inflow, outflow, and vent Teflon™ spouts. For each sampling station, a filtering kit (laboratory pre-cleaned 0.45-μm filter with C-Flex™ and Teflon™ tubing placed in a double Ziploc™ bag) will be assembled and attached to a peristaltic pump and mixing containers. A 10-μm pre-filter may be attached in-line to prolong the filtering capacity of the 0.45-μm filter. Four types of sampling tubing are required:

1. Shallow-water (near bottom sampling) intake tubing requires a 4-meter long Teflon™ tubing.
2. Deep-water (integrated water column sampling) intake tubing requires a 25-meter Teflon™ tubing.
3. Intake tubing kit for the mixing containers is composed of 30-cm C-Flex™ tubing, 1-meter Teflon™ tubing, and a 10-cm C-Flex™ tubing, placed sequentially.

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4. Outlet tubing kit from the mixing containers is composed of 10-cm C-Flex™ tubing, 0.5-meter Teflon™ tubing, 30-cm C-Flex™ tubing and 30-cm Teflon™ tubing, placed sequentially.

Two filtering kits (0.45- and 10-μm) will be composed of 10-cm C-Flex™ tubing, the filter cartridge, and another 10-cm C-Flex™ tubing, placed sequentially.

A 10-μm air filter kit will be attached to the mixing container vent spout.

A portable 3000-Watt power generator will be used if on-board electricity is not available.

PROCEDURES

EQUIPMENT DECONTAMINATION

Each participating laboratory is responsible for preparing their equipment prior to the sampling cruise. Pre-designated commercial laboratories will do decontamination of sample tubing, mixing containers, and sampling jars according to their specific SOPs (see attachments in the forthcoming Round 2 QAPP). Additional field equipment will be cleaned and decontaminated by Integral Consulting, Inc. (Integral), Olympia WA as described below.

Surface Water Sampling Equipment Preparation

A sufficient amount of decontaminated sampling tubing and filtering kits will be brought to the field in order to avoid performing decontamination procedures between stations. The following steps will be taken to setup the peristaltic pump system.

A Plastic Processing Chamber

A 3- by 3- by 3-foot cube will be built with ¾ inch PVC tubing and covered with a 6-mil plastic sheet. One side of the box will be left open for placing sampling equipment and sample containers. The chamber will be placed over a pan, which will be connected to a drain that will carry excess pumped water outside the boat. All components will be washed with Alconox™, tap water rinsed, acid washed, and deionized water (DIW) rinsed.

Stands and clamps used to secure the receiving Teflon™ tubing and filter cartridge are made of non-metallic components or resin-coated stainless steel and will be soap washed, tap-water rinsed, acid washed, and DIW rinsed.

A Near Bottom Sampling Device

When near-bottom surface water samples are required to be sampled at a fixed depth from the bottom, a “near bottom sampling device” is used. Figure C-2 illustrates how the Teflon™ tubing inlet is attached to a vane, which will keep the water intake into

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the flow and elevated at a constant height from the bottom. The device, made of PVC tubing and a polypropylene vane, is weighted by PVC-coated lead weights and attached to the boat by a nylon or Kevlar rope. All components will be washed with Alconox™, tap-water rinsed, acid washed and DIW rinsed.

Conventional Field Parameter Equipment Preparation

A YSI 5563 multiprobe will be used for measuring surface water parameters, such as temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential. The unit will come pre-calibrated from the laboratory and will be checked daily for proper functioning and drift. If necessary, the multiprobe can be calibrated in the field. The proper handling of the multiprobe is described in detail in Appendix E.

Except for the probe sensor, all components will be soap washed (Alconox™), and tap water rinsed. Since this equipment will not be used in surface water sample collection, there is no need for a thorough decontamination. The handling of this equipment will be done exclusively by the DH person.

SURFACE WATER SAMPLE COLLECTION

Clean Hands/Dirty Hands Techniques

CH/DH techniques require two or more people working together. At the field site, one person is designated as "clean hands" (CH) and a second person as "dirty hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless nitrile gloves during the entire sampling operation and change gloves frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes).

CH takes care of all operations that involve equipment that comes into contact with the sample, including the following responsibilities:

- Handles the surface-water sample bottle
- Handles the discharge end of the surface-water sample tube or line
- Prepares a clean workspace (inside boat)
- Sets up the processing and preservation chambers

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- Sets the equipment (i.e., the sample bottles and the filtration and preservation equipment) inside the chambers
- Works exclusively inside the chambers during collection, processing, and preservation
- Changes the chamber covers as needed.

DH takes care of all operations that involve contact with potential sources of contamination, including the following responsibilities:

- Works exclusively exterior to the processing and preservation chambers
- Prepares and operates the sampling equipment, including the pumps and discrete samplers, peristaltic pump switch, pump controller, and manifold system
- Handles the generator or other power supply for samplers
- Handles the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds
- Handles the single or multiparameter instruments for field measurements
- Sets up and checks the field-measurement instruments
- Measures and records the water depths and field measurements.

Surface Water Sampling

Two persons are needed to conduct the sampling and a third person to keep track of sample logging and sample processing. In addition, the third person may be responsible for taking surface water parameters.

The following steps will be taken in order to set up the surface water collection system and processing of samples:

1. Assemble and secure a Flexframe™ support rod and base onto the starboard rail and leave in place for the day.
2. Determine the correct position of the sampling station, have the captain anchor the vessel at the sample site and switch off the engines.
3. Set up a clean area for the workbox (done by CH).
4. Set up a workbox made of PVC pipes and plastic sheeting in a secure table or bench top on board the sampling vessel to house two stir plates and a small peristaltic pump. Provide enough space inside the workbox for a stand to hold

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the outlet tubing and filter and for collecting surface water and processing sample jars.

5. Place two stirring plates inside the workbox and two mixing containers on top of each plate. Each container (a polycarbonate for metals and conventionals, and glass or stainless steel for organics) will be checked to ensure:
 - Containers were properly wrapped by the labs and do not contain rips or holes that may have occurred during shipment to the field
 - Each container contains a 5-inch stir-bar at the bottom
 - All components, such as inflow and outflow tubing are intact and securely placed on the cap.
6. Attach the outlet tubing kits to the mixing containers (Figure C-1). The kits are composed of 10-cm C-Flex™ tubing, 0.5-meter Teflon™ tubing, 30-cm C-Flex™ tubing and 30-cm Teflon™ tubing, placed sequentially.
7. Place the small peristaltic pump inside the workbox but do not place tubing inside the pump head until all mixing containers have been filled.
8. Place a stand inside the working chamber and secure each tubing outlet from both mixing containers by clamps.
9. Attach a 4-meter (25-meters for deep water) Teflon™ tubing (collecting end) to 30-cm C-Flex™ tubing and a 1-meter Teflon™ tubing, sequentially, and then connect it to a mixing container (polycarbonate for metals and glass or stainless steel for organics). Clamp the C-Flex™ tubing section is firmly into place inside the large peristaltic pump head, which is placed outside the workbox.
10. Attach the intake part of the Teflon™ tubing to the end of a long aluminum pole. Take care not to remove a protective cap from the tip of the collecting tube until ready for submersion.
11. Secure the pump and pump speed controller just below the Flexframe™ assembly (by the DH) and connect them to the vessel's power source with an extension cord. If vessel power is not available, the pump can be operated under its own battery power supply.
12. Assemble an aluminum sampling pole with the sample tubing inlet secured to one end and with the tubing tip hanging loose approximately 2 feet off the pole end.
13. Remove the protective cap from the sampling tube and lower the pole gently below the water surface.

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14. To sample water near-surface, submerge the sample tubing inlet approximately 0.3 to 1 meter (1-3 feet) below the surface of the water column.
15. To sample water near-bottom, submerge the sample tubing inlet approximately 0.3 to 1 meter (1-3 feet) above the bottom with the help of the near-bottom sampling device, which in turn is tethered to a nylon rope and looped through the vessel's davit. If sampling near-bottom surface waters at depths greater than 2 meters is required, a device such as illustrated in Figure C-2 will maintain the sample tubing inlet into the current and at a constant depth (1 meter) above the sediment-water interface and 15 feet away from the boat with the help of the aluminum pole.
16. Switch the pump on and pump surface water through the sample tubing and into the mixing containers (done by DH). Once the water reaches one-third the container's volume, turn on the stir plates.
17. Turn off the pump once the mixing containers have been filled to ½ inch below the inflow spout.
18. Place the outflow tubing kit from the first container to be sampled inside the small peristaltic pump head and clamp firmly.
19. Make final adjustments to the stand holding the outflow spout before the small pump is turned on (done by CH).

Note: The DH person assists the primary CH sampler by controlling the flow controller for the peristaltic pump, holding on to or adjusting the sample pole, adjusting the outlet tubing or filter cartridge, and handing sample containers to the CH person.

20. For trace element samples, drain the ultrapure water from the pre-cleaned sample bottle onto the bottle cap and pour the remaining ultrapure water over the bottle threads several times (done by CH). Rinse the sample container with the sample water 5 times, then fill up to the "neck" with sample water. The CH/DH system is not critical for the ancillary samples, and these bottles may be rinsed just 3 times with sample water before collecting the sample.
21. Without touching the trace-metal clean bottles, the DH person opens the Ziploc™ bags so that the CH person may remove them from the bags. The CH person, wearing at least one pair of polyethylene gloves, does not touch anything with her/his hands except the inner Ziploc™ bag, the bottles, and the water.
22. Use the following sample collection sequence for total trace metals (unfiltered) sampling:

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- Total suspended solids
 - (TSS) Total bulk metals, total arsenic (As), selenium (Se)
 - Total mercury (Hg).
23. After the above samples are collected, attach the filter cartridge to the sample tubing outlet and secure it to the stand with a clamp. Drain the storage solution inside the filter, and flush the entire sample tubing and filter assembly with sample water for 5 minutes. The sample collection sequence for dissolved trace metals (filtered) sampling is as follows:
- Dissolved bulk metals
 - Dissolved As, Se
 - Dissolved Hg
 - Dissolved organic carbon
 - Total dissolved solids.
24. As soon as a sample container is filled up, the DH turns off the peristaltic pump, and the CH seals the container and writes the label. The sampling label should contain the date, time, project name or number, sample ID, type of analysis required, and sampler initials.

The 0.45- μ m filtration cartridge and 10- μ m prefilter cartridge are changed after each sampling site.

The appropriate number of sample replicates and splits are predetermined prior to starting the field sampling event and assigned to specific sampling stations.

After all sampling is done, surface water field parameters are measured by the DH using a hand-held YSI 5563 MPS multi probe sensor with a 20-meter cable. Detailed explanations on how to take measurements with the multi probe are described in Appendix E.

SAMPLE PROCESSING

Once a surface water sample container is properly closed, labeled, and then sealed inside a Ziploc™ bag by the CH person, the DH person seals the second Ziploc™ bag and places it inside a large plastic bag, which in turn is placed inside a cooler containing wet ice.

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All samples will be stored in sealed coolers with wet ice on board the vessel and transferred to the field laboratory at the conclusion of the cruise. Integral personnel will then transfer the samples to the laboratory. The field leader is responsible for maintaining sample integrity throughout the cruise. Once at the field lab, sample contamination is avoided by handling the double-bagged sample containers with clean gloves, and transferring the samples into clean refrigerators immediately after samples are brought back from the field.

Storage Temperature Quality Control

Each storage freezer or refrigeration unit is monitored daily to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

CHAIN-OF-CUSTODY

Field

The cruise leader or other designated field sample custodian is responsible for all sample tracking and chain-of-custody procedures until sample custody is transferred to the laboratory. Custody procedures in the field are as follows:

1. Record all field and sample collection activities (including sample identification number, collection time and date) in the field logbook. While being used in the field, the logbook remains with the field team at all times. Upon completion of the sampling effort, the logbook should be reproduced and then kept in a secure area.
2. Complete a chain-of-custody form whenever samples are being transferred or removed from the custody of field sampling personnel. A sample form is provided in Appendix C (Integral 2004). Record each individual sample on the form. Include additional information to assist in sample tracking such as collection date and time, number of containers, and sample matrix. The chain-of-custody may also serve as the sample analysis request form, with the required analysis indicated for each individual sample.
3. Sign the form and ensure that the samples are not left unattended unless secured.
4. Store, pack, or ship samples as described in the following section. Place the original completed chain-of-custody form in a

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sealed plastic bag inside the shipping container. A copy is retained by the shipping party.

5. Complete a separate custody form for each individual shipping container or a single form for all samples in multiple shipping containers in a single shipment, with the number of containers noted on the custody form.
6. Attach completed custody seals to any shipping container that will be sent to the laboratory by delivery service or courier. Delivery personnel are not required to sign the custody form if custody seals are used. Custody seals are used to detect unauthorized tampering with the samples. Gummed paper or tape should be used so that the seal must be broken when the container is opened. The laboratory sample custodian (or other sample recipient) will establish the integrity of the seals.
7. The laboratory custodian (or other sample recipient) acknowledges receipt of the samples by signing, dating, and noting the time of transfer on the chain-of-custody form. The condition of the samples and any problems or irregularities (e.g., cracked or broken jars, loose lids, evidence of tampering) should also be recorded. Return a copy of the completed custody form to the project manager or designated sample coordinator.

