PORTLAND HARBOR RI/FS

DRAFT FINAL SEDIMENT CHEMICAL MOBILITY TESTING FIELD SAMPLING PLAN

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Recommended for Inclusion in Administrative Record

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LIST OF ACRONYMS

ARI	Analytical Resources, Inc.
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Regulation and Liability Act
CLP	Contract Laboratory Program
CCC	Continuous Concentration Criteria
CRD	Columbia River Datum
DDI	distilled-deionized
DGPS	differential global positioning system
DOC	dissolved organic carbon
EET	Effluent Elutriate Test
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
HSP	Health and Safety Plan
iAOPC	Initial Area of Potential Concern
iCOC	Initial Chemical of Concern
LWG	Lower Willamette Group
MET	Modified Elutriate Test
NAD83	North American Datum of 1983
NAPL	non-aqueous phase liquid
PCBs	polychlorinated biphenyls
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
SBLT	Sequential Batch Leachate Test
Site	Portland Harbor Superfund Site
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound
TPH	total petroleum hydrocarbons

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1.0 INTRODUCTION

This Sediment Chemical Mobility Testing Field Sampling Plan (FSP) presents the approach and procedures to implement supplemental sediment chemical mobility tests for the Remedial Investigation and Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site; Figure 1-1). Specifically, this information will be used in the FS portion of the project to evaluate chemical mobility under various physical removal and disposal scenarios. This FSP describes the field sampling and laboratory procedures for this testing and is supported by the Sediment Chemical Mobility Quality Assurance Project Plan Addendum (QAPP Addendum 11; Integral 2008, in prep.). The FSP and QAPP Addendum provide the procedures to accomplish the following types of data collection:

- Perform Modified Elutriate Test (MET[1]), Sequential Batch Leachate Test (SBLT) (USACE 2003), and Toxicity Characteristic Leaching Procedure (TCLP) (40 CFR §261.24) chemical mobility tests on sediments from select initial areas of potential concern (iAOPCs) with elevated concentrations of initial chemicals of concern (iCOCs)
- Bulk sediment chemistry to evaluate the sediment quality of the sediment collected to perform the MET, SBLT, and TCLP tests
- Surface water chemistry and conventional water quality parameters on Site waters used in the MET tests

The field study sampling procedures, methods, and analyses for sediment and surface water to be used are described in this document and build upon previous experience collecting sediments and surface waters for the RI/FS as described in the Round 2 FSP (Integral et al. 2004a), Round 2A FSP (Integral 2004), Round 2 QAPP (Integral and Windward 2004) and Round 2 QAPP Addendum 10 (Integral 2007a). Field work will follow the project health and safety plans (HSP; Integral 2004b, 2007b) already established for similar types of sampling.

1.1 BACKGROUND

The Portland Harbor RI/FS began in 2001 and has proceeded through three rounds of data collection including physical conditions; fish, shellfish and invertebrate tissue chemistry; surface and subsurface sediment chemistry; sediment toxicity testing; surface water chemistry; transition zone water chemistry and supporting measurements; and stormwater data among others. Currently, Round 3B sampling is being completed this year and will include final data collection to support the FS. This FSP, as well as a side scan sonar survey, will complete Round 3B sampling.

[1] This test is now named the Effluent Elutriate Test (EET) in the most recent U.S. Army of Corps of Engineers (USACE) guidance on these tests (USACE 2003). However, we continue to use the older term MET for convenience given that more people are familiar with that historical name.

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The U.S. Environmental Protection Agency (EPA) has requested that sediment chemical mobility testing be conducted in sampling Round 3B to support the FS to evaluate the chemical mobility of contaminated material that may potentially be removed from selected iAOPCs. At this time in the RI/FS process, exact locations of potential dredge areas, dredge volumes, and the range of conditions where dredged materials may be disposed are unknown. The MET, SBLT, and TCLP sediment mobility tests provide the most value at the FS stage of the project given that identification of dredge material and disposal options is preliminary at this time. This information will be used directly in the FS evaluation of the feasibility of capping, dredging, containment, and disposal options. The term "chemical mobility" in this document refers to the movement of chemicals in aqueous dissolved and particulate phases as it may occur during sediment remediation and disposal. It does not refer to the movement or transport of bulk sediment chemicals from one location to another under non-remedial scenarios (e.g., erosion of contaminated sediments).

1.2 SEDIMENT CHEMICAL MOBILITY SAMPLING OBJECTIVES

The objectives of the Sediment Chemical Mobility sampling program are to assess the mobility of chemicals in sediments from iAOPCs where iCOC concentrations are relatively high for the Site. At the FS stage of the project, it is reasonable to assume that areas with higher chemical concentrations will be more likely to have physical removal at least as an evaluated option later in the FS. Sampling efforts will target these areas where known sediment chemical concentrations are elevated, and will focus on collecting sediments that would represent a range of chemical concentrations within each selected area. Although areas of higher concentrations are more likely to be subject to removal, disposal, and capping, these technologies will be applied to relatively wide areas and large volumes of sediments. Thus, the sampling should not focus exclusively on just the area represented by a single location of highest concentrations within each iAOPC. In addition, EPA has selected some additional locations that EPA has indicated are overall "representative" of the Site without necessarily being areas of "high" concentrations.

The sampling effort will include collection of sediments that will be subjected to three types of elutriate or leachate production protocols: MET, SBLT, and TCLP tests. These tests are commonly used to understand potential environmental impacts associated with various remediation and disposal technologies for contaminated sediments (USACE 2003). These tests are most commonly performed in design phases of work, but can and have also been conducted for sediment FS reports and other preliminary evaluations. The MET, SBLT, and TCLP test protocols are intended to provide information about leachate or elutriate production and chemical concentrations during various stages of removal and disposal. The MET test is intended to mimic conditions in effluent from a confined disposal facility (CDF) as it is being filled using Site sediments and surface waters. The SBLT test is intended to provide information on the leaching characteristics of chemicals in sediments that can be applied to several types of disposal situations and is also useful in evaluating chemical migration in in-situ capping scenarios. The TCLP test is a standard regulatory procedure for simulating leachate production in an upland landfill. Federal regulations (40

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CFR §261.24) use the results of this test to determine whether a material should be classified as a hazardous waste. To support these tests, analysis of subsurface bulk sediment chemistry and surface water chemistry will also be conducted to understand the chemical levels already present in the materials used in the tests.

Elutriate and leachate data will be used in the FS to:

- Predict effluent chemical concentrations for dredged material from a confined disposal facility (MET elutriate)
- Estimate leaching of sediments in various confined disposal scenarios (SBLT leachate)
- Estimate the range of disposal facility sizes for dredged contaminated sediment such as CDFs (MET elutriate)
- Refine evaluations and costs for the use of disposal facilities (MET and SBLT)
- Refine evaluations and the effectiveness of in-situ caps at the Site (SBLT)
- Evaluate Site sediments for hazardous waste criteria (TCLP).

Bulk sediment data collected will allow an understanding of the relationship between bulk sediment chemical levels and leachate/elutriate chemical levels. In the case of the SBLT, the paired sediment/leachate data allows derivation of site-specific partitioning relationships. Surface water chemistry data collected will be used to understand whether chemicals present in MET elutriates originate from Site surface water, rather than the sediments.

1.3 DOCUMENT ORGANIZATION

The remaining sections of this document describe the sampling plan and field procedures that will be used to collect surface water samples during the Sediment Chemical Mobility sampling. Section 2 describes the sampling location rationale for the MET, SBLT, and TCLP sediment samples. Section 3 describes the project organization and key personnel roles as well as the project schedule. Sections 4 to 6 describes the sampling approaches for MET, SBLT, and TCLP tests, respectively. Section 7 summarizes sample procedures that will be used in the field, including specific sampling methods for collecting surface water. Section 8 summarizes laboratory analysis. Section 9 summarizes field data management. Section 10 summarizes how the data will be reported. References are provided in Section 11.

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2.0 SAMPLING LOCATION RATIONALE

This section describes the sediment sampling locations selected to support the objectives of the Sediment Chemical Mobility FSP investigations. The rationale for selecting the sampling stations is presented in the following subsections, which are organized by sediment chemical mobility test.

2.1 MET AND SBLT

As discussed in Section 1.2, proposed sediment sampling locations for the MET and SBLT tests focus on Site areas with elevated chemical concentrations that are potential physical removal areas. The potential removal areas will be defined in the FS and are not known at this time. However, it is reasonable to assume that physical removal, at least as an evaluated option, will be addressed in the FS for areas with higher chemical concentrations. Table 2-1 summarizes the Site-wide 95th percentile chemical concentrations for the iCOCs identified in the Round 2 Comprehensive Report (Integral et al. 2007) and identifies those iAOPCs where concentrations are above the Site-wide maximum 95th percentile concentration for each iCOC. Table 2-2 further summarizes the iAOPCs that exceed these 95th percentile chemical levels and the chemical class that exceeds these levels in each iAOPC. After EPA review of the initial selected iAOPC locations based on 95th percentile exceedances, EPA eliminated iAOPCs 15 and 17 and added iAOPCs 23 and 24 to the list of selected iAOPCs for MET and SBLT sampling. EPA added iAOPC 23 because it represents a depositional area influenced by stormwater discharges, and iAOPC 24 to characterize an iAOPC influenced by stormwater discharges transporting polychlorinated biphenyl (PCB) and metals contamination to Portland Harbor. The addition of iAOPCs 23 and 24 obviate the need for sampling at iAOPC 15 as required by EPA comments on the draft FSP. In addition, EPA deleted cores in iAOPC 17 because iAOPC 6 was already selected and is representative of a bulk fuel facility iAOPC. The result in Table 2-2 is a selection of 11 iAOPCs (1, 3, 6, 7, 11, 13, 14, 19, and 21, 23, and 24) for the proposed sediment sampling for MET and SBLT testing. Chemical analysis of the sediment will include metals, SVOCs, PCBs (Aroclors and congeners), chlorinated pesticides, total petroleum hydrocarbons (TPH), sulfide, ammonia, and conventionals (see Section 8). Sediment from specific iAOPCs will be tested for dioxins/furans and cyanide. The suite of chemicals for each chemical class will be consistent with the analyte list used in the Round 2 report.

From each of the above selected iAOPCs, four sediment cores will be collected that will be representative of material that might be removed from the entire iAOPC based on Round 2 sediment data. The material from the four cores will be composited, and chemical analysis of the sediment will include all iAOPC-specific chemicals. Table 2-3 summarizes sample numbers, types, and target analyte groups.

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2.1.1 MET and SBLT Sample Locations

The four core locations within each iAOPC were selected based on a focused evaluation of iAOPC-specific iCOCs, such that a representative range of iCOC concentrations within a given iAOPC would be sampled. iCOC maximum, minimum, and mean concentrations were evaluated to obtain core locations distributed spatially across chemical gradients in each iAOPC. Typically, one to two of the cores are located adjacent to or between previously sampled stations where data indicate that at least one (or more) iCOCs exceeded the Site-wide maximum 95th percentile concentration. Generally, cores adjacent to previous samples that exceeded a Site-wide maximum 95th percentile concentration represent sediment with elevated iCOC concentrations for several chemicals. Placing one or two cores in these areas is consistent with the idea that dredging is more likely to occur in areas of higher chemical concentrations. However, at many iAOPCs, areas of highest concentrations do not overlap for every iCOC.

The remaining cores in each set of four focus on areas where sediment iCOC concentrations are overall average or lower as compared to the areas of highest iCOC concentrations. This approach is consistent with the idea that dredging will not be isolated to a very small area around one or two maximum concentration samples. Thus, collectively the four cores were placed in locations that in aggregate characterize a range of iCOC concentrations within a given iAOPC. In addition, EPA moved core locations originally identified through the above approach at iAOPC 6 and added cores at iAOPCs 23 and 24 to be consistent with the EPA's stated rationale of providing more Site-wide representative sampling locations. Based on this same rationale, EPA moved locations within iAOPCs 7, 11, and 14; these changes are still consistent with the above approach. Figure 2-1 summarizes select Round 2 data for previously sampled locations near and around the proposed MET/SBLT core locations to illustrate core locations with respect to multiple chemical concentration distributions within each iAOPC.

2.2 TCLP

An EPA promulgated screening calculation was used to assess the locations for TCLP testing. The calculation assumes that the entire bulk sediment concentration would leach into the test water during the TCLP test and is performed by dividing the sediment concentration by a factor of 20 to obtain the theoretical maximum leachable concentration in mg/L. If the calculated water concentrations are below the TCLP criteria, an exceedance during an actual TCLP test is impossible. The screening calculation was performed using the maximum sediment chemical concentrations from the Site to determine if the calculated water concentrations would be greater than the TCLP regulatory criteria. The results of the initial screening calculation were further screened at five times the TCLP criteria level. The five times level was selected as a reasonable conservative measure of sediments that have a substantial potential to leach contaminants at concentrations greater than the TCLP limits in an actual TCLP test. The calculated water concentrations for Site sediments exceeded the TCLP regulatory criteria by a factor of 5 at several locations as summarized in Table 2-4. The screening calculation and resulting iAOPC selection for TCLP sampling is

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also summarized in Table 2-4. Table 2-3 summarizes sample numbers, types, and target analyses. Figure 2-2 shows the locations of the proposed TCLP cores within the selected iAOPCs.

2.2.1 TCLP Sample Locations

Because there will likely be some ability to segregate materials into hazardous and non-hazardous dredge management units within individual iAOPCs, the TCLP cores focus on zones of maximum chemical levels within each of the iAOPCs identified in Table 2-4. TCLP sediment sampling locations will target previous sample locations from Round 2 where maximum chemical concentrations for TCLP analytes were measured; the specific areas are located within iAOPCs 1, 7, 11, 14, 15, 18, 19, and 23. Note that this approach maximizes the chances of finding any potential hazardous waste level materials, and if any locations exceed actual TCLP test criteria, further work will be needed in the design phase to delineate areas and volumes of hazardous vs. non-hazardous materials within these iAOPCs.

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3.0 PROJECT ORGANIZATION

This section presents the organizational structure for sampling and analysis activities associated with the Sediment Chemical Mobility investigation, including fieldwork, laboratory analyses, and data management.

3.1 TEAM ORGANIZATION AND RESPONSIBILITIES

The FSP will be implemented by both Anchor Environmental, L.L.C (Anchor) and Integral. Anchor will contract the analytical laboratories, providing the Statement of Work (SOW) and the initial coordination with the laboratories through the completion of the MET, SBLT, and TCLP tests. Sample analyses, data validation, and data reporting will be managed by Integral. In addition, Integral will lead, staff, and schedule the fieldwork effort, subcontract necessary coring contractors, and support Anchor with subsequent reporting. Anchor will provide a representative in the field and will also be responsible for subsequent reporting.

The Sediment Chemical Mobility sampling and analysis activities will be performed by contractors retained by the Lower Willamette Group (LWG). The qualifications of this team are presented in the RI/FS Work Plan (Integral et al. 2004c). The organizational structure of the lead sampling and analysis personnel and associated laboratories is described below. Additional information on project organization, coordination, and communication between EPA, the LWG, and the consultant team is provided in the RI/FS Work Plan.

3.1.1 CERCLA Project Coordinator

Gene Revelas (Integral) will be the Comprehensive Environmental Regulation and Liability Act (CERCLA) Project Coordinator, responsible for managing the Portland Harbor. In this role, he will oversee the RI technical work, participate in agency negotiations, and coordinate RI activities with the LWG consultant team and other technical consultants. Mr. Revelas will work closely with the Sampling and Analysis Coordinator (SAC) to ensure that the objectives of the Sediment Chemical Mobility field investigation are achieved. In the event that changes in the FSP are needed, he will discuss proposed changes with EPA's Project Manager or other designated EPA staff. Changes to the FSP will not be made without prior approval from the EPA Project Manager unless conditions in the field or laboratory require immediate response.

3.1.2 Sampling and Analysis Coordinator

Nick Varnum (Integral) will be the SAC, responsible for all facets of the sampling and analysis programs. He will report directly to the CERCLA Project Coordinator. His specific responsibilities include the following:

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- Coordinate the field and laboratory analyses
- Ensure that laboratory capacity is sufficient to undertake the required analyses in a timely manner
- Ensure adherence to the schedule by tracking sampling, laboratory analysis, validation, and data management tasks
- Provide solutions to problems if they occur
- Inform the CERCLA Project Coordinator of any decisions that involve changes to the FSP and QAPP.

3.1.3 Field Coordinator

Joss Moore (Integral) will be the Field Coordinator and will be responsible for overall coordination of all the field sampling tasks. Specifically, he will be responsible for the following:

- Oversee the planning and coordination for all sampling efforts
- Oversee all aspects of the sampling to ensure that the appropriate procedures and methods are used
- Oversee the establishment and operation of the field laboratory and equipment facility near the study site

He will work closely with the SAC and will be immediately notified if problems occur in the field. If changes to the FSP or QAPP are warranted, he will immediately notify the SAC.

Due to the complexity of the Sediment Chemical Mobility sampling program, the Field Coordinator will be assisted in his role by a field task leader. Ross Pickering (Anchor) will be primarily responsible for understanding and tracking the details of the subsurface sampling program and updating Mr. Moore, as needed, on the program's progress and any problems encountered.

3.1.4 Field Crews

Field staff for all sampling events will be drawn by Integral from the LWG common consultant team. The operators of sampling vessels and equipment, as appropriate, will supply additional staff. A qualified scientist will be on board the sampling vessel to determine proper sampling station location. Station positioning will generally be the responsibility of the vessel operator. In the event the vessel operator does not have this capability or cannot meet the positioning requirements of the project, a qualified subcontractor will provide station-positioning services. For all sampling tasks, the field crew will include the following individuals: site safety officer, field task leader, and field crew.

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The site safety officer will have the following responsibilities:

- Correct any work practices or conditions that may result in personnel injury or exposure to hazardous materials
- Determine appropriate personal protection levels and necessary clothing and equipment, and oversee its proper use
- Verify that the field crew is aware of the provisions of the health and safety plan and instructed in safe work practices
- Verify that the field crew has received the required safety training.

The field task leader will have the following responsibilities:

- Ensure that all activities adhere to the FSP and QAPP
- Inform the field coordinator of any decisions that involve changes to the FSP and QAPP
- Mobilize and prepare for field work
- Ensure sample custody, including chain-of-custody.

Various field staff from the consultant team will assist in sample collection, handling, and storage. They may maintain the field sampling logs and notebooks and will be responsible for properly labeling sample containers.

3.1.4.1 Key Field Personnel for Subsurface Sampling

In addition to the general project roles described above, geologists from Integral will provide technical expertise and project oversight to ensure continuity with previous Portland Harbor RI/FS sampling rounds in the subsurface sampling program. Joss Moore will oversee the core sampling program and will directly coordinate all core processing and core sample identification. Other qualified Integral scientists will work on this project, and their efforts will be directed by these key project personnel. .

Both Nick Varnum and Joss Moore have extensive experience in vibracore collection in the Pacific Northwest and both understand the Sediment Chemical Mobility sediment sampling program rationale. They will coordinate any modifications to the field sampling program, if needed, and any significant changes to target locations or core lengths will be coordinated with EPA before implementation.

Nick Varnum and Joss Moore are also both experienced in visual sediment core description, core logging, and sediment field screening techniques. During the first few days of the coring program, they will work together to ensure that a consistent approach to core section identification and subsampling is implemented (see Section 7.5.1 for details). They will also train other qualified staff on the core description and sampling approach. They will coordinate the core processing for the duration of the coring program.

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3.1.5 Quality Assurance Managers

Quality assurance managers have been assigned for all aspects of Sediment Chemical Mobility sampling and analysis. All quality assurance managers for Sediment Chemical Mobility will report to the SAC.

3.1.5.1 Field QA Manager

Nick Varnum (Integral), the SAC, will also serve as the QA manager for all Sediment Chemical Mobility field sampling activities. She will oversee all aspects of the sampling events to ensure that the appropriate procedures and methods are used.

3.1.5.2 Chemistry QA Manager

Maja Tritt (Integral) will be the QA manager for analytical chemistry. She will perform laboratory oversight for the analytical laboratories and will direct the quality assurance review of chemical data. Maja Tritt will coordinate with the analytical laboratories for chemical analysis of the bulk sediment, site water, and the MET, SBLT, and TCLP elutriate/leachate samples. Ross Pickering (Anchor) will coordinate directly with the analytical laboratories before and during MET, SBLT, and TCLP testing and until the elutriate/leachate samples are produced and ready for chemical analysis.

3.1.6 Data Management

Tom Schulz (Integral) will have primary responsibility for data management. Integral will continue to utilize the EQuIS database as the primary repository of environmental data. Mr. Schulz has extensive experience with this database and is familiar with its structure and operation. Prior to the initiation of fieldwork, he will work with the laboratories to ensure that data are delivered in the correct format for entry into the EQuIS database. Use of this system will also ensure the easy transfer of data in the required format to EPA.

3.1.7 Laboratory Services

Analytical Resources, Incorporated (ARI) of Tukwila, Washington, will analyze all sediment chemistry samples, site water chemistry samples, MET and SBLT elutriate/leachate samples, and TCLP leachate samples except for PCB congeners and dioxin/furan analyses. Sue Dunnihoo will be the ARI project manager. Vista Analytical Laboratory (Vista) of El Dorado Hills, California, will perform analyses of PCB congeners and dioxins/furans in all sediment, water, and elutriate/leachate samples. Martha Maier will be the Vista project manager.

3.2 COMMUNICATION/INFORMATION FLOW

During field operations, the field staff will report to the field task leader (Ross Pickering for subsurface sediment) for their sampling event. The field task leaders will report to the Field Coordinator (Joss Moore). The chemical laboratories will report to the Chemistry QA

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Manager (Maja Tritt). The Field Coordinator (Joss Moore), laboratory oversight personnel (Maja Tritt), and data manager (Tom Schulz) will report to the SAC (Nick Varnum). Issues requiring the attention of the LWG or EPA will be discussed with the CERCLA Project Coordinator (Gene Revelas), who will communicate the issues to the LWG.

To the extent possible, official communications between EPA and the LWG will occur through their respective project managers.

Field change request forms (Appendix D) will be completed for any change to the FSP or QAPP; EPA approval will be required for all changes. Any field staff or manager may request changes. The change request form should be submitted to the SAC. If the SAC approves the change, he will submit the form to the CERCLA Project Coordinator. The CERCLA Project Coordinator may notify the LWG and will submit the forms to the EPA Project Manager for approval. If circumstances require immediate action, verbal authorization may be obtained and the change may be implemented, but a field change request form must still be completed and submitted as soon as possible to document the change and ensure that all managers are informed.

3.3 COORDINATION WITH EPA

3.3.1 Field Sampling Notification

The CERCLA Project Coordinator will notify the EPA Project Managers at least one week prior to beginning field activities so that EPA can schedule any necessary oversight tasks. EPA's Project Manager will contact the CERCLA Project Coordinator to coordinate these activities and determine appropriate logistics. The CERCLA Project Coordinator will notify EPA, in writing, when field activities are completed.

3.3.2 Lab Audits and Split Samples

Both laboratories that will be used for the mobility study have participated in previous Portland Harbor RI work and no additional routine audits will be conducted. ARI was audited previously in connection with work completed for Round 1 of the Portland Harbor RI/FS. Vista Analytical Laboratory (Vista; formerly known as Alta Analytical Laboratory) analyzed PCB congeners in Round 2 and Round 3 sediment and the quality of its data was very good. The laboratories will only be audited if significant problems are encountered. Anchor may observe ARI during performance of their specific procedures for the MET and SBLT extractions.

In the event that EPA or its designated representative wishes to accompany the LWG project team during a laboratory audit or observation, the EPA Project Manager should make this request to the CERCLA Project Coordinator. Following this initial contact, the appropriate QA managers for the LWG project team should interact directly with their counterparts at EPA.

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If adequate sample volume is available, split and/or verification samples for chemical testing can be provided to EPA or its designated representative (details on the QC samples planned for this sampling program are provided in Section 7.8). EPA's Project Manager should contact the CERCLA Project Coordinator at least three days in advance to coordinate this activity and determine appropriate logistics.

3.4 PROJECT SCHEDULE

Actual start dates for the Sediment Chemical Mobility sampling will be determined following EPA approval of the Sediment Chemical Mobility Testing FSP. Other conditions that may affect the sampling schedule are weather, river flows and stages, and equipment conditions and availability. Currently, it is anticipated that the Sediment Chemical Mobility Testing field investigations will begin in the summer of 2008. Reporting of Sediment Chemical Mobility sediment sampling results is discussed in Section 10.2.

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4.0 MODIFIED ELUTRIATE TEST (MET)

The MET (or more recently Effluent Elutriate Test; EET) is intended to estimate potential chemical concentrations in CDF or temporary dewatering facility effluents discharged during construction. The MET, along with several models available from the U.S. Army Corps of Engineers (USACE), can be used to assess the sizing and filling requirements for such facilities. The MET will be completed in accordance with the procedure developed by the USACE, as described in Appendix B of the Upland Testing Manual (USACE 2003).

As described in Section 2, target subsurface sample locations will be located within iAOPCs 1, 3, 6, 7, 11, 13, 14, 19, 21, 23, and 24. Target subsurface sediment core locations are shown in Figure 2-1.

4.1 BULK SEDIMENT SAMPLING AND COMPOSITING

Four locations within each iAOPC will be sampled using a vibracore as shown in Figure 2-1. For each iAOPC, the four cores will be composited into one sample for submittal to the laboratory for bulk sediment analyses and MET testing, for a total of 11 samples. Sediment chemistry sample location coordinates and the compositing scheme is shown in Table 4-1. The analyte groups for each sediment sample are listed in 4-2 and the complete list of analytes and proposed method detection and method reporting limits are shown in Table 4-3. These same analyte groups will be analyzed in the elutriate produced from the MET test, as well as the surface water used in the MET test as shown in Tables 4-4 and 4-5.

Sediment compositing of the four cores from each iAOPC will be performed such that a homogenized sample representative of the four individual core lengths is achieved. Approximately equal subsamples will be obtained from each linear foot of the core over the entire length of the core. For example, if the core is 14 feet long, approximately equal subsamples will be obtained from each of the 14 1-foot segments, and placed in a bowl and thoroughly homogenized. The contents of the four bowls containing sediments from the four cores will be combined into one bowl in contributions that are proportional to the volume obtained from each core. Thus, longer cores will represent a greater proportion of combined sample. For example, if cores of 14 feet, 11 feet, 13 feet, and 12 feet are obtained, the subsamples will be combined into the final composite sample as follows:

- 14-foot core –28 percent (i.e., 14 divided by the sum of core lengths, or 50 feet)
- 11-foot core – 22 percent
- 13-foot core – 26 percent
- 12-foot core – 24 percent

This subsample method will be implemented using a known volume (e.g., two 16-oz glass jars) to obtain sediment from each foot of each core. Using the above example, 28 16-oz

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containers would be collected from the first core and placed into the composite bowl, 22 16-oz containers from the next core, and so on. When all of the desired material is placed into the compositing container, the material will be homogenized with a stainless steel paddle attached to a variable speed drill or stainless steel spoon until uniform in color and texture, then placed into the appropriate sample jars, as identified in Section 6, and stored/preserved. In order to satisfy the volume requirements for bulk sediment analyses and the MET test, the composite must consist of approximately 15 liters of sediment. The homogenate will be mixed throughout the process of filling sample jars to ensure that each sample jar is representative of the homogenate mixture. Because the compositing and homogenizing process may release volatile organics, the sediment subsamples for total sulfides analyses (required for iAOPCs 11 and 14, see Table 4-2) will be taken from each linear foot of each core prior to removal of other sediments for homogenization and composited into a single sample container (i.e., one sulfides sample container submitted for analysis per four cores). (Note that no other volatiles or volatile organic compounds (VOCs) are present in the analyte list for any iAOPC.) Immediately after the first core is collected and cut open, approximately 1 gram of sediment will be collected from each 1-foot interval and placed in the appropriate sample container. This sample will be preserved with a pre-measured volume of zinc acetate in the field. Sediment subsampled from the remaining three cores will be sampled after the core is cut open, prior to homogenization, and placed in the same sample container until all four cores have been subsampled and are preserved in one sample container.