Laboratory

The laboratory will designate a sample custodian who is responsible for receiving samples and documenting their progress through the laboratory analytical process. Each custodian will ensure that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed on transfer of the samples. Specific laboratory chain-of-custody procedures should be in writing, included in the laboratory QA plan, and approved prior to beginning sampling and analysis. Laboratory custody procedures should include the following:

- A designated laboratory person initiates and maintains a sample tracking log that will follow each sample through all stages of laboratory processing and analysis.
- The laboratory tracking log includes, at a minimum, the sample number, location and type of storage, date and time of each removal, and signature of the person removing or returning the sample.

The final disposition of the sample is recorded.

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CHAIN-OF-CUSTODY QUALITY CONTROL PROCEDURES

Complete and correct chain-of-custody is essential to ensure and demonstrate sample integrity. Errors in entering information or transferring custody can result in analytical or data reporting errors. Inaccuracies or errors in sample tracking and custody records can compromise data usability, particularly as legal evidence.

Quality control procedures include the following:

- Allow adequate time to take accurate and complete field records and to carefully complete chain-of-custody forms.
- When possible, work in pairs or more to complete the chain-of-custody form and check for accurate information entry.
- Complete all custody records in ink; errors should be neatly crossed out and corrected and initialed by the person making the change.
- Immediately notify the project manager of any deviation from required custody procedures.

PACKING AND SHIPPING SAMPLES

Environmental samples are packed in a manner to reduce the chance of sample breakage, ensure sample integrity, and prevent material leakage and potential exposure to hazardous materials in the event of breakage. Samples are placed in sealed plastic bags and packed in a sturdy container with adequate packing material to prevent breakage. Ice or dry ice may be included to maintain sample storage conditions. Samples are transported by field personnel or shipped via courier or common carrier. Shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24).

All preserved samples should be shipped as soon as possible after completion of sampling. This minimizes the number of people handling samples and protects sample quality and security.

Sample Packing

Upon completion of final sample inventory by the field sample custodian and completion of chain-of-custody, samples are packed as follows:

1. Line a cooler bottom with bubble wrap and place a large 30-gallon bag inside another bag of same size and place it inside the cooler. The cooler should have the drain sealed with duct tape.

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2. Wearing disposable powderless nitrile gloves, wrap each doubly wrapped glass sample container in bubble wrap or place it in a bubble wrap plastic bag. [Note: When samples are being transported by field personnel directly from the field site to the laboratory (thereby ensuring careful handling), this step is recommended but may be omitted. However, this step is required when a courier or delivery service is transporting the samples.]
3. Place the samples tightly inside the double bag in the shipping container:
 - Use dividers or bubble wrap to separate all glass containers.
 - Seal large plastic bags with rubber bands or plastic tie.
 - Fill any empty space in the shipping cooler or box with packing material so that the jars are held securely.
4. Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. If using a cooler or ice chest, the form should be securely taped to the inside of lid.
5. If required to meet sample storage requirements, fill the ice chest with crushed or block ice, blue ice (refrigerated samples, 4°C) or dry ice (frozen samples). A temperature blank (provided by the laboratory) should be packed in each cooler.
6. Seal shipping container securely with packing or duct tape.
7. If the shipping container will be transported by anyone other than the person who completed and signed the chain-of-custody form, attach completed custody seals so that the shipping container cannot be opened without breaking the seal.
8. Attach a *This End Up* label to each side of the shipping container to ensure that jars are transported in an upright position. A *Fragile* label may also be attached to reduce rough handling of the samples.
9. Label the shipping container with all appropriate information (name of project, time and date, responsible person and company name, address and phone) to enable positive identification.

Sample Shipping

Packed containers may be delivered to the laboratory or storage facility by field personnel, courier, or common carrier (FedEx, UPS). However, any outside carrier or courier service must provide a delivery receipt. The carrier or courier must also ensure delivery time if holding time and storage conditions are critical. Unless

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arranged in advance, shipping charges should be prepaid by sender to avoid confusion and possible rejection of the package by the laboratory.

The adequacy of handling and shipping procedures is reflected in the condition of the samples upon receipt by the laboratory:

- No jars are cracked or broken.
- There is no evidence of sample leakage.
- Measuring the temperature of the temperature black indicates that correct storage conditions have been maintained.

The sample custodian or other designated person is responsible for confirming that copies of all shipping documents, completed in full and correctly, are on file at Integral.

QUALITY CONTROL PROCEDURES

Field quality control (QC) samples that may be collected during sediment coring are the same as for any field sampling program. The types and frequency of field QC sample collection are project-specific. The most commonly collected field QC sample are described below (USGS 2000):

- **Field Blank**. A field blank is a sample of analyte-free water that is supplied by the laboratory. The field blank is generated by transferring the analyte-free water to another laboratory-supplied sample container while at the field sampling location. Field blank results are used to measure and document any possible onsite contamination.
- **Field Split Sample**. A field split sample consists of aliquots of the same composited surface water sample that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.
- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample. It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

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REFERENCES

David, N., D. Bell, and J. Gold. 2001. Field Sampling Manual for the Regional Monitoring Program for Trace Substances. San Francisco Estuarine Institute, San Francisco, CA. (February 2001).

EPA. 1996. Method 1669. Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303). Washington, DC. (July 1996).

USGS. 2000. Interagency Field Manual for the Collection of Water-Quality Data. Compiled by D.L. Lurry and C.M. Kolbe. U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency. Open-File Report 00-213. Austin, TX.

Table 1-1. Equipment List for Surface Water Sampling Using a Peristaltic Pump System

<i>Quantity</i>	<i>Description</i>
1	Masterflex™ peristaltic pump
2	Pump speed controller boxes
2	Pump heads
2	Spare pump head screws
2	Spare pump fuses (3 amp)
2	Electrical power extension cords, 25 foot
	Flexframe™ fittings and clamps (2 small to hold tubing and 2 large for filter cartridges)
1	1/2-inch aluminum support rod and plastic-covered base
1 each	Plastic, duct, and electrical tape
1	Hand tool box: screwdriver, pliers, crescent wrench
3	Stainless steel adjustable (screw-tighten) hose clamps (to hold sample poles together)
20	4-meter (3/16 ID), 890 Teflon™ resin FEP intake tubing for shallow water intake tubing
3	25-meter (3/16 ID), 890 Teflon™ resin FEP intake tubing for deep water
23	Kit: 30-cm C-Flex™ tubing, 1-meter (3/16 ID), 890 Teflon™ resin FEP tubing, and a 10-cm C-Flex™ tubing
23	10-cm (1/4 ID), C-Flex™ tubing (Masterflex), 0.5-meter (3/16 ID), 890 Teflon™ resin FEP tubing, 30-cm (1/4 ID), C-Flex™ tubing (Masterflex) and 30-cm Teflon™
3	20-liter polycarbonate carboy
3	20-liter glass carboy
20	10-liter polycarbonate carboy
20	10-liter glass carboy
2	Stir-plates
46	5-inch Teflon™ coated stir-bars
1	Ziploc™ tool
as needed	Straps, bungee cords, nylon rope, cable ties
<i>Additional Field Gear</i>	
1	15- to 20-foot sampling pole (2 pieces; 1 hollow, 1 with a telescopic insert)
1	Plastic work box (PVC tubing covered with 6-mil clear polypropylene sheet)
1	YSI 556 MPS (Multi-Probe System)
1 each	Standard solutions for pH, conductivity, and oxidation reduction potential
1	Hand-held certified field thermometer (no mercury)

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Table 1-1. Equipment List for Surface Water Sampling Using a Persitaltic Pump System

<i>Quantity</i>	<i>Description</i>
5	10-L container with ultrapure laboratory grade deionized water
5	500-mL plastic beaker
2	1000-mL plastic container for storage of calibration fluids waste
2	Sampling buckets
2	Plastic Chairs
30	10-µm pre-filter (Whatman Polycap 36HD)
30	0.45-µm filter cartridges (Whatman Polycap 36TC)
2	Coolers containing: 20 pounds wet ice/sampling day
1	Field log book
1	Field sampling plan
1	Health and safety plan with forms
	Tape: (2) plastic, (6) labeling
	Pens: (6) ballpoint, (6) Sharpies
1	Box of single edge razor blades
1	Box of trash bags (13 gal)
1	Box of trash bags (30 gal)
1 each	Ziploc™ bags (box each size; quart, gallon)
	Nylon gloves (4 pair, large; 2 pair, medium)
	Nitrile powderless gloves (3 boxes, large; 2 boxes, medium)
3 each	boxes of Kimwipes™ large and small
	Sun-protection lotion
	Spare batteries
	Bucket opener
	Foul weather gear

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APPENDIX B-4
STANDARD OPERATING PROCEDURE
HIGH VOLUME SURFACE WATER SAMPLING WITH PR2900

STANDARD OPERATING PROCEDURE (SOP)

HIGH-VOLUME SURFACE WATER SAMPLING FOR ANALYSIS OF ORGANIC COMPOUNDS WITH LOW DETECTION LIMITS

Scope and Application

This Standard Operating Procedure (SOP) prepared by Gravity Marine Services (Gravity) describes the protocol for collecting high-volume (HV) water samples using a Gravity PR2900 pump system (Figure 1) coupled with XAD-2 cartridges, 0.5-micron (μm) glass flat fiber filter (GFF filter), and a vortex separator. This SOP is specific to HV techniques for the pre-design investigation (PDI) studies and is included as an attachment to the Surface Water Field Sampling Plan (FSP).

Large volumes of surface water are pumped through a filter system to quantify surface water concentrations of targeted organic chemicals at low-level concentrations. This method also allows for separate quantification of hydrophobic organic chemicals (HOCs) in the suspended particle and dissolved phases of the water column. HV surface water sampling techniques make it possible to obtain enough mass of HOC from the water column to allow quantitation of these compounds. In summary, a large volume of water (i.e., as much as 1,000 L) is pumped with a PR2900 (which has an internal flow-metered peristaltic pump) and is passed through a vortex separator and a glass flat fiber filter (0.5- μm pore size) and then through a cartridge containing XAD-2 resin that binds the dissolved forms of the compound in question. The compounds that bind to the adsorbent XAD-2 material are later extracted in the laboratory and measured on a gas chromatograph/mass spectrometer.



Figure 1: PR-2900

SOP Guidance

This SOP utilizes and augments the procedures outlined in the San Francisco Estuary Institute's Field Sampling Manual for the Regional Monitoring Program for Trace Substances (David et al. 2001), the Interagency Field Manual for the Collection of Water-Quality Data (United States Geological Survey [USGS] various dates), and United States Environmental Protection Agency (EPA) Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (EPA 1996). 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 EPA guidelines.

This SOP details: 1) set-up of the sampling equipment, 2) sample handling, 3) collection methods for HOC surface water samples, and 4) measurement of water quality parameters *in situ*. An important component of sample handling for low-level organics and trace metals are clean hands, dirty hands sampling techniques per EPA 1996, as described in SOP for Surface Water Sampling [Integral Consulting (Integral) 2004a]) for handling of HV sampling equipment, filters, and samples. Using these techniques maximizes sample integrity and minimizes the potential for contamination during sample handling.

Summary of HV Method

Surface water samples to be analyzed for ultra-low concentrations of organic compounds will be collected using a high-volume PR2900 peristaltic pump with an extended Teflon™-lined polyethylene sampling tube lowered to the desired depths (see the Field Sampling Plan [FSP]). A 2-foot length of flexible tubing is spliced into the line to allow the pump head to move water through the sampling apparatus. Water pumped at a rate of up to 1.5 liters per minute (L/min) will be drawn through the Teflon™-lined tubing, passing sequentially through a vortex separator, a 0.5-μm GFF filter (142 millimeter [mm] diameter) and then through an XAD-2 cartridge. A work-flow diagram for the PR-2900 is shown in Figure 2.