The ARI Sample Processing Standard Operating Procedure (ARI SOP 1128) is presented in Appendix A. The bulk sediment composite sample will be thoroughly homogenized prior to conducting the MET test according to the procedures in Appendix A.

4.2 SITE WATER COLLECTION

Site water will be collected from within each iAOPC to be used in the MET analysis. Approximately 12 gallons of river water will be collected from the water column from each iAOPC. This volume will be sufficient to supply both the MET test and analysis of the river water itself. The river water will be collected from approximately mid-depth in the water column using a peristaltic pump as described in Section 7.5.2. Given that surface water is generally well mixed, a specific transect or pattern of movement will not be defined for each iAOPC. However, the general intent is to collect water from across the area of the iAOPC that is generally representative of water in the vicinity of the iAOPC.

4.3 LABORATORY ANALYSIS

ARI in Tukwila, Washington, will perform the MET, as well as the analysis of the bulk sediment composite, Site water, and elutriate water for all analytes except for PCB Congeners and dioxins/furans, which will be conducted by Vista.

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Sample Chemical Analyses. Samples will be subject to the chemical analyses shown in Tables 4-2 and 4-3 for bulk sediments and Tables 4-4 and 4-5 for elutriate/leachate waters and Site surface waters. Site water samples will be field filtered for dissolved organic carbon (DOC) only and metals analysis will be performed on a total basis as shown in Table 4-4. As noted in Tables 4-3 and 4-5, ARI will not be able to meet the project detection limits and/or reporting limits for some cases, although the ARI limits are generally close to the project limits. In the case of elutriate water, Table 4-5 also shows where those limits may be higher than potential water quality criteria that may be used as benchmarks in the FS evaluation of the dredge alternatives. However, in some cases the project limits are also above these same potential benchmarks. Consequently, it does not appear that ARI's inability to meet these limits will demonstrably limit the use of MET test results in the FS evaluations. ARI is the preferred laboratory because they have greater familiarity and experience with running the MET (and SBLT) test. (It should be noted that MET detection and reporting limits should be compared to freshwater continuous concentration criteria [CCC], but not the human health consumption based criteria, because effluent discharges do not represent a long-term impact relevant to the bioaccumulation pathway.)

Modified Elutriate Test. The MET will be completed in general accordance with the procedure developed by the USACE Waterways Experiment Station, as described in Appendix B of the Upland Testing Manual (USACE 2003). A water-to-sediment ratio of 4-to-1 will be used to prepare the MET slurry as recommended in the MET test procedure. Excess sediment from the MET composite will be archived for future analysis if needed.

Elutriate samples extracted from the MET test will be divided and both total and dissolved fractions all constituents in the MET elutriate samples will be analyzed. This will allow for the calculation of the fraction of analytes in the total suspended solids and the process of filtration to obtain subsamples for analysis of dissolved concentrations. Metals will be analyzed in samples that have been passed through a 0.45 micron filter. To avoid the effects of adsorption onto the filter surface, dissolved organics will be analyzed in unfiltered samples that are instead prepared by centrifugation, consistent with recommended MET test procedures. The description of test protocols in the USACE (2003) guidance will be followed by ARI except as noted in ARI established MET procedures as described in ARI SOP 1110 (see Appendix A).

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5.0 SEQUENTIAL BATCH LEACHATE TEST (SBLT)

The SBLT test helps to estimate groundwater leachate concentrations and characteristics from CDFs and is typically recommended for use on freshwater sediments. The SBLT is a test that relies less closely on disposal Site specific conditions and can establish a general desorption isotherm that is potentially applicable in a wide range of situations, including a variety of confined disposal options, as well as in-situ capping of sediments. SBLT tests may provide additional site-specific information to refine evaluations of both disposal facilities and in-situ caps for the project. One caution per the guidance (USACE 2003) is that sediments with high levels of product such as non-aqueous phase liquid (NAPL) may result in potentially inapplicable results using the SBLT. Thus, SBLT results from any such samples would need to be evaluated carefully. However, given the screening nature of these tests and that many Portland Harbor sites do not fall into this category, this appears to be a reasonable level of uncertainty for use of the leachate results.

The SBLT will be completed in accordance with the procedure developed by the USACE Waterways Experiment Station, as described in Appendix D of the Upland Testing Manual (USACE 2003).

5.1 SEDIMENT SAMPLING APPROACH

Subsurface sample locations described for the SBLT (and MET) are described in Section 2. The same composited and homogenized sediment from each iAOPC will be used for both the MET and SBLT tests and these procedures are described in Section 4. In order to satisfy the volume requirements for the SBLT test, the composite must consist of approximately 8 liters of sediment.

5.2 CHALLENGE WATER

The SBLT involves “challenging” the sediment sample with water to produce a leachate sample for testing. Per the guidance in USACE (2003), the appropriate challenge water is deoxygenated, distilled-deionized (DDI) water. Therefore, laboratory supplied DDI water will be the challenge water used in the SBLT.

5.3 LABORATORY ANALYSIS

The SBLT will be completed in general accordance with the procedure developed by the USACE Waterways Experiment Station, as described in Appendix D of the Upland Testing Manual (USACE 2003). A water-to-sediment ratio of 4-to-1 will be used to prepare the SBLT slurry as recommended in the SBLT test procedure. The sediment-water mixture will then be tumbled for a 24-hour period to ensure intimate contact and encourage chemical equilibrium between sediment and water phases.

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The leachate is drawn off and processed to recover dissolved and colloidal constituents. Each sample will be centrifuged before filtering. In accordance with the USACE protocol, metals are filtered through a 0.45-micron filter. To avoid adsorption onto the filter surface, organics are pre-filtered at 4 microns then filtered through a 1-micron glass fiber filter. After the leachate is extracted, the same sediment will be subjected to another cycle of leaching with new DDI supply water. A total of four consecutive leaching cycles will be performed to generate four leachate samples per SBLT test. The description of test protocols in the USACE (2003) guidance will be followed by ARI except as noted in the ARI established SBLT procedures, which are described in ARI SOP 1125 (see Appendix B).

ARI and Vista (for PCB Congeners and dioxin/furans) will perform chemical analyses on SBLT leachate as shown in Tables 4-4 and 4-5. Table 4-5 summarizes the specific analytes, methods, reporting limits, and detection limits. This table also compares the project target detection limits to those achievable by ARI, as well as how those levels compare to potential water quality benchmarks that may be of interest for the eventual FS evaluations of remedy alternatives. As noted for the MET, ARI cannot meet some of the project method and reporting limits. In some cases, these limits are greater than potential water quality benchmarks. However, many of the project limits are also above these same benchmarks. Consequently, ARI's inability to meet the limits for these analyses is not expected to demonstrably impact the FS evaluation, and using ARI as the project laboratory is preferred given their experience with conducting the SBLT test.

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6.0 TOXICITY CHARACTERISITC LEACHING PROCEDURE (TCLP)

The TCLP is a standardized simple leaching procedure that is promulgated in federal regulation to determine whether a material is a "hazardous waste" based on toxicity and is designed to approximately simulate contaminant mobility in landfill conditions. Hazardous wastes generally have to be disposed of in Subtitle C landfills, which have more robust groundwater leachate controls resulting in higher disposal costs.

The TCLP will be completed in accordance with the procedure developed by EPA, as described in EPA Publication SW-846 Test Methods for Evaluating Solid Wastes (EPA 1992).

6.1 SEDIMENT SAMPLING APPROACH

One core will be collected using a vibracore at each location shown in Figure 2-2 and composited into one sample per location for submittal to the laboratory for bulk sediment analyses and TCLP testing, for a total of 11 samples. Subsurface sediment chemistry sample locations and analyses are listed in Table 6-1.

Sediment compositing across intervals in the single core from each iAOPC will be performed such that a homogenized sample representative of the entire length of that core is achieved. Approximately equal subsamples will be obtained from each linear foot of core over the entire length of the core. For example, if the core is 14 feet long, 14 approximately equal subsamples will be obtained from each of the 1-foot segments and placed in a bowl and thoroughly homogenized. Because the compositing and homogenizing process may release volatile organics, the sediment subsamples for VOC analyses will be taken from each linear foot of each core prior to removal of other sediments for homogenization. Approximately 4 grams of sediment will be subsampled from each linear foot prior to homogenization and composited into two VOC sample containers such that 2 grams of sediment per 1-foot interval is placed into each of the two VOC sample containers (i.e., two 1.5-oz VOC sample containers submitted for analyses per core). Containers for VOC samples will be completely filled so that no airspace remains.

This subsample method will be implemented using a known volume (e.g., one 8-oz glass jar) to obtain sediment from each foot of the core. When all of the desired material is placed into the compositing container, the material will be homogenized with a stainless steel paddle attached to a variable speed drill or stainless steel spoon until uniform in color and texture, then placed into the appropriate sample jars and stored/preserved as described in Section 7. In order to satisfy the volume requirements for bulk sediment analyses and the TCLP test, the composite must consist of approximately 2 liters of sediment. Additionally, a separate non-homogenized sample of 0.09 liters (two 1.5-oz jars) will be collected for TCLP VOC analyses, as described above.

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6.2 LABORATORY ANALYSIS

The TCLP will be completed in general accordance with the procedure EPA Method 1311 (EPA 1992). The ARI SOP (ARI SOP 1311) for TCLP extraction is presented in Appendix C. In addition, ARI will analyze the bulk sediments per standard EPA methods. The specific analytes, methods, reporting limits, and detection limits for bulk sediments and leachate waters will be consistent with EPA 40 CFR §261.24, as shown in Tables 6-2 and 6-3.

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7.0 SAMPLE COLLECTION PROCEDURES

The following sections describe the detailed procedures and methods that will be used during Sediment Chemical Mobility sampling. This includes sampling procedures for sediment and surface water samples; record keeping; sample handling, storage, and shipping; and field quality control procedures.

7.1 STATION POSITIONING AND VERTICAL CONTROL

Latitude and longitude coordinates will be obtained using a differential global positioning system (DGPS). The standard projection method to be used during field activities is Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System, Oregon North Zone. The positioning objective is to accurately determine and record the positions of all sampling locations to within +2 meters.

Station positioning from the sampling vessel will be accomplished using a DGPS, which consists of a GPS receiver on the sampling platform and a differential receiver located at a horizontal control point. At the control point, the GPS-derived position is compared with the known horizontal location, offsets or biases are calculated, and the correction factors are telemetered to the GPS receiver located on the sampling platform. Positioning accuracies on the order of +1 to 3 meters can be achieved by avoiding the few minutes per day when the satellites are not providing the same level of signal. The GPS system provides the operator with a listing of the time intervals during the day when accuracies are decreased. Avoidance of these time intervals permits the operator to maintain better positioning accuracy. The GPS receiver routes latitude and longitude to an integrated navigation system, which displays the platform's position in plan view. Navigation data, such as range and bearing from the target sampling location, are provided at a user-defined scale to guide the sampling platform's pilot to the desired location.

Vertical positioning is required to establish the elevation of the riverbed at the sampling locations. While the sampling device is in place at the sampling station, depth to mudline will be measured using a lead line or fathometer immediately prior to or during the sampling. Vertical measurements will be recorded to the nearest 0.1 foot. Water depths will be converted to elevations [feet Columbia River Datum (CRD)] based on the river stage at the time of sampling as recorded at the Morrison Street Bridge.

During sediment sampling, subsurface obstructions or low river stage may preclude collecting a sample at the planned location. Attempts will be made to relocate the sample to an area that has comparable sediment characteristics and rationale objectives for the initial location. The EPA Project Manager will be contacted, if available, regarding the proposed revised sampling location. If the EPA Project Manager is not available for immediate approval of the change, then the station will be relocated, sampled, and appropriately documented.

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7.2 FIELD LOGBOOK AND FORMS

All field activities and observations will be noted in a field logbook during fieldwork. The field logbook will be a bound document containing individual field and sample log forms. Information will include personnel, date, time, station designation, sampler, types of samples collected, and general observations. Any changes that occur at the Site (e.g., personnel, responsibilities, and deviations from the Work Plan or FSP) and the reasons for these changes will be documented in the field logbook.

Logbook entries will be clearly written with enough detail so that participants can reconstruct events later if necessary. Requirements for logbook entries will include the following:

- Logbooks will be bound, with consecutively numbered pages
- Removal of any pages, even if illegible, will be prohibited
- Entries will be made legibly with black (or dark) waterproof ink
- Unbiased, accurate language will be used
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself)
- Each consecutive day's first entry will be made on a new, blank page
- The date and time, based on a 24-hour clock (e.g., 0900 for 9 a.m. and 2100 for 9 p.m.), will appear on each page
- When field activity is complete, the logbook will be entered into the Portland Harbor project file

In addition to the preceding requirements, the person recording the information must initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who makes the last entry. The field team and task leader, after reading the day’s entries, also must sign and date the last page of each daily entry in the field logbook.

Logbook corrections will be made by drawing a single line through the original entry allowing the original entry to be legible. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation.

The type of information that may be included in the field logbook and/or field data forms includes the following:

- Names of all field staff
- Sampling vessel

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- A record of Site health and safety meetings, updates, and related monitoring
- Station name and location
- Date and collection time of each sample
- Observations made during sample collection, including weather conditions, complications, and other details associated with the sampling effort
- Sample description
- Depth of mudline below water surface
- River stage at the Morrison Street Bridge immediately prior to sampling
- Any deviation from the FSP

A sample collection checklist will be produced prior to sampling and completed following sampling operations at each station. The checklist will include station designations, types of samples to be collected (e.g., one jar for metals), and whether blind field replicates or additional sample volumes for laboratory quality control (QC) analyses are to be collected.

Field data sheets and sample description forms will be completed for all samples and kept in the project file. Information such as habitat descriptions, sediment, water, and biota sampling data will be noted on the field data sheets. Depending on the activity, the type of field data sheet and the information recorded on it may vary. Examples of the types of forms that may be used are provided in Appendix D.

The field task leader is responsible for ensuring that the field logbook and all field data forms are correct.

7.3 EQUIPMENT AND SUPPLIES

Equipment and supplies will include sampling equipment, utensils, decontamination supplies, sample containers, coolers, logbooks and forms, personal protection equipment, and personal gear. Protective wear (e.g., hard hats, gloves), as required for health and safety of field personnel, will be as specified in the HSP (Integral 2004b, 2007b). Equipment checklists for sediment and surface water sampling are included in Appendix E and F, respectively.

Sample containers and preservatives, as well as coolers and packing material, will be supplied by the analytical laboratory. Commercially available pre-cleaned jars will be used, and the laboratory will maintain a record of certification from the suppliers. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier, and bottle wash analysis results can be

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reviewed. The bottle wash certificate documentation will be archived in the Integral 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 nomenclature used for designating field samples is described in Section 9.4.

7.4 EQUIPMENT DECONTAMINATION PROCEDURES

7.4.1 Subsurface Sediment

Sediment handling equipment that comes in direct contact with the sample, such as scoops, spoons, and mixing bowls, will be decontaminated in the following manner prior to use at each station:

- Rinse with Site water
- Wash with brush and Alconox™ or other phosphate-free detergent
- Double rinse with distilled water
- Rinse with 0.1 N nitric acid
- Rinse with deionized water
- Rinse with methanol or ethanol (omit for TCLP, where sampling for volatiles)

If a residual creosote or petroleum sheen remains on the sampling equipment or is difficult to remove using the standard decontamination procedures above, a final hexane rinse may be added.

Decontamination of stainless-steel bowls and utensils will be performed before sampling and in between each composite sample. Sample handling equipment also will be wrapped in aluminum foil following the methanol rinse. Before being used to remove sediment from the samplers, all equipment will be rinsed with deionized water. To minimize sample contamination, gloves will be replaced or thoroughly washed using Alconox™ or other 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. Waste solvent rinses will be held in sealed plastic buckets and disposed of into the sanitary sewer.

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7.4.2 Surface Water

Decontamination of the peristaltic pump will be done according to the Surface Water Sampling SOP in Appendix F.

7.5 SAMPLE COLLECTION AND PROCESSING PROCEDURES

7.5.1 Subsurface Sediment

Core samples will be collected from the locations shown in Figures 2-1 and 2-2 (target coordinates listed in Tables 4-1 and 6-1) using a vibracorer equipped with 14-foot core tubes. The vibracorer offers a high rate of production, superior retention of shallow samples, and a greater sample volume compared to conventional drilling equipment. It also provides greater penetration capabilities than piston-type or conventional gravity corers when encountering compact subsurface sediments. Specific core collection, core processing, and sample handling methods are described in this section. SOPs for collection of subsurface sediment are presented in Appendix E.

7.5.1.1 Collection

Subsurface sediment will be collected using a customized vibracorer deployed from the sampling vessel. A typical vibracorer uses a hydraulic system that vibrates and drives a 4-inch outside diameter aluminum core tube into the sediment. A continuous sediment sample is retained within the tubing with the aid of a stainless-steel core cutter/catcher attached to the bottom of each aluminum tube.

Following positioning to a given sampling station, as described in Section 6.1, the vibracorer will be deployed off the fore deck of the vessel and slowly lowered to the sediment surface. Vibracoring will continue for a length of time necessary to obtain adequate core penetration (sample depth). The core penetration depth will be estimated by means of a transducer attached to the top of the vibracorer rack and will be recorded for each station on the core log sheet.

After collection of the core sample, the vibracorer will be slowly raised to the deck of the research vessel. Before removing the aluminum core tube from the vibracorer, the core cutter/catcher will be visually inspected to ensure that proper penetration was attained and that there was no obvious loss of sediment from the tube. Any presence of noticeable odors or sheen at the end of the tube or in the water will also be noted.

The core penetration depth and physical characteristics (e.g., color, texture, and odor) of the sediment sample as seen at the ends of the tube will be recorded on field log sheets (Appendix D).

Cores will be cut into manageable sections (3 to 4 feet) on board the vessel immediately after their retrieval. They will then be capped with aluminum foil and plastic caps, and sealed with duct tape. Following sectioning, the cores will be stored upright on board the

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vessel in a core box and transported periodically throughout each field day by small boat to a field-based laboratory in Portland where they will be stored upright on ice or refrigerated at 4°C to await processing.

7.5.1.2 Sample Handling and Storage

Cores will be processed concurrently with core collection. Every effort will be made to process the cores within 24 hours of collection. Cores awaiting processing will be sealed tightly at both ends and stored upright in a refrigerator. If core collection outpaces processing such that significant delays in core processing appear likely, core collection will be suspended to allow the core processing to catch up. The field laboratory will be equipped with a core cutting table, core processing tables, a decontamination area, and a storage area with appropriate refrigeration. Appropriate lighting will be installed in the core processing area in order to collect consistent, high quality photographs of the opened cores. Once the field laboratory is located, care will be taken to create a core processing area that minimizes the potential for outside contamination.

Each core tube will be fixed to the core-cutting table and cut along the long axis using a circular saw. The tube will be rotated 180° and cut again. After each core is cut, the entire core tube will be moved to a stainless-steel sampling tray and opened. Each sediment core will then be systematically logged, described, and photographed.

After each core is cut open, the sediment will be described on a core log (Appendix D). The following information will be recorded for each core:

- Physical sediment description (i.e., sediment type, density/consistency, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification and lenses
- Vegetation
- Debris
- Evidence of biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Other distinguishing characteristics or features

For consistency, core descriptions and terms used will follow the criteria below, which unless otherwise noted, are based on methods presented in ASTM D 2488-00 (ASTM 2000).

1. Visual estimates of the grain size percentages (rounded to the nearest 5 percent) of the sediment units within each core will be recorded on the core logs so that the total sum will add up to 100. The sediment may also be described narratively on the log

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based on the estimated grain size percentages. The dominant constituent grain size will be the primary unit descriptor, with the other grain sizes present described using the following terms:

- The grain size adjective (e.g., gravelly, sandy, silty, or clayey), if estimated to constitute 30 percent or more of the sediment
- "With" for example, sand with silt, silt with sand, etc., if estimated to constitute 15 percent to 25 percent of the sediment
- "Few" if estimated between 5 percent and 10 percent of the sediment
- "Trace" if estimated less than 5 percent of the sediment (and not included in the total 100 percent).

2. For other features observed such as organics or debris, additional descriptive terms may include:

   - "Abundant" if estimated to comprise 30 percent or more of the unit
   - "Moderate" or "some" if estimated to comprise from 10 percent to 30 percent of the unit
   - "Occasional" or "few" if estimated between 5 percent and 10 percent of the unit
   - "Trace" if estimated less than 5 percent (and not included in the total 100 percent).

3. Density (for coarse-grained sediment) and consistency (for fine-grained sediment) will be described using the following terms:

   - Density: "loose" if easily penetrated with a sampling spoon or "dense" if penetration is more difficult.
   - Consistency: "very soft" if present as an ooze that holds no shape, "soft" if saggy, "stiff" if it holds a shape, and "very stiff" if penetration is low.

4. Other observations (e.g., obvious anthropogenic material, dramatic color changes) may also be used to define or help define sample intervals.

The boundaries of lithologic units will be determined primarily by changes in the top two dominant grain sizes (e.g., a change from a silty sand to a gravelly sand or to a sandy silt).

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With the exception of subsampling for volatile organics for the TCLP cores and total sulfides for selected MET/SBLT cores, the cores will be photographed before any sediment is removed for processing. It is important for each core section to be photographed, with adequate lighting, from a standard measured distance from the core. Digital photographs will be used later in the production of digital core logs.

Sediment subsampling methods for MET and SBLT subsurface cores will follow the bulk sediment composite approach described in Section 3.1. Sediment from TCLP cores will follow the bulk sediment composite approach described in Section 5.1. Sediment will be placed into a decontaminated stainless steel bowl for homogenization (except sediments for TCLP VOC analyses and MET/SBLT sulfides analyses). Adequate volumes of sediment will be collected for all required analyses (Table 6-1).

Sediment from each subsample will be individually mixed in the decontaminated, stainless steel bowl to a uniform color and texture using a decontaminated, stainless steel spoon. The sediment will be stirred periodically while individual samples are taken to ensure that the mixture remains homogeneous. Care will be taken to not include sediment that is in direct contact with the aluminum tube. In addition, the cutting of the aluminum tube can introduce metal shavings to the core sediment. Care will also be taken to avoid mixing these shavings into the homogenate. Pre-labeled jars for chemical testing will be filled with the homogenized sediment.

If additional volumes of sediment are required to perform all analyses in addition to quality control analyses, an additional core may need to be collected from the same location and subsampled and homogenized accordingly.

Sample handling and storage procedures will follow as described above with the exception of TCLP VOCs and MET/SBLT total sulfides analyses. For these analyses, sediment subsamples for volatile organics will be collected from within appropriate intervals following the opening of the core. This process will minimize the release of volatile organics caused by mixing.

7.5.2 Surface Water

Surface water samples for standard chemical and conventional analyses will be collected using a peristaltic pump. The peristaltic pump's water intake will be placed 15 feet away from the bow of the boat with the aid of an A-frame or davit. The outflow of the pump will be directed into a 11-gallon decontaminated glass container. During each sample collection, the sampling vessel will move across the area of the iAOPC while maintaining water depths of greater than 10 feet or a minimum of 6 feet in shallow areas. In addition, a multi-probe will be used to measure surface water parameters, such as temperature, pH, dissolved oxygen, specific conductance, and oxidation-reduction potential. As the sample is collected, field notes of the sampling activities and observations will be maintained in a project notebook as described in Surface Water Sampling SOP (Appendix F). Included in this documentation will be the following:

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- Positioning information, including coordinates of start and end of sample collection as well as several points in between to describe the area over which the surface water was sampled
- Locations relative to shoreline landmarks
- Date and time of sampling
- Chronological occurrence of events during sampling operations
- Deviations, if any, from the specifications of this FSP

The river water will be prepared for shipping to the laboratory. Containerized river water will be transported to the laboratory under proper chain-of-custody procedures as described in Section 7.7. The shipping container will be clearly labeled with sufficient information (name of project, time and date of sample collection, sampler name, and consultant's office address) to enable positive identification. This container will be held on ice and transported directly to the field laboratory on the day of collection and stored in the refrigerator at 4°C until subsequent transport to the laboratory for use in the MET analysis. The water will also be separately analyzed as noted in Section 4.2 for the analytes in Tables 4-4 and 4-5.

7.6 WASTE DISPOSAL

Any excess water or sediment remaining after processing will be returned to the river in 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.

All disposable materials used in sample processing, such as paper towels and disposable coveralls and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the Site by sampling personnel and placed in a normal refuse container for disposal at a solid waste landfill. Phosphate-free, detergent-bearing, liquid wastes from decontamination of the sampling equipment will be washed overboard or disposed of into the sanitary sewer system. Waste solvent rinses will be held in sealed plastic buckets and disposed of into the sanitary sewer. Oily or other obviously contaminated investigation-derived waste will be placed in appropriate containers, and a waste determination will be made before it is disposed of at an appropriate facility.

7.7 SAMPLE HANDLING AND TRANSPORT

Because samples collected in support of CERCLA activities may be used in litigation, their possession must be traceable from the time of sample collection through laboratory and data analysis to introduction as evidence. To ensure samples are traceable, the chain-of-custody and transport procedures discussed in Sections 7.7.1 and 7.7.2 will be followed.

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7.7.1 Chain-Of-Custody Procedures

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A chain-of-custody record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the chain-of-custody will be included in laboratory and quality assurance/quality control (QA/QC) reports.

Example chain-of-custody forms are provided in Appendix D. At minimum, the form will include the following information:

- Site name
- Field task leader's name and team members responsible for collection of the listed samples
- Collection date and time of each sample
- Sampling type (e.g., composite or grab)
- Sampling station location
- Number of sample containers shipped
- Requested analysis
- Sample preservation information
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility

The field task leader, as the designated field sample custodian, will be responsible for all sample tracking and chain-of-custody procedures for samples in the field. The sample custodian will be responsible for final sample inventory and will maintain sample custody documentation. The custodian will complete chain-of-custody forms prior to removing samples from the sampling vessel. Upon transferring samples to the laboratory sample custodian, the field task leader will sign, date, and note the time of transfer on the chain-of-custody form.

The original chain-of-custody form will be transported with the samples to the laboratory. Each laboratory will also designate a sample custodian, who will be 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 upon transfer of the samples.

Chemistry samples will be shipped to the laboratory in ice chests sealed with custody seals. Each ice chest will have three seals, one on the front of the chest and one on each side. The laboratory sample custodian will establish the integrity of the seals at the laboratory.

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Upon receipt of the samples at the laboratory, the laboratory sample custodian will inventory the samples by comparing sample labels to those on the chain-of-custody document. The custodian will enter the sample number into a laboratory tracking system by project code and sample designation. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or storing samples in an appropriate secure area. Specific laboratory chain-of-custody procedures are described in the laboratory QA plans for each of the designated labs (Integral and Windward, 2004).

7.7.2 Sample Shipping

The analytical laboratories will supply sample coolers and packing materials. Upon completion of final inventory by the field sample custodian, individual sample containers will be placed into a sealed plastic bag. Samples will then be packed in a cooler lined with a large plastic bag. Glass jars will be packed to prevent breakage and separated in the shipping container by bubble wrap or other shock-absorbent material. Ice in sealed plastic bags or "blue ice" will then be placed in the cooler to maintain a temperature of approximately 4º C.

When the ice chest is full, the chain-of-custody form will be placed into a zip-locked bag and taped on the inside lid of the cooler. A temperature blank and a trip blank will be added to each cooler. Each ice chest will be sealed with three chain-of-custody seals. On each side of the cooler a "This End Up" arrow label will be attached; a "Fragile" label will be attached to the top of the cooler. Coolers will be transported to the laboratory by courier or overnight shipping service. These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24.

The coolers will be clearly labeled with sufficient information (i.e., name of project, time and date container was sealed, person sealing the cooler, and company name and address) to enable positive identification.