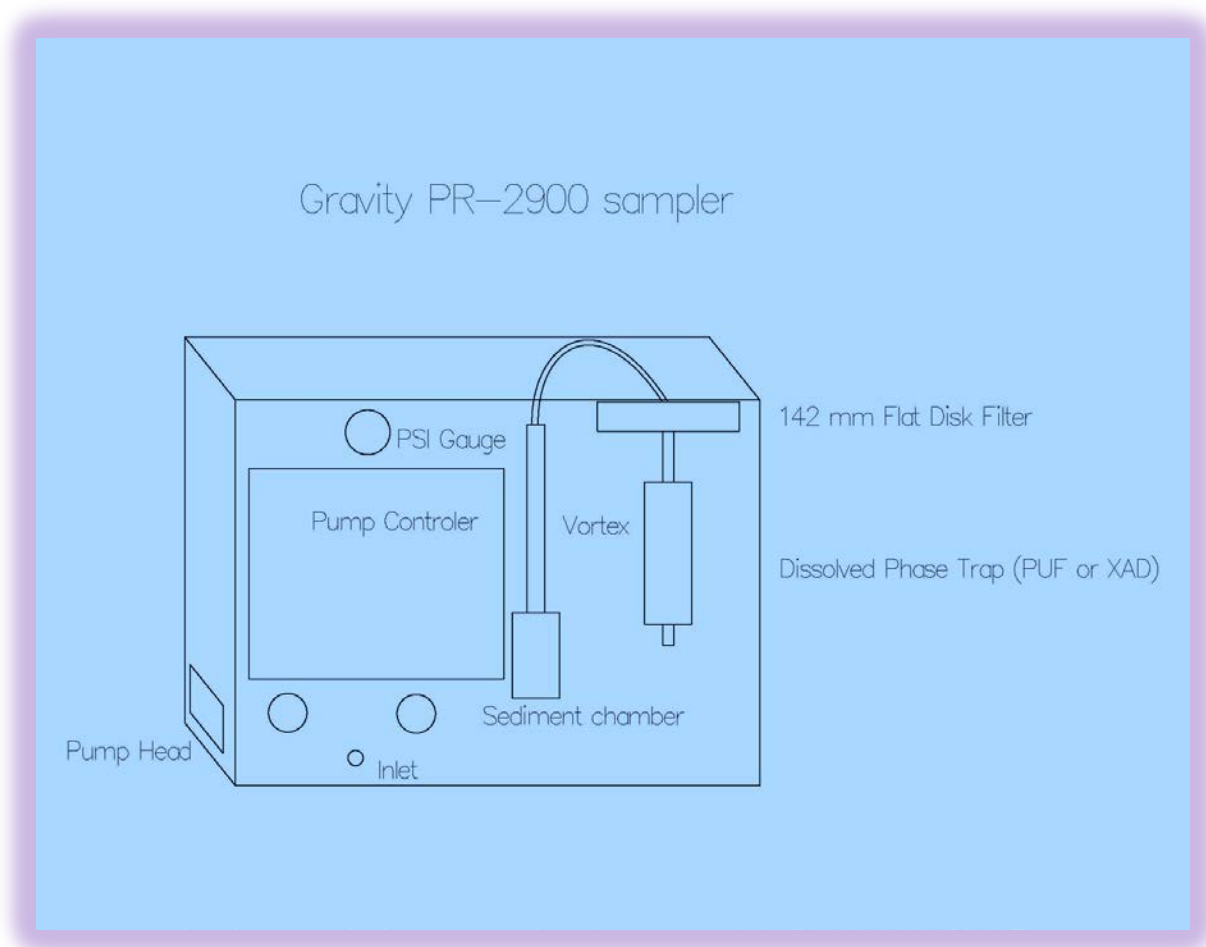


Figure 2: PR2900 Work-flow Diagram

At each station, the two lengths of Teflon™-lined tubing will be attached to a weight and the water quality meters (a YSI multiparameter sonde) with zip ties. Data from the YSI sonde will be monitored in real time on the vessel and data will be logged electronically. The tubing will be attached to the YSI sonde hanging approximately 6 inches lower than the sonde housing. While the boat is kept facing the current, the water sampler unit will be lowered to the appropriate depth with the help of a hydraulic or electric winch. Using a peristaltic pump, water will be directed into a high vortex separator. The high vortex separator will be able to separate suspended sediments by forcing the water in a centrifugal fashion before exiting towards the 0.5-µm GFF filter and then the XAD-2 cartridge (Figure 3). The XAD-2 cartridges contain solid phase extraction material (i.e., XAD-2 resin) that binds dissolved forms of the compounds in question (e.g., HOCs). A constant rate of water, up to 1.5 L/min, will be pumped through this system. The 1.5 L/min flow rate is optimum since the speed of the vortex separator is positively linked to the flow rate, and flow rates must be appropriately low to allow sorption of HOCs in the XAD-2 medium.

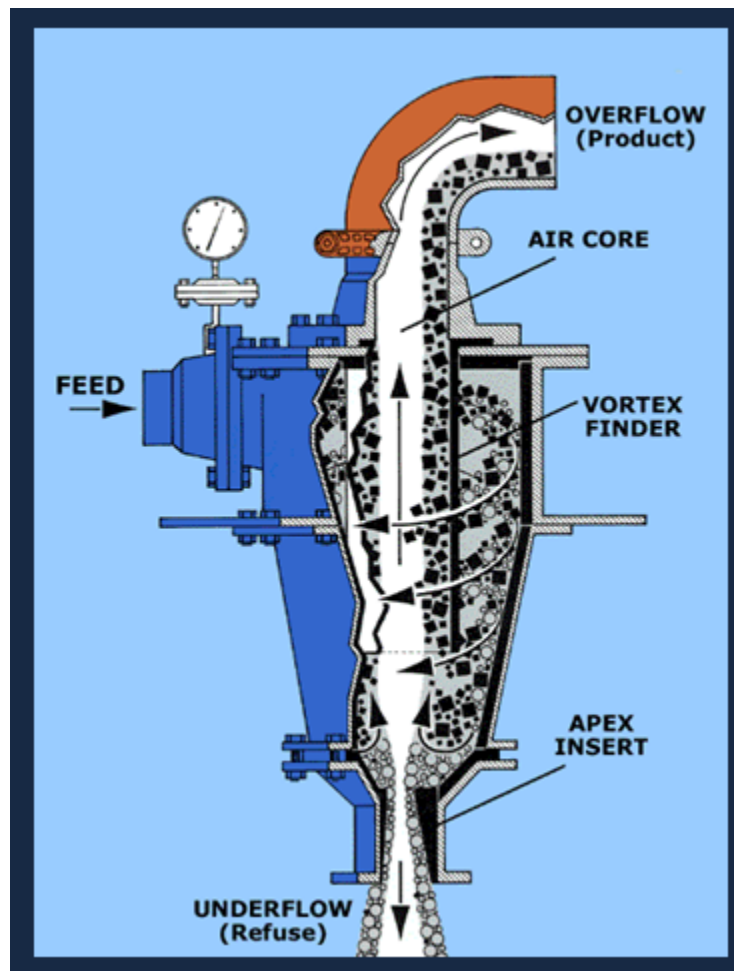


Figure 3: Vortex Separator

The design of the PR2900 includes an integrated flow meter to monitoring pumping rates. The flow meter will be calibrated in the field prior to collection of samples by pumping a known volume of water through the system into a graduated cylinder and then entering that volume into the control panel of the PR2900 as prompted by the system. The system then associates that volume with the numbers of revolutions of the pump it took to yield that volume. Every 15 minutes, the flow rate of water pumped will be confirmed manually to ensure that water is flowing at a constant desired rate. To check that the pump is accurately delivering water at the desired rate, the pump outflow must be checked with a 1L graduated plastic cylinder and a timer. The pump outflow will be checked from the discharge tubing. The tubing will not be disconnected before the vortex unit during testing of flow rates. If the pump is not delivering the correct flow rate, fine adjustment in the flow rate will be made until the desired flow rate is achieved.

After the desired volume has passed through the XAD-2 cartridge (see FSP), the HV peristaltic pump will be turned off and the XAD-2 cartridge and 0.5- μ m GFF filter will be removed. Two stainless steel nuts that cap each end of the XAD-2 will be reattached. The cartridges will be labeled, taped, placed in resealable bags, and placed in a cooler with wet ice. As intermittent filter

changes may be required, more than one 0.5- μ m GFF filter may be used. As total system pressure approaches 15 pounds per square inch (psi), the system should be shut down and the 0.5- μ m GFF filter should be changed. Each 0.5- μ m GFF filter that is used during the sampling will be added to the labeled 8-ounce (oz) jar. The volume from the vortex separator containing the suspended particles sample will be added to the labeled 8-oz jar together with the 0.5- μ m GFF filter(s) before being placed in a cooler with ice. The solids in the vortex sampler will be removed by shutting the main line valve (located post vortex and pre-GFF filter) to the off position and opening the vortex outlet valve while running the pump for 10 seconds to purge captured solids into the sample jar.

Procedures for Collection of HV Samples

The sampling team should be comprised of three people. Two people are needed to conduct the sampling and a third person is required to keep track of sample logging and sample processing. In addition, the third person may be responsible for measuring the *in situ* surface water quality parameters.

To avoid potential cross-contamination, new tubing is used at each station and covered when moving between sub-stations on a transect to avoid contamination onboard the vessel. The PR2900 uses a peristaltic pump to avoid contact of the sample with pump components. The body of the filtration system is decontaminated between stations to avoid cross-contamination. Lastly, the intake tubing is placed below the sampling equipment by 6 inches and the additional distance between the tubing and the weight will prevent potential contamination from equipment.

Equipment Preparation

A sufficient amount of decontaminated sampling equipment will be brought to the field to minimize the amount of decontamination procedures that need to be performed between stations. Axy's will be responsible for preparing equipment prior to the sampling event. This includes dedicated TeflonTM-lined polyethylene and tubing, GFF filters, and XAD-2 cartridges. All precleaning will be done in the laboratory and the clean equipment transferred to Gravity or Geosyntec Consultants, Inc. (Geosyntec)/AECOM Technical Services (AECOM) under chain-of-custody. All GFF filters will be cleaned, pre-weighed, numbered at the laboratory, and individually packaged before being shipped to the site under chain-of-custody. The list of necessary equipment is provided as Attachment 1 to this SOP.

The following steps are taken to set up the surface water collection system in the field:

1. Assemble and secure the water inlet and tube to the YSI sonde line using cable ties. The end of the water inlet tube should be covered with aluminum foil or other protective cap until just prior to deployment.
2. Determine the correct position of the sampling station and have the captain anchor the vessel into the current at the sample site and switch off the engines. If anchoring is not possible and the engine must be on, care should be taken that the water intake tubing is always upstream of the engines.

3. Set up the sampling equipment on clean plastic sheeting, leaving an area sufficient for staging sampling bottles and other equipment necessary during sample collection.
4. Attach Teflon™-lined tubing (outflow end) to 30-centimeter tubing and a 1-meter Teflon™-lined tubing, sequentially, and then connect the end these interconnected pieces of tubing firmly into place inside the large peristaltic pump head. The outlet tubing should be directed outside of the boat gunnel. (The length of the Teflon™-lined tubing will vary depending on project-specific requirements and water depth at a given station.) Use tie wraps to hold tubing connections together if pressure causes tubing to leak, entrain air, or connections fail.
5. Insert a new pre-cleaned 0.5-µm GFF filter to the filter housing. Record the filter identification number (ID) (provided by the laboratory) on the log sheets. Each filter will be pre-cleaned and packaged separately, minimizing exposure of unused filters to ambient conditions.
6. Insert a new pre-cleaned XAD-2 cartridge as the primary sorbent of dissolved HOC. Record cartridge ID (provided by the laboratory) on the log sheets.
7. Attach the intake part of the Teflon™-lined tubing and YSI multi-parameter sonde from Step 1 to the weight. Sufficient weight should be added to allow near vertical deployment of the sampling tubing and sonde. The weight will be located approximately 3 feet below the instrument array. The intake tubing will extend 6 inches below the instrument array.
8. Secure the pump and pump speed controller and connect them to the vessel's GFCI-protected power source with an extension cord. If vessel power is not available, the pump can be operated by battery or a generator. If a generator is used, it must be run downwind from the sampling activities and should not be run while the XAD-2 cartridges are being transferred to or from the sampler, or while GFF filters are exposed or material is being transferred from the vortex separator.

Sample Collection

The following steps are taken to collect and process an HV surface water sample:

1. Remove the protective cap from the sampling tube and lower the sampler gently below the water surface.
2. Submerge the sample tubing inlet to the required sample depth using the shipboard fathometer to determine overall depth at the sampling location.
3. Switch the pump on and purge at least three volumes of river water through the tubing to ensure a representative sample is collected. Total volume pumped is logged by the PR2900. During purge, calibrate pump flow rate to 1.5 L/min (or other pre-determined flow rate based on desired sample volume) using a 1-L graduated cylinder and a stop watch. Record reading and adjustments in field log book.
4. Once purging is complete and flow rates are set, pump surface water through the sample tubing into the solids-separation devices and through the XAD-2 cartridges at target rate.

5. Every 15 minutes, record pump rate to ensure that the target rate of 1.5 L/min is maintained. If the pump rate falls +/- 5% outside this range (i.e., outside of the range of 1.425 L/min to 1.575 L/min), adjust the speed of the pump.
6. GFF filters may need to be replaced mid-sample. If system pressure reaches 15 psi prior to completion of sampling desired volume of water, shut down the system. The 0.5- μ m GFF filter will be replaced. Release pressure by closing the valve above the GFF filter array and purging any water from the vortex separator into the 8-oz glass sample jar. Open the filter housing for the 0.5- μ m GFF filter. Cover the filter paper with a new clean laboratory-weighed and numbered filter to sandwich the solids and absorb any perched water. Record the ID of the new filter paper. Fold the sandwiched filters in half, then in half again. Remove the GFF filters with stainless steel forceps by grasping the folded filters from the outside edge, taking care to ensure that all material retained on the filter is added to the jar. Place the GFF filters in the 8-oz glass sample jar and replace with a clean filter (record the filter ID on the log sheets). Reassemble the filter housing. Filter changes will be conducted as efficiently as possible, minimizing ambient exposure. Open the valve and resume pumping.
7. Use turbidity sensor to monitor ambient water quality while pumping.
8. Once the desired volume has been pumped through the system at each target location/depth, shut the pump system off, move to the next target location/depth, and repeat from Step 2.
9. Once the desired volume of surface water at each transect has been pumped through the XAD-2 cartridge, pump system dry and turn off the pump system.
10. Remove the XAD-2 cartridge, cap each end with stainless steel nuts and label the cartridges. Wrap XAD-2 cartridge in bubble wrap to cushion sharp edges and place in a labeled 1-gallon Ziploc® bag.
11. Remove the 0.5- μ m GFF filter (using the same technique as above) and place in the 8-oz jar.
12. Add the volume from the vortex separator into the 8-oz jar that contains all the 0.5- μ m GFF filters used during the sampling by shutting the main line valve to the off position and opening the vortex outlet valve while running the pump for 10 seconds to purge the vortex separator. If needed, rinse the inside of the vortex separator with a squirt bottle filled with deionized water.
13. Ensure that a sample label is attached to the 8-oz jar, the XAD-2 cartridges, and the Ziploc® bag containing the XAD-2 cartridges. The label must contain the date, time, project name or number, sample ID, type of analysis required, and sampler initials per the PDI Quality Assurance Project Plan (QAPP).
14. Once the Ziploc® bags containing the XAD-2 cartridges and the 8-oz solids jar are properly sealed and labeled, place them inside a cooler containing wet ice and store at approximately 4 degrees Celsius (°C). All samples are to be stored in coolers with ice onboard the vessel and transferred to the field facility no later than at the conclusion of the sampling day.

15. Quality assurance/control samples can be collected using the sampling techniques listed above. Field duplicates (as co-located samples) using the PR2900, if collected, should be collected in tandem with the site sample by using a second pump system on the vessel. The second pump system is a parallel system where the tubing intakes for the two systems are connected, thereby drawing water from the same location in the water column. It is critical that field duplicates be started and stopped at the same time as the site sample that is targeted for duplication. If filters are changed during sampling, both units should have exact same number and timing (L pumped per filter) of filter changes. Equipment blanks should follow the same sample process as a field sample with the following exceptions:

- HOC-free deionized water from the laboratory should be used in place of river water; and
- Sample volume should be adjusted to 100 L.

Sample Handling – Clean and Dirty Hand Techniques

Standard “clean and dirty hand” techniques will be observed on this project per Surface Water Sampling SOP (Integral 2004a) and EPA (1996). Clean hands are required for tubing assembly, filter installation and removal, handling the XAD-2 cartridges, sample collection, and sample handling, as described above. Field staff will wear appropriate non-contaminating, disposable, powderless nitrile gloves during the entire sampling operation. Gloves will be changed frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes).

Clean hands are required for all operations that involve equipment that comes into contact with the sample, including the following activities:

- Handling the XAD-2 cartridge(s), 0.5-µm GFF filter, and vortex separator vial;
- Handling the intake end of the sample tube or line;
- Setting up working space inside the processing chambers;
- Setting up the equipment (i.e., HV sampler and XAD-2 cartridges) inside the chambers;
- Handling the vortex separator; and
- Changing the chamber covers as needed.

Dirty hands take care of all operations that involve contact with potential sources of contamination, including the following activities:

- Working exclusively exterior to the processing and preservation chambers;
- Preparing a clean workspace (inside boat);
- Decontamination of equipment;
- Preparing and operating the sampling equipment, including the pumps and discrete samplers;
- Handling the generator or other power supply for samplers;
- Handling the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds;

- Setting up, handling, and checking the single or multi-parameter instruments for field measurements; and
- Measuring water depths and field measurements and recording field data.

All samples will be stored in coolers with ice at approximately 4°C onboard the vessel and transferred under chain-of-custody to cold storage at the field facility at the conclusion of the sampling day. Samples will be shipped under chain-of-custody and on ice to the analytical labs. The sampling team leader will be responsible for maintaining sample integrity throughout the sampling event.

Sample contamination will be avoided by handling the sample containers with clean gloves and transferring the samples into clean refrigerators (or clean coolers) immediately after samples have been brought back from the field. Sample bottles will always be handled by personnel wearing disposable, powderless nitrile gloves. This includes any and all sample handling that may occur during sample packing and shipping.

Decontamination

The following steps are taken to decontaminate the HV surface water sampling equipment between sample stations. Decontamination should be done at the field facility to minimize risk of carrying solvents and waste on the sampling vessel. The procedure specific to the HV sampling equipment is provided below.

1. Remove all silicone and Teflon™-lined tubing and discard.
2. Connect a new set of tubing to PR2900 system. A dedicated clean hands sampler with new disposable nitrile gloves handles all clean tubing and makes all tubing connections.
3. Open the GFF filter housing and brush inside of housing with a dedicated clean brush and deionized water. Reassemble the filter housing.
4. Open the vortex valve during the pumping of each of the decontamination liquids listed in Steps 5-11. Leave the valve open until three vortex volumes are rinsed through the vortex.
5. Pump 2 L of Liquinox solution through the PR2900 system. Liquinox solution consists of 1 capful of Liquinox per 20 L of deionized water.
6. Pump 1 L of deionized water through the PR2900 system.
7. Pump 1 L of methanol through the PR2900 system.
8. Inject 1 milliliter (ml) methanol through the injection port.
9. Pump 1 L of deionized water through the PR2900 system.
10. Pump 0.5 L of hexane through the PR2900 system.
11. Pump 1 L of deionized water through PR2900 system. If PR2900 is to be used immediately, cap all exposed inlets and outlets with aluminum foil and secure with tape until next sample is ready for collection. If system is to be used the next day, allow to air dry prior to capping.
12. Capture all decontamination solutions in a container designated for investigation-derived waste (IDW).

13. Recap the IDW container and store in a designated area.

References

- David, N., D. Bell, and J. Gold. 2001. Field sampling manual for the Regional Monitoring Program for Trace Substances. San Francisco Estuarine Institute, San Francisco, California.
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- Integral (Integral Consulting). 2004a. Round 2A Field Sampling Plan – Surface Water. Appendix C – Surface Water Sampling SOP. Prepared by Integral Consulting Inc. for the LWG for submittal and approval by EPA Region 10. April 2.
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ATTACHMENT 1: HV SAMPLING FIELD EQUIPMENT LIST

- High volume peristaltic pump with vortex separator
- Surface water parameter multi-meter capable of measuring pH, reduction/oxidation (redox) potential, temperature, specific conductance, turbidity, and dissolved oxygen
- 6-mil plastic sheeting
- Teflon™-lined polyethylene sample tubing (length is site dependent)
- Platinum cured silicone tubing
- Plastic zip-ties
- Water Sampling Log forms
- Sample tags/labels and appropriate documentation (e.g., chain-of-custody forms)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample containers (XAD-2 cartridges [numbered with ID at laboratory], 8-oz amber glass wide-mouth jars for filters and separated solids)
- Coolers
- Wet ice
- Nitrile gloves
- First aid kit
- Eye wash kit
- Duct tape
- Clear tape
- Packing tape dispenser
- Tool box
- Coated weights for water samplers
- Non-metallic wire for winch spool
- 2,000-watt power generator or inverter with GFCI protection
- Paper towels
- Dilute solution of Liquinox
- Deionized water
- Extension cord
- Power strip
- Resealable plastic bags (i.e., 1 gallon and 1 quart)
- Yuma Trimble
- HOC-free deionized water
- IDW containers
- Laboratory-grade methanol
- Laboratory-grade hexane
- Pre-cleaned, weighed and numbered 0.5-micron glass fiber flat filters

APPENDIX B-5
STANDARD OPERATING PROCEDURE
HORIZONTAL AND VERTICAL LOCATION
CONTROL
(AUGUST 2018)

STANDARD OPERATING PROCEDURE

HORIZONTAL AND VERTICAL SURVEY CONTROL

Introduction

This Standard Operating Procedure (SOP) has been developed for the Pre-Remedial Design Sampling and Baseline Investigations (PDI) at the Portland Harbor Superfund Site located in Portland, Oregon to confirm accurate positioning of vessels and samples during sample collection activities. The survey control requirements described in this SOP are specifically for environmental sample collection and will generally comply with map-grade precision and accuracy in contrast to the geodetic-grade precision and accuracy performed for the Bathymetric Survey conducted by David Evans and Associates (DEA). However, the same survey control points and geodetic parameters will be used in both surveys for consistency, and a portion of the quality assurance/quality control (QA/QC) process will involve consultation with DEA Oregon Professional Land Surveyor (PLS) staff to review the map-grade data collected for the environmental sample collection.

The organization of this SOP is as follows:

- Methodology Overview
- Project Geodetic Parameters
- Survey Accuracy, Precision, and Control
- Primary Equipment
- Hand-Held GPS Operation
- Vessel Navigation and Equipment Operation
- Data Processing and QA/QC Procedures

Tables, figures, and attachments are presented at the end of the SOP.

Methodology Overview

Horizontal (Map) Data Collection

A combination of vessel-mounted and hand-held GPS receivers will be used to navigate to sampling locations and to collect map location coordinates (Northings, Eastings) for those sampling locations. The vessel-mounted GPS receivers will be the primary tool used for navigation to the pre-planned sampling locations in a GIS file, which will be pre-loaded into the vessel navigational system. The hand-held GPS devices will be used as a backup and confirmation of vessel position only if there are problems with the vessel GPS navigation system or if there is no specific vessel navigation system (i.e., smaller boats). Since the inception of field work, the vessel GPS coordinates have been consistently verified and deemed to be sufficient to meet position and accuracy requirements for the project. The hand-held GPS devices will primarily be used for studies involving small vessels. These devices will also have the pre-loaded basemap content depicting planned sampling locations.

The vessel GPS will operate in two modes, collecting both a separate continuous data stream of positional information (line file) and recording GPS soundings (target file) when a sample is specifically collected. The sample location target file will be recorded when the sampling device is in position for the grab (e.g., when sampler is on the river bottom). The specific Location ID associated with the sample will also be recorded in the GPS device log. Field personnel will be required to write that same Location ID on their field data collection forms at the same time. Both the continuous and episodic dataset will be timestamped to allow comparison of the two types of data. This data will be recorded and maintained on the vessel, and will also be exported from the vessel navigation system and archived to project servers on a daily basis.

The hand-held GPS devices will be operated independently of the vessel's systems and will be used to record a location sounding wherever a sample is collected only for studies unable to use the vessel GPS navigation system. The sample location sounding will be recorded approximately at the same time as when the vessel GPS measurement is collected (e.g., when sampler is in position). The specific Location ID associated with the sample will also be recorded on the GPS device. Field personnel will write this Location ID on the field forms only if the vessel measurement described earlier cannot be collected for some reason (e.g., equipment failure). These measurements will also be timestamped. The data from the hand-held GPS devices will be wirelessly synchronized to a "cloud" web service in near real-time; the data from the "cloud" will also be downloaded and saved to project servers daily.

Vertical Data Collection

Vertical (elevation) data is also required for water levels, sample collection depth below surface water, and bottom (mudline) depth location for some types of sample locations. For increased precision and accuracy, it is proposed that bottom (mudline) depth locations (e.g., for sediment cores) be calculated from the 2018 bathymetric surface to be developed by the hydrographic survey performed by DEA (since the data will be collected within a few months of each other). The NAVD88 elevation will be calculated from the intersection of the surface map location coordinates collected as described earlier, projected vertically down to the bathymetric surface (United States Army Corps of Engineers [USACE], 2004). The elevation from the intersection of the bathymetric surface will be used as the final or "best" elevation for the sample.