7.8 QUALITY CONTROL PROCEDURES

QC requirements will be instituted during sampling, laboratory analysis, and data management to ensure that the data quality objectives are met. Detailed information on QA/QC procedures, limits, and reporting are described in detail in the Round 2 QAPP (Integral and Windward 2004) and are elaborated further in the QAPP Addendum 11 (Integral 2008, in prep). Field QC requirements are described in the following sections. If QC problems are encountered, they will be brought to the attention of the Project Coordinator. Corrective actions, if appropriate, will be implemented to meet the project's data quality objectives.

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7.8.1 Field QC Samples

Field QC samples are used to evaluate the effectiveness of sample homogenization and within-sample variability (e.g., splits), evaluate potential sources of sample contamination (e.g., trip blanks), or confirm proper storage conditions (e.g., temperature blanks). The types of QC samples that will be collected for this sampling event are described in this section and summarized in Table 7-2. The estimated numbers of field and QC samples are listed in Table 7-3.

7.8.1.2 Other Field QC Samples

Blind field splits will be generated for sediment samples and surface water samples at one field-determined station (2.5 percent of the stations) and their origin is not revealed to the laboratory. Split samples are multiple samples taken from a single sample composite after it is fully homogenized. One split sample will be taken from the same sediment composite or surface water sample in addition to one split sample taken from one of the TCLP sediment composite samples. The resulting data will provide information on the variability associated with sample handling and laboratory analysis operations.

Temperature blanks are used to measure and ensure cooler temperature upon receipt by the laboratory. One temperature blank will be prepared and submitted with each cooler shipped to the analytical laboratory. The temperature blank will consist of a sample jar containing deionized water that will be packed into the cooler in the same manner as the rest of the samples and labeled "temp blank."

Field trip blanks are used to determine if volatile chemicals are introduced to samples during holding or storage prior to analysis. One trip blank will be included with each cooler containing samples for analysis of VOCs. The field trip blanks will consist of deionized water sealed in a sample container by the analytical laboratory. The trip blank will be generated and transported to and from the field and then returned to the laboratory unopened for analysis.

7.8.2 Performance Audits

The Field QA Manager will conduct field performance audits at least once during each field program. The audits will involve assessing the sample collection and processing procedures relative to the procedures described in this FSP and to standard collection procedures. Data recording procedures will be reviewed for completeness.

7.8.3 Corrective Actions

Results of the field performance audit may identify the need for corrective actions. The Field QA Manager will immediately institute the necessary corrective actions, complete a corrective action form (see Appendix D), and conduct an additional audit to ensure that the correct procedures continue to be followed.

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If corrective actions require a departure from the FSP, these changes will be documented on a field change request form (see Appendix D). In any other circumstances where sampling conditions are unexpected, the appropriate sampling actions consistent with project objectives will be conducted after the Field QA Manager informs the SAC. This change will be noted in the field log, and a change request form will be completed for the project files.

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8.0 LABORATORY ANALYSIS

This section summarizes the physical and chemical analyses performed for the characterization of sediment, water, elutriate, and leachate samples. The required analyses for each sample that will be collected for the Sediment Chemistry Mobility Testing study are summarized in Tables 4-2, 4-3, 4-4, 4-5, 6-1, 6-2, and 6-3. Details regarding laboratory methodology will be provided in the Sediment Mobility QAPP Addendum 11 (Integral 2008, in prep).

8.1 PHYSICAL AND CHEMICAL ANALYSES

Analytes, project-specific reporting limits, and analytical methods for sediments are listed in Table 4-3. For all of the MET/SBLT sediment composite samples, the chemical suite to be analyzed for each iAOPC is shown in Table 4-2. The chemicals that will be analyzed include metals (aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), SVOCs, chlorinated pesticides, PCB Aroclors, PCB Congeners, total petroleum hydrocarbons (TPH), ammonia, and sulfides. Dioxins and furans and total cyanide will be analyzed in select iAOPCs as shown in Table 4-2. The conventional parameters, grain size, total solids, specific gravity and total organic carbon (TOC), will be analyzed for all MET/SBLT sediment composite samples. Sediment collected for TCLP will be analyzed for the complete list of TCLP analytes (Table 6-2).

All surface water stations and MET/SBLT leachates will be analyzed for total suspended solids (TSS), TOC, total dissolved solids (TDS), and DOC. Site surface water will be field-filtered prior to analysis for DOC only, and site water metals analysis will be on a non-filtered (i.e., total) basis. Analytes, project-specific reporting limits, and analytical methods for surface water, and MET and SBLT leachate are listed in Table 4-5. The iAOPC-specific chemical suite used for sediments will also apply to surface water and MET and SBLT leachate, in addition to amenable and free cyanide analysis for iAOPC 11, as shown in Table 4-4. All MET elutriate samples will be analyzed for both total and dissolved chemical concentrations. TCLP leachates will be analyzed for the full list of TCLP analytes. TCLP leachate analytes, project-specific reporting limits, and analytical methods are listed in Table 6-3.

Analytical methods and QC measurements and criteria are based on current Contract Laboratory Program (CLP) and SW-846 requirements, and EPA guidance. Detailed laboratory methods, QA procedures, and QA/QC requirements are described in the Round 2 QAPP (Integral and Windward 2004) and are elaborated further in the Sediment Chemistry Mobility Testing QAPP Addendum 11 (Integral 2008, in prep).

All samples will be maintained according to the appropriate holding times and temperatures for each analysis, as summarized in Table 7-1. Field QC sample requirements are described in Section 7.8 and summarized in Table 7-2. A temperature blank will be included in each cooler.

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Laboratory QA will be implemented as described in the Round 2 QAPP, Round 2 QAPP addendum 10 and Sediment Chemistry Mobility Testing QAPP addendum, and according to each of the identified laboratory's respective QA programs, plans, and SOPs. Additional information on analytical methods and laboratory QA program plans for each laboratory is provided in the QAPP and QAPP addendum.

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9.0 FIELD DATA MANAGEMENT PLAN

During field operations, effective data management is the key to providing consistent, accurate, and defensible documentation of data quality. Field data will include descriptive and geographical information associated with sediment and water collection.

A detailed data management plan is provided as an appendix to the Work Plan (Integral et al 2004c). Daily field records (a combination of field logbooks and field data sheets) and navigational records will make up the main documentation for field activities. The plan components most applicable to field activities are summarized in the following sections.

9.1 FIELD LOGBOOKS

All field activities and observations will be noted in a field logbook during fieldwork. The descriptions will be clearly written with enough detail so that participants can reconstruct events later if necessary. Field logbooks will describe any changes that occur at the Site, in particular, personnel and responsibilities or deviations from the Work Plan or FSP, as well as the reasons for the changes. Requirements for logbook entries are listed in Section 7.2.

9.2 FIELD DATA SHEETS

Field data sheets and sample description forms will be completed for all samples and kept in the project file as a permanent record of the sampling or field measurement activities. Information such as habitat descriptions, sediment, water, and biota sampling data will be noted on the field data sheets. Depending on the activity, the type of field data sheet and the information recorded on it may vary. A reference date and activity will be entered into the logbook to refer to the field data sheets being generated. If field data sheet entries are entered in an electronic format, each sheet will indicate who completed the data entry and when. The field task leader is responsible for ensuring that all field data sheets are correct and that they become part of the permanent file.

9.3 FIELD DATA MANAGEMENT

As soon after collection as possible, field notes and data sheets will be scanned to create an electronic record for use in creating the cruise report. Field data will be hand-entered into the database. Twenty percent of the transferred data will be verified based on hard copy records. Electronic QA checks to identify anomalous values will also be conducted following entry.

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9.4 SAMPLE IDENTIFICATION

The Sediment Chemical Mobility target surface and subsurface sampling location stations will be renumbered sequentially. The revised station numbers will be included in the FSP addendum for the sediment sampling program.

A unique code will be assigned to each sample as part of the data record. This code will indicate the project phase, sampling location, sample type, and level of replication/duplication.

All samples will be assigned a unique identification number based on a sample designation scheme designed to meet the needs of the field personnel, laboratory and Lower Willamette Group (LWG) data management, validation chemists, and data users. Sample identifiers will consist of two to three components separated by dashes. The first component, LWM, identifies the data as belonging to the Lower Willamette River RI/FS, Sediment Mobility. The second component will contain a one-letter or multi-letter abbreviation for the sample type followed by the station number (i.e., iAOPC number). For SBLT leachate samples, a third component will contain a letter (i.e., A, B, C, or D) that will identify each of the four leachates generated from a single SBLT test. The following abbreviation for sample types will be used:

- METCS = core composite sample for MET and SBLT tests and bulk sediment chemistry
- TCLPCS = core composite sample for TCLP tests and bulk sediment chemistry
- SW = surface water sample
- MET = MET elutriate sample
- SBLT = SBLT leachate sample
- TCLP = TCLP leachate sample

A single digit number will be used to indicate blind field split samples. For example, for sediment composite samples this number will be appended directly to end of the sample identifier (e.g., LWM-METCS1-2).

Example sample identifiers are:

- LWM-METCS1: core composite sample from iAOPC 1
- LWM-SW19: surface water sample from iAOPC 19
- LWM-SBLT23-A: SBLT leachate sample “A” from iAOPC 23
- LWM-MET11: MET elutriate sample from iAOPC 11

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9.5 CHAIN-OF-CUSTODY

The chain-of-custody record provides documentation of sample possession and handling from the time of collection until final Site decisions are approved. The chain-of-custody record will include:

- Sample labels and custody seals
- Sample logbooks and field data sheets
- Chain-of-custody sheets
- Laboratory-generated sample logs produced upon receipt of the samples at the laboratory.

Chain-of-custody forms and procedures are described in Section 7.7.1.

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10.0 REPORTING

10.1 LABORATORY CHEMICAL DATA

Validated analytical laboratory data will be provided to EPA in an electronic format within 60 days of receipt of the final laboratory report for each sampling event (e.g., subsurface sampling, Site surface water sampling). A sampling event is considered complete when the last sample of that type described in this FSP has been collected.

10.2 SEDIMENT CHEMICAL MOBILITY REPORTING

A Sediment Chemical Mobility field sampling report will be prepared and submitted to EPA within 60 days of completing the Sediment Chemical Mobility field sample collection effort described in this FSP including submittal of all samples to the laboratory. The field sampling report will summarize field sampling activities, including sampling locations (maps), requested sample analyses, sample collection methods, and any deviations from the FSP.

A data report will not be prepared. The results of the mobility tests will be reported and evaluated in an appendix to the FS. LWG-validated data for the sediment and water chemistry samples will be delivered to EPA as noted in Section 10.1.

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Tables

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Table 2-1. Analysis of Peak Concentrations in Bulk Sediment by General Site Area.

Analytes of Concern from Round 2 Report	**Units**	**Site-Wide Surface 95th**	**Site-Wide Subsurface 95th**	**Site-Wide Surface Riparian Zone 95th**	**Site-Wide Subsurface Riparian Zone 95th**	**Site-Wide Maximum 95th**	**iAOPCs exceeding Site-Wide Maximum 95th with Corresponding Maximum Concentration**
Total PCB Aroclors (calc'd)	µg/kg	810	843	9.1	13500	**13500**	3 (26,000), 19 (27,400)
Total PCB Congeners (calc'd)	µg/kg	972	2830	25900	NA	**25900**	19 (36,800)
PCB congener TEQ (calc'd)	pg/g	41.7	48.8	NA	NA	**48.8**	3 (161), 1 (149), 7 (86.7), 19 (324)
Dioxin/Furan TCDD toxicity equivalent	pg/g	75.8	54.7	NA	NA	**75.8**	13 (102), 14 (16,600)
Sum DDD (calc'd)	µg/kg	136	282	7.13	NA	**282**	11 (2,220), 14 (690,000), 17 (385), 19 (2,980)
Sum DDE (calc'd)	µg/kg	55.6	51	3.34	NA	**55.6**	14 (24000), 19 (2830)
Sum DDT (calc'd)	µg/kg	193	342	25.8	NA	**342**	11 (1,110), 14 (3,500,000)
alpha-BHC	µg/kg	2.2	7.37	1.78	NA	**7.37**	19 (98.9)
beta-BHC	µg/kg	7.3	12.3	NA	NA	**12.3**	11 (318), 14 (120)
delta-BHC	µg/kg	2.2	5.8	2.23	NA	**5.8**	11 (45.4)
Aldrin	µg/kg	11.4	92	NA	NA	**92**	14 (1,340), 19 (637)
Dieldrin	µg/kg	9.17	15.6	NA	NA	**15.6**	19 (356)
Endrin Ketone	µg/kg	4.57	8.65	4.48	NA	**8.65**	3 (16), 11 (263), 19 (90.1)
Ammonia	mg/kg	225	522	NA	NA	**522**	11 (334), 18 (481), 19 (352)
Sulfide	mg/kg	96.3	72	NA	NA	**96.3**	11 (998), 14 (445)
Mercury	mg/kg	0.276	0.5	0.18	0.09	**0.5**	6 (0.74), 13 (4.14), 14 (0.72), 19 (2.01)
Arsenic	mg/kg	9	6.95	54.8	7.65	**54.8**	15 (83.5)
Silver	mg/kg	1.13	0.924	0.876	NA	**1.13**	7 (5.65), 14 (4.24), 19 (4.44)
Cadmium	mg/kg	1.135	0.803	1.02	5.92	**5.92**	19 (5.41)
Lead	mg/kg	110	102	516	251	**516**	NL

Table 2-1. Analysis of Peak Concentrations in Bulk Sediment by General Site Area.

Analytes of Concern from Round 2 Report	**Units**	**Site-Wide Surface 95th**	**Site-Wide Subsurface 95th**	**Site-Wide Surface Riparian Zone 95th**	**Site-Wide Subsurface Riparian Zone 95th**	**Site-Wide Maximum 95th**	**iAOPCs exceeding Site-Wide Maximum 95th with Corresponding Maximum Concentration**
Zinc	mg/kg	374	288	2650	1530	**2650**	21 (1,930)
Dibutyl phthalate	µg/kg	136	91	34	NA	**136**	1 (180), 14 (1500), 19 (185), 21 (250), 11(1500)
Benzo(a)antrhacene	µg/kg	5570	9900	168	200	**9900**	11 (760,000),
Benzo(a)pyrene	µg/kg	3800	12000	196	279	**12000**	11 (940,000)
Benzo(b)fluoranthene	µg/kg	6400	9900	170	266	**9900**	11 (590,000)
dibenzo(a,h)anthracene	µg/kg	1000	1500	47.1	845	**1500**	11 (67,000)
Indeno(1,2,3-cd)pyrene	µg/kg	6000	11000	224	430	**11000**	11 (610,000)
Diesel Range Hydrocarbons	mg/kg	1900	3400	92.2	11600	**11600**	11 (190,000), 19 (12,000)
Residual Range Hydrocarbons	mg/kg	2640	3200	640	NA	**3200**	3 (11,000), 11 (110,000), 13 (6,000), 19 (25,000)

Notes:
*Sum DDD calculated by totaling 2,4' and 4,4'-DDD
**Sum DDE calculated bytotaling 2,4' and 4,4'-DDE
***Sum DDT calculated by totaling 2,4' and 4,4'-DDT
****-BHC reports values for -hexachlorocyclohexane
*****NA - Not available
****** The 95th value was selected from an ascending ranked list of all results. Where n = the number of samples, the actual sample result corresponding to the rand of the closest integer to n * 0.95 (95th percentile) or n * 0.50 (median) is presented.
NL - Chemical not listed as an iCOC for any iAOPC on Table 11.3 Summary Statistics for Sediment
Bold - Indicates the 95th percentile concentration used to screen the iAOPCs

Table 2-2. Summary of Selected iAOPCs for MET and SBLT Sediment Sampling

iAOPC	PCBs	Dioxins	DDx	Pesticides	Metals	Phthalate	PAH	TPH	Initial Locations for MET and SBLT Testing	Selected Locations for MET and SBLT Testing
1	X					X			**1**	**1**
2									**-**	**-**
3	X			X				X	**2**	**2**
4									**-**	**-**
5									**-**	**-**
6					X				**3**	**3**
7	X				X				**4**	**4**
8									**-**	**-**
9									**-**	**-**
10									**-**	**-**
11			X	X		X	X	X	**5**	**5**
12									**-**	**-**
13		X			X			X	**6**	**6**
14		X	X	X	X	X			**7**	**7**
15					X				**8**	**-**
16									**-**	**-**
17			X						**9**	**-**
18									**-**	**-**
19	X		X	X	X	X		X	**10**	**8**
20									**-**	**-**
21					X	X			**11**	**9**
22									**-**	**-**
23									**-**	**10**
24									**-**	**11**
25									**-**	**-**
26									**-**	**-**
27									**-**	**-**

X - Indicates this area above Site-wide maximum 95th percentile value (per Table 2-1) for this chemical class.

Table 2-3. Summary of Sediment, Surface Water, and Leachate Sample Types, Numbers and Chemical Analyses.

Sample Type	Number of Individual Samples for Analysis[1]	Chemical Analyses[4]											
		Metals	SVOCs	PCB Aroclors	PCB Congeners	Chlorinated Pesticides	TPH	Dioxins /Furans	Cyanide[7]	Sulfide	Ammonia	TCLP Analytes[5]	Other[6]
Surface Water and Leachate Chemistry													
Site Surface Water for MET	11	11	11	11	11	11	11	4	1	11	11		11
MET Elutriate[2]	22	22	22	22	22	22	22	8	2	22	22		22
SBLT Leachate[3]	44	44	44	44	44	44	44	16	4	44	44		44
TCLP Leachate	11											11	
Total:	88												
Bulk Sediment Chemistry													
MET/SBLT	11	11	11	11	11	11	11	4	1	11	11		11
TCLP	11											11	
Total:	22												

Notes:

[1] QC samples not included, see Table 7-2.

[2] These 11 MET elutriate samples will be analyzed for both total and dissolved constituents to yield 22 samples for the laboratory. Conentrations derived from filtered aliquots will be reported by the laboratory as dissolved concentrations.

[3] 11 SBLT tests yield a total of 44 leachate samples (i.e., four leachate samples per SBLT test).

[4] See Table 4-4 for elutriate/leachate samples and analyses.
See Tables 4-2 and 6-1 for sediment samples and analyses for MET/SBLT and TCLP bulk sediment analytes respectively.

[5] TCLP bulk sediment and leachates will be analyzed for the full list of TCLP analytes. See Tables 6-2 and 6-3 for TCLP bulk sediment and leachate list of analytes repectively.

[6] TOC, solids, grain size, and specific gravity will be analyzed in all MET/SBLT bulk sediment samples. TSS, TDS, TOC and DOC will be analyzed in all surface water samples and MET and SBLT elutriate/leachate samples.

[7] MET/SBLT bulk sediment samples will be analyzed for total cyanide as shown in Table 4-2. Site water, MET and SBLT elutriate/leachate samples will be analyzed for total, amenable, and free cyanide as shown in Table 4-4.

Table 2-4. Comparison of All Site Sediment Data to TCLP Screening Levels and Selection of TCLP Testing Locations.

Contaminant	TCLP Regulatory Level Criteria (mg/L)	iAOPC	Maximum Detected Concentration (mg/kg)	Calculated Maximum Leachate Concentration (mg/L)[1]	Number of Samples ≥ TCLP Criteria	Ratio of Maximum over TCLP Criteria	Selected Location for TCLP Testing[2,3]
Arsenic	5.00	1	132.00	6.60	1	1.3	
Chromium	5.00	1	819.00	40.95	12	8.2	**1**
Lead	5.00	1	166.00	8.30	7	1.7	
Chromium	5.00	3	117.00	5.85	1	1.2	
Lead	5.00	3	310.00	15.50	7	3.1	
Chromium	5.00	5	103.00	5.15	1	1.0	
Lead	5.00	5	120.00	6.00	1	1.2	
Lead	5.00	6	330.00	16.50	1	3.3	
Arsenic	5.00	7	105.00	5.25	1	1.1	
Chromium	5.00	7	249.00	12.45	6	2.5	
Lead	5.00	7	577.00	28.85	12	5.8	**2**
Mercury	0.20	7	4.84	0.24	1	1.2	
Chromium	5.00	9	130.00	6.50	1	1.3	
Lead	5.00	9	232.00	11.60	1	2.3	
Lead	5.00	9	416.00	20.80	2	4.2	
Lead	5.00	9	117.00	5.85	1	1.2	
Chromium	5.00	10	212.00	10.60	6	2.1	
Lead	5.00	10	332.00	16.60	5	3.3	
Benzene	0.50	11	270.00	13.50	12	27.0	**3**
Benzene	0.50	11	11.00	0.55	1	1.1	
Chromium	5.00	11	175.00	8.75	1	1.8	
Lead	5.00	11	684.00	34.20	4	6.8	**4**
Lead	5.00	11	331.00	16.55	2	3.3	
Trichloroethylene	0.5	11	1900	95.00	2	190.0	**5**
Vinyl Chloride	0.2	11	4	0.20	1	1.0	

Table 2-4. Comparison of All Site Sediment Data to TCLP Screening Levels and Selection of TCLP Testing Locations.

Contaminant	TCLP Regulatory Level Criteria (mg/L)	iAOPC	Maximum Detected Concentration (mg/kg)	Calculated Maximum Leachate Concentration (mg/L)[1]	Number of Samples ≥ TCLP Criteria	Ratio of Maximum over TCLP Criteria	Selected Location for TCLP Testing[2,3]
Lead	5.00	13	238.00	11.90	2	2.4	
Mercury	0.20	13	4.14	0.21	1	1.0	
Barium	100.00	14	5950.00	297.50	1	3.0	
Chromium	5.00	14	270.00	13.50	4	2.7	
Hexachlorobenzene	0.13	14	14.00	0.70	1	5.4	**6**
Hexachlorobutadiene	0.50	14	34.00	1.70	2	3.4	
Lead	5.00	14	1290.00	64.50	12	12.9	
Lead	5.00	14	3330.00	166.50	1	33.3	**7**
Chromium	5.00	15	184.00	9.20	3	1.8	
Lead	5.00	15	516.00	25.80	2	5.2	**8**
Lead	5.00	16	204.00	10.20	1	2.0	
Chromium	5.00	18	774.00	38.70	1	7.7	**9**
Lead	5.00	18	350.00	17.50	3	3.5	
Lead	5.00	18	242.00	12.10	1	2.4	
Chlordane	0.03	19	2.33	0.12	1	3.9	
Chromium	5.00	19	157.00	7.85	3	1.6	
Lead	5.00	19	1080.00	54.00	15	10.8	**10**
Lead	5.00	19	164.00	8.20	2	1.6	
Arsenic	5.00	21	140.00	7.00	1	1.4	
Lead	5.00	21	330.00	16.50	14	3.3	
Chromium	5.00	22	148.00	7.40	2	1.5	
Lead	5.00	22	116.00	5.80	2	1.2	
Cadmium	1.00	23	46.20	2.31	1	2.3	
Lead	5.00	23	936.00	46.80	2	9.4	**11**
Selenium	1.00	23	20.00	1.00	1	1.0	

Table 2-4. Comparison of All Site Sediment Data to TCLP Screening Levels and Selection of TCLP Testing Locations.

Contaminant	TCLP Regulatory Level Criteria (mg/L)	iAOPC	Maximum Detected Concentration (mg/kg)	Calculated Maximum Leachate Concentration (mg/L)[1]	Number of Samples ≥ TCLP Criteria	Ratio of Maximum over TCLP Criteria	Selected Location for TCLP Testing[2,3]
Lead	5.00	26	178.00	8.90	2	1.8	
Lead	5.00	26	348.00	17.40	2	3.5	
1,1-Dichloroethylene	0.70	NA	ND	NA		NA	
1,2-Dichloroethane	0.50	NA	0.0004	0.00		0.0	
1,4-Dichlorobenzene	7.50	NA	0.73	0.04		0.0	
2,4,5-TP (Silvex)	1.00	NA	0.01	0.00		0.0	
2,4,5-Trichlorophenol	400.00	NA	0.20	0.01		0.0	
2,4,6-Trichlorophenol	2.00	NA	1.40	0.07		0.0	
2,4-D	10.00	NA	3.25	0.16		0.0	
2,4-Dinitrotoluene	0.13	NA	2.10	0.11		0.8	
Carbon Tetrachloride	5.00	NA	ND	NA		NA	
Chlorobenzene	100.00	NA	35.00	1.75		0.0	
Chloroform	6.00	NA	0.14	0.01		0.0	
Cresol	200.00	NA	ND	NA		NA	
Endrin	0.02	NA	0.03	0.00		0.1	
Heptachlor (and its epoxide)	0.01	NA	0.01	0.00		0.0	
Hexachloroethane	3.00	NA	1.60	0.08		0.0	
Lindane	0.40	NA	0.43	0.02		0.1	
m-Cresol	200.00	NA	0.30	0.02		0.0	
Methoxychlor	10.00	NA	0.51	0.03		0.0	
Metyl Ethyl Ketone	200.00	NA	0.05	0.00		0.0	
Nitrobenzene	2.00	NA	ND	NA		NA	
o-Cresol	200.00	NA	0.29	0.01		0.0	
p-Cresol	200.00	NA	2.50	0.13		0.0	
Pentachlorophenol	100.00	NA	8.41	0.42		0.0	

Table 2-4. Comparison of All Site Sediment Data to TCLP Screening Levels and Selection of TCLP Testing Locations.

Contaminant	TCLP Regulatory Level Criteria (mg/L)	iAOPC	Maximum Detected Concentration (mg/kg)	Calculated Maximum Leachate Concentration (mg/L)[1]	Number of Samples ≥ TCLP Criteria	Ratio of Maximum over TCLP Criteria	Selected Location for TCLP Testing[2,3]
Pyridine	5.00	NA	ND	NA		NA	
Silver	5.00	NA	14.80	0.74		0.1	
Tetrachloroethylene	0.70	NA	0.01	0.00		0.0	
Toxaphene	0.50	NA	1.90	0.10		0.2	

1 - The calculated maximum leachate concentration was derived by dividing the maximum detected concentration by a factor of 20.

2 - Selected locations for TCLP testing were chosen based on the ratio of the calculated maximum detected leachable concentration over the TCLP criteria. Ratios greater than 5 exceeded the five times screening criteria.

3 - See Tables 6-2 and 6-3 for TCLP bulk sediment and leachate list of analytes repectively. TCLP bulk sediment and leachate will be analyzed for the complete list of TCLP analytes shown in Tables 6-2 and 6-3

NA No Locations exceeded the TCLP screening value

Table 4-1. MET and SBLT Sediment Chemistry Sampling Locations and Compositing Scheme.

iAOPC	Station ID	Core Tube Length (ft)	Sample Location Coordinates		Composite Sample ID
			X	Y	
1	LWM-C1-A	16	7617536.63	724423.08	LWM-METCS1
	LWM-C1-B	16	7617322.48	723897.68	
	LWM-C1-C	16	7617132.71	723364.94	
	LWM-C1-D	16	7617052.81	723036.90	
3	LWM-C3-A	16	7619050.41	717072.01	LWM-METCS3
	LWM-C3-B	16	7619246.96	717172.14	
	LWM-C3-C	16	7619573.41	717052.33	
	LWM-C3-D	16	7619876.55	717041.87	
6	LWM-C6-A	16	7618961.49	711051.75	LWM-METCS6
	LWM-C6-B	16	7618864.24	711279.06	
	LWM-C6-C	16	7618879.16	711192.56	
	LWM-C6-D	16	7619048.03	710925.33	
7	LWM-C7-A	16	7621884.73	708974.25	LWM-METCS7
	LWM-C7-B	16	7622144.81	708692.26	
	LWM-C7-C	16	7622243.47	708530.18	
	LWM-C7-D	16	7622511.34	708154.02	
11	LWM-C11-A	16	7623269.70	706106.11	LWM-METCS11
	LWM-C11-B	16	7623575.73	705974.84	
	LWM-C11-C	16	7624595.56	705316.73	
	LWM-C11-D	16	7625048.37	705053.83	
13	LWM-C13-A	16	7626974.33	705818.41	LWM-METCS13
	LWM-C13-B	16	7627372.31	705676.03	
	LWM-C13-C	16	7627057.36	705652.43	
	LWM-C13-D	16	7627101.07	705493.82	
14	LWM-C14-A	16	7627510.14	702895.37	LWM-METCS14
	LWM-C14-B	16	7627873.14	702489.20	
	LWM-C14-C	16	7627935.25	702392.29	
	LWM-C14-D	16	7628247.00	702118.12	
19	LWM-C19-A	16	7632625.30	697113.80	LWM-METCS19
	LWM-C19-B	16	7633308.34	696716.78	
	LWM-C19-C	16	7633451.75	696795.71	
	LWM-C19-D	16	7635180.20	695774.30	
21	LWM-C21-A	16	7632330.66	700403.39	LWM-METCS21
	LWM-C21-B	16	7632973.11	700512.89	
	LWM-C21-C	16	7632710.97	700821.71	
	LWM-C21-D	16	7632786.63	701484.79	
23	LWM-C23-A	16	7635945.20	699867.75	LWM-METCS23
	LWM-C23-B	16	7636984.37	698937.24	
	LWM-C23-C	16	7635489.60	699506.79	
	LWM-C23-D	16	7636665.54	698563.33	
24	LWM-C24-A	16	7637628.48	694311.48	LWM-METCS24
	LWM-C24-B	16	7637361.59	694219.74	
	LWM-C24-C	16	7637242.73	694156.59	
	LWM-C24-D	16	7637265.10	693886.46	

[1] - Oregon State Plane North. International Feet, NAD 83

Table 4-2. MET and SBLT Bulk Sediment Sample Analyses Matrix.

iAOPC	Composite Sample ID	ANALYTES[1]													
		Metals	SVOCs	PCB Aroclors	PCB Congeners	Chlorinated Pesticides	TPH	Dioxins /Furans	Total Cyanide	Sulfide	Ammonia	Total Solids	Grain Size	TOC	Specific Gravity
1	LWM-METCS1	x	x	x	x	x	x			x	x	x	x	x	x
3	LWM-METCS3	x	x	x	x	x	x			x	x	x	x	x	x
6	LWM-METCS6	x	x	x	x	x	x			x	x	x	x	x	x
7	LWM-METCS7	x	x	x	x	x	x			x	x	x	x	x	x
11	LWM-METCS11	x	x	x	x	x	x		x	x	x	x	x	x	x
13	LWM-METCS13	x	x	x	x	x	x	x		x	x	x	x	x	x
14	LWM-METCS14	x	x	x	x	x	x	x		x	x	x	x	x	x
19	LWM-METCS19	x	x	x	x	x	x	x		x	x	x	x	x	x
21	LWM-METCS21	x	x	x	x	x	x	x		x	x	x	x	x	x
23	LWM-METCS23	x	x	x	x	x	x			x	x	x	x	x	x
24	LWM-METCS24	x	x	x	x	x	x			x	x	x	x	x	x

Notes
[1] See Table 4-3 for MET/SBLT bulk sediment list of analytes.

Table 4-3. Parameters, Methods, Reporting Limits, and Detection Limits for MET/SBLT Sediment Samples.

Analytes	Analytical Method	ACG	Project Limits		ARI Limits	
			MDL	MRL[a]	MDL	MRL
Conventional Analyses						
Total solids (percent of whole weight)	160.3	*	0.01	0.01	0.01	0.01
Grain size (percent)[b]	ASTM D422/PSEP	*	0.1	0.1	0.1	0.1
Total organic carbon (percent)	Plumb, 1981	*	0.02	0.05	0.0122	0.02
Total sulfides (mg/kg)	4500-S2	*	0.1	0.2	0.068	1.0
Total Cyanide	4500-CN-E	*	--	--	0.005	0.25
Ammonia (mg/kg)	350.1	*	0.05	0.1	0.004	0.1
Specific gravity (g/cc)	D854	*	--	0.01	--	0.01
Metals, mg/kg dry wt						
Aluminum	6010	*	0.5	2	2.84	5.0
Antimony	6020	*	0.03	0.05	0.01	0.2
Arsenic	6020	*	0.03	0.1	0.04	0.5
Cadmium	6020	*	0.008	0.02	0.02	0.2
Chromium	6020	*	0.04	0.2	0.12	0.5
Copper	6010	*	0.1	0.1	0.02	2.0
Lead	6020	*	0.02	0.05	0.36	1.0
Mercury	7471A	*	0.006	0.02	0.005	0.05
Nickel	6020	*	0.05	0.2	0.16	0.50
Silver	6020	*	0.02	0.02	0.01	0.20
Zinc	6010	*	0.2	0.5	0.8	1.0
Petroleum Hydrocarbons, µg/kg dry wt						
Diesel Range Organics (DRO)	NWTPH-DX	*	2.7	25	1.89	5
Residual Range Organics (RRO)	NWTPH-DX	*	4.5	100	3.27	10
Organochlorine Pesticides, µg/kg dry wt						
2,4'-DDD	8081	*	0.11	0.2	0.921	2.0
2,4'-DDE	8081	*	0.12	0.2	0.917	2.0
2,4'-DDT	8081	*	0.070	0.2	1.261	2.0
4,4'-DDD	8081	0.083	0.060	0.2	0.417	2.0
4,4'-DDE	8081	0.0588	0.050	0.2	0.548	2.0
4,4'-DDT	8081	0.0588	0.032	0.2	0.646	2.0
Aldrin	8081	0.00038	0.075	0.2	0.394	1.0
alpha-BHC	8081	0.001	0.13	0.2	0.298	1.0
beta-BHC	8081	0.0036	0.15	0.2	0.754	1.0
delta-BHC	8081	*	0.028	0.2	0.404	1.0
gamma-BHC (Lindane)	8081	0.005	0.075	0.2	0.410	1.0
alpha-Chlordane	8081	*	0.12	0.2	0.247	1.0
gamma-Chlordane	8081	*	0.032	0.2	0.356	1.0
Oxychlordane	8081	*	0.029	0.2	0.874	2.0
cis -Nonachlor	8081	*	0.036	0.2	1.133	2.0
trans -Nonachlor	8081	*	0.033	0.2	0.891	2.0
Dieldrin	8081	0.0004	0.15	0.2	0.516	2.0
Endosulfan I	8081	1.7	0.085	0.2	0.334	1.0
Endosulfan II	8081	*	0.10	0.2	0.501	2.0
Endosulfan sulfate	8081	*	0.040	0.2	0.734	2.0

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This document is currently under review by U.S. EPA and its federal, state and tribal partners and is subject to change in whole or in part.

Table 4-3. Parameters, Methods, Reporting Limits, and Detection Limits for MET/SBLT Sediment Samples.

Analytes	Analytical Method	ACG	Project Limits		ARI Limits	
			MDL	MRL[a]	MDL	MRL
Endrin	8081	0.084	0.10	0.2	0.494	2.0
Endrin aldehyde	8081	*	0.027	0.2	1.111	2.0
Endrin ketone	8081	*	0.041	0.2	0.802	2.0
Heptachlor	8081	0.0014	0.040	0.2	0.331	1.0
Heptachlor epoxide	8081	0.0007	0.065	0.2	0.181	1.0
Methoxychlor	8081	1.4	0.050	0.2	5.458	10
Toxaphene	8081	0.0059	4.5	20	48.1	100
Hexachlorobenzene	8081	0.33	0.040	0.2	0.225	1.0
Hexachlorobutadiene	8081	0.6	0.065	0.2	0.415	1.0
Hexachloroethane	8081	2.0	0.075	0.2	--	1.0
Mirex	8081	0.056	0.032	0.2	1.22	2.0
PCB Aroclors, µg/kg dry wt						
Aroclor 1016	8082	*	1.6	10	1.12	10.0
Aroclor 1221	8082	*	1.6	20	1.12	10.0
Aroclor 1232	8082	*	1.6	10	1.12	10.0
Aroclor 1242	8082	0.004	1.6	10	1.12	10.0
Aroclor 1248	8082	0.004	1.6	10	1.33	10.0
Aroclor 1254	8082	0.004	1.6	10	1.33	10.0
Aroclor 1260	8082	0.004	1.6	10	1.33	10.0
Aroclor 1262	8082	*	1.6	10	1.33	10.0
Aroclor 1268	8082	*	1.6	10	1.33	10.0
Polycyclic Aromatic Hydrocarbons, µg/kg dry wt						
Acenaphthene	8270-SIM	72	0.23	5	4.29	6.7
Acenaphthylene	8270-SIM	*	0.24	5	2.47	6.7
Anthracene	8270-SIM	360	0.47	5	3.25	6.7
Benz(a)anthracene	8270-SIM	0.038	0.48	5	6.18	6.7
Benzo(a)pyrene	8270-SIM	0.0038	0.14	5	2.39	6.7
Benzo(b)fluoranthene	8270-SIM	0.038	0.25	5	6.02	6.7
Benzo(g,h,i)perylene	8270-SIM	*	0.64	5	3.45	6.7
Benzo(k)fluoranthene	8270-SIM	0.38	0.15	5	5.88	6.7
Chrysene	8270-SIM	3.8	0.25	5	2.74	6.7
Dibenz(a,h)anthracene	8270-SIM	0.0038	0.59	5	5.59	6.7
Dibenzofuran	8270-SIM	8.2	0.28	5	3.65	6.7
Fluoranthene	8270-SIM	48	0.61	5	3.4	6.7
Fluorene	8270-SIM	48	0.5	5	3.58	6.7
Indeno(1,2,3-cd)pyrene	8270-SIM	0.038	0.16	5	3.39	6.7
Naphthalene	8270-SIM	24	0.37	5	2.74	6.7
Phenanthrene	8270-SIM	*	0.75	5	4.47	6.7
Pyrene	8270-SIM	36	0.37	5	3.46	6.7
Semivolatile Organic Compounds, µg/kg dry wt						
Phthalate Esters						
Bis(2-ethylhexyl) phthalate	8270-SIM	3.4	1.7	200	11	20
Butylbenzyl phthalate	8270-SIM	400	1.5	10	11.2	20
Dibutyl phthalate	8270-SIM	204	2.6	10	12.4	20

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Table 4-3. Parameters, Methods, Reporting Limits, and Detection Limits for MET/SBLT Sediment Samples.

Analytes	Analytical Method	ACG	Project Limits		ARI Limits	
			MDL	MRL[a]	MDL	MRL
Diethyl phthalate	8270-SIM	*	3.5	10	16.4	20
Dimethyl phthalate	8270-SIM	20000	1.8	10	7.77	20
Di-n-octyl phthalate	8270-SIM	40.9	1.2	10	8.34	20
Chlorinated Phenols						
2-Chlorophenol	8270	26	1.7	10	7.48	20
2,4-Dichlorophenol	8270	16	1.8	10	40.9	100
2,4,5-Trichlorophenol	8041	524	0.55	5	5.230	6.25
2,4,6-Trichlorophenol	8041	1.8	0.39	5	2.566	6.25
2,3,4,5-Tetrachlorophenol	8041	157	0.62	5	3.629	6.25
Tetrachlorophenol (2,3,4,6 and 2,3,5,6)	8041	157	0.3	5	4.279	6.25
Pentachlorophenol	8041	0.58	0.14	5	4.171	6.25
Other Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	8270	*	1.5	10	9.07	20
1,2-Dichlorobenzene	8270	184	1.3	10	7.88	20
1,3-Dichlorobenzene	8270	*	1.6	10	7.45	20
1,4-Dichlorobenzene	8270	2	1.9	10	7.36	20
2,4-Dimethylphenol	8270	*	5.5	50	14.8	20
2,4-Dinitrophenol	8270	*	36	200	110	200
2,4-Dinitrotoluene	8270	*	2.8	10	38.5	100
2,6-Dinitrotoluene	8270	*	2.8	10	53.8	100
2-Chloronaphthalene	8270	*	3.6	10	7.96	20
2-Methylphenol	8270	26	3.4	10	14.2	20
2-Nitroaniline	8270	*	2.7	20	76.2	100
2-Nitrophenol	8270	*	2.6	10	39.8	100
3,3'-Dichlorbenzidine	8270	*	3.7	100	48.8	100
3-Nitroaniline	8270	*	2.6	20	76.2	100
4,6-Dinitro-2-methylphenol	8270	*	--	--	84.0	200
4-Bromophenyl phenyl ether	8270	*	1.4	10	9.62	20
4-Chloro-3-methylphenol	8270	*	2.1	10	8.41	100
4-Chloroaniline	8270	*	2.1	10	34.7	100
4-Chlorophenyl-phenyl ether	8270	*	2	10	8.41	20
4-Methylphenol	8270	26	2.9	10	12.8	20
4-Nitroaniline	8270	*	3.4	20	51.2	100
4-Nitrophenol	8270	*	30	100	66.2	100
Aniline	8270	*	1.5	20	--	67
Azobenzene[g]	8270	184	1.3	10	7.43	20
Benzoic Acid	8270	*	96	200	115	200
Benzyl alcohol	8270	*	3.7	10	14.5	20
Bis-(2-chloroethoxy) methane	8270	*	1.3	10	8.86	20
Bis-(2-chloroethyl) ether	8270	*	2.4	10	7.48	20
Bis(2-chloroisopropyl) ether	8270	*	1.2	10	7.98	20
Hexachlorobenzene[e]	8270	0.33	2.1	10	8.02	20
Hexachlorobutadiene[e]	8270	0.6	1.4	10	8.12	20
Hexachlorocyclopentadiene	8270	*	15	50	43.9	100

Table 4-3. Parameters, Methods, Reporting Limits, and Detection Limits for MET/SBLT Sediment Samples.

Analytes	Analytical Method	ACG	Project Limits		ARI Limits	
			MDL	MRL[a]	MDL	MRL
Hexachloroethane	8270	2	2.2	10	7.20	20
Isophorone	8270	*	1.6	10	8.29	20
Nitrobenzene	8270	*	2	10	8.79	20
n-Nitrosodimethylamine	8270	0.0073	6.1	50	35.0	100
n-Nitroso-di-n-propylamine	8270	0.053	3.2	10	35.8	100
n-Nitrosodiphenylamine	8270	*	2.2	10	8.67	20
Phenol	8270	3146	1.9	30	13.7	20
Chlorinated Dioxins and Furans, pg/g dry wt[c,f]						
2,3,7,8-TCDD	EPA 1613B	0.0001	0.08	0.2	--	--
2,3,7,8-TCDF	EPA 1613B	0.001	0.09	0.2	--	--
1,2,3,7,8-PeCDD	EPA 1613B	0.01	0.36	0.5	--	--
1,2,3,7,8-PeCDF	EPA 1613B	0.01	0.25	0.5	--	--
2,3,4,7,8-PeCDF	EPA 1613B	0.01	0.16	0.5	--	--
1,2,3,4,7,8-HxCDD	EPA 1613B	0.09	0.27	0.5	--	--
1,2,3,6,7,8-HxCDD	EPA 1613B	9.4	0.62	0.5	--	--
1,2,3,7,8,9-HxCDD	EPA 1613B	0.001	0.50	0.5	--	--
1,2,3,4,7,8-HxCDF	EPA 1613B	0.001	0.30	0.5	--	--
1,2,3,6,7,8-HxCDF	EPA 1613B	0.0002	0.37	0.5	--	--
1,2,3,7,8,9-HxCDF	EPA 1613B	0.01	0.28	0.5	--	--
2,3,4,6,7,8-HxCDF	EPA 1613B	0.01	0.29	0.5	--	--
1,2,3,4,6,7,8-HpCDD	EPA 1613B	0.01	0.27	0.5	--	--
1,2,3,4,6,7,8-HpCDF	EPA 1613B	0.01	0.39	0.5	--	--
1,2,3,4,7,8,9-HpCDF	EPA 1613B	0.09	0.42	0.5	--	--
OCDD	EPA 1613B	0.09	1.55	1.0	--	--
OCDF	EPA 1613B	9.4	4.04	1.0	--	--
Total tetrachlorinated dioxins	EPA 1613B	*	--	--	--	--
Total pentachlorinated dioxins	EPA 1613B	*	--	--	--	--
Total hexachlorinated dioxins	EPA 1613B	*	--	--	--	--
Total heptachlorinated dioxins	EPA 1613B	*	--	--	--	--
Total tetrachlorinated furans	EPA 1613B	*	--	--	--	--
Total pentachlorinated furans	EPA 1613B	*	--	--	--	--
Total hexachlorinated furans	EPA 1613B	*	--	--	--	--
Total heptachlorinated furans	EPA 1613B	*	--	--	--	--
PCB Congeners, pg/g dry wt[c,d,f]						
Dioxin-like PCB congeners (WHO list)	1668A					
PCB-77	1668A	10	0.94	50	--	--
PCB-81	1668A	10	0.65	50	--	--
PCB-105	1668A	10	0.68	50	--	--
PCB-114	1668A	2	0.64	50	--	--
PCB-118 (coelution with PCB 106)	1668A	10	2.40	50	--	--
PCB-123	1668A	10	1.00	50	--	--
PCB-126	1668A	0.01	0.33	50	--	--
PCB-156	1668A	2	0.88	50	--	--
PCB-157	1668A	2	0.47	50	--	--

Table 4-3. Parameters, Methods, Reporting Limits, and Detection Limits for MET/SBLT Sediment Samples.

Analytes	Analytical Method	ACG	Project Limits		ARI Limits	
			MDL	MRL[a]	MDL	MRL
PCB-167	1668A	100	0.25	50	--	--
PCB-169	1668A	0.1	0.36	50	--	--
PCB-170	1668A	*	--	50	--	--
PCB-180	1668A	*	--	50	--	--
PCB-189	1668A	10	0.31	50	--	--
187 Non-planar PCB congeners	1668A	*	0.2 - 29	25 - 75	--	--

Notes:

* A risk-based ACG has not been established.

[a] The MRL is provided on a dry-weight basis and assumes 50% moisture in the samples.
The MRL for project samples will vary with moisture content in the samples.
The MRL generally represents the level of lowest calibration standard (i.e., the practical quantitation limit).

[b] Grain-size intervals will include the following:

Medium gravel	Fine sand	Very fine silt
Fine Gravel	Very fine sand	lay, phi size 8-9
Very coarse sand	Coarse silt	Clay, phi size >9
Coarse sand	Medium silt	
Medium sand	Fine silt	

[c] Expected MDLs are shown. MDLs for PCB congeners and dioxins and furans are sample-dependent and

[d] Results for the WHO PCB congeners will be reported to sample-specific MDLs. Method modifications are described in Section B4.4 to improve detection limits if PCBs 126 or 169 are not detected in sediment

[e] Hexachlorobenzene and hexachlorobutadiene will also be analyzed by GC/ECD with the pesticides to improve MRLs.

[f] Chlorinated Dioxins/Furans and PCB Congeners analyses will be conducted by Vista Analytical and will meet project limits.

[g] The analyte Azobenzene includes 1-2 Diphenylhydrazine.

MDL = method detection limit
MRL = method reporting limit
ACG - analytical concentration goals
PCB = polychlorinated biphenyl
WHO = World Health Organization
ARI - Analytical Resources, Inc.
MDL/MRL is less than Analytical Resources, Inc. (ARI) achievable MDL/MRL.

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Table 4-4. Surface Water, MET, SBLT, and TCLP Leachate Sample Analyses Matrix

		ANALYTES[1,2]														
iAOPC	**Sample ID**	**Metals[3]**	**SVOCs**	**PCB Aroclors**	**PCB Congeners**	**Chlorinated Pesticides**	**TPH**	**Dioxins /Furans**	**Cyanide[5]**	**Sulfide**	**Ammonia**	**TSS**	**TDS[4]**	**TOC**	**DOC[5]**	**TCLP Analytes**
1	LWM-SW1	x	x	x	x	x	x			x	x	x	x	x	x	
3	LWM-SW3	x	x	x	x	x	x			x	x	x	x	x	x	
6	LWM-SW6	x	x	x	x	x	x			x	x	x	x	x	x	
7	LWM-SW7	x	x	x	x	x	x			x	x	x	x	x	x	
11	LWM-SW11	x	x	x	x	x	x		x	x	x	x	x	x	x	
13	LWM-SW13	x	x	x	x	x	x	x		x	x	x	x	x	x	
14	LWM-SW14	x	x	x	x	x	x	x		x	x	x	x	x	x	
19	LWM-SW19	x	x	x	x	x	x	x		x	x	x	x	x	x	
21	LWM-SW21	x	x	x	x	x	x	x		x	x	x	x	x	x	
23	LWM-SW23	x	x	x	x	x	x			x	x	x	x	x	x	
24	LWM-SW24	x	x	x	x	x	x			x	x	x	x	x	x	
1	LWM-MET1	x	x	x	x	x	x			x	x	x	x	x	x	
3	LWM-MET3	x	x	x	x	x	x			x	x	x	x	x	x	
6	LWM-MET6	x	x	x	x	x	x			x	x	x	x	x	x	
7	LWM-MET7	x	x	x	x	x	x			x	x	x	x	x	x	
11	LWM-MET11	x	x	x	x	x	x		x	x	x	x	x	x	x	
13	LWM-MET13	x	x	x	x	x	x	x		x	x	x	x	x	x	
14	LWM-MET14	x	x	x	x	x	x	x		x	x	x	x	x	x	
19	LWM-MET19	x	x	x	x	x	x	x		x	x	x	x	x	x	
21	LWM-MET21	x	x	x	x	x	x	x		x	x	x	x	x	x	
23	LWM-MET23	x	x	x	x	x	x			x	x	x	x	x	x	
24	LWM-MET24	x	x	x	x	x	x			x	x	x	x	x	x	
1	LWM-SBLT1-A	x	x	x	x	x	x			x	x	x	x	x	x	
1	LWM-SBLT1-B	x	x	x	x	x	x			x	x	x	x	x	x	
1	LWM-SBLT1-C	x	x	x	x	x	x			x	x	x	x	x	x	
1	LWM-SBLT1-D	x	x	x	x	x	x			x	x	x	x	x	x	
3	LWM-SBLT3-A	x	x	x	x	x	x			x	x	x	x	x	x	
3	LWM-SBLT3-B	x	x	x	x	x	x			x	x	x	x	x	x	
3	LWM-SBLT3-C	x	x	x	x	x	x			x	x	x	x	x	x	
3	LWM-SBLT3-D	x	x	x	x	x	x			x	x	x	x	x	x	
6	LWM-SBLT6-A	x	x	x	x	x	x			x	x	x	x	x	x	
6	LWM-SBLT6-B	x	x	x	x	x	x			x	x	x	x	x	x	
6	LWM-SBLT6-C	x	x	x	x	x	x			x	x	x	x	x	x	
6	LWM-SBLT6-D	x	x	x	x	x	x			x	x	x	x	x	x	
7	LWM-SBLT7-A	x	x	x	x	x	x			x	x	x	x	x	x	
7	LWM-SBLT7-B	x	x	x	x	x	x			x	x	x	x	x	x	
7	LWM-SBLT7-C	x	x	x	x	x	x			x	x	x	x	x	x	
7	LWM-SBLT7-D	x	x	x	x	x	x			x	x	x	x	x	x	
11	LWM-SBLT11-A	x	x	x	x	x	x		x	x	x	x	x	x	x	
11	LWM-SBLT11-B	x	x	x	x	x	x		x	x	x	x	x	x	x	
11	LWM-SBLT11-C	x	x	x	x	x	x		x	x	x	x	x	x	x	
11	LWM-SBLT11-D	x	x	x	x	x	x		x	x	x	x	x	x	x	
13	LWM-SBLT13-A	x	x	x	x	x	x	x		x	x	x	x	x	x	
13	LWM-SBLT13-B	x	x	x	x	x	x	x		x	x	x	x	x	x	

Table 4-4. Surface Water, MET, SBLT, and TCLP Leachate Sample Analyses Matrix

		ANALYTES[1,2]														
iAOPC	**Sample ID**	**Metals[3]**	**SVOCs**	**PCB Aroclors**	**PCB Congeners**	**Chlorinated Pesticides**	**TPH**	**Dioxins /Furans**	**Cyanide[5]**	**Sulfide**	**Ammonia**	**TSS**	**TDS[4]**	**TOC**	**DOC[5]**	**TCLP Analytes**
13	LWM-SBLT13-C	x	x	x	x	x	x	x		x	x	x	x	x	x	
13	LWM-SBLT13-D	x	x	x	x	x	x	x		x	x	x	x	x	x	
14	LWM-SBLT14-A	x	x	x	x	x	x	x		x	x	x	x	x	x	
14	LWM-SBLT14-B	x	x	x	x	x	x	x		x	x	x	x	x	x	
14	LWM-SBLT14-C	x	x	x	x	x	x	x		x	x	x	x	x	x	
14	LWM-SBLT14-D	x	x	x	x	x	x	x		x	x	x	x	x	x	
19	LWM-SBLT19-A	x	x	x	x	x	x	x		x	x	x	x	x	x	
19	LWM-SBLT19-B	x	x	x	x	x	x	x		x	x	x	x	x	x	
19	LWM-SBLT19-C	x	x	x	x	x	x	x		x	x	x	x	x	x	
19	LWM-SBLT19-D	x	x	x	x	x	x	x		x	x	x	x	x	x	
21	LWM-SBLT21-A	x	x	x	x	x	x	x		x	x	x	x	x	x	
21	LWM-SBLT21-B	x	x	x	x	x	x	x		x	x	x	x	x	x	
21	LWM-SBLT21-C	x	x	x	x	x	x	x		x	x	x	x	x	x	
21	LWM-SBLT21-D	x	x	x	x	x	x	x		x	x	x	x	x	x	
23	LWM-SBLT23-A	x	x	x	x	x	x			x	x	x	x	x	x	
23	LWM-SBLT23-B	x	x	x	x	x	x			x	x	x	x	x	x	
23	LWM-SBLT23-C	x	x	x	x	x	x			x	x	x	x	x	x	
23	LWM-SBLT23-D	x	x	x	x	x	x			x	x	x	x	x	x	
24	LWM-SBLT24-A	x	x	x	x	x	x			x	x	x	x	x	x	
24	LWM-SBLT24-B	x	x	x	x	x	x			x	x	x	x	x	x	
24	LWM-SBLT24-C	x	x	x	x	x	x			x	x	x	x	x	x	
24	LWM-SBLT24-D	x	x	x	x	x	x			x	x	x	x	x	x	
1	LWM-TCLP1															x
7	LWM-TCLP7															x
11	LWM-TCLP11A															x
11	LWM-TCLP11B															x
11	LWM-TCLP11C															x
14	LWM-TCLP14A															x
14	LWM-TCLP14B															x
15	LWM-TCLP15															x
18	LWM-TCLP18															x
19	LWM-TCLP19															x
23	LWM-TCLP23															x

Notes
1 - See Table 4-5 for surface water, MET and SBLT elutriate/leachate list of analytes. See Table 6-3 for TCLP leachate analytes.
2 - MET elutriates will be analyzed on both a total and dissolved basis for all selected chemical consituents.
3 - Metals analysis for site surface water samples will be conducted for total (i.e., non-filtered) metals only.
4 - Site water samples will be field filtered for DOC only.
5 - Selected site water, MET and SBLT elutriate/leachate samples will be analyzed for total, amenable, and free cyanide.