In contrast, for depth measurements that require less precision (e.g., water levels, depth to samples below water surface), the onboard vessel sonar will be used to record depth and then subsequently calculate elevation. All depths will be recorded relative to the water surface and time tagged to correct with time tagged gauge data for obtaining riverbed elevations. The elevation will be calculated to NAVD88 datum (in feet). To correct elevations, gauge data from the Northwest River Forecast Center will be downloaded for gauge PRT03, which is representative of the former Morrison gauge which has been moved. This gauge does not report NAVD88 elevations but rather reports a value that is 0.3 feet above Columbia River Datum (CRD). Corrections from CRD to NAVD88 differ moving down the river from the gauge due to the fact that NAVD88 is a reference normal to gravity (water does not flow if the elevation is unchanging), and CRD is a gradient datum that follows the lower water surface. In Portland Harbor, the difference between CRD and NAVD88 (Geoid12b) ranges from 0.00 feet CRD = -5.16 feet NAVD88 (Geoid12b) at Willamette River river mile (RM) 2.0, to 0.00 feet CRD = -5.41

feet NAVD88 (Geoid12b) at Willamette River RM 12.8 (approximate location of PRT03 Gauge). Accordingly, a correction to the Willamette Gauge in Portland would be $-5.41+0.3$ or -5.11 feet at RM 12.8. An approximation would be to subtract 5 feet from the gauge reading for the full length of the study area, but precision will vary depending on tides and river gradient.

For sample locations requiring vertical information, depth will be recorded by field staff on their data collection forms relative to the water surface, and these values will be loaded to the project database as described in the Data Quality Management Plan (DQMP). Final calculated NAVD88 elevation data (feet) will also be entered into a separate data field in the project database after completion of spatial analysis, calculations, and QA/QC. DEA will provide support during the QA/QC process to verify proper calculation of NAVD88 elevation data.

Location Position Recording in Project Database

Discrete Samples

When discrete samples are collected, the Location ID and the location coordinates (Northing/Easting) will be recorded on the GPS device(s) and the field data collection form(s). The location coordinates will be based on the vessel GPS instantaneous target measurement. This target measurement will be the location coordinate pair loaded initially to the project database. After the field event is completed, the target measurement will be compared to the line file (vessel continuous GPS measurement) to confirm that the coordinate pair loaded to the project database is appropriate. If analysis reveals precision or accuracy issues, the loaded location coordinate pair in the project database may be updated and edited with a better value derived from the line file. In general, the hand-held GPS devices will be used as a backup and confirmation of vessel position only if there are problems with the vessel GPS navigation system or an independent navigation system is not available on the vessel. These coordinates will be loaded to the project database only if there is a significant problem with the vessel GPS (e.g., equipment failure) or if there is no vessel GPS.

Composite Samples

When composite samples are collected, location coordinates will also be recorded as both target measurements and continuous measurements using the vessel GPS. The continuous GPS measurements will be recorded during the entire compositing event, and instantaneous target measurements will be collected when the sampler is in position for each individual composite grab. At each compositing location, a target measurement will be recorded in the vessel GPS along with the Location ID with an “a,” “b,” or “c” suffix. These measurements will be recorded on the field forms in the same manner (e.g., there will be three sets of location coordinates, lithologic descriptions, etc.).

When the location data is loaded to the project database, a single set of location coordinates will be recorded in the project database with a Location ID that excludes the “a,” “b,” or “c” suffix. As a presumed middle time point, the “b” set of coordinates will be loaded with the primary Location ID to the project database. After the field event is completed, the target measurement associated with the “b” location composite will be compared to the line file (vessel continuous GPS measurement) to assess vessel position and the timeframe of the entire sampling event to confirm if the coordinate pair loaded to the project database is appropriate. The goal will be to finalize the location coordinate information in the project database based on the most representative position based on this analysis. Similar to

discrete sample collection, a hand-held GPS device and related data will only be loaded to the project database if there is a significant problem with operation of the vessel GPS or if the vessel does not have a GPS.

Finally, after field data are collected and surveys are completed, as defined in the DQMP, the location coordinate data will be joined with the tabular data collected by the field teams and loaded to the project database.

Project Geodetic Parameters

The geodetic parameters to be used for the PDI field studies will be as follows:

Horizontal Datum: North American Datum of 1983 (2011)

Projection: State Plane Coordinate System (SPCS) Oregon North Zone

Vertical Datum: North American Vertical Datum of 1988 (NAVD88) Geoid12b

Horizontal Units: International Feet

Vertical Units: Feet

Survey Accuracy, Precision, and Control

The anticipated horizontal accuracy of environmental sampling associated with vessel and hand-held GPS devices is a range of 1 to 5 meters (target 1 to 2 meters for the DGPS unit itself). This should be consistent with RI target accuracy (Integral 2002) and best practices (Puget Sound Estuary Protocols [PSEP] 1998 and US Environmental Protection Agency [EPA] 2008).

The anticipated vertical accuracy of final elevation calculations derived from vessel sonar systems is anticipated to be 1.0 meter.

Table 1 summarizes the survey control locations used in the DEA Bathymetric Survey, which will be used for the environment sample collection work described in this SOP. Figure 1 shows the PH2 piling at the Fred Devine boat dock, and Figure 2 shows the approximate locations of the survey control references for PH1 and PH2. Figure 3 shows approximate location of PH3 for survey control above the Willamette Falls. Attachment 1 contains detailed survey sheets of the following control points: Raindeer, PH1 and PH2, and PH3. Additional information regarding the DEMSI and 2100 control points is available upon request.

Primary Equipment

- Trimble® SPS 461 GPS with dual antennas (vessel GPS)
- A-frame assembly, sampling winch (vessel boom)
- Trimble® R1 (hand held GPS), tethered to Bluetooth® capable smartphone or tablet, ESRI Collector software with Trimble® GNSS Status middleware
- GPS owner's manual
- Writing tools (pencils, Sharpie®)

- Field logbook
- Spare batteries and/or battery charger
- Compass
- Tape measure

Hand-Held GPS Operations

For ease of use, the project team will utilize smartphones tethered to the Trimble® R1 GNSS Receiver via a Bluetooth® connection. The smartphone will be configured with Trimble's middleware software called GNSS Status to convert and stream NMEA satellite data to the smartphone for real-time correction and display to a simple electronic data collection form developed on the ESRI Collector platform. The form will contain a limited number of data fields, including location, study name and operator, date, and notes or comments. This form is not intended to duplicate the content and scope of the field data collection forms, but rather clearly link the GPS data to those forms via the unique Location ID. There are metadata fields available as well from these GPS records, such as estimated horizontal accuracy.

Collected data recorded onto the phone will be transmitted wirelessly via a synchronization process invoked when data is "saved" to the device. The data will be pushed to AECOM Online's Portal and ArcGIS Server for storage of "corrected" location coordinates, Location ID, and other information captured when the GPS sounding is recorded. The sampling event will be trackable in near-real-time as samples are collected on the ArcGIS Portal Interface. Either dedicated, experienced GPS-operators will be collecting the measurements on the smartphones, or, due to the very simple nature of the interface, field personnel will be trained to use the devices. Initial training sessions were already successfully conducted March 19-20, 2018 on use of the smartphone GPS interface. These handheld devices were successfully used for the first 2 weeks of field work. For some studies, such as the smallmouth bass tracking study, these handhelds may be used as the primary GPS due to smaller vessel configuration.

Vessel Navigation and Equipment Operation

Vessel positioning will be conducted through the marine navigation and hydrographic software package HYPACK. This software package allows the visualization of the vessel over navigable charts, the processing of satellite corrections, stored hardware, and vessel parameters, as well as the storing of physical target locations during sampling activities. HYPACK version 2017 will be used for this project.

Vessel position is measured using a Trimble SPS 461 GPS dual antenna receiver. The dual antennas provide precise vessel positioning via both satellite and differential radio corrections along with heading correction to 0.09 degree. GPS data is output through a serial connection into computer running the HYPACK software, for vessel positioning and target collection.

At each sampling location, depth to mudline will be measured using an onboard fathometer (with lead line as confirmation as needed) immediately prior to or during the sampling. Water depths are measured at each station using an Airmar ss510 survey sonar at the sampling point and confirmed daily with a lead line with reference to water surface. Vertical measurements will be recorded to the

nearest 0.1 foot. Water depths will be converted to elevations in NAVD88 based on the river stage at the time of sampling as recorded at the closest available tide gage.

Data Processing and QA/QC Procedures

All GPS devices will be subject to a position check to confirm the accuracy of the on-vessel GPS and hand-held GPS devices and to validate the positions derived from each GPS receiver. Correctors will be applied as needed, resulting in a position that is within specified positioning accuracy of the DEA published position for control monuments PH1, PH2, and PH3 (or future control point approved by EPA). At the start and end of each field day, the benchmark location will be visited to perform a position check.

At the piling serving as the PH2 control monument (accessible by boat), the on-vessel GPS calibrated to the top of A-frame assembly will be maneuvered as close to the benchmark piling as possible to record a point. The GPS-derived position of the sampling vessel is compared with the known horizontal location; results will be recorded in HYPACK to confirm that accuracy is within +/- 2 meters.

For handheld GPS, field staff will occupy the PH1 at the Swan Island boat launch parking lot or PH3 at the Willamette Park boat launch. Using the R1 and phone/tablet combination GPS setup, the field staff will hold the R1 above PH1 or PH3 and wait for a satellite “fix,” and when ready, the staff will record the GPS location in Collector. This GPS location will be compared to the known coordinates to confirm the accuracy is within +/- 2 meters. The survey control monuments act as a known location to allow for corrected station location coordinates during post-processing of data as needed. If a need arises to locate another benchmark, there are several USGS control points near the project area and near the AECOM project warehouse. Experienced GPS operators on the project team will be involved in all aspects of field data collection events to troubleshoot devices and assist in daily review of extracted geospatial datasets. Additional details on QA/QC procedures can be found on the DQMP.

References

- AECOM (AECOM Technical Services) and Geosyntec (Geosyntec Consultants, Inc.). 2018. Data Quality Management Plan Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. 22 February.
- Integral (Integral Consulting). 2002. Round 1 Field Sampling Plan. Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. June 14.
- EPA (United States Environmental Protection Agency). 2008. National Geospatial Data Policy. August 24.
- PSEP. 1998. Recommended Guidelines for Station Positioning in Puget Sound. Prepared for United States EPA Region 10 and the Puget Sound Water Quality Action Team. September.
- USACE (United States Army Corps of Engineers). 2004. Engineering and Design Hydrographic Surveying Manual, EM 1110-2-1003, U.S. Army Corps of Engineers, April 2004

Tables and Figures

Table 1. Benchmark Monument Coordinates and Description

Figure 1. Photograph of Piling PH2, at the end of the Fred Devine Boat Dock

Figure 2. Locations of control monuments PH1 and PH2 at Swan Island Boat Launch and Fred Devine Boat Dock, respectively

Figure 3. PK nail in the middle of Willamette Park Boat Launch parking is survey monument PH3

Attachments

Detailed survey sheets of PH Control Points of Portland Harbor (PH1, PH2, and PH3), and Raindeer survey monuments

Table 1. Benchmark Monument Coordinates and Description

Designation	Approx. Location	Description	NAD83 (2011), Oregon SPCS North (ft)		NAVD88 Elevation (ft)
			Northing	Easting	
DEMSI-BASE	Columbia River	Fixed antenna with height at antenna reference point	718172.70	7654431.05	73.58
DEMSI- CHECK	Columbia River	Fixed antenna with height at antenna reference point	718170.73	7654419.84	71.67
RAINDEER	RM 2	USACE Brass Cap	722443.24	7614886.64	35.44
Portland Harbor 1 (PH1)	Swan Island Boat Ramp	1/2" Iron Rod with red plastic cap stamped "DEA Control" Point is 0.3 feet south of the back of curb at the Swan Island Boat Ramp, 10.5 feet north of a cyclone fence, and 60 feet east of a light post	698702.46	7637426.37	33.38
Portland Harbor 2 (PH2)	Fred Devine Boat Dock	Reference point is 0.2 feet SE of the SE side of a 1-1/2-foot diameter steel pile. This is the furthest SE pile at the end of the Fred Devine Diving and Salvage Company dock in the Swan Island Lagoon.	700967.87	7634507.67	NA
Portland Harbor 3 (PH3)	Willamette Park Boat Launch (above the falls)	PK nail in trailer parking lot of boat launch ramp, near center of loop and approximately even with seventh parking space.	617123.76	7649701.80	72.42
2100	RM 13	5/8" bolt on SW corner of screen wall at DEA office 2100 SW River Parkway, Portland, OR	678400.01	7645190.81	159.51

General Notes:

1. The two DEMSI and the 2100 stations (indicated with green shading) are transceiver beacon stations in upland areas. These stations will not be used for daily location control checks by sampling team. More information regarding these stations is available upon request.
2. PH1 is located at the Swan Island boat ramp parking lot and accessible by foot.
3. PH2 is located at a piling at the boat dock where project-related vessels will be docked and is accessible by boat. This pile is to be used for daily position checks for sediment sampling operations. Pile is for position only and not elevation.
4. PH3 is located in the parking lot of the boat launch above the Willamette Falls and is accessible by foot.
5. Raindeer station is located adjacent to the river and accessible by foot (for the hand-held GPS).