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
Conventional Analyses, mg/L							
Total suspended solids	160.2	--	--	--	1.00	N/AV	N/AV
Total dissolved solids	2540 C-97	--	--	--	10.00	N/AV	N/AV
Total organic carbon	5310B	--	--	0.147	1.50	N/AV	N/AV
Dissolved organic carbon	5310B	--	--	0.147	1.50	N/AV	N/AV
Total Cyanide	4500-CN-E	--	--	0.001	0.005	0.0052	0.14
Amenable Cyanide	4500-CN-G	--	--	0.001	0.005	N/AV	N/AV
Free Cyanide[b]	D4282	--	--	--	--	N/AV	N/AV
Total sulfides	376.2	--	--	0.026	0.05	0.002	N/AV
Ammonia	350.1	--	--	0.004	0.01	N/AV	N/AV
Metals, ug/L							
Aluminum	6020	0.3	1	2.96	20.00	87	N/AV
Antimony	6020	0.005	0.05	0.02	0.20	N/AV	5.6
Arsenic	6020	0.05	0.5	0.05	0.20	150	0.018
Cadmium	6020	0.002	0.02	0.02	0.20	0.25	5
Chromium	6020	0.02	0.2	0.03	0.50	74	100
Copper	6020	0.01	0.1	0.11	0.50	9	1300
Lead	6020	0.002	0.02	0.15	1.00	2.5	N/AV
Mercury	7470A	0.02	0.2	0.005	0.10	0.77	N/AV
Nickel	6020	0.03	0.2	0.15	0.50	52	610
Silver	6020	0.002	0.02	0.01	0.20	N/AV	N/AV
Zinc	6010	0.05	0.5	1.05	4.00	120	7400
Petroleum Hydrocarbons, ug/L							
Diesel Range Organics (DRO)	NWTPH-DX	2.7	25	6	25	N/AV	N/AV
Residual Range Organics (RRO)	NWTPH-DX	4.5	100	5.1	50	N/AV	N/AV
Organochlorine Pesticides, ug/L							
2,4'-DDD	8081	0.00078	0.01	*	0.01	N/AV	N/AV
2,4'-DDE	8081	0.0016	0.01	*	0.01	N/AV	N/AV
2,4'-DDT	8081	0.00089	0.01	*	0.01	N/AV	N/AV

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
4,4'-DDD	8081	0.001	0.01	0.00154	0.01	N/AV	0.00031
4,4'-DDE	8081	0.00053	0.01	0.00211	0.01	N/AV	0.00022
4,4'-DDT	8081	0.0014	0.01	0.00226	0.01	0.001	0.00022
Aldrin	8081	0.00083	0.01	0.00155	0.005	N/AV	0.000049
alpha-BHC	8081	0.0025	0.01	0.00165	0.005	N/AV	0.0026
beta-BHC	8081	0.00091	0.01	0.00154	0.005	N/AV	0.0091
delta-BHC	8081	0.00048	0.01	0.00177	0.005	N/AV	N/AV
gamma-BHC (Lindane)	8081	0.0014	0.01	0.00132	0.005	N/AV	0.98
alpha-Chlordane	8081	0.00058	0.01	0.00121	0.005	0.0043	0.0008
gamma-Chlordane	8081	0.00029	0.01	0.00519	0.005	0.0043	0.0008
Oxychlordane	8081	0.0032	0.01	*	0.01	N/AV	N/AV
cis -Nonachlor	8081	0.00093	0.01	*	0.01	N/AV	N/AV
trans -Nonachlor	8081	0.0013	0.01	*	0.01	N/AV	N/AV
Dieldrin	8081	0.00045	0.01	0.00165	0.01	0.056	0.000052
Endosulfan I	8081	0.0005	0.01	0.00109	0.005	0.056	62
Endosulfan II	8081	0.00094	0.01	0.00171	0.01	0.056	62
Endosulfan sulfate	8081	0.00078	0.01	0.00113	0.01	N/AV	62
Endrin	8081	0.00049	0.01	0.00197	0.01	0.036	0.059
Endrin aldehyde	8081	0.00068	0.01	0.00275	0.01	N/AV	0.29
Endrin ketone	8081	0.00062	0.01	0.00331	0.01	N/AV	N/AV
Heptachlor	8081	0.00048	0.01	0.00256	0.005	0.0038	0.000079
Heptachlor epoxide	8081	0.0011	0.01	0.00168	0.005	0.0038	0.000039
Methoxychlor	8081	0.0015	0.01	0.00892	0.05	N/AV	N/AV
Toxaphene	8081	0.14	0.5	*	0.5	0.002	0.00028
Hexachlorobenzene	8081	0.0011	0.01	0.00208	0.005	N/AV	N/AV
Hexachlorobutadiene	8081	0.0067	0.01	0.00203	0.005	N/AV	N/AV
Hexachloroethane	8081	0.0032	0.01	*	0.005	N/AV	N/AV
Mirex	8081	0.0012	0.01	*	0.01	0.001	N/AV
PCB Aroclors, ug/L							
Total PCBs		--	--	--	--	0.014	0.000064

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
Aroclor 1016	8082	0.012	0.2	0.002	0.01	N/AV	N/AV
Aroclor 1221	8082	0.054	0.4	0.002	0.01	N/AV	N/AV
Aroclor 1232	8082	0.028	0.2	0.002	0.01	N/AV	N/AV
Aroclor 1242	8082	0.019	0.2	0.002	0.01	N/AV	N/AV
Aroclor 1248	8082	0.025	0.2	0.0014	0.01	N/AV	N/AV
Aroclor 1254	8082	0.01	0.2	0.0014	0.01	N/AV	N/AV
Aroclor 1260	8082	0.0085	0.2	0.0014	0.01	N/AV	N/AV
Aroclor 1262	8082	0.016	0.2	0.0014	0.01	N/AV	N/AV
Aroclor 1268	8082	0.015	0.2	0.0014	0.01	N/AV	N/AV
Polycyclic Aromatic Hydrocarbons, ug/L							
Acenaphthene	8270-SIM-LL	0.0029	0.022	0.00173	0.01	N/AV	670
Acenaphthylene	8270-SIM-LL	0.0022	0.0022	0.00225	0.01	N/AV	N/AV
Anthracene	8270-SIM-LL	0.002	0.022	0.00173	0.01	N/AV	8300
Benz(a)anthracene	8270-SIM-LL	0.0012	0.022	0.00195	0.01	N/AV	0.0038
Benzo(a)pyrene	8270-SIM-LL	0.0023	0.022	0.00135	0.01	N/AV	0.0038
Benzo(b)fluoranthene	8270-SIM-LL	0.0018	0.022	0.00165	0.01	N/AV	0.0038
Benzo(g,h,i)perylene	8270-SIM-LL	0.0021	0.022	0.00273	0.01	N/AV	N/AV
Benzo(k)fluoranthene	8270-SIM-LL	0.004	0.022	0.00358	0.01	N/AV	0.0038
Chrysene	8270-SIM-LL	0.0015	0.022	0.00191	0.01	N/AV	0.0038
Dibenz(a,h)anthracene	8270-SIM-LL	0.0014	0.022	0.00139	0.01	N/AV	0.0038
Dibenzofuran	8270-SIM-LL	0.013	0.2	0.00247	0.01	N/AV	N/AV
Fluoranthene	8270-SIM-LL	0.0026	0.022	0.00141	0.01	N/AV	130
Fluorene	8270-SIM-LL	0.0028	0.022	0.00359	0.01	N/AV	1100
Indeno(1,2,3-cd)pyrene	8270-SIM-LL	0.0023	0.022	0.00173	0.01	N/AV	0.0038
Naphthalene	8270-SIM-LL	0.0035	0.022	0.00712	0.01	N/AV	N/AV
Phenanthrene	8270-SIM-LL	0.0035	0.022	0.00249	0.01	N/AV	N/AV
Pyrene	8270-SIM-LL	0.0024	0.022	0.00233	0.01	N/AV	830
Semivolatile Organic Compounds, ug/L							

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
Phthalate Esters							
Bis(2-ethylhexyl) phthalate	8270-SIM	0.27	2	0.194	0.2	N/AV	1.2
Butylbenzyl phthalate	8270-SIM	0.026	0.2	0.022	0.1	N/AV	1500
Dibutyl phthalate	8270-SIM	0.027	0.2	0.112	0.2	N/AV	2000
Diethyl phthalate	8270-SIM	0.026	0.2	0.083	0.1	N/AV	17000
Dimethyl phthalate	8270-SIM	0.013	0.2	0.023	0.1	N/AV	270000
Di-n-octyl phthalate	8270-SIM	0.032	0.2	0.046	0.1	N/AV	N/AV
Chlorinated Phenols							
2-Chlorophenol	8270	0.015	0.5	0.189	1.0	N/AV	81
2,4-Dichlorophenol	8270	0.024	0.5	0.664	5.0	N/AV	77
2,4,5-Trichlorophenol	8041	0.025	0.5	0.076	0.25	N/AV	1800
2,4,6-Trichlorophenol	8041	0.037	0.5	0.072	0.25	N/AV	1.4
2,3,4,5-Tetrachlorophenol	8041	NA	NA	0.079	0.25	N/AV	N/AV
Tetrachlorophenol (2,3,4,6 and 2,3,5,6)	8041	NA	NA	0.073	0.25	N/AV	N/AV
Pentachlorophenol	8041	0.029	0.96	0.071	0.25	19	0.27
Other Semivolatile Organic Compounds							
1,2,4-Trichlorobenzene	8270	0.016	0.2	0.196	1.0	N/AV	35
1,2-Dichlorobenzene	8270	0.015	0.2	0.198	1.0	N/AV	420
1,3-Dichlorobenzene	8270	0.011	0.2	0.165	1.0	N/AV	320
1,4-Dichlorobenzene	8270	0.014	0.2	0.203	1.0	N/AV	63
2,4-Dimethylphenol	8270	0.32	2	0.303	1.0	N/AV	380
2,4-Dinitrophenol	8270	0.53	4	1.795	10.0	N/AV	69
2,4-Dinitrotoluene	8270	0.019	0.2	0.861	5.0	N/AV	0.11
2,6-Dinitrotoluene	8270	0.0088	0.2	1.049	5.0	N/AV	N/AV
2-Chloronaphthalene	8270	0.015	0.2	0.167	1.0	N/AV	1000
2-Methylphenol	8270	0.06	0.48	0.163	1.0	N/AV	N/AV
2-Nitroaniline	8270	0.015	0.2	0.670	5.0	N/AV	N/AV
2-Nitrophenol	8270	0.014	0.5	0.839	5.0	N/AV	N/AV

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
3,3'-Dichlorbenzidine	8270	0.43	2	1.114	5.0	N/AV	0.021
3-Nitroaniline	8270	0.23	1	0.754	5.0	N/AV	N/AV
4,6-Dinitro-2-methylphenol	8270	0.013	2	1.813	10.0	N/AV	13
4-Bromophenyl phenyl ether	8270	0.018	0.2	0.227	1.0	N/AV	N/AV
4-Chloro-3-methylphenol	8270	0.029	0.5	0.717	1.0	N/AV	N/AV
4-Chloroaniline	8270	0.017	0.2	0.893	5.0	N/AV	N/AV
4-Chlorophenyl-phenyl ether	8270	0.0084	0.2	0.164	1.0	N/AV	N/AV
4-Methylphenol	8270	0.051	0.5	0.117	1.0	N/AV	N/AV
4-Nitroaniline	8270	0.16	1	0.922	5.0	N/AV	N/AV
4-Nitrophenol	8270	0.54	2	0.898	5.0	N/AV	N/AV
Aniline	8270	NA	1	0.115	1.0	N/AV	N/AV
Azobenzene[d]	8270	NA	NA	0.215	1.0	N/AV	N/AV
Benzoic Acid	8270	1.71	5	3.112	10.0	N/AV	N/AV
Benzyl alcohol	8270	0.43	4.8	0.876	5.0	N/AV	N/AV
Bis-(2-chloroethoxy) methane	8270	0.012	0.2	0.188	1.0	N/AV	N/AV
Bis-(2-chloroethyl) ether	8270	0.014	0.2	0.165	1.0	N/AV	0.03
Bis(2-chloroisopropyl) ether	8270	0.014	0.2	0.159	1.0	N/AV	1400
Hexachlorobenzene	8270	0.0037	0.012	0.208	1.0	N/AV	0.00028
Hexachlorobutadiene	8270	0.0043	0.012	0.236	1.0	N/AV	0.44
Hexachlorocyclopentadiene	8270	0.041	1	0.935	5.0	N/AV	40
Hexachloroethane	8270	0.019	0.2	0.267	1.0	N/AV	1.4
Isophorone	8270	0.0084	0.2	0.196	1.0	N/AV	35
Nitrobenzene	8270	0.0074	0.2	0.199	1.0	N/AV	17
n-Nitrosodimethylamine	8270	0.00026	0.002	0.709	5.0	N/AV	0.00069
n-Nitroso-di-n-propylamine	8270	0.032	0.2	0.751	5.0	N/AV	0.005
n-Nitrosodiphenylamine	8270	0.028	0.2	0.290	1.0	N/AV	3.3
Phenol	8270	0.02	0.48	0.137	1.0	N/AV	21000
Chlorinated Dioxins and Furans, pg/L[c]							

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
2,3,7,8-TCDD	EPA 1613B	1.10	10	--	--	N/AV	N/AV
2,3,7,8-TCDF	EPA 1613B	1.90	10	--	--	N/AV	N/AV
1,2,3,7,8-PeCDD	EPA 1613B	4.04	50	--	--	N/AV	N/AV
1,2,3,7,8-PeCDF	EPA 1613B	4.08	50	--	--	N/AV	N/AV
2,3,4,7,8-PeCDF	EPA 1613B	4.15	50	--	--	N/AV	N/AV
1,2,3,4,7,8-HxCDD	EPA 1613B	4.46	50	--	--	N/AV	N/AV
1,2,3,6,7,8-HxCDD	EPA 1613B	6.98	50	--	--	N/AV	N/AV
1,2,3,7,8,9-HxCDD	EPA 1613B	6.49	50	--	--	N/AV	N/AV
1,2,3,4,7,8-HxCDF	EPA 1613B	5.07	50	--	--	N/AV	N/AV
1,2,3,6,7,8-HxCDF	EPA 1613B	5.03	50	--	--	N/AV	N/AV
1,2,3,7,8,9-HxCDF	EPA 1613B	4.63	50	--	--	N/AV	N/AV
2,3,4,6,7,8-HxCDF	EPA 1613B	6.25	50	--	--	N/AV	N/AV
1,2,3,4,6,7,8-HpCDD	EPA 1613B	4.95	50	--	--	N/AV	N/AV
1,2,3,4,6,7,8-HpCDF	EPA 1613B	2.63	50	--	--	N/AV	N/AV
1,2,3,4,7,8,9-HpCDF	EPA 1613B	4.76	50	--	--	N/AV	N/AV
OCDD	EPA 1613B	19.33	100	--	--	N/AV	N/AV
OCDF	EPA 1613B	12.96	100	--	--	N/AV	N/AV
Total tetrachlorinated dioxins	EPA 1613B	--	--	--	--	N/AV	N/AV
Total pentachlorinated dioxins	EPA 1613B	--	--	--	--	N/AV	N/AV
Total hexachlorinated dioxins	EPA 1613B	--	--	--	--	N/AV	N/AV
Total heptachlorinated dioxins	EPA 1613B	--	--	--	--	N/AV	N/AV
Total tetrachlorinated furans	EPA 1613B	--	--	--	--	N/AV	N/AV
Total pentachlorinated furans	EPA 1613B	--	--	--	--	N/AV	N/AV
Total hexachlorinated furans	EPA 1613B	--	--	--	--	N/AV	N/AV
Total heptachlorinated furans	EPA 1613B	--	--	--	--	N/AV	N/AV
PCB Congeners, pg/L [c]							
Dioxin-like PCB congeners (WHO list)						N/AV	N/AV
PCB-77	1668A	3.23	25	--	--	N/AV	N/AV

Table 4-5. Parameters, Methods, Reporting Limits, and Detection Limits for Surface Water and MET/SBLT Leachate Samples.

Analytes	Analytical Method	Project Limits		ARI Limits		AWQC Criteria	
		MDL	MRL [a]	MDL	MRL	Freshwater CCC	Water + Organism
PCB-81	1668A	3.11	25	--	--	N/AV	N/AV
PCB-105	1668A	7.34	25	--	--	N/AV	N/AV
PCB-114	1668A	3.49	25	--	--	N/AV	N/AV
PCB-118 (coelution with PCB 106)	1668A	31.7	50	--	--	N/AV	N/AV
PCB-123	1668A	2.40	25	--	--	N/AV	N/AV
PCB-126	1668A	2.37	25	--	--	N/AV	N/AV
PCB-156	1668A	2.90	25	--	--	N/AV	N/AV
PCB-157	1668A	2.86	25	--	--	N/AV	N/AV
PCB-167	1668A	2.17	25	--	--	N/AV	N/AV
PCB-169	1668A	4.14	25	--	--	N/AV	N/AV
PCB-189	1668A	2.56	25	--	--	N/AV	N/AV
187 Non-planar PCB congeners	1668A	1.93 - 41.58	25 - 100	--	--	N/AV	N/AV

Notes:

[a]The MRL generally represents the level of lowest calibration standard (i.e., the practical quantitation limit).
[b]Free Cyanide analyses will be conducted by Columbia Analytical Services.
[c]Chlorinated Dioxins/Furans and PCB Congeners analyses will be conducted by Vista Analytical and will meet project limits.
[d]The analyte Azobenzene includes 1-2 Diphenylhydrazine.
*MDL studies are in progress.
MDL = method detection limit
MRL = method reporting limit
PCB = polychlorinated biphenyl
WHO = World Health Organization
AWQC = EPA Ambient Water Qualiaty Criteria
ARI = Analytical Resources, Inc.
N/AV = Not Available
MDL/MRL is less than Analytical Resources, Inc. (ARI) achievable MDL/MRL.
ARI MDL/MRL exceeds AWQC Freshwater CCC criteria.
ARI MDL/MRL exceeds AWQC Water + Organism criteria.
ARI MDL/MRL exceeds both AWQC Freshwater CCC criteria and Water + Organism criteria.

Table 6-1. TCLP Sediment Chemistry Locations and Analyses

iAOPC	Station ID	Core Tube Length (ft)	Sample Location Coordinates		Sample ID	TCLP Analytes[2]
			X	Y		
1	LWM-TCLPC1	16	7617565.50	724363.63	LWM-TCLPCS1	X
7	LWM-TCLPC7	16	7622260.37	708474.85	LWM-TCLPCS7	X
11	LWM-TCLPC11-A	16	7623679.02	705920.83	LWM-TCLPCS11A	X
11	LWM-TCLPC11-B	16	7624555.66	705332.78	LWM-TCLPCS11B	X
11	LWM-TCLPC11-C	16	7624685.19	705385.09	LWM-TCLPCS11C	X
14	LWM-TCLPC14-A	16	7626465.71	704308.06	LWM-TCLPCS14A	X
14	LWM-TCLPC14-B	16	7627881.14	702469.25	LWM-TCLPCS14B	X
15	LWM-TCLPC15	16	7629083.22	704037.03	LWM-TCLPCS15	X
18	LWM-TCLPC18	16	7631210.38	698102.40	LWM-TCLPCS18	X
19	LWM-TCLPC19	16	7633417.00	696807.00	LWM-TCLPCS19	X
23	LWM-TCLPC23	16	7637076.78	699065.10	LWM-TCLPCS23	X

Notes

[1] - Oregon State Plane North. International Feet, NAD 83

[2] See Table 6-2 for the list of TCLP bulk sediment analytes.

Table 6-2. Parameters, Methods, Reporting Limits, and Detection Limits for TCLP Bulk Sediment Analyses.

Parameter	Analytical Method	Method Detection Limit	Method Reporting Limit
Metals		**(mg/kg)**	**(mg/kg)**
Arsenic	6010	0.47	5.0
Barium	6010	0.04	0.3
Cadmium	6010	0.02	0.2
Chromium	6010	0.16	0.5
Lead	6010	0.16	2.0
Mercury	6010	0.005	0.05
Selenium	6010	0.63	5.0
Silver	6010	0.03	0.3
Semivolatiles Organics		**(µg/kg)**	**(µg/kg)**
2-Methylphenol (o-Cresol)	8270D	44.4	67
3-Methylphenol (m-Cresol, coelutes with 4-Methyl phenol)	8270D	-	-
4-Methylphenol (p-Cresol)	8270D	43.9	67
Cresol (sum of 2- and 4-Methyl phenol)	8270D	-	-
2,4-Dinitrotoluene	8270D	148	330
Hexachlorobenzene	8270D	22.4	67
Hexachlorobutadiene	8270D	22.7	67
Hexachloroethane	8270D	22.4	67
Nitrobenzene	8270D	21.5	67
Pentachlorophenol	8270D	131	330
Pyridine	8270D	210	330
2,4,5-Trichlorophenol	8270D	172	330
2,4,6-Trichlorophenol	8270D	156	330
Volatile Organics		**(µg/kg)**	**(µg/kg)**
Benzene	8260C	0.325	1.0
Chlorobenzene	8260C	0.372	1.0
Chloroform	8260C	0.370	1.0
Carbon Tetrachloride	8260C	0.467	1.0
1,4-Dichlorobenzene	8260C	0.094	1.0
1,2-Dichloroethane	8260C	0.37	1.0
1,1-Dichloroethene	8260C	0.428	1.0
2-Butanone (Methyl Ethyl Ketone)	8260C	1.228	5.0
Tetrachloroethene	8260C	0.423	1.0
Trichloroethene	8260C	0.335	1.0
Vinyl Chloride	8260C	0.772	1.0
Pesticides		**(µg/kg)**	**(µg/kg)**
Chlordane, alpha-	8081A	0.645	1.7
Chlordane, gamma-	8081A	0.638	1.7
Endrin	8081A	0.949	3.3

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Table 6-2. Parameters, Methods, Reporting Limits, and Detection Limits for TCLP Bulk Sediment Analyses.

Parameter	Analytical Method	Method Detection Limit	Method Reporting Limit
Heptachlor	8081A	0.803	1.7
Heptachlor epoxide	8081A	1.06	1.7
Lindane	8081A	0.794	1.7
Methoxychlor	8081A	7.568	17.0
Toxaphene	8081A	48.1	170
Herbicides		**(µg/kg)**	**(µg/kg)**
2,4,5-TP (Silvex)	8151	3.41	8.3
2,4-D	8151	13.8	33.0

Table 6-3. Parameters, Methods, Reporting Limits, and Detection Limits for TCLP Leachate Testing.

Parameter	Analytical Method	Method Detection Limit	Method Reporting Limit
Metals		**mg/L**	**mg/L**
Arsenic	6010	0.024	0.2
Barium	6010	0.0036	0.02
Cadmium	6010	0.00075	0.01
Chromium	6010	0.017	0.02
Lead	6010	0.0046	0.1
Mercury	7470A	0.00004	0.0001
Selenium	6010	0.024	0.2
Silver	6010	0.002	0.02
Semivolatiles Organics		**ug/L**	**ug/L**
2-Methylphenol (o-Cresol)	8270D	1.85	10
3-Methylphenol (m-Cresol, coelutes with 4-Methyl phenol)	8270D	-	-
4-Methylphenol (p-Cresol)	8270D	2.3	10
Cresol (sum of 2- and 4-Methyl phenol)	8270D	-	-
2,4-Dinitrotoluene	8270D	9.4	50
Hexachlorobenzene	8270D	2.2	10
Hexachlorobutadiene	8270D	3.2	10
Hexachloroethane	8270D	3.0	10
Nitrobenzene	8270D	1.9	10
Pentachlorophenol	8270D	2.2	50
Pyridine	8270D	1.6	50
2,4,5-Trichlorophenol	8270D	1.6	50
2,4,6-Trichlorophenol	8270D	1.2	50
Volatile Organics		**ug/L**	**ug/L**
Benzene	8260C	0.094	1.0
Chlorobenzene	8260C	0.053	1.0
Chloroform	8260C	0.094	1.0
Carbon Tetrachloride	8260C	0.082	1.0
1,4-Dichlorobenzene	8260C	0.121	1.0
1,2-Dichloroethane	8260C	0.084	1.0
1,1-Dichloroethene	8260C	0.094	1.0
2-Butanone (Methyl Ethyl Ketone)	8260C	1.55	5.0
Tetrachloroethene	8260C	0.097	1.0
Trichloroethene	8260C	0.102	1.0
Vinyl Chloride	8260C	0.116	1.0
Pesticides		**ug/L**	**ug/L**
Chlordane, alpha-	8081A	0.13	0.5
Chlordane, gamma-	8081A	0.08	0.5
Endrin	8081A	0.78	1.0
Heptachlor	8081A	0.11	0.5

Table 6-3. Parameters, Methods, Reporting Limits, and Detection Limits for TCLP Leachate Testing.

Parameter	Analytical Method	Method Detection Limit	Method Reporting Limit
Heptachlor epoxide	8081A	0.09	0.5
Lindane	8081A	0.08	0.5
Methoxychlor	8081A	0.87	5.0
Toxaphene	8081A	-	50
Herbicides		**ug/L**	**ug/L**
2,4,5-TP (Silvex)	8151	1.2	1.2
2,4-D	8151	1.98	5.0

Table 7-1. Sample Containers, Preservation, Holding Times, and Sample Volume.

Sediment	**Containers[1]**		**Preservation**	**Holding Time**	**Sample Size[2]**
	Type	**Size**			
Grain size (sediment)	G/P	16 oz	≤6ºC	6 months	300 g
Specific gravity	G/P	8 oz	≤6ºC	6 months	100 g
Total sulfides	WMG	2 oz	No headspace; 5mL 2N Zn Acetate ≤6ºC (do not freeze)	7 days	5 g
Ammonia	WMG	4 oz	≤6ºC	7 days	40 g
Cyanide	WMG	4 oz	≤6ºC	14 days	50 g
Total organic carbon	WMG	4 oz	Deep Frozen (-20ºC)	6 months	1 g
Mercury	WMG	2 oz	Deep Frozen (-20ºC)	180 days[3]	5 g
Metals and total solids	WMG	4 oz	Deep Frozen (-20ºC)	6 months[4]	10 g
TPH - diesel- and oil-	WMG	8 oz	Deep Frozen (-20ºC)	1 year	20 g
SVOCs	WMG	16 oz	Deep Frozen (-20ºC)	1 year	30 - 60 g
Chlorinated phenols	WMG		Deep Frozen (-20ºC)	1 year	30 g
Pesticides	WMG		Deep Frozen (-20ºC)	1 year	30 g
PCBs	WMG		Deep Frozen (-20ºC)	1 year	30 g
PCDD/PCDFs	WMG	8 oz	Deep Frozen (-20ºC)	1 year	50 g
PCB Congeners	WMG	8 oz	≤6ºC	1 year	50 g
Bulk Sediment (TCLP Parameters)	WMG	16 oz	≤6ºC	NA	100 g
Bulk Sediment (TCLP VOC List)	WMG	1-1/2 oz septa	≤6ºC	NA	5 g
TCLP Test (SV, Pest, Herb, Met)	WMG	16 oz	≤6ºC	NA	100 g
TCLP Test (VOCs)	WMG	8 oz	No headspace; ≤6ºC (do not freeze)	NA	25 g
MET Test	WMG	14 - 32 oz	≤6ºC	NA	8000 g
SBLT Test	WMG	8 - 32 oz	≤6ºC	NA	4500 g

Table 7-1. Sample Containers, Preservation, Holding Times, and Sample Volume.

Water, Elutriate/Leachate	**Containers**		**Preservation**	**Holding Time**	**Sample Size**
	Type	**Size**			
TSS	HDPE	250 mL	≤6ºC	7 days	100 mL
TDS	HDPE	1 L	None	7 days	1 liter
Total Sulfides	HDPE	250 mL	NaOH/ZnAC; ≤6ºC	7 days	50 mL
Ammonia	HDPE	500 mL	H_2SO_4; ≤6ºC	28 days	50 mL
Total Cyanide	HDPE	1 L	NaOH; ≤6ºC	14 days	500 mL
Amenable Cyanide	HDPE	1 L	NaOH; ≤6ºC	14 days	500 mL
Free Cyanide	HDPE	1 L	NaOH; ≤6ºC	14 days	500 mL
TOC	AG	250 mL	H2SO4; ≤4ºC	28 days	50 mL
DOC	AG	250 mL	H2SO4; ≤6ºC	28 days	50 mL
Metals and Mercury	HDPE	500 mL	5 ml of 1:1& HNO_3 & ≤6ºC	6 months	100 ml
TPH - diesel and oil	AG	2- 500 mL	HCl to pH 2; ≤6ºC	14 days/40 days[5]	500 mL
SVOCs	AG	2 - 1 L	Dark; ≤6ºC	7 days/40 days[6]	1 liter
Chlorinated phenols	AG	2 - 500 mL	Dark; ≤6ºC	7 days/40 days[6]	500 mL
Pesticides	AG	2 - 1 L	Dark; ≤6ºC	7 days/40 days[6]	1 liter
PCBs	AG	2 - 1 L	Dark; ≤6ºC	7 days/40 days[6]	1 liter
PCDD/PCDFs	AG	1 L	Dark; ≤6ºC	30 days/45 days[7]	1 liter
PCB Congeners	AG	2 - 1 L	Dark; ≤6ºC	1 year/1 year[8]	1 liter
MET test site water	AG	30 - 1 L	Dark; ≤6ºC	NA	30 liters

Notes:

WMG = Wide Mouth Glass AG = Amber Glass

HDPE = High Density Polyethylene G/P = Glass or Plastic

[1]Size and number of containers may be modified by analytical laboratory.

[2]All samples will need a minimum of 2.5% QA. Collection of 3x normal sample size listed will be necessary.

[3]As approved by EPA (EPA 2000, Humphrey 2002)

[4] Metals (except mercury) may be held at -20ºC for 2 years (PSEP 1986).

[5]Holding time is 14 month to extraction and extracts must be analyzed within 40 days from extraction.

[6]Holding time is 7 days to extraction and extracts must be analyzed within 40 days from extraction.

[7]Holding time is 30 days to extraction and extracts must be analyzed within 45 days from extraction.

[8]Holding time is 1 year to extraction and extracts must be analyzed within 1 year from extraction.

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Table 7-2. Field QC Samples Collection Summary for Sediment Samples.

Sample Type	**Frequency**
Temperature Blanks	1 per cooler
Blind Field Splits (sediment and surface water only)	2.5 percent
Field Trip Blanks (VOC analysis only)	1 per cooler

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Table 7-3. Summary of Estimated Numbers of Sediment Chemical Mobility Field QC Samples[1].

Sample Type	Samples	Blind Field Sample Splits	Total Number of Field Samples
Surface Water			
Conventionals	11	1	12
Metals	9	1	10
SVOCs	6	1	7
PCB Aroclors	9	1	10
PCB Congeners	9	1	10
Pesticides	6	1	7
Total Petroleum Hydrocarbons	7	1	8
Dioxins/Furans	6	1	7
Sediment			
Conventionals	11	1	12
Metals	9	1	10
SVOCs	6	1	7
PCB Aroclors	9	1	10
PCB Congeners	9	1	10
Pesticides	6	1	7
Total Petroleum Hydrocarbons	7	1	8
Dioxins/Furans	6	1	7
TCLP Analytes[2]	11	1	12

[1]All sediment samples will be analyzed for total solids, grain size, and total organic carbon. All surface water samples will be analyzed for TSS, TDS, TOC, and DOC. Surface water samples will be field filtered for DOC.

[2] TCLP split sample will be taken from a TCLP sediment composite sample. Field QC sample numbers based on a frequency of 2.5%

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Figures

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Appendix A – Sample Processing SOP and MET SOP

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Standard Operating Procedure

Sample Processing
ASTM

SOP 1128
Revision 001

Revision Date: 5/21/07
Effective Date: 5/21/07

Prepared By:

_____

Approvals:

_____
Laboratory / Section Manager

_____
Quality Assurance

Annual Review

SOP Number:	1128S
Title:	Sample Preparation
Revision:	001
Revision Date:	5/21/07
Effective date:	5/22/07

The ARI employee named below certifies that this SOP is accurate, complete and requires no revisions.

Reviewer's Name	Reviewer's Signature	Date

1.0 Scope and Application

This procedure describes methods, materials, equipment, and special conditions required to prepare samples for testing. The procedure applies to sample preparation for all testing in the Geotechnical laboratory.

2.0 Materials and Equipment

2.1 RIFFLE SAMPLERS -- A device with at least 12 chutes to divide a sample into two parts. It usually includes at least two pans to catch the soil and a soil pan from which the soil is poured over the chutes. The sampler may have fixed width chutes, such as ¾ inch or 1 inch, or it may have adjustable width chutes.

2.2 STAINLESS STEEL OR HDPE BOWLS AND BINS – Large containers in which to mix a sample. Depending on the job, these may be cleaned containers or not.

2.3 SHOVEL – A blunt nosed or flat shovel used for scooping soil of a flat surface.

2.4 SPOONS, SCOOPS AND TROWELS – Hand tools to mix and transfer soil.

2.5 LABORATORY HOODS – Exhaust hoods for working with dusty or hazardous soils.

2.6 LABORATORY MIXER – This can be either a bench top “Kitchen Aide” type mixer or a mixer paddle on a motor, used to mix samples.

2.7 MOTAR and RUBBER TIPPED PESTLE

2.13 DEIONIZED WATER

3.0 Procedure

3.1 AIR DRYING A SAMPLE

3.1.1 Remove samples from storage and verify ID numbers. Notify supervisor of any ID discrepancies. Label and weigh a tare pan for each sample..

3.1.2 Homogenize each sample incorporating any freestanding liquid. Remove the entire sample from its container and place in a bowl or bin. Take an aliquot of the sample for as-received moisture content, according to SOP 1103. Spread the reduced sample in the pan to air dry at room temperature. The sample can be mixed periodically during this period to facilitate drying, or placed in a laboratory hood so that the air flow will speed the process.

3.2 SAMPLE SIZE REDUCTION USING A RIFFLE SAMPLER

3.2.1 Remove sample from refrigerator and check ID numbers. Notify supervisor of any ID discrepancies.

3.2.2 Homogenize sample incorporating any freestanding liquid. This may be done using bowls and spoons or a mechanical mixer, depending on the sample size and end use of the sample.

3.2.3 A wet sample (more than damp), can’t be used in a riffle splitter. Air dry the sample before using the riffle sampler.

3.2.4 Select a sampler based on the largest particle in the sample. The sampler should have chutes that are larger than the largest particle present. If the sampler will fit, set up the riffle sampler in a hood, with two pans underneath and in position to receive the sample splits.

3.2.5 Slowly pour the sample into the hopper of the sampler and let the soil fall through the chutes and into the receiving pans. Continue with another portion until the entire sample has passed through the sampler at least once. Randomly select one receiving pan to continue with, and set the soil in the other pan aside. Pour the soil through the sampler as many times as necessary to reduce the sample volume to the desired size.

3.3 SAMPLE SIZE REDUCTION BY QUARTERING

3.3.1 Place the sample on a clean, smooth and flat surface such as the floor for large sample or on a bench top or in a bin.

3.3.2 Mix the soil by scooping it into a conical pile. Using the shovel, flatten the top of the pile down and scoop from the edges toward the middle and rebuild the pile. Continue until the material is thoroughly mixed. If the soil is too dry, segregation may occur during this process. If allowed by the test parameters, add DI water to moisten the soil and reduce dust and segregation.

3.3.3 Flatten the pile as before, and scribe two lines at 90 degrees in the soil. Using great care, remove the soil from opposite quadrants and set aside. Remix the remaining soil and repeat the process until the remaining soil volume is appropriate for the testing requested.

3.4 SAMPLE COMPOSITING

3.4.1 When multiple samples must be combined into a single larger sample, they must be adequately mixed together. Usually a compositing scheme is prepared by the client that describes the amount of each sample to be used in preparing the composite sample. It is preferred that the compositing be on a volume basis, as this does not require taking moisture contents on each individual sample. Verify that adequate sample volumes are available before beginning the process.

3.4.2 Each individual sample must be adequately homogenized prior to beginning. This may require adding DI water to prevent excessive dust or segregation of particles. It may also require the removal of oversize particles. Record the type (wood, rock, shell, etc.) and amount of oversized material that is removed. Mix the sample using either a spoon or mechanical mixer. A minimum of 50 spoon strokes or 30 sec of mechanical mixing is required.

3.4.3 Once the individual samples are ready to go, select an adequately sized bowl or bin for the composite. Place each individual aliquot in the compositing bowl. Thoroughly mix the composite using either a spoon or mechanical mixer. After the composite looks thoroughly mixed, mix it for an additional 200 spoon strokes or 2 minutes with a mechanical mixer. Once the mixing is complete, take an aliquot of soil for moisture content, per SOP 1103. Spoon the composite sample into either the test apparatus or into storage jars.

3.4.4 If the sample is to be used for chemical tests, the composite may need to be prepared in an anaerobic chamber to prevent oxidation of the sediment and chemical species. Prepare the chamber as described in SOP 1114.

4.0 CALCULATIONS

The only calculations for this SOP are related to compositing schemes and are project specific. Sample calculations will be provided with the final report.

5.0 SAFETY

5.1 LAB WEAR – Lab wear including a lab coat, safety glasses or goggles, dust masks, and gloves should be worn at all times.

5.2 FINE DUST – Care should be taken not to inhale fine dust while processing a sample, use a dust mask if necessary. If samples are known to be hazardous, sample handling shall be done under a hood or in a chamber.

6.0 CORRECTIVE ACTION

6.1 Note any sample inconsistencies, excluded material or anomalous findings on the project data sheets or a “green sheet.”

7.0 REPORT

The report shall include the following:

7.1 Maximum size of particles encountered.
7.2 Description of samples including any excluded material.
7.3 The type mixer used, hand or mechanical and the approximate total mixing time.
7.4 The type of sample reduction used (riffle sampler or quartering).
7.5 The use of any water to reduce dust or segregation of particles.

8.0 REFERENCES

ASTM C-702, “Standard Practice for Reducing Samples of Aggregate to Testing Size,” Annual Book of ASTM Standards, American Society for Testing and Materials, West Conshohocken, Pennsylvania.

ASTM C-75, “Practice for Sampling Aggregates,” Annual Book of ASTM Standards, American Society for Testing and Materials, West Conshohocken, Pennsylvania.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Standard Operating Procedure

Modified Elutriate Test
EPA 823-B-98-004

SOP 1110
Revision 001

Revision Date: 9/25/05
Effective Date: 4/1/03

Prepared By:

Harold Benny

Approvals:

Harold Benny
Laboratory / Section Manager

David R Mitchell
Quality Assurance

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Annual Review

SOP Number:	1110S
Title:	Modified Elutriate Test
Revision:	001
Revision Date:	9/25/05
Effective date:	4/1/03

The ARI employee named below certifies that this SOP is accurate, complete and requires no revisions.

Reviewer's Name	Reviewer's Signature	Date

1.0 PURPOSE AND SCOPE

This procedure describes the method, materials, equipment, and special conditions required to perform the modified elutriate test.

2.0 EQUIPMENT

2.1 Glass carboy or other container for holding the sample
2.2 Large Spoon or Spatula
2.3 Wash Bottle
2.4 Laboratory Mixer – A standard laboratory mixer with a bowl, shaft, and paddle that are compatible with the chemical analysis to follow the extraction step.
2.5 Centrifuge and bottles (optional depending on analysis)
2.6 Balance (Capable of precision to 0.01g)
2.7 Aeration apparatus
2.8 Filtration Equipment and 0.45μm Filters (Compatible with the tested analytes)
2.9 Sample Bottles

3.0 REAGENTS

3.1 Concentrated Hydrochloric Acid (Used for optional filter process)

4.0 DEFINITIONS

4.1 Mixer – A laboratory mixer capable of stirring and/or agitation of the sample slurry
4.2 Elutriate – To purify, separate, or remove by washing.

5.0 DOCUMENTATION

5.1 Standard/Modified Elutriate Test #F63

6.0 PROCEDURE

A careful review of the chemical analyses that the elutriate sample will be subjected to must be performed. Take care to include both "total" and "dissolved" analyses. Record the sample volume for each analysis and sum them. When the sediment is sandy, multiply this total volume by 1.3. If the sediment is clayey, multiply the total by 1.5. This will provide enough sample volume for all of the analyses, and provide enough water to leave a layer of undisturbed water over the settled solids. This exercise then determines the scale of the remainder of the test. Select and prepare appropriate sizes of glassware and mass of sediment and volumes of water for testing.

6.1 PREPARATION OF THE SAMPLE

6.1.1 Prior to use, all glassware and equipment should be thoroughly cleaned and decontaminated. (See Glassware Prep and Decontamination of Laboratory Equipment, Procedure 116)
6.1.2 Remove sample from refrigerator and check client ID numbers. Notify supervisor of any ID discrepancies.
6.1.3 Homogenize the sample using a large spoon or spatula. Subsample a small portion of the sediment and run a moisture content determination according to SOP #1103. Return the sample to the refrigerator until the results of the moisture content test are available. From

this data, calculate the mass of sediment and volume of water required, according to the calculations shown in section 7.0.

6.1.4 Slowly scoop the sediment into the preparation container using a large spoon funnel. Rinse sample retained on funnel into the container using a wash bottle filled with extraction water.

6.1.5 The actual amount of water to be added is determined by volumetric displacement. Add sample liquid provided by the client (usually obtained from the dredging or disposal site) into the preparation container with the sediment sample until the volume required is obtained.

6.1.6 The combined sediment to water ratio of is 150 g/L.

6.1.7 Mix the slurry with laboratory mixer for 5 minutes to a uniform consistency containing no agglomerations of sediment.

6.2 PREPARATION OF THE ELUTRIATE

6.2.1 Assemble the tubing necessary to aerate the test sample, and insert the tubing into the sample bottle/carboy to within 1/4 inch of the bottom of the container. Open the supply valve and adjust the flow until a vigorous mixing is occurring. Aerate the material for 60 minutes.

6.2.2 After the aerating process is complete, allow the mixture to settle for expected mean field retention time up to 24 hours. If the field mean retention time is not known, allow settling for 24 hours.

6.2.3 Prepare preserved sample bottles if needed (see Procedure SAMPLE BOTTLE PREP, Number 137 Rev. 0).

6.2.4 Siphon off the supernatant without disturbing the sediment using the J-tube device into appropriate sample bottles. Record the date, time of siphoning and your initials on a data sheet.

6.3 CENTRIFUGATION

6.3.1 Centrifugation is an optional step, depending on the analysis requested.

6.3.2 Place centrifuge bottle on balance. Fill bottle with supernatant choosing a weight to fill all bottles to balance centrifuge. Use a disposable pipette necessary. Label centrifuge bottles.

6.3.3 Place in refrigerated centrifuge and spin for 30 minutes at a speed appropriate for the centrifuge bottle.

6.3.4 Prepare preserved sample bottles, if needed (see Procedure SAMPLE BOTTLE PREP Number 137 Rev. 0).

6.3.5 Carefully remove centrifuge bottles from centrifuge. Decant supernatant into the labeled sample bottle without transferring solids. Use disposable pipette if necessary.

6.3.6 Record time and estimated recovery of supernatant on data sheet and refrigerate sample.

6.4 FILTRATION

6.4.1 Filtration is an optional step, depending on the analysis requested.

6.4.2 Set up filtering apparatus. REGL uses filtering chamber that holds sample bottle and accommodates the filtering funnel that houses the filter.

6.4.3 Using lab tweezers, carefully remove the appropriate filter from DI bath and place on filtering funnel. Pre-rinse filters with concentrated HCl acid and DI water, and store them in DI water bath.

6.4.4 Place labeled sample bottle in chamber and screw on lid. Place filtering funnel in hole on lid. Connect vacuum hoses.

6.4.5 Turn on vacuum pump and slowly pour sample into filtering funnel. Do not splash sample out of funnel or over fill. Continue until all sample has passed filter.

6.4.6 Remove sample bottle from chamber, preserve, if necessary and refrigerate.

7.0 CALCULATIONS

7.1 Calculation of the amount of elutriate sample required. On the data sheet, list all of the analyses to be conducted on the elutriate sample, including both dissolved and total analyses. Fill in the volumes required for each analysis, and total the volumes to obtain a total elutriate sample volume. Multiply this volume by the appropriate number. This is the amount of water required to complete the test.

7.2 Calculation of the amount of sediment required. Multiply the amount of water required, in liters, by 150. This provides the mass of dry sediment required. Multiply the dry sediment weight by one plus the moisture content to obtain the amount of moist sediment required. This is the weight of sediment needed for testing.

8.0 SAFETY

8.1 LAB WEAR – Wear a lab coat and use safety glasses or goggles and gloves.

8.2 SPILLED SAMPLES - Attempt to brush a sample spilled in any process of this procedure into a pan. Keeping lab surfaces clean in order to recover spilled samples is extremely important. Report un-recoverable samples to your supervisor.

9.0 REFERENCE

9.1 Dredged Material Testing Manual, February 1991

9.2 United States Environmental Protection Agency, Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (Draft), June 1994

9.3 US Army Corps of Engineers Waterway Experiment Station Environmental Laboratory, Environmental Effects of Dredging Technical Notes, June 1985.

Appendix B – SBLT SOP

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Analytical Resources, Incorporated
Analytical Chemists and Consultants

Standard Operating Procedure

Sequential Batch Leach Test

SOP 1125
Revision 000

Revision Date: 3/5/08
Effective Date: 3/5/08

Prepared By:

Harold Berry

Approvals:

Harold Berry
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Sequential Batch Leach Test
U.S. Army Corps of Engineers

1.0 PURPOSE AND SCOPE

This procedure describes methods, materials, equipment, and special conditions required to determine guidance on the conduct of the anaerobic sequential batch leach testing.

2.0 EQUIPMENT

2.1 Leaching Bottles, of a size and composition suitable for the analytes and volumes required
2.2 Balance with precision to ± 0.01g for samples having mass of 200g, and a precision of 0.1g for samples over 200g.
2.3 Nitrogen Chamber of sufficient size to contain centrifuge bottles, sediment, and balance.
2.4 Glass fiber filter, 1μm, 47mm diameter, binder free
2.5 Glass fiber prefilter, 4 μm, 47mm diameter, binder free
2.6 Cellulose acetate filters, 0.45 μm, 47mm diameter
2.7 Filtration manifolds for organics and metals
2.8 High capacity tumbler
2.9 Muffle furnace
2.10 Oxygen meter

3.0 REAGENTS

3.1 Deionized water
3.2 Concentrated HCl
3.3 Concentrated HNO_3

4.0 PROCEDURE

4.1 For organic contaminant leaching, use clean stainless steel or glass centrifuge bottles, stainless steel spatulas, and glass filtration apparatus. Combust glass fiber filter and prefilter at 400°C for 15 minutes.
4.2 For metal contaminant leaching, use clean polycarbonate centrifuge bottles, stainless steel spatulas, and polycarbonate filtration apparatus.
4.3 Prepare forms and labels. Measure the moisture content, following SOP 1103, and calculate solids and water content and required weights of water and sediment to achieve a water-to-solids ratio of 4:1 (weight of pore water + weight of DI water/dry weight of sediment).
4.4 Seal the glove box, purge with nitrogen until oxygen meter registers less than 1 percent. Ensure that a slight overpressure of nitrogen exists inside the glove box. This can be determined by observation of a slight expansion of the rubber gloves attached to the glove box.
4.5 Add all necessary equipment to the glove box through the airlock. Continue to purge box with nitrogen to remove any residual oxygen.
4.6 In the glove box, homogenize the sediment to ensure uniformity. Place a centrifuge bottle with cap on the balance and record the weight. Tare the centrifuge bottle and cap and load with sediment to the desired weight. Record the weight of the sediment added. Tare the centrifuge bottle, cap, and added sediment and add DI water to bring the final water-sediment ratio to 4:1. Wipe sediment from any surface that contacts the O-ring of the leakproof top. Record the weight of DI water, then zero the balance and record the weight of bottle cap, sediment, and leach water. Bottles should be loaded in pairs to balance to within 0.1g. For organic contaminants, multiple bottles may be required to obtain sufficient leachate for chemical analysis.

4.7 Ensure that all centrifuge bottles are sealed, then remove the bottles from the glove box and transfer them to a tumbler. Tumble the samples for 24 hours at a rate of 40 rpm. Record the time tumbling starts and stops.

4.8 Remove the centrifuge bottles from the tumbler and place paired bottles opposite one another in a refrigerated centrifuge. Centrifuge stainless steel bottles at 6,500 x g for 30 minutes. Centrifuge glass bottles at 1,000 x g for 30 minutes. Centrifuge polycarbonate bottles at 6,500 x g for 30 minutes.

4.9 Assemble the decontaminated filtration apparatus. For organic contaminants, the 4-µm prefilter is placed over the 1-µm glass fiber filter. Filter the samples; maintaining a nitrogen atmosphere over the samples while filtration is ongoing. Acidify leachate for organic analysis with 1 mL of concentrated HCl per liter of leachate to prevent iron precipitation and organic scavenging, then transfer sample to a precleaned, 1L amber glass bottle. Bottles for analysis of organic contaminants should be filled to the top. For metals, much the same procedure is followed. Filter the sample through a 0.45- filter and acidify with 1 mL of concentrated nitric acid per liter of leachate. Transfer leachate samples to plastic bottles for storage and analysis.

4.10 In the deoxygenated glove box, record the weight of the centrifuge bottle with lid and sediment after filtering. Repeat with remaining samples.

4.11 Add DI water to the centrifuge tubes to bring them back to the same water-to-solids ratio of 4:1. Record the weight of bottle with lid, DI water, and sediment. Repeat with remaining samples.

4.12 Tumble samples and centrifuge as described in 4.7 thru 4.9. Repeat a minimum of four times.

4.13 Using DI water, prepare and run a procedure blank according to the procedure described above for one cycle.

4.14 Clean workstation when work is finished. Initial and date data sheet.

5.0 SAFETY

5.1 Lab wear including a lab coat, safety goggles, and gloves should be worn at all times.

5.2 Keep workstation clean at all times. Wipe any spills to avoid safety hazards.

6.0 REPORT

7.1 A report summarizing the testing, including any anomalies in the samples or methods shall be prepared. Included in the report will be a summary table listing the results of any water tests such as pH, Eh, conductivity, etc. that are run.

8.0 REFERENCES

8.1 Leachate Test and Evaluation for Freshwater Sediment, USACOE-WES Misc. Report D-94-1

8.2 Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual, USACOE, ERDC/EL TR-03-01

Appendix C – TCLP Extraction SOP

DO NOT QUOTE OR CITE
This document is currently under review by U.S. EPA and its federal, state and tribal partners and is subject to change in whole or in part.

Standard Operating Procedure

TCLP Extraction for Nonvolatile Organic & Inorganic Parameters SW-846 Method 1311 ARI Prep Code: LEN/LEM

SOP 531S
Revision 009

Revision Date: 9/14/07
Effective Date: 9/14/07

Prepared By:

Jay Kuhn

Approvals:

Laboratory Manager

David R Mitchell

Quality Assurance

Annual Review

SOP Number:

Title: TCLP Extraction for Nonvolatile Organic & Inorganic Parameters SW-846 Method 1311 ARI Prep Code: LEN/LEM

The ARI employee named below certifies that this SOP is accurate, complete and requires no revisions

Name	Reviewer's Signature	Date

1. Scope and Application

1.1. This is the Toxicity Characteristic Leaching Procedure (TCLP) extraction procedure designed to determine the mobility of both nonvolatile organic and inorganic contaminants present in liquid, solid, or multiphase wastes. Samples prepared by this method will be labeled with preparation code “LEN” or, in the case of Mercury, “LEM.”

2. Summary of the Procedure

3. Definitions

3.1. TCLP - Toxicity Characteristic Leaching Procedure

3.2. RPM - Revolutions per minute. The number of revolutions an extractor makes over a time period of one minute.

4. Interferences

5. Safety

5.1. The toxicity or carcinogenicity of each reagent used in this SOP is not been precisely defined. Treat each chemical compound as a potential health hazard. Reduce exposure to all chemicals to the lowest possible level by whatever means available.

5.2. Always wear appropriate PPE (personal protective equipment) when working in the Organics Extraction Laboratory. Gloves, safety glasses, ear protection, lab coats, respirators, face shields, etc. are provided for your protection

5.3. DO NOT attempt to cleanup acid spills in the laboratory. Immediately evacuate the area and contact a member of the Emergency Response Team (ERT).

5.4. Material Safety Data Sheets (MSDS) that outline hazards, exposure treatments and regulatory guidelines are available for all chemicals used in this procedure and should be consulted as the need may arise. The MSDS file is located in the central project management area. MSDS are also available online, at http//hazard.com/MSDS/.

5.5. Environmental Samples may contain hazardous waste; treat them as potential health hazards.

5.6. Dispose of all unwanted, broken glassware into a broken glassware disposal box. Inspect every piece of glassware. Do not glassware that is chipped, cracked, etched, or scratched. Glassware with minor damage should be set aside for repair.

6. Equipment and Supplies

6.1. Equipment

6.1.1. Personal protective equipment (PPE)

6.1.1.1. Gloves

6.1.1.2. Laboratory coat

6.1.1.3. Goggles

6.2. Extraction vessels, 2000 mL borosilicate glass and 1000 mL acid-rinsed HDPE.

6.3. Teflon film.

6.4. Beakers, 500 mL.

6.5. Watch glasses, 90 mm flat.

6.6. Magnetic stir bars, Teflon coated.

6.7. pH Meter, accurate to 0.05 units at 25 deg. C, calibrated daily and checked against a reference buffer.

6.8. End-over-end rotator, tested before each use for proper rpm (30 2 rpm).

6.9. Stopwatch or timer.

6.10. Filter holder.

6.11. Filter flask.

6.12. Filter, borosilicate glass microfiber, 42.5 mm and 110 mm diameter, 0.6 - 0.8 mm pore size, acid-rinsed with 5% Nitric Acid followed by deionized water.

6.13. Polyethylene 50 mL HotBlock tubes.

6.14. Amber glass sample bottles, 250 mL, 500 mL, and 1000 mL.

6.15. Carboy, 20 L, Nalgene.

6.16. Standard sieves, 1 mm and 9.5 mm (.375”).

6.17. Laboratory balance, accurate to within 0.1g, calibrated regularly and tracked by QA officer and/or supervisor.

6.18. Thermometer, NIST traceable.

6.19. Hydrochloric Acid (1N), HCl: use trace metal grade HCl that has been lot QC checked.

6.20. Nitric Acid, HNO3: use trace metal grade HNO3 that has been lot QC checked.

6.21. Glacial Acetic Acid (1N), HOAc (low metals).

6.22. Sodium Hydroxide (1N), NaOH: dissolve 40 grams of NaOH pellets in 1000 mL of deionized water. Mark reagent bottle with the date, reagent number, and initial.

6.23. Hotplate.

7. Reagents and Standards

7.1. Extraction Fluids

7.1.1. Fluid #1: Add 5.7 mL glacial acetic acid to 500 mL deionized water. Add 64.3 mL of 1.0N NaOH and dilute to 1000 mL. Measure pH, it should be (4.93, 0.05). If the pH is not within the above specification, the fluid should be discarded and fresh extraction fluid prepared. This reagent is usually prepared in a 20 liter carboy using 114 mL of glacial acetic acid and 1286 mL of

1.0N NaOH with 20 L deionized water. Label the carboy with the date, reagent batch number and initial.

7.1.2. Fluid #2: Add 11.4 mL of glacial acetic acid to 2000 mL deionized water. Measure pH, it should be (2.88, 0.05). If the pH is not within the above specification, the fluid should be discarded and fresh extraction fluid prepared. Any amount of excess extraction fluid that is to be saved for later use should be labeled as described in step 3.22.1.

7.1.3. NOTE: These extraction fluids should be monitored frequently for impurities. The pH should be checked and recorded in the Reagent Logbook prior to use to ensure the fluids are accurately mixed. If impurities are found, or the pH is not within the above specifications, the fluid should be discarded and fresh extraction fluid prepared.Reagents and Standards

8. Sample Collection, Preservation, Shipment and Storage

8.1. Some samples are shared with the organics and or conventionals laboratories. These samples are placed in a share bin in Refrigerator 5. SOP 1019S includes procedures for handling shared samples.

9. Quality Control

9.1. The purity of the extraction fluids is monitored for purity by the analysis of method blank samples. Each extraction batch includes at least one method blank sample for each extraction fluid used in the preparation of the batch.