Acronyms:

DEA = David Evans and Associates; ft = feet; NAD83 = North American Datum of 1983; NAVD88 = North American Vertical Datum of 1988; PH = Portland Harbor; RM = river mile; PK nail = survey marker; USACE = US Army Corps of Engineers; SPCS = State Plane Coordinate System



Figure 1. Photograph of Piling PH2, at the end of the Fred Devine Boat Dock. Piling was surveyed during and captured in DEA bathymetric survey. Photo is facing northwest.



PH2 is located on the SE corner of the Fred Devine Boat Dock, where Gravity's boats berth every night.



PH1 is located on the SW side of the Swan Island Boat Launch parking lot, where field crews park to meet the boats at the launch dock.

Figure 2. Locations of control monuments PH1 and PH2 at Swan Island Boat Launch and Fred Devine Boat Dock, respectively.

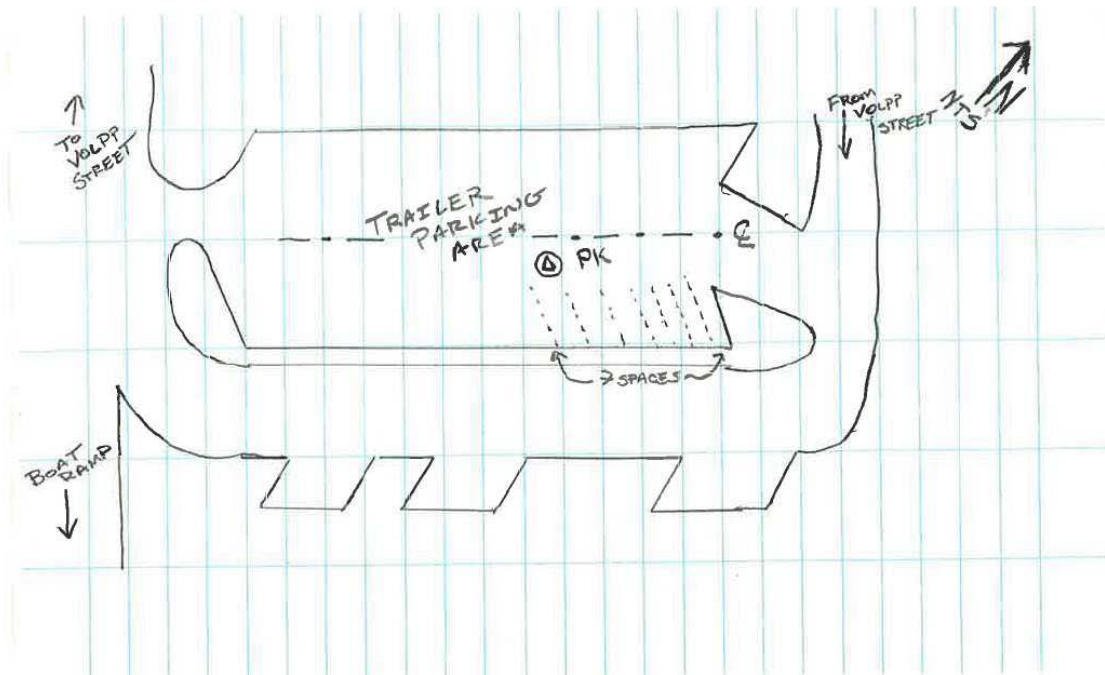



Figure 3. PK nail in the middle of Willamette Park Boat Launch parking marks survey monument PH3. It was land-surveyed by DEA and marked with pink survey tape. Photo shows survey equipment set-up over PH3.

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 GPS STATION OBSERVATION LOG April 16, 2003	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC __ BM) Portland Harbor 1 (PH1)		Station PID, if any:		Date (UTC): 06-Mar-18								
	General Location: Swan Island Boat Launch		Airport ID, if any:		Station 4-Character ID: 065								
Project Name: Portland Harbor - AETR00000034			Project Number: GPS-		Station Serial # (SSN): 065								
NAD83 Latitude 0		NAD83 Longitude 0		NAD83 Ellipsoidal Height meters NAVD88 Orthometric Ht. meters GEOID99 Geoid Height meters		Agency Full Name: David Evans and Associate, Inc. Operator Full Name: David T. Moehl Phone #: () e-mail address: dtm@deainc.com							
Observation Session Times (UTC): Sched. Start _____ Stop _____ Actual Start 19:30 Stop 21:32		Epoch Interval= 1 Seconds Elevation Mask = 10 Degrees											
Receiver Brand & Model: Trimble SPS985 82500-60 P/N: S/N: Firmware Version: 5.30		Antenna Code*, Brand & Model: Trimble SPS985 Internal P/N: S/N: Cable Length, meters: n/a Vehicle is Parked 10 meters N (direction) from antenna.		Antenna plumb before session? <input checked="" type="checkbox"/> (Y/N) Circle Antenna plumb after session? <input checked="" type="checkbox"/> (Y/N) Yes or No Antenna oriented to true North? <input checked="" type="checkbox"/> (Y/N) -If no, Weather observed at antenna ht. <input checked="" type="checkbox"/> (Y/N) explain Antenna ground plane used? <input checked="" type="checkbox"/> (Y/N) explain Antenna radome used? <input checked="" type="checkbox"/> (Y/N) If yes, Eccentric occupation (>0.5 mm)? <input checked="" type="checkbox"/> (Y/N) describe. Any obstructions above 10°? <input checked="" type="checkbox"/> (Y/N) Use Radio interference source nearby <input checked="" type="checkbox"/> (Y/N) Vis. form									
Tripod or Antenna Mount: Check one: <input checked="" type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod, <input type="checkbox"/> Fixed Mount Brand & Model: Seco fixed height P/N: S/N: Last Adjustment date: 2018-03-05		** ANTENNA HEIGHT **		Before Session Begins: Meters Feet		After Session Ends: Meters Feet							
Psychrometer (if used) Brand & Model: P/N: S/N: Last Calibration or check Date:		A= Datum point to Top of Tripod (Tripod Height)		2.000		2.000							
		B= Additional offset to ARP if any (Tribrach/Spacer)		0.000		0.000							
		H= Antenna Height = A + B = Datum Point to Antenna Reference Point (ARP)		2.000		6.56							
		Meters = Feet x (0.3048) Height Entered Into Receiver = 2.000 meters.		Note &/or sketch ANY unusual conditions. Be Very Explicit as to where and how Measured!									
Barometer (if used) Brand & Model: S/N:		Weather Data		Weather Codes		Time (UTC)							
		Before		00000		19:30							
		Middle											
		After		00000		21:32							
Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc: Control point is a 1/2" iron rod with red plastic cap stamped "DEA CONTROL" set 0.1' below natural grade. Control point is 0.3' south of the back of curb, 10.5' north of a cyclone fence and 60' easterly of the 2nd light post east of the boat ramp. See detached sketch and photos.													
Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.													
Data File Name(s): 95100650.T02 (Standard NGS Format = aaaadddd.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension				Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached		LOG CHECKED BY: Jon Dasler							
Table of		CODE		PROBLEM		VISIBILITY		TEMPERATURE		CLOUD COVER		WIND	
Weather		0		did not occur		Good, over 15 miles		Normal, 32° F- 80° F		Clear, below 20%		Calm, under 5mph (8km/h)	
Codes		1		did occur		Fair, 7-15 miles		Hot, over 80°F (27 C)		Cloudy, 20% to 70%		Moderate, 5 to 15 mph	
		2		- not used -		Poor, under 7 miles		Cold, below 32° F (0 C)		Overcast, over 70%		Strong, over 15 mph (24km/h)	
Examples:		00000 = No problem, good visibility, normal temp, clear, calm wind						12121 = Problems, poor visibility, hot, overcast, moderate wind					

Sketch of Monument PH1

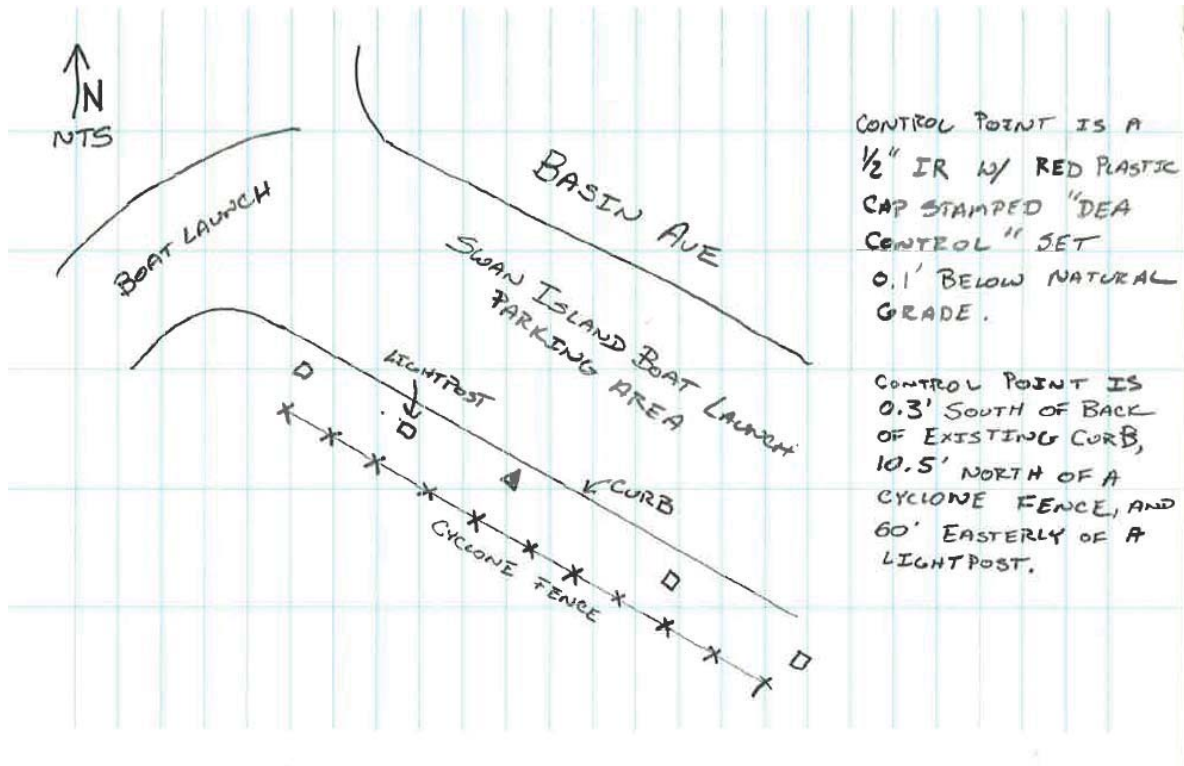



Photo of Monument PH1



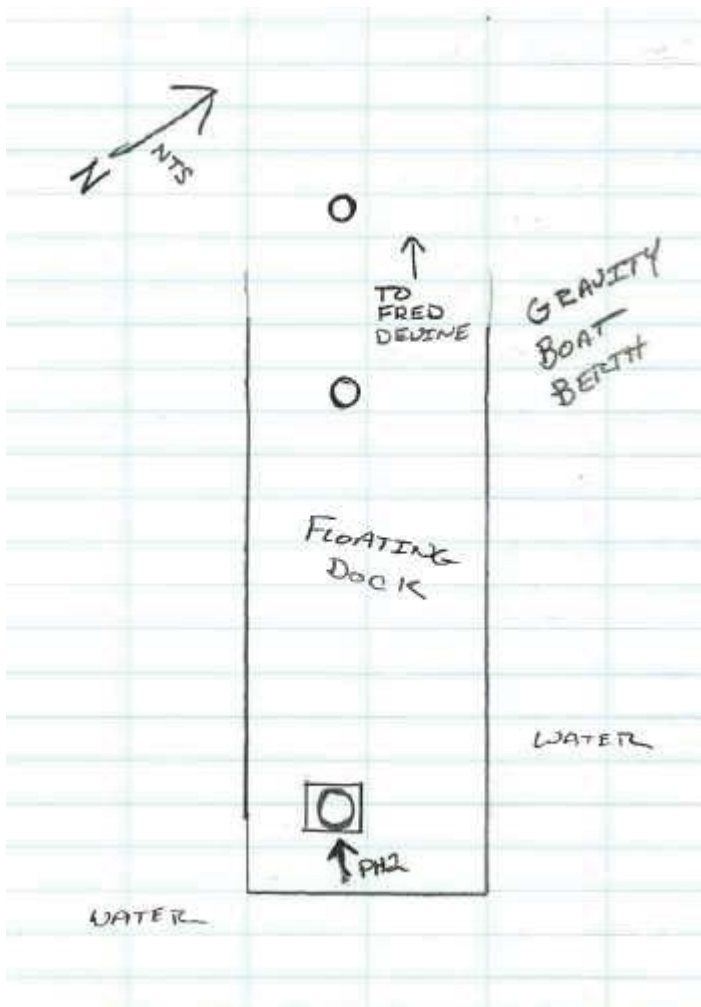
GNSS Setup on PH1



NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 GPS STATION OBSERVATION LOG April 16, 2003	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM) Portland Harbor 2 (PH2)		Station PID, if any:		Date (UTC): 20-Apr-18		
	General Location: Fred Devine Boat Dock		Airport ID, if any:		Station 4-Character ID: 111		
Project Name: Portland Harbor - AETR00000034			Project Number: GPS-		Station Serial # (SSN): Session ID:(A,B,C etc)		
NAD83 Latitude o ' "		NAD83 Longitude o ' "		NAD83 Ellipsoidal Height meters		Agency Full Name: David Evans and Associate, Inc.	
Observation Session Times (UTC): Sched. Start _____ Stop _____		Epoch Interval= <u>1</u> Seconds		NAVD88 Orthometric Ht. meters		Operator Full Name: David T. Moehl	
Actual Start 19:45 Stop 19:49		Elevation Mask = <u>10</u> Degrees		GEOID99 Geoid Height meters		Phone #: () (360) 314-3200	
Receiver Brand & Model: Trimble SPS985		Antenna Code*, Brand & Model: Trimble SPS985 Internal		Antenna plumb before session? (Y / N) <input checked="" type="checkbox"/> Circle		e-mail address: dtm@deainc.com	
P/N: 82500-60		P/N: 5616F59510		Antenna plumb after session? (Y / N) <input checked="" type="checkbox"/> Yes or No		Weather observed at antenna ht. (Y / N) <input checked="" type="checkbox"/> -If no, explain	
S/N: 5.30		S/N: n/a		Antenna oriented to true North? (Y / N) <input checked="" type="checkbox"/>		Antenna ground plane used? (Y / N) <input checked="" type="checkbox"/>	
Firmware Version: 5.30		Cable Length, meters: n/a		Antenna radome used? (Y / N) <input checked="" type="checkbox"/> If yes, describe.		Any obstructions above 10'? (Y / N) <input checked="" type="checkbox"/> Use	
<input type="checkbox"/> CamCorder Battery, <input type="checkbox"/> 12V DC, <input type="checkbox"/> 110V AC, <input checked="" type="checkbox"/> Other		Vehicle is Parked <u>n/a</u> meters _____(direction) from antenna.		Radio interference source nearby (Y / N) <input checked="" type="checkbox"/> Vis. form			
Tripod or Antenna Mount: Check one: <input checked="" type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod, <input type="checkbox"/> Fixed Mount		** ANTENNA HEIGHT **		Before Session Begins:		After Session Ends:	
Brand & Model: Seco fixed height				Meters Feet		Meters Feet	
P/N: 5115-00-FLY		A= Datum point to Top of Tripod (Tripod Height)		2.000		2.000	
S/N: 2018-03-05		B=Additional offset to ARP if any (Tribrach/Spacer)		0.000		0.000	
Last Adjustment date: 2018-03-05		H= Antenna Height = A + B		2.000		6.56	
Psychrometer (if used) Brand & Model:		= Datum Point to Antenna Reference Point (ARP)		2.000		6.56	
P/N: S/N:		Meters = Feet x (0.3048)		Note &/or sketch ANY unusual conditions.			
Last Calibration or check Date:		Height Entered Into Receiver = 2.000 meters.		Be Very Explicit as to where and how Measured!			
Barometer (if used) Brand & Model:		Weather Data		Weather Codes		Time (UTC)	
S/N:		Before		00010		19:45	
		Middle					
		After		00010		19:49	
Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc: Reference point is 0.2 feet SE of the SE side of a 1-1/2 foot steel pile. This is the furthest SE pile at the end of the Fred Devine Diving and Salvage Company dock in the Swan Island Lagoon. This pile is to be used for daily position checks for sediment sampling operations. Pile is for position only and not elevation. NAD83(2011) Oregon North Zone International Feet Coordinates North 700967.9 East 7634507.7							
Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.							
Data File Name(s): (Standard NGS Format = aaaadddd.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension				Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached		LOG CHECKED BY: Jon Dasler	
Table of		CODE		PROBLEM		VISIBILITY	
Weather		0		did not occur		Good, over 15 miles	
Codes		1		did occur		Fair, 7-15 miles	
		2		- not used -		Poor, under 7 miles	
Examples:		00000 = No problem, good visibility, normal temp, clear, calm wind		12121 = Problems, poor visibility, hot, overcast, moderate wind			

Sketch and Fieldnotes

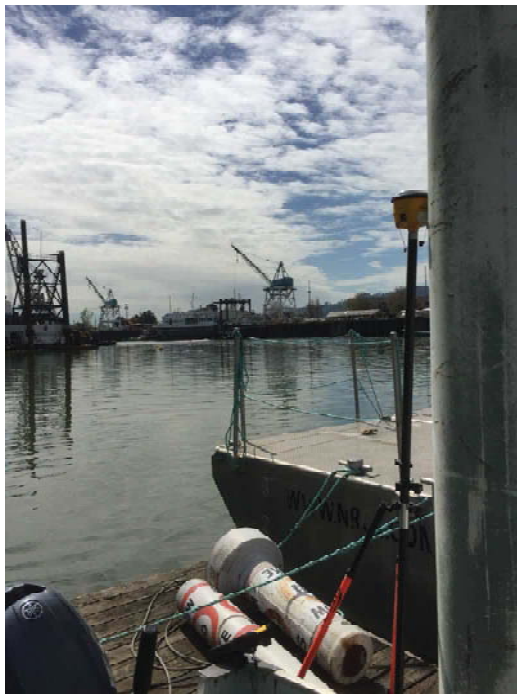


200	CHK PHI		
	KNOWN COORDS	OBS	Δ (FT)
	N = 698702.46	N = 698702.45	0.01
	E = 7637426.37	E = 7637426.39	0.02
	Z = 33.38	Z = 33.37	0.01
201	SE FACE OF PILE		
	3-MIN OBS		
	N = 700967.87		
	E = 7634507.67		
	Z = N/A		
202	SW FACE	TOPO	
203	NW FACE	TOPO	
204	NE FACE	TOPO	

Overview of PH2 Pile



GNSS Setup on PH2 Pile




View facing south



View facing northwest

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 GPS STATION OBSERVATION LOG April 16, 2003	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM)		Station PID, if any:		Date (UTC):				
	General Location:		Airport ID, if any:		Station 4-Character ID:		Day of Year:		
	Project Name:		Project Number: GPS-		Station Serial # (SSN):		Session ID:(A,B,C etc)		
NAD83 Latitude o ' "		NAD83 Longitude o ' "		NAD83 Ellipsoidal Height meters NAVD88 Orthometric Ht. meters GEOID99 Geoid Height meters		Agency Full Name: Operator Full Name: Phone #: () e-mail address:			
Observation Session Times (UTC): Sched. Start _____ Stop _____ Actual Start _____ Stop _____		Epoch Interval= _____ Seconds Elevation Mask = _____ Degrees							
Receiver Brand & Model: P/N: S/N: Firmware Version: <input type="checkbox"/> CamCorder Battery, <input type="checkbox"/> 12V DC, <input type="checkbox"/> 110V AC, <input type="checkbox"/> Other		Antenna Code*, Brand & Model: P/N: S/N: Cable Length, meters: Vehicle is Parked _____ meters _____(direction) from antenna.		Antenna plumb before session? (Y / N) Circle Antenna plumb after session? (Y / N) Yes or No Antenna oriented to true North? (Y / N) -If no, Weather observed at antenna ht. (Y / N) explain Antenna ground plane used? (Y / N) " Antenna radome used? (Y / N) If yes, Eccentric occupation (>0.5 mm)? (Y / N) describe. Any obstructions above 10'? (Y / N) Use Radio interference source nearby (Y / N) Vis. form					
Tripod or Antenna Mount: Check one: <input type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod <input type="checkbox"/> Fixed Mount Brand & Model: P/N: S/N: Last Adjustment date: Psychrometer (if used) Brand & Model: P/N: S/N: Last Calibration or check Date:		** ANTENNA HEIGHT **		Before Session Begins:		After Session Ends:			
				Meters Feet		Meters Feet			
		A= Datum point to Top of Tripod (Tripod Height)							
		B=Additional offset to ARP if any (Tribrach/Spacer)							
		H= Antenna Height = A + B = Datum Point to Antenna Reference Point (ARP)		2.003		6.57		2.003 6.57	
		Meters = Feet x (0.3048) Height Entered Into Receiver = _____ meters.		Note &/or sketch ANY unusual conditions. Be Very Explicit as to where and how Measured!					
Barometer (if used) Brand & Model: S/N:	Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp Fahrenheit Celsius	WetBulb Temp Fahrenheit Celsius	Rel. % Humidity	Atm. Pressure inches Hg millibar		
	Before								
	Middle								
	After								
Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:									
Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.									
Data File Name(s): (Standard NGS Format = aaaaddds.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension				Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached		LOG CHECKED BY:			
Table of Weather Codes	CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND			
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)			
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph			
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over15 mph (24km/h)			
Examples: 00000 = No problem, good visibility, normal temp, clear, calm wind 12121 = Problems, poor visibility, hot, overcast, moderate wind									

Sketch of Monument PH3

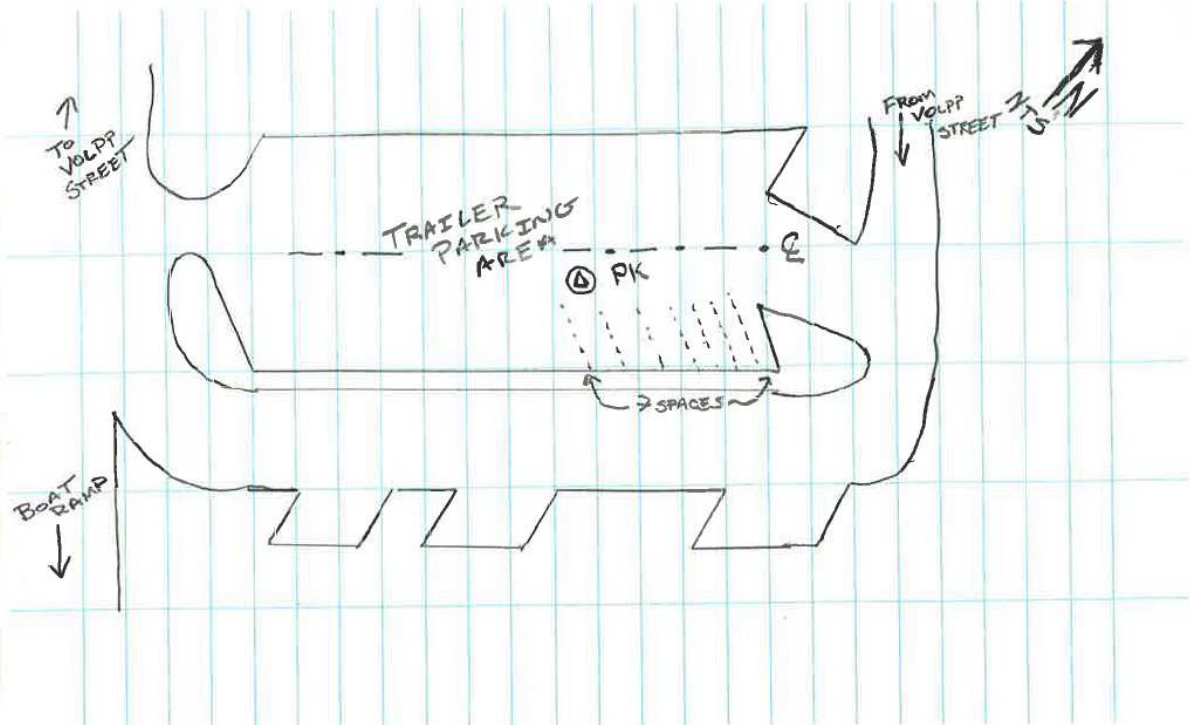


Photo of Monument PH3



GNSS Setup on PH3



NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.