9.2. Extraction fluids are tested for pH prior to use. (See step 3.22)

9.3. The balances and pH meter are calibrated according to the appropriate SOPs.

9.4. Matrix spike and duplicate samples are prepared after the extraction by splitting the extract into two or more aliquots after extraction. Appropriate samples volumes need to be filtered to ensure enough extract will be available. For samples being analyzed without digestion spiking solutions are added at the instrument. For samples to be digested follow the appropriate SOP in 6.2.1.2. A spike and duplicate need to be analyzed with each job and/or batch, not greater than 20 samples. The sample to be used for QC purposes is specified in the job folderFor each extraction fluid used, a method blank is extracted along with the rest of the job and/or batch, not greater than 20 samples.

10. Calibration and Standardization

10.1. The pH Meter must be calibrated before each use.

10.1.1. Calibrate the pH meter according to manufacturers instructions using 2-point calibration (pH 4 and 7).

10.1.1.1. Touch "**std**" on the screen to access standardization

10.1.1.2. Touch "**clear**" to delete the previous standardization

10.1.1.3. Place electrode into the pH 4 buffer solution and gently stir. The meter will automatically recognize the buffer and will accept its value when the reading is stable. The word "STABLE" will appear on the screen along with a beaker icon and the pH value. The meter will return to the measure mode.

10.1.1.4. Repeat the process for the pH 7 standard.

10.1.2. Enter the calibration data into the "TCLP Extraction Fluid Logbook" each time the meter is calibrated.

11. Procedure

11.1. Perform Preliminary Determinations:

11.1.1. Determine percent solids: For most samples this is performed by vacuum filtration. For all clients requiring strict method compliance, with samples that have a solids content (>10%) or are not highly granular liquid-containing wastes will be done using pressure filtration.

11.1.1.1. Homogenize the sample. If the sample does not appear to be moist and obviously contains no filterable liquid, then the sample is assumed to be dry and consist of 100% solids. In this case, the sample is classified as a Solid Waste. Proceed to step 6.1.2. Otherwise, follow steps B1 through B11 on the bench sheet to determine the percent solids of the sample. First weigh the filter flask, enter the value in section B1 then weigh the funnel and filter paper and record in B2 and B3. Assemble the filter apparatus and weigh a weighing boat, record the weight in B4. Next weigh up to 100 grams of sample into the weigh boat, do not zero the balance, and record the weight of the boat plus the sample in section B5. Transfer sample to the weighed filtering apparatus. At this point zero the balance an reweigh the boat with any sample residue remaining and record this weight in section B6. Calculate the weight of the sample filtered, B7 on the bench sheet. NOTE: use a full 100 grams if enough sample is available. If the client requests strict adherence to Method 1311, a minimum of 100 grams and pressure filtration must be used.

11.1.1.2. Filter the weighed sample, using only one acid-rinsed filter. Gradually apply vacuum or gentle pressure of 1-10 psi to the filter until air/liquid starts moving through it. When no liquid has passed through the filter for a period of about 2 minutes increase the vacuum or pressure at 10 psi increments again until air/liquid starts to again move through the filter. Again wait until no liquid has passed through the filter for 2 minutes and

repeat by continuing to increase vacuum or pressure to a maximum of 50 psi until no liquid will pass for the given period of time (2 minutes). NOTE: Application of instantaneous vacuum or pressure may cause the filter to plug, care should be taken. Do not under any circumstances replace the original filter with a fresh filter. Centrifugation may be used as an aid to filtration. If the TCLP extract of the sample will not be analyzed for metals, the filter does not need to be acid rinsed. If no liquid passes through the filter, then the sample is 100% solids and is classified as a Solid Waste. Proceed to step 6.1.2.

11.1.1.3. Determine the weight of the flask plus the filtrate and record the value in B8. Calculate the weight of the filtrate, B9, by subtracting the weight of the flask, B1, from the weight of the flask and the filtrate contained inside, B8. The (wet) percent solids, B10, is 100 times the solid weight, B7 minus B9, divided by the sample weight B7. If the same subsample used for percent solids determination will also be used for the extraction, include the filter with the solid phase during the extraction process. Record the (wet) percent solids B10 in the logbook. If the percent solids is less than 0.5%, then the sample is classified as a Liquid Waste. Proceed to step 6.2.1 (Method 1).

11.1.1.4. NOTE: Some wastes, such as oily wastes and some paint wastes, will obviously contain some material that appears to be a liquid. Even after applying vacuum and/or pressure filtration, this material may not filter. If this is the case, the material within the filtration device is defined as a solid. Before proceeding with these types of samples, the project manager and/or the division manager should be consulted so the client can be informed as to the potential problems.

11.1.1.5. Calculate the weight ratio of solid to liquid, B11, by dividing the weight of subsample filtered, B7 minus B9, by the weight of initial filtrate B9. Record this ratio.

11.1.2. Determine extraction fluid:

11.1.2.1. If necessary, crush, cut, or grind 5 or more grams of sample so that it has a particle size of 1 mm or less, a 1mm standard sieve can be used, if required, to ensure proper particle size.

11.1.2.2. Weigh 5.0 grams of solid into a 500 mL beaker and add a magnetic stir-bar and 96.5 mL of deionized water. Stir vigorously for 5 minutes. Measure and record pH, C1 on the bench sheet. If pH is 5.0 then use Extraction Fluid #1 and proceed to step 6.1.3.

11.1.2.3. If the pH is <5.0 then add 3.5 mL 1N HCl, mix, cover, heat to 50 C and hold for 10 minutes then cool for 30 minutes or to room temperature. Measure the pH, record C2 on the bench sheet. If it is 5.0, use Extraction Fluid#1. Otherwise, use Extraction Fluid #2.

11.2. TCLP Extraction of Liquid, Solid and Multiphase Wastes.

11.2.1. Method I: Liquid Wastes

11.2.1.1. Filter enough sample for all analyses. The waste after filtration through an acid rinsed 0.6 - 0.8 µm glass fiber filter is defined as the TCLP extract. Note: Extracts for Hexavalent Chromium determination should be taken to the Conventionals Lab immediately after they are removed from the tumbler and the Conventionals Supervisor should be notified. Conventionals personnel will filter the extracts when the calorimetric finish is performed.

11.2.1.2. Extracts for non-volatile organic analysis are stored in amber glass sample bottles obtained from Sample Receiving and labeled with the sample identification, date and prep (TCLP). The Organics Extraction Lab will notify the Metals Lab regarding the amount of extract desired.

11.2.1.3. Extracts for metals analysis are stored in 50 mL digest tubes and are preserved with 0.5% Nitric Acid. Label the extract with the sample identification, date and “LEN” for ICP or GFA analysis and/or “LEM” for the portion to be used for mercury determination. Transfer custody of the extracts to the lab(s), which will perform the analyses.

11.2.1.4. Metals samples at this point require digestion. Digestion methods are TWC (SOP #510S) prep for ICP analysis and/or a TWN (SOP #505S) for GFAA needs to be done. Hg is always digested using TWM (SOP #533S) prep. Sample containers for the digested samples should be labeled with both prep-codes, i.e. LEN/TWC. QC samples should be prepared as specified in the digestion SOP.

11.2.1.5. NOTE: Extracts or portions of extracts for organic contaminants must not be acidified. They should be refrigerated and the organic extraction supervisor should be notified that the extracts are ready for organic preparation procedures.

11.2.2. Method II: Solid Wastes

11.2.2.1. If particle size reduction is needed, crush, cut, or grind the sample to pass through a 9.5 mm (.375”) sieve. For paper, cloth, and similar waste materials, such size reduction will not be necessary so long as the solid has a surface area per gram of 3.1 sq. cm or greater. Surface area per gram measurements are to be made by visual inspection unless the material is particularly dense. To measure surface area per gram on dense materials, cut a rectangular piece of sample approximately 5 cm by 5 cm. Measure two adjacent sides of the rectangle with a centimeter stick (ruler) and multiply the lengths together. This product is the surface area. Weigh the rectangular piece on the balance (in grams) and divide the surface area by this mass. The result is the surface area per gram. For example, a 5 cm by 5 cm piece weighing 8 grams would have a surface area per gram of 3.125 sq. cm per gram and would not need particle size reduction.

11.2.2.2. Weigh 100 grams of solids into a 2 liter glass extraction vessel. Record weight. If the client has approved the modification, weigh 40.0 grams of solids into in a 1 liter HDPE extraction bottle. If extraction is for nonvolatile organics, make certain the extraction is performed in a glass bottle with a Teflon-lined cap.

11.2.2.3. Add a volume of extraction fluid equal to (20 x weight of sample). Record volume.

11.2.2.4. Turn on the extractor and verify the tumbler rotating speed of 30 rpm ±2.

11.2.2.5. Start the stopwatch and count the revolutions for one minute.

11.2.2.6. Indicate on the bench sheet the revolutions per minute for the extractor. If the unit has not completed a revolution at the one minute count, estimate the partial revolution and include in the RPM value (e.g. 30 ½ RPMs).

11.2.2.7. Place samples in tumbler and rotate at 30 rpm (± 2) for 18 hours (± 2). Record the start time and temperature of the extraction. If the temperature is not 23 ± 2 °C, then notify the supervisor and take corrective action. Once the proper temperature is achieved, check to see that it is maintained during the extraction period.

11.2.2.8. Filter through special acid-rinsed glass fiber filters. Note: Do not filter extract for hexavalent chromium analysis. (See 6.2.1.1.)

11.2.2.9. Calibrate the pH meter, measure and record the pH of an aliquot of the TCLP extract. Discard the aliquot used for pH determination.

11.2.2.10. Place the filtrate in a properly labeled poly digest tube and preserve with HNO3. Do not preserve extracts to be used for organic analyses. Samples are now ready for digestion and/or analysis (See 6.2.1.2 and 6.2.1.3.) Transfer custody of the extracts the lab(s), which will perform the analyses. If precipitate forms after sample preservation, the extract must be digested.

11.2.3. Method III: Multiphase Wastes

11.2.3.1. If the same sample aliquot from preliminary determination (6.1.1.1) will be used for the extraction, skip to step 6.2.3.4. Use the same flask as was used for the preliminary determinations, but replace the rest of the filtering apparatus with clean components. Tare an acid-rinsed filter and place it in the filtering apparatus.

11.2.3.2. Tare a clean weigh boat and weigh out a 100 gram subsample, if available, to 0.1 grams. (See 6.2.2.2.) More may need to be filtered to insure an adequate amount of extract will be obtained. Record the weight of the subsample.

11.2.3.3. Pass the liquid fraction through the filter.

11.2.3.4. Refrigerate the liquid fraction (filtrate) at 4 C.

11.2.3.5. Weigh the remaining solids and the filter to 0.1 grams. Record the weight in the logbook, E11 on the bench sheet.

11.2.3.6. If particle size reduction is needed, grind the solids to pass through a 9.5 mm sieve. (See step 6.2.2.1.)

11.2.3.7. Place the sample in an extraction bottle, and add a volume of extraction fluid equal to (20 x weight of the solid) mL. Use the extraction fluid to rinse any solids clinging to funnels, etc.

11.2.3.8. Check and record tumbler RPM (see 6.2.2.4) and rotate the extraction bottle for 18 hours (2). (See 6.2.2.5.)

11.2.3.9. Filter enough sample for all analyses. (See 6.2.1.) Before adding the initial filtrate to the filtered extract, test for miscibility. The miscibility test should be performed in a small plastic cup with a milliliter or less of each filtrate. Stir the mixture and look for suspensions, precipitates, layering or any other sign of poor miscibility. Discard the liquid used for this test. If the initial filtrate (liquid fraction) and the filtrate (filtered extract) are immiscible, store the liquids separately and indicate on the sample bottles that they are two phases of the same extract. If the liquids are miscible, add the initial filtrate to the filtered extract and mix. If the weight of solids extracted was less then the weight of solids remaining after filtration, the amount of initial filtrate to add back should be adjusted proportionally using the weight ratio of solid to liquid calculated in the preliminary determinations. To make this adjustment, measure the volume of the filtered extract, record in section G2 of the bench sheet, in a graduated cylinder. To calculate the amount of solids this represents, divide the volume by twenty (20). Divide the resulting quotient by the ratio of solid to liquid obtained earlier to find the weight of initial filtrate to add to the filtered extract G3 on the bench sheet. This mixture becomes the TCLP extract.

11.2.3.10. Calibrate the pH meter, measure and record the pH of an aliquot of the TCLP extract. Discard the aliquot used for pH determination.

11.2.3.11. Place the filtrate in a properly labeled poly digest tube and preserve with HNO3. Do not preserve extracts to be used for organic analyses. Samples are now ready for digestion. (See 11.2.1.2 and 11.2.1.3.) Transfer custody of the digested extracts the Metals Instrument Laboratory, which will perform the analyses.

12. Data Analysis and Calculations

12.1. Logbooks are periodically reviewed by the QA officer and/or supervisor.

12.2. Data are reviewed according to the Metals Data Review SOP Method Performance

12.2.1. QA maintains control charts for the recovery of surrogate standards and spiked compounds.

12.2.2. Management periodically reviews the charts to detect and correct any negative trends in analyte recovery.

13. Pollution Prevention

13.1. Disposed expired standards into the designated barrel in the hazardous waste room.

13.2. Samples that are designated as hazardous waste by the LIMS "Hazardous Report" must be placed in the designated drum in the Hazardous Waste Storage Area when they are disposed. This process is described in SOP 1003S.

14. Data Assessment and Acceptance Criteria for Quality Control Measures

15. Corrective Actions for Out of Control Events

15.1. In the event that a method blank is out of control, any remaining extraction fluid from the batch used for the extraction is properly disposed and the container is cleaned. All samples associated with the method blank are reprepped.

15.2. In the event that the pH of an extraction fluid is out of range, the extraction fluid is properly disposed and the container is cleaned.

15.3. Any unusual sample or problem that arises must be noted both in the logbook and on an Analyst Notes Form. Also bring the problem to the attention of the supervisor/manager.

16. Contingencies for Handling Out-of-Control or Unacceptable Data

16.1. Unacceptable QA data noted during GC or GCMS analysis may result in a request for re-extraction using a 'Request for Re-extraction/Re-analysis Form (Form 0030F). Re-extract parameters (sample volume, final volume etc.) may be modified from the original extraction based on analytical results.

17. Waste Management

17.1. Place the solids in the designated 5-gallon "satellite accumulation stations" located at various places in the laboratory. This includes spent sodium sulfate, glass wool, solid sample, silica gel and paper wipes. Transfer the solids to the 55-gallon drum labeled "Solvent Contaminated Solids" located in the Hazardous Waste Room when the accumulation pails are full.

17.2. Discard all waste solvent (Hexane and Methylene Chloride) into the 55 gallon drum labeled "Chlorinated Solvents" located in the Hazardous Waste Storage Area

17.3. Disposed expired standards into the designated barrel in the hazardous waste room.

17.4. Place samples that designate as hazardous using the LIMS "Hazardous Report" in the designated drum in the Hazardous Waste Storage Area when they are disposed. SOP 1003S describes the process for disposal of samples. Excess extracts and expired spiking solutions

must be disposed of in the container labeled “Chlorinated Solvents” located in the Hazardous Waste Storage Area.

17.5. ARI’s Laboratory Chemical Hygiene Plan (CHP) describes internal hazardous waste handling procedures. All analysts must be familiar with these requirements.

17.6. ARI properly profiles and disposes all hazardous waste using an EPA registered TSD (Treatment, Storage and Disposal) facility.

18. Method References

18.1. USEPA Test Methods for Evaluating Solid Waste, SW-846, Volume IC, Method 1311, July 1992.

18.2. USEPA Test Methods for Evaluating Solid Waste, SW-846, Volume IA, Method 7000A, July 1992.

18.3. USEPA Test Methods for Evaluating Solid Waste, SW-846, Volume IA, Method 6010A July 1992.

Appendix D – Field Forms and Checklists

DO NOT QUOTE OR CITE
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Core Description and Sample Information

STATION:
REPLICATE:

Field Log by:	Processing by:	Coring by:
Tide Level from MLLW: Depth to Mudline: Mudline Elev.:	Date: Time:	Total Drive Length: Recovered Length: Recovery Efficiency:

Note: All elevations, depths, and distances in feet.

Core Description - Core Tube Lengths

Tube Length	Sample No.	Visual Description
_1		
_2		
_3		
_4		
_5		
_6		
_7		
_8		
_9		
_10		
_11		
_12		
_13		
_14		
_15		
_16		
_17		
_18		

In-Situ Summary Log

Interpreted Summary	Sample No.	Acquisition Notes
_1		
_2		
_3		
_4		
_5		
_6		
_7		
_8		
_9		
_10		
_11		
_12		
_13		
_14		
_15		
_16		
_17		
_18		

Core Tube Field Cut Information

Sample No.	Tube Length Interval	Segment Length

Sample Test Information

Sample No./Tests	In-Situ Depth Int.

Notes:

CORRECTIVE ACTION RECORD

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

Report Originator: _____ Person Responsible for Response: _____

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: _____ By: _____

Date of Actual Occurrence: _____ By: _____

Analyte: _____ Analytical Method: _____

Cause of Problem:

CORRECTIVE ACTION PLANNED:

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

Corrective Action Plan Approval: _____ Date: _____

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Person Responsible for Follow-up Activities: _____ Date of Follow-up Activity: _____

Final Corrective Action Approval: _____ Date: _____

FIELD CHANGE REQUEST

Page ____ of ____ Field Change No.: _____ Project Number: _____

Project Name: _____

CHANGE REQUEST

Applicable
Reference: _____

Description of Change:

Reason for Change:

Impact on Present and Completed Work:

Requested by: _____ Date: _____
(Field Scientist)

Acknowledged by: _____ Date: _____
(Field Task Leader)

SAMPLING AND ANALYSES COORDINATOR RECOMMENDATION

Recommended Disposition:

Recommendation by: _____ Date: _____

CERCLA COORDINATOR APPROVAL

LWG Notification Requred: Yes / No

Final Disposition:

Approved/Disproved by: _____ Date: _____

EPA PROJECT MANAGER APPROVAL

Approved/Disproved by: _____ Date: _____

SEDIMENT SAMPLE LOG

Date: **Page:**

Time	Station	Rep	Pen (cm)	Texture	Color	Debris	Odor	Sample Quality/Comments

Comments:

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

Page _____ of _____ Turn Around Requested: _____

Report to:	Phone:				Analyses Requested										Notes/Comments
Company:	Fax:														
Address:	Proj Name:														
City:	Proj Number:														
State:	Sampler:														
Zipcode:															
Sample ID	Sample Date	Sample Time	Sample Matrix	No. Con-tainers											

Relinquished: (Signature)	Received by: (Signature)	Special Instructions/Notes	
Printed name:	Printed name:		
Company:	Company:		Number of Coolers:
			Cooler Temp(s):
Date: Time:	Date: Time:		COC Seals Intact?
			Bottles Intact?

COMMERCIAL INVOICE FOR INTERNATIONAL SHIPPING

DATE OF EXPORTATION:	EXPORTER REFERENCE (i.e., order no., invoice no., etc.):
SHIPPER/EXPORTER (complete name and address):	CONSIGNEE (complete name and address:
Country of Export:	REASON FOR SHIPMENT:
Country of Manufacture:	
Country of Ultimate Destination:	
International Air Waybill No.:	

MARKS / Nos.	No. of PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	Qty.	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.
DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT.

SIGNATURE OF SHIPPER/EXPORTER (Type name and title, and sign). DATE

_____ _____

Sediment Sampling Equipment Checklist

Sample Handling

- ❑ Bowls, large, stainless
- ❑ Jars, sample-analysis-specific
- ❑ Sampler, core and tubes[1]
- ❑ Sampler, grab[2] and stand
- ❑ Hand cores and plates[3]
- ❑ Spoons, large, stainless
- ❑ Spoons, large, stainless

Tools

- ❑ Beakers, plastic, 50 mL
- ❑ Core extrusion pole[1]
- ❑ Hacksaw[1]
- ❑ Locking-pliers, chain clamp[1]
- ❑ Measuring tape[1]
- ❑ Measuring stick
- ❑ Pipe cutter[1]
- ❑ Rubber mallet[1]
- ❑ Screwdrivers (Phillips, flat)
- ❑ Sieves, 63 µm
- ❑ Siphon tubes[2]
- ❑ Utility knife
- ❑ Lead line (if not on vessel)

Equipment Decontamination

- ❑ Brushes, long-handled and short-handled
- ❑ Detergent, laboratory (Alconox)
- ❑ Methanol in dispensing bottle
- ❑ Nitric acid, 10% in dispensing bottle
- ❑ Pail
- ❑ Distilled water in dispensing bottle

Documentation

- ❑ Field sampling plan
- ❑ Health and safety plan
- ❑ Field logs
- ❑ Sample description logs
- ❑ Chain-of-custody forms
- ❑ Request-for-change forms
- ❑ Correction forms
- ❑ Maps

PPE Equipment

- ❑ Boots, steel-toed, waterproof
- ❑ Gloves, nitrile, heavy outer
- ❑ Gloves, nitrile, thin inner
- ❑ Hard hats
- ❑ Hearing protection
- ❑ Rain slicks
- ❑ Safety glasses/goggles

Supplies

- ❑ Aluminum foil
- ❑ Bags, plastic zip, gallon-size
- ❑ Bags, plastic zip, quart-size
- ❑ Coolers
- ❑ Custody seals
- ❑ Duct tape
- ❑ Ice
- ❑ Tape, clear, shipping
- ❑ Pens, felt-tip, permanent
- ❑ Pens, ballpoint, permanent
- ❑ Pencils
- ❑ Sample labels
- ❑ Bubble wrap
- ❑ Cell phone
- ❑ First aid kit

[1] Specific to core sampling.
[2] Specific to grab sampling.
[3] Specific to beach sampling.

Appendix E – Sediment Core Sampling and Processing SOP

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SEDIMENT CORE COLLECTION AND PROCESSING

Sediment cores are collected to evaluate chemical and/or biological characteristics of surface and subsurface sediments at depths that greatly exceed those achieved by grab or other surface samplers. The purpose of this SOP is to define and standardize procedures for the collection of samples from surface and subsurface sediment cores. Additionally, this SOP will help ensure that the highest quality, most representative data are collected, and that these data are comparable to data from other programs. This SOP is based on the procedures outlined in Puget Sound Estuary Program guidelines (PSEP 1996).

SUMMARY OF METHOD

Sediment cores are collected using some type of coring device, including gravity corers, piston corers, vibracorers and diver-driven cores. Actual operations will vary depending on the equipment selected. Selection of the most appropriate corer usually depends on may factors, including but not limited to:

- The quantity of sample required
- The penetration depth required
- The sediment type (e.g. rocky, soft, compact)
- Vessel availability and capability (i.e. size, lifting capacity etc.).

Regardless of the coring method, the core tube should be constructed of a non-contaminating material such as stainless steel or aluminum, or should use a liner constructed of a non-contaminating material (e.g., polycarbonate).

Once the sediment core is collected, it is extruded or split so that the sediment can be sampled, processed, and transported to the analytical laboratory.

Supplies and Equipment

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

- Sampling device:

  Corer
  Core tubes
  Core tube liners (optional)
  Core tube caps

- Field equipment:

  Aluminum foil
  Duct tape
  Hack saw
  Indelible ink pen
  Pipe cutter

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Circular saw (if splitting tube longitudinally)
Plunger (if necessary)
Table or tray
Ice (if storing cores)
Stainless-steel bowls
Stainless-steel spoons, spatulas, and/or mixer
Personal protective equipment for field team
(rain gear, safety goggles, hard hats, nitrile gloves) First Aid kit
Cell phone
Sample containers
Bubble wrap
Clear tape
Permanent markers
Pencils
Coolers

- Documentation

  Core description forms or log book
  Waterproof field logbook
  Field sampling plan
  Health and safety plan
  Correction forms
  Request for change forms
  Waterproof sample description forms

CORE COLLECTION PROCEDURES

CORER DEPLOYMENT

Gravity and piston corers utilize inertia as the primary driving force to achieve the desired penetration depth. The degree of penetration can be altered by either adjusting the number of weights at the top of the tube or by changing the vertical distance that the core tube is allowed to free-fall. During descent, the corer should be lowered under power to its predetermined free-fall distance above the bottom. The lowering should be halted when this vertical distance equals the difference between the meter wheel reading and the fathometer reading.

If the device is equipped with a trip-weight or a small gravity trip-corer, the free-fall distance will equal the length of the core tube plus the vertical distance between the core cutter and the trip-weight suspended beneath it. When the trip-weight contacts the bottom, it relaxes the tension on the release mechanism and the core tube free-falls into the sediment. Consistent penetration depths can be obtained with this method, as the free-fall distance is independent of winch control and changing bottom depth.

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The vibracorer uses a hydraulic system that vibrates and drives a length of aluminum tubing into the sediment. A continuous sediment sample is retained within the tubing with the aid of a stainless-steel core cutter/catcher. Coring can continue until the total sample depth is reached.

CORE RETRIEVAL

The core is extracted from the substrate and pulled onto the sampling vessel using the vessel winch or crane. The amount of pull that is required depends on the coring device and its contents, plus the amount of frictional force against the surface of the core tube that must be overcome. The frictional force depends on the sediment type (e.g. clay-based material requires more pull) and the depth penetrated (PSEP 1996). During core extraction, the wire strain should be steady and continuous, with the vessel held stationary directly above the coring device. Once the core is extracted from the bottom, the winch speed may be increased to about 4 ft/sec.

The core is brought on board the vessel. While the tube is still vertical, overlying water may be siphoned off the top of the core tube. Recovery is estimated to accurately determine the true depth from which the sediments were collected and the location of those sediments within the core barrel. In most cases, recovery is estimated by comparing the length of the sediment core material to the overall penetration depth (as indicated by traces of sediment material on the outer surface of the core tube). The ratio of penetration depth to core material length is calculated to determine the compaction of the sediment during coring. Alternatively, some vibracorers are equipped with a transducer to measure penetration depth. A second transducer is mounted directly above the core tube to determine the height of the sediment column within the core barrel. Recovery can be estimated from the difference between the two transducer readings. Recoveries typically range between 50 and 90 percent.

Continuous core lengths (such as those obtained by a vibracorer) may be sectioned into smaller lengths for ease of handling and/or to represent the desired sampling intervals. The core tube is placed on a secure surface and tightly anchored. Beginning at the top of the core tube, sample sections are marked on the outside of the core tube in indelible ink. Before the tube is cut, a label identifying the station and core section is securely attached to the outside of the casing at the <u>top</u> of each section, and wrapped with transparent tape to prevent loss or damage of the label. (Note that care should be taken when measuring core sections to consider core compaction.) Core sections may then be cut using a manual, heavy-duty pipe cutter.

After the tube is cut, sediment at the end of each tube section cut is visually classified for qualitative sample characteristics. Changes from the top to the

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bottom of each section of the tube are noted and recorded in the field log or core description forms. If the core section will be stored or transported, the core ends are then covered with aluminum foil, a protective cap, and duct tape to prevent leakage. Ideally, the core sections should be stored upright in a container chilled with ice to approximately 4°C. Empty tubing should be removed to help ensure that each section is full of sediment. This limits disturbance during storage and transport. If necessary, cores should be stored securely in a manner consistent with chain-of-custody procedures. Typically, cores remain in the custody of field staff until sampling is completed and sample jars transported to the analytical laboratory (see SOPs for Surface Sediment Sampling).

CORE PROCESSING PROCEDURES

SEDIMENT CORE EXTRUSION

Cores should be split or extruded and processed within 24 hours of collection, either onboard the vessel or at an onshore sample processing facility. The sediment may be removed from the core tube by either extrusion or longitudinal sectioning (i.e., splitting). Extrusion is done by tilting the core tube until the sediment core slides out onto a clean, aluminum-foil-covered table or tray. Vibration or tapping of the core tube may aid extrusion. If the sediment core does not slide out easily, a plunger may be used to push the sediment out of the tube. The plunger should be cleaned and covered with clean aluminum foil each time it is used. Once the tube is extruded, a thin (0.25 to 0.5 cm) outer layer of the sediment core is scrapped away using a decontaminated, stainless-steel knife (see SOP for Surface Sediment Sampling. This outer material may be used for sediment grain-size determination if sediment volume is of concern, but should not be used for any chemical analyses.