 GPS STATION OBSERVATION LOG April 16, 2003	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM) Raindeer		Station PID, if any:		Date (UTC): 06-Mar-18		
	General Location: Sauvie Island, Willamette River		Airport ID, if any:		Station 4-Character ID: 065		
Project Name: Portland Harbor - AETR00000034			Project Number: GPS-		Station Serial # (SSN): 065		
NAD83 Latitude 0		NAD83 Longitude 0		NAD83 Ellipsoidal Height meters		Agency Full Name: David Evans and Associates, Inc.	
Observation Session Times (UTC): Sched. Start _____ Stop _____		Epoch Interval= <u>1</u> Seconds		NAVD88 Orthometric Ht. meters		Operator Full Name: David T. Moehl	
Actual Start <u>17:38</u> Stop <u>23:45</u>		Elevation Mask = <u>10</u> Degrees		GEOID99 Geoid Height meters		Phone #: () (360) 314-3200	
Receiver Brand & Model: Trimble SPS855 69855-60 P/N: S/N: Firmware Version: 5.30		Antenna Code*, Brand & Model: Trimble Zephyr 3 Base 115000-00 P/N: S/N: Cable Length, meters: 10		Antenna plumb before session? <input checked="" type="checkbox"/> (Y/N) Circle Antenna plumb after session? <input checked="" type="checkbox"/> (Y/N) Yes or No Antenna oriented to true North? <input checked="" type="checkbox"/> (Y/N) -If no, Weather observed at antenna ht. (Y/N) explain Antenna ground plane used? (Y/N) explain		e-mail address: dtm@deainc.com	
<input type="checkbox"/> CamCorder Battery, <input checked="" type="checkbox"/> 12V DC, <input type="checkbox"/> 110V AC, <input type="checkbox"/> Other		Vehicle is Parked <u>n/a</u> meters ____ (direction) from antenna.		Antenna radome used? (Y/N) If yes, Eccentric occupation (>0.5 mm)? (Y/N) describe. Any obstructions above 10°? (Y/N) Use Radio interference source nearby (Y/N) Vis. form			
Tripod or Antenna Mount: Check one: <input checked="" type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod, <input type="checkbox"/> Fixed Mount Brand & Model: Seco fixed height P/N: S/N: Last Adjustment date: 2018-03-05		** ANTENNA HEIGHT **		Before Session Begins: Meters Feet		After Session Ends: Meters Feet	
Psychrometer (if used) Brand & Model: P/N: S/N: Last Calibration or check Date:		A= Datum point to Top of Tripod (Tripod Height)		2.000		2.000	
		B= Additional offset to ARP if any (Tribrach/Spacer)		-0.003		-0.003	
		H= Antenna Height = A + B = Datum Point to Antenna Reference Point (ARP)		1.997		6.55	
		Meters = Feet x (0.3048) Height Entered Into Receiver = 2.000 meters.		Note &/or sketch ANY unusual conditions. Be Very Explicit as to where and how Measured!			
Barometer (if used) Brand & Model: S/N:		Weather Data		Weather Codes		Time (UTC)	
		Before		00000		17:38	
		Middle					
		After		00000		23:45	
Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:							
Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.							
Data File Name(s): 00740650.T02 (Standard NGS Format = aaaaddds.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension				Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached		LOG CHECKED BY: Jon Dasler	
Table of		CODE		PROBLEM		VISIBILITY	
Weather		0		did not occur		Good, over 15 miles	
Codes		1		did occur		Fair, 7-15 miles	
		2		- not used -		Poor, under 7 miles	
Examples:		00000 = No problem, good visibility, normal temp, clear, calm wind		12121 = Problems, poor visibility, hot, overcast, moderate wind			

Photo of Monument RAINDEER



Photo of Monument RAINDEER



GNSS Setup on RAINDEER



APPENDIX B-6
EXCERPTS FROM SEDIMENT TRAP FSP
(Integral 2006c)

reviewed. The bottle wash certificate documentation will be archived in the LWG project file. Field personnel will not obstruct these stickers with sample labels.

Sample containers will be clearly labeled at the time of sampling. Labels will include the project name, sample location and number, sampler's initials, analysis to be performed, date, and time. The scheme used for designating field sample identification numbers is described in Section 3.8.

3.5 EQUIPMENT DECONTAMINATION PROCEDURES

The containers for collecting suspended sediment will be glass tubes with one end open. Sample processing equipment will be stainless steel utensils and mixing bowls. Glass tubes will be decontaminated prior to initial deployment and before each successive quarterly re-deployment. Sediment handling equipment that comes in direct contact with the samples will be decontaminated prior to use at each station and between field replicates. The equipment will be decontaminated in the following manner

- Rinse with site water.
- Wash with brush and Liquinox™ or other phosphate-free detergent.
- Double rinse with distilled water.
- Rinse with 0.1 N nitric acid.
- Rinse with deionized water.

Sample handling equipment also will be wrapped in aluminum foil following the methanol rinse.. To minimize the potential for sample contamination, gloves will be replaced or thoroughly washed using Liquinox™ or another phosphate-free detergent and rinsed with distilled water before and after handling each sample, as appropriate. Rinse waters will be diluted with site water and discarded into the river.

3.6 SEDIMENT TRAP DEPLOYMENT AND RECOVERY PROCEDURES

Collecting suspended sediment samples will require four deployment and four recovery operations. The following subsections describe the procedures for performing these operations.

3.6.1 Sediment Trap Design

Figure 3-1 shows schematics of the sediment trap construction and deployment. Each sediment trap will consist of an assembly of four glass tubes, each placed inside a

protective PVC sleeve. The sleeves will be fastened together and will include hardware for mounting and securing on a rebar post driven into the river bottom.

The glass tubes will be approximately 10 cm in diameter and 55 cm long. The tubes will contain a dense salt and sodium azide or formalin preservative if these substances pose no risk to the integrity of sample analyses. Dye may be added to the preservative so visual examination of the recovered trap can determine whether traps have been spilled or flushed.

3.6.2 Sediment Trap Deployment

The sediment traps will be installed and retrieved by commercial divers. The divers will drive a rebar support rod vertically into the sediment bed a sufficient distance to ensure the bar will remain in place. A lead line (line on the bottom) 100 feet long will be tied to the rebar, extended downstream of the rebar, and terminated in an anchor to keep the line taut. The lead line will assist divers in locating the sediment trap locations for re-sampling during the project.

The glass tubes will be decontaminated prior to insertion into the protective PVC sleeves and subsequent deployment of the sediment trap assembly. The sediment trap assembly will be lowered using the vessel's winch. The diver will descend with the trap assembly and control its movement. The diver will affix the trap assembly to the rebar so that the open tops of the cylinders are 3 feet above the mudline elevation. Prior to departing, the diver will inspect the installation for stability and tight connections. In addition, the location of a given sediment trap will be confirmed and recorded in the vessel's navigation computer.

3.6.3 Sediment Trap Recovery

The vessel will occupy the location of a given sediment trap, and one member of the dive team will enter the water. If the diver does not locate the trap immediately, the diver will then move downstream of the location and use a hook or hand to locate the lead line that lies on the bottom downstream of the trap location. The diver will follow the line to the trap.

After locating the sediment trap, the diver will place foil over the top of each glass tube and secure it in place with a rubber band. Sediment traps will be retrieved by loosening the connections that secure the assembly to the rebar and slowly lifting the assembly off the rebar support. The vessel's winch will be used to slowly hoist the trap assembly to the surface and onto the deck. The diver will guide the trap to the surface to keep the trap vertical as much as possible.

APPENDIX B-7
STANDARD OPERATING PROCEDURE
INVESTIGATION-DERIVED WASTE

STANDARD OPERATING PROCEDURE

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Introduction

Investigation derived wastes (IDW) generated during the Pre-Remedial Design Investigations at the Portland Harbor Superfund Site may include:

- Soils/sediments
- Surface water
- Other materials:
 - Personal protective equipment
 - Disposable sampling equipment
 - Spent decontamination liquids
 - Plastic sheeting, containers, etc.

The management of these wastes will be conducted to limit exposure of Site personnel to hazardous materials, and to prevent introduction of contaminated materials to uncontaminated environmental media at the Site (soils, sediment). The following Standard Operating Procedures (SOPs) establish protocols for testing, storage, and disposal of these materials.

Disposal of laboratory test equipment and supplies will be handled in accordance with the laboratory Quality Assurance Project Plan (QAPP).

General

IDW management will follow guidance described in the Office of Solid Waste and Emergency Response (OSWER) document, Guide to Management of Investigation-Derived Wastes (United States Environmental Protection Agency [EPA] 1992). This guidance discusses factors to consider as part of an IDW management program. These factors include protectiveness of human health and the environment, compliance with applicable and relevant or appropriate requirement (ARAR)-based cleanup levels, land disposal restrictions, storage requirements, recordkeeping and manifesting, and handling of non- Resource Conservation and Recovery Act (RCRA) hazardous wastes. The IDW management program described in this section incorporates these factors in the program.

All IDW identified as potentially contaminated with hazardous materials will be stored in a designated and clearly marked IDW management area located at the AECOM Technical Services (AECOM) Field Laboratory. All vessels will also be clearly labeled to indicate the source of the IDW. The IDW storage area will be inspected daily to ensure that storage procedures (as outlined below) are being followed. Any violations of these procedures will be

documented and remedied as quickly as possible. Potentially contaminated IDW will be identified based on its origin, olfactory evidence, and visual evidence. Laboratory testing will be required to determine the proper disposition of these IDW.

Media Specific IDW Management

Sediment/Soils

Waste soils and sediments will be generated as excess sample material. The required testing and handling of this IDW will depend on its origin and characteristics. Olfactory and visual observations will be used to determine if the soils contain potentially elevated levels of hazardous materials. The amount of sediment generated will be minimized to the volume necessary for sampling and analysis, if possible. During field operations, leftover sediment material will be returned to the location it was generated from unless a significant sheen or non-aqueous phase liquid (NAPL) is observed. If significant sheen or NAPL is observed, sediment on the vessel or laboratory processing area will be temporally stored in 5-gallon buckets with lids, then transferred to 55-gallon drums. Each drum will be labeled using a grease pencil or paint pen to indicate the date sealed, location, and contents. Each of the sealed drums will then be staged at a designated solid waste management unit location for later disposal characterization.

Surface Water

Sampling activities may result in the creation of surface water sheens. Sorbent booms will be deployed if significant sheen is encountered on the water surface during coring/grab sampling. A small support boat may be used to manage the boom so the sampling vessel can operate without interruption. AECOM will coordinate with the Office of Spill Prevention Section on additional mitigation measures and agency notifications for releases. Surface water generated during sediment collection will be returned to the lake unless a significant sheen is observed. If a sheen is observed, water will be contained in 55-gallon drums or plastic containers and managed accordingly.

Personal Protective Equipment (PPE)

Investigation-derived PPE consists of gloves, chemically protective clothing, respirator canisters, and other one-time use equipment used during the field investigation. All used PPE will be containerized in plastic garbage bags and disposed of on-site for subsequent transport to the municipal landfill.

Decontamination Fluids

Decontamination fluids will be drummed up in either 55-gallon drums or disposed of in sanitary sewers if no significant sheen is observed. Alconox used on the boat will be discarded overboard if no significant sheen is observed. The decontamination containers will be kept on-site until the water has been analyzed for hazardous materials, at which time the water will be discarded appropriately.

Chemical Liquid Wastes

Chemical liquid wastes will include the spent solvents and acids and other residual chemicals generated during the decontamination process.

Waste acids and solvents will be collected in (dedicated) satellite containers as follows:

- Waste acids (e.g., hydrogen chloride, nitric acid) will be collected in a plastic storage carboy (20-L) SEPARATE FROM WASTE SOLVENTS, labeled with a Class 8 Corrosive Liquid label and containing a tag that indicates acid name, concentration, and volume along with users' initials and date/time.
- Waste solvents (e.g., acetone, methanol, and hexane) will be collected in Type I or II UL-approved galvanized steel disposal can, SEPARATE FROM WASTE ACIDS, labeled with a Class 3 Flammable Liquid label and containing a tag that indicates solvent name, concentration, and volume along with users' initials and date/time.

Solvent Waste (Acetone, Methanol, Hexane)

- Assign a unique identification number to the Type I or II UL-approved steel disposal can (clearly marked on the top and sides).
- Prepare a log for the drum, listing the volume and concentration of each solvent transferred to the drum along with date/time.
- Place a label indicating that the drum contains IDW pending characterization and a Class 3 Flammable Liquid label on the drum.
- Close the drum after each transfer.
- Store the drum in a secure area at the field facility until pickup by an authorized waste handler at the end of the field phase. Drums containing hazardous waste will be removed from the facility within the time mandated for the governing hazardous waste generator status (large quantity generator, small quantity generator, or conditionally except generator).

Other Materials

All plastic sheeting, sampling containers, and other disposable equipment that is free from hazardous materials will be containerized in plastic garbage bags and disposed of on-site for subsequent transport to the municipal landfill. Materials that have visible NAPL will also be drummed and shipped off-site for disposal at an approved facility. Non-disposable or bulky materials may be decontaminated and re-used or disposed as solid waste (see SOP for decontamination). Other disposable materials used on-site (tarps covering non-contaminated soils, caution tape, potable water containers) that have not contacted contaminated media will be disposed as solid waste.

Testing and Disposal

All drummed materials will be tested to determine the proper disposal method. Composite samples will be collected from each drum for analysis. Composite samples will be collected such that reasonable likelihood exists that the entire volume of material in a drum is represented in the sample.

Composite samples will be tested for the parameters identified in the QAPP. Modifications of this analyte list may be made based on specific knowledge of the origin and likely contaminants in the materials.

Soils contaminated above hazardous waste criteria will be shipped to a licensed disposal facility following any further required waste characterization or stabilization.

References

United States Environmental Protection Agency (EPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Solid Waste and Emergency Response. 9345-03FS.

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