In longitudinal core splitting, the core tube or liner is split with a circular saw to expose the sediment core, or the core material can be run across a splitting knife as it is extruded. If a core tube liner is used, care should be taken to scrap the surface of the sediment core to remove any shavings of liner material.

SEDIMENT SAMPLE PROCESSING

Regardless of how the sediment core is obtained and prepared, the procedures for record keeping, sediment processing and sampling techniques are as follows:

1. Immediately following core extrusion or splitting, collect samples for volatile compounds (either organics or sulfides) using a decontaminated,stainless-steel spoon. The volatile organics sample jar should be tightly packed (to eliminate obvious air pockets) and filled so that there is no head-space remaining in the jar. Alternatively, if there is adequate water in the sediment, the container may be filled to overflowing so that a convex meniscus

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forms at the top, and the cap carefully placed on the jar. Once sealed, there should be no air bubbles. The sulfides sample is preserved with 0.2 N zinc acetate.

2. Record core sediment characteristics on a core description form (see attached). Observations should include stratification of color and sediment composition, odor, biological organisms, foreign objects etc.
3. Place remaining core sediment in a decontaminated, stainless-steel bowl (see SOP for Surface Sediment Sampling) and mix thoroughly with a stainless-steel spoon, spatula or mixer until uniform color and texture are achieved. Large rocks or wood pieces may be omitted from the final laboratory sample, but should be noted in the log or description form.
4. If sediment from multiple core sections will be composited, cover the bowl with clean foil and set the bowl aside (refrigerate or keep cool on ice) while handling additional cores. Once all the required sediment has been placed in the bowl, thoroughly mix until uniform color and texture are achieved.
5. Transfer aliquots of homogenized sediment to labeled sample containers provided by the analytical laboratory. Labels should include, at minimum, the company name, project name, sample identifier, date and time of collection, and the initials of sampling personnel.
6. Pack and transport samples as described in the SOP for Surface Sediment Sampling. If samples will be stored, follow procedures specified in the project sampling plan.

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 and will be described in the field sampling plan. The most commonly collected field QC sample are described below (PSEP 1996):

- **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 homogenized sediment 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.

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- **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.

Additional types of QC samples are described in the SOP for Surface Sediment Sampling.

REFERENCES

PSEP. 1996. Puget Sound Estuary Program: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, and Puget Sound Estuary Program Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA

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Appendix F – Surface Water Sampling SOP

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PORTLAND HARBOR RI/FS

SEDIMENT CHEMICAL MOBILITY TESTING
SURFACE WATER SAMPLING

APPENDIX F

SOP FOR PERISTALTIC PUMP
SURFACE WATER SAMPLING

March 13, 2008

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Attachment 1. Measurement of Surface Water Field Parameters

LIST OF ACRONYMS

COC	chemicals of concern
EPA	U.S. Environmental Protection Agency
DIW	deionized-water
SOP	standard operating procedure
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids

1.0 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. 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.

The sampling techniques outlined in this SOP will be used for the collection of surface water for analysis of metals, unfiltered organic compounds, and conventional analyses, such as total suspended solids (TSS) and total organic carbon (TOC), and collection of filtered conventional analyses including total dissolved solids (TDS) and dissolved organic carbon (DOC). Following this SOP during the collection of surface water samples guarantees a high level of sample integrity and minimizes contamination during sample collection and processing.

2.0 SUMMARY OF METHOD

Surface water samples for chemical and conventional analyses will be collected using a peristaltic pump with an extended sampling tube lowered to the desired depths. At each sampling station the sampling device will be deployed at mid-water-column depth to collect surface water samples. The sampling tube will be attached to a water sampler unit (Figure F-1a), and the water intake will be placed approximately 15 feet away from the bow of the boat with the aid of an A-frame or davit. The water sampler unit will then be lowered to the appropriate depth with the help of a hydraulic or electric winch. The outflow of the pump is directed into a composite mixing container for sampling. The required volume will be pumped into pre-cleaned mixing containers equipped with a magnetic stirring device (Figure F-1b). The container, made of glass (Figure F-1b), is used for compositing and mixing samples for subsequent organic, inorganic, and conventional analyses.

Following sample compositing in the mixing containers, appropriate sample bottles are filled using a second peristaltic pump, with the outflow directed into the bottle. The sample bottle is held near the tubing outlet, and the sample bottle is then filled. The sample bottles are capped, labeled, and then placed inside a cooler.

Two types of surface water samples will be collected: unfiltered and filtered. For filtered TDS and DOC 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.

3.0 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 F-1. Additional equipment may be required depending on the project.

Two peristaltic pumps are used at each sample station; the first for collecting surface water to fill the mixing container; the second will be used to collect unfiltered and filtered samples from the mixing container into the individual sample bottles. A workbox made of PVC pipes and plastic sheeting is used to house the stir plate and the peristaltic pump. Each glass mixing carboy is placed over the stir plate. The mixing container is equipped with a 3-inch-long Teflon™-coated stir-bar at the bottom and a lid containing an inflow, outflow, and vent Teflon™ spouts (Figure F-1b). For each sampling station, a filtering kit (DI rinsed 0.45-μm filter with C-Flex™ and Teflon™ tubing placed in a double Ziploc™ bag) is assembled and attached to a peristaltic pump and mixing container. If necessary, a 10-μm pre-filter may be attached in-line to prolong the filtering capacity of the 0.45-μm filter. Pre-determined lengths of dedicated intake Teflon™ tubing will be used at each of the sample locations to collect surface water at the mid-water-column depth. Additional information regarding tubing inlet, outlet, filtering kits, and power is summarized below:

- The intake tubing kit for each mixing carboy is composed of the intake Teflon™ tubing (depending on station water depth), a 30-cm C-Flex™ tubing, and a 220-cm Teflon™ tubing (Figure F-1b) placed sequentially. The C-Flex tubing is inserted into the peristaltic pump head and locked firmly against the stainless-steel rollers, which is, in turn, connected to the mixing sampling carboys' 50-cm intake Teflon™ tubing.

- The outlet tubing kit from the mixing containers is composed of a 140-cm Teflon™ tubing, a 30-cm C-Flex™ tubing, and a 60-cm Teflon™ tubing placed sequentially (Figure F-1b).

- The filtering kits (0.45-μm) are composed of 15-cm C-Flex™ tubing and the filter cartridge, placed sequentially.

- A 10-μm air filter is attached to each mixing container vent spouts. Set-up details are described in Table F-1 and shown in Figure F-1b.

- A portable 3000-watt power generator is used if onboard electricity is not available.

4.0 PROCEDURES

4.1 EQUIPMENT DECONTAMINATION

Sample tubing, mixing containers, sampling jars, and any additional field equipment will be cleaned and decontaminated by Integral Consulting Inc. (Integral) in the LWG laboratory.

4.1.1 Surface Water Sampling Equipment Preparation

Multiple decontaminated sampling tubing and filtering kits are brought to the field to avoid performing decontamination procedures in the field between stations. The following steps are taken to set up the peristaltic pump system.

Plastic Processing Workbox
A workbox will be constructed with 2-inch PVC tubing and covered with a 6-mil plastic sheet to contain the peristaltic pump sampling equipment and conduct the subsampling from the carboy. One side of the workbox is left open for placing sampling equipment and sample containers. The inside of the processing workbox is washed with Alconox™ and deionized-water (DIW) rinsed prior to commencement of sampling activities.

Stands and clamps used to secure the receiving Teflon™ tubing and filter cartridge, made of non-metallic components or resin-coated stainless-steel, will be washed (Alconox), tap-water rinsed, acid washed, and DIW rinsed, prior to commencement of sampling activities.

Sampling Device
The sampling device for mid-water-column sampling is constructed of stainless-steel with a polypropylene vane, and is attached to the boat by a nylon or Kevlar rope. An alternate sampling device, made of PVC tubing and a polypropylene vane, with a resin-coated weight attached to the base, will be constructed and, if utilized, will also be attached to the boat by a nylon or Kevlar rope. Figure F-1a shows the PVC sampling device setup with a YSI and underwater setup, the Teflon™ tubing inlet, and the vane. The vane keeps the water intake directed into the flow and elevated at a constant height. Prior to commencement of sampling activities, all components will be washed with Alconox™, tap-water rinsed, acid washed, and DIW rinsed.

4.1.2 Conventional Field Parameter Equipment Preparation

A YSI 650/6600 multi probe is used for measuring surface water parameters, such as temperature, pH, dissolved oxygen, turbidity, conductivity, and 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 multi probe can be calibrated in the field. A YSI unit will be used at each sampling depth and will be attached to the sampling devices, as shown in Figure F-1a. The proper handling of the multi

probe and procedure for collecting surface water field parameters is described in detail in Attachment 1 to this SOP.

Except for the probe sensor, all components are washed (Alconox™) and tap-water rinsed. Since this equipment will not be used in actual surface water sample collection, there is no need for additional decontamination.

4.2 SURFACE WATER SAMPLE COLLECTION

4.2.1 Equipment and Sample Handling

Gloved hands are required for sample collection and handling, as described below. Field staff will wear appropriate non-contaminating, disposable, powderless, nitrile gloves during the entire sampling operation and change gloves frequently, usually with each change in task.

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

- Handling the surface-water sample bottle
- Handling the discharge end of the surface-water sample tube or line
- Preparing a clean workspace (inside boat)
- Setting up the processing and preservation workbox
- Setting the equipment (i.e., the sample bottles and the filtration and preservation equipment) inside the workbox
- Working exclusively inside the workbox during collection, processing, and preservation
- Changing the workbox covers as needed.

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

- Working exclusively outside the processing and preservation workbox
- 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
- Handling the single or multi-parameter instruments for field measurements
- Setting up and checking the field-measurement instruments

- Measuring and recording the water depths and field measurements.

4.2.2 Surface Water Sampling Procedures

Two persons are needed to conduct the sampling. The following steps are taken in order to set up the surface water collection system and processing of samples:

1. Assemble and secure the sampling devices to either the A-frame or a davit.
2. Determine the correct position of the sampling station and ask the captain to position the vessel at the sample site and switch off the engines.
3. Initiate calibration procedures for the multi probe by following the instructions of the SOP in Attachment 1 of this SOP.
4. Set up a clean area for the workbox. Set the workbox on a secure table or bench top on board the sampling vessel to house the stir plate and a small peristaltic pump. Provide enough space inside the workbox for a stand to hold the outlet tubing and filter and to collect surface water and processing sample jars.
5. Place the stir plate inside the workbox and mixing container on top of the plate. The glass container will be checked to ensure:
    - Container is properly wrapped by the labs and does not contain rips or holes that may have occurred during shipment to the field
    - Container contains a 3-inch stir-bar at the bottom
    - All components, such as inflow and outflow tubing, are intact, securely placed on the cap, and properly set at required lengths inside the mixing carboy.
6. Secure the peristaltic pump and pump speed controller to the table 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.
7. Attach the intake part of the Teflon™ tubing to the tip of the sampling device vane (Figure F-1a). Take care not to remove a protective cap from the tip of the collecting tube until ready for submersion.
8. Uncoil the sampling tube and attach the intake (collecting end) Teflon™ tubing length (pre-determined for each sampling location) to the mixing carboy (Figure F-1b). Clamp the C-Flex™ tubing section firmly into place inside the peristaltic pump head, which is placed outside the workbox
9. Remove the protective cap from the sampling tube and lower the sampling device gently below the water surface.
10. Ensure the sampling device is at the approximate mid-water-column depth for the sample location. To avoid the intake of sediment stirred up by the

sampling vessel, the sampling device must be at least 5 ft above the sediment surface. If conditions result in the water column being less than 10 ft, the sampling device must maintain a 5-ft minimum distance from the sediment surface. The sampling device can be moved higher into the water column up to 1 ft from the water surface. Therefore, the minimum total water depth required for mid-column surface water sampling is 6 ft.

11. Begin collection of water quality parameters using the YSI unit. Data collection intervals should be set to collect every minute for sampling periods longer than one hour and to every second if either 1) the continuous sampling period less than one hour, or 2) a vertical profile due to varying mid-water-column depth of the water column is needed over a sample transect.
12. Switch the pump on and pump surface water through the sample tubing and into the mixing container. Once the water covers the stir rod, turn on the stir plate.
13. Turn off the pump once the mixing containers have been filled to appropriate volume needed for all required chemical and physical analyses.
14. After the mixing containers have been filled, place the peristaltic pump inside the workbox and affix C-Flex tubing section of appropriate Teflon™ tubing outflow to pump head.
15. Place a stand inside the working workbox and secure one outlet tubing at a time from the appropriate mixing container with a clamp.
16. Make final adjustments to the stand holding the outflow spout before the small pump is turned on.
17. Use the following sample collection sequence for (unfiltered) sampling:
    a. Organics
    b. Metals
    c. Conventionals
    d. MET analysis (carboy of remaining volume).
18. After the above samples are collected, attach the dedicated 0.45-µm Teflon™ 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 5 times the filter cartridge volume with sample water. The sample collection sequence filtered sampling is as follows:
    a. DOC
19. As soon as sample containers are filled up, the peristaltic pump is turned off, and the containers are labeled. The sampling label should contain the date,

time, project name or number, sample ID, type of analysis required, and sampler initials.

The 0.45-µm filtration cartridge is replaced 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.

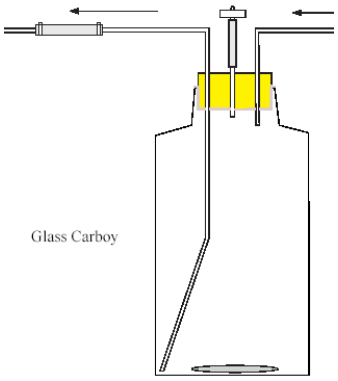
5.0 REFERENCES

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. Open-File Report 00–213. U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency, Austin, TX.

Table F-1. Checklist of Supplies for Surface Water Sampling with Peristaltic Pump



For glass carboys

Teflon™

Quantity	*Description*
1	10-cm for air filter connection
1	50-cm for inflow from Kynar tee into carboy
1	140-cm for outflow from carboy to small peristaltic pump
1	60-cm for outflow from small peristaltic pump to sample bottle

C-Flex

Quantity	*Description*
1	6-cm for connecting air filter on carboy
1	30-cm for connecting outflow tubing from carboys to tubing for filling sample bottles

Other

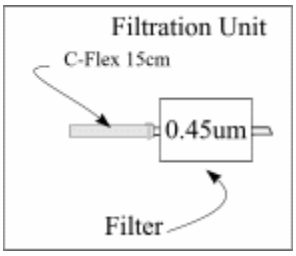
Quantity	*Description*
1	3-inch stir bar
1	Vacu-guard filter
2	small plastic zip-ties for C-Flex tubing
3	large plastic zip-ties for securing silicone stopper to glass carboy

From sample intake tubing to large peristaltic pump to carboys

Teflon™

Quantity	*Description*
1	220-cm for inflow from large peristaltic pump to carboy
1	Pre-determined length based on sample station water depth

Set of one filter in line for filtered samples



C-Flex

Quantity	*Description*
1	15-cm for connecting the filter to the outflow from small peristaltic pump to sample bottle

Filter

1	0.45 μm Whatman POLYCAP 36 TF

Other

1	small plastic zip-tie for C-Flex tubing
1	loose small plastic zip-tie (extra zip-tie to be placed in bag to connect to carboy outflow)

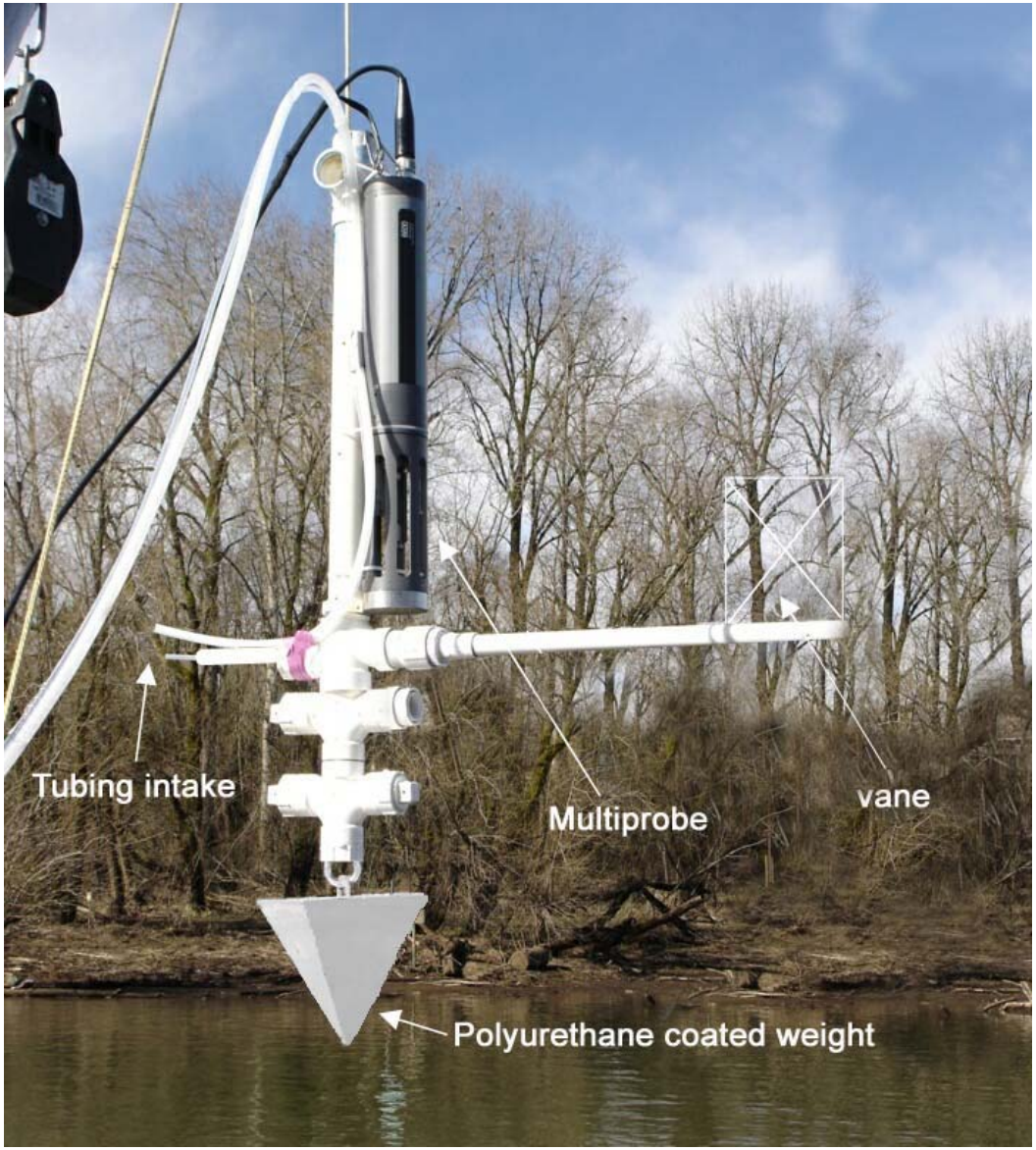


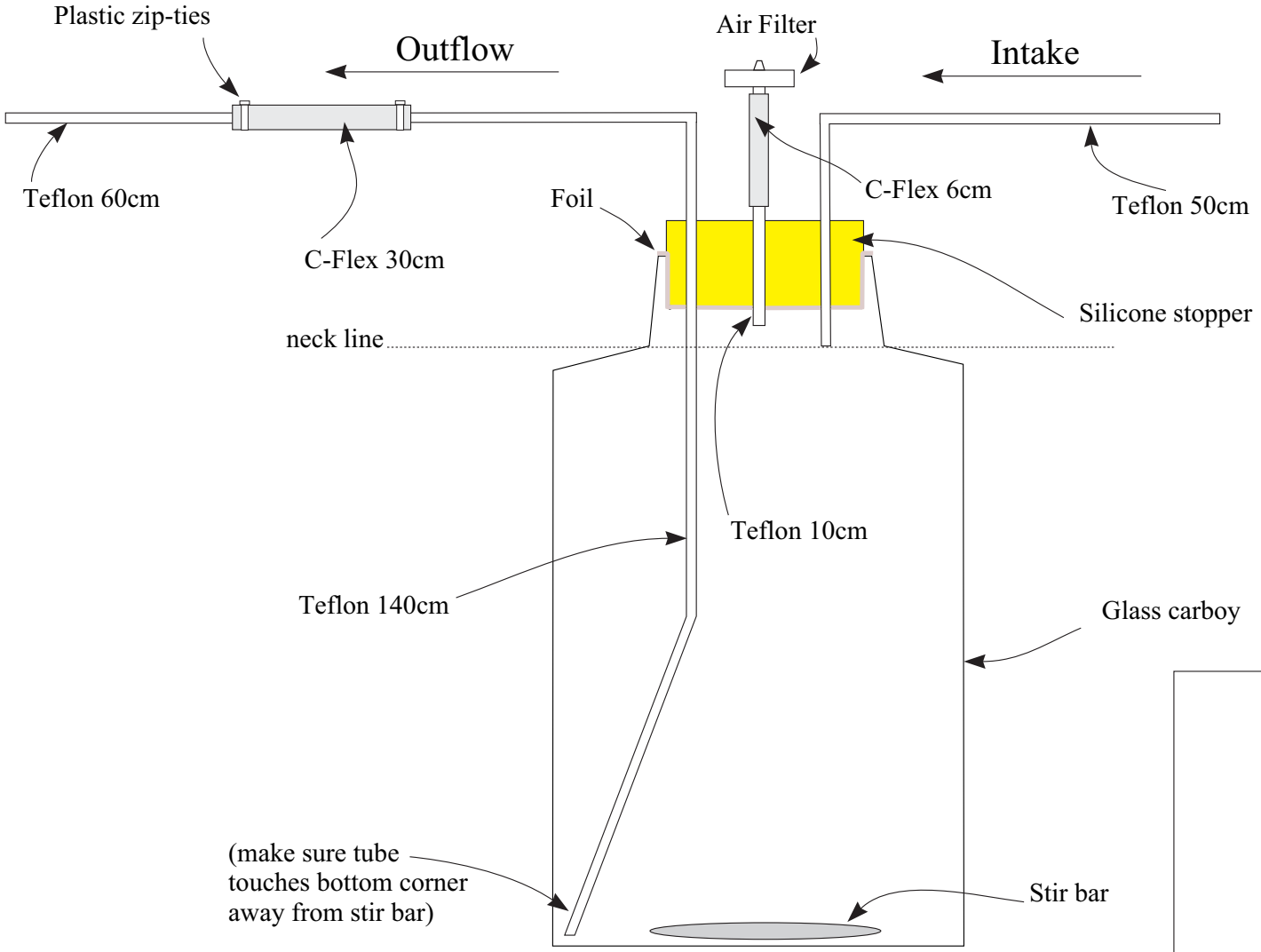
Figure F-1a

PVC Surface Water Sampling Device Setup

integral consulting inc.

LWG Lower Willamette Group

Glass Carboy Setup



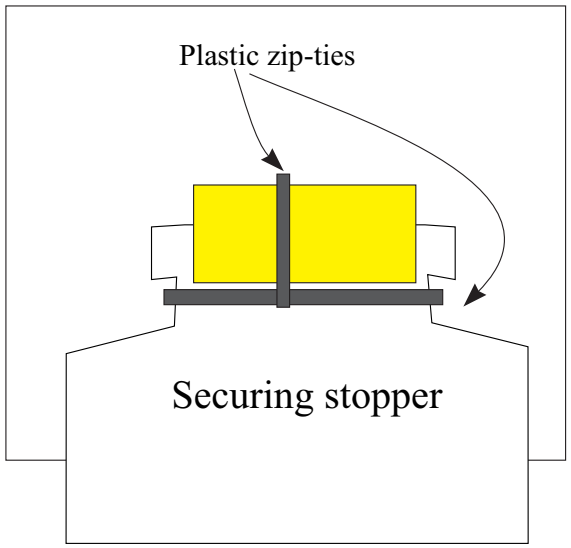


Figure F-1b

SEDIMENT CHEMICAL MOBILITY TESTING SURFACE WATER SAMPLING

APPENDIX F, ATTACHMENT 1

MEASUREMENT OF SURFACE WATER FIELD PARAMETERS

This SOP utilizes the procedures outlined in Wilde, F.D. (variously dated), *Field Measurements: U.S. Geological Survey Techniques of Water-Resources Investigations*.

Scope and Application

Information and general instructions for field measurement of water quality parameters [pH, Eh (ORP), specific conductance, dissolved oxygen, and temperature] are presented below. Due to the variety and complexity of water quality meters available, calibration and measurement procedures should be conducted in accordance with manufacturer's recommendations for specific meters used. The following information describes general procedures for the measurement of water quality parameters. Where possible, sampling should be conducted first in areas least affected by constituents of interest, followed by increasingly affected areas.

Equipment and Reagents Required

- Water quality parameter multimeter or meters specific to parameters of interest (i.e., temperature, dissolved oxygen, pH, transparency, turbidity, salinity, specific conductance, and oxidation-reduction potential)
- Calibration solutions and deionized distilled water.

Procedures

Before any calibration takes place, the probe has to be acclimated to the ambient field temperature along with all calibration solutions for at least one hour.

Calibrate meter(s) in the field at the beginning of each day of field or laboratory work when water quality parameters will be measured. If feasible, meters must be checked for drift with calibration standards after every 4 hours of continuous use. Otherwise, a final check must be done at the end of the sampling event. If drift is evident, recalibrate.

1. Calibrate meter(s) in accordance with manufacturer's instructions using fresh (unused) calibration buffers and standards for each sensor.

2. Check slope reading with specifications (in operating manual) to verify slope is within the manufacturer's specified range.
3. Thoroughly rinse a 500-mL beaker or 8-ounce jar with sample water. Discard sample water.
4. Rinse electrodes with sample water to acclimate them.
5. Fill beaker with fresh sample water.
6. Immerse electrodes in sample while swirling the sample, if needed, to provide thorough mixing. Turn on meter(s). If a flow-through cell is used, install probes and connect sample water to bottom port of flow-through cell, directing sample water up through the cell, exiting through the top port. Direct effluent tubing back in the water or into an appropriate container for storage and handling.
7. When the readings have stabilized, record the measurements displayed on the meter. It is important to determine that the correct units and unit scale are displayed on the meter and recorded for each parameter measured. Record and correct any problems encountered during measurement.
8. If available, field measurement results should be compared to previous measurements for quality control.

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). In addition, measurements of temperature and transparency can only be collected accurately in the field. Eight parameter measurements for water are described in the following sections of this SOP.

Temperature

Water temperature may be measured with either an alcohol or digital thermometer. It is recommended that mercury thermometers not be used to avoid possible breakage and introduction of mercury into the environment and to remove a source of possible contamination to samples collected for the analysis of mercury. Temperature should be measured as soon as the sample is collected to obtain a measurement that is an accurate representation of the *in situ* sample temperature. All instruments used to measure temperature should be traceable to a NIST temperature reference. In the case of digital thermometers, if there is a calibration procedure recommended by the manufacturer, it should be followed. Multi probes in general contain a temperature probe and these should be checked against a calibrated thermometer before use. For more detailed procedures, see discussion in Wilde (2006).

Dissolved Oxygen

Dissolved oxygen may be measured in the field by either a dissolved oxygen polarographic-membrane type sensor or a luminescent type sensor. Dissolved oxygen can also be measured by a field-portable Winkler titration kit.

> It is recommended that calibration be done at temperatures that are at least within 10ºC of the ambient water temperature. The smaller the temperature difference is between the environmental water and the calibration chamber a more accurate calibration will be attained.

When using static samples (i.e. water sample collected in a container), samples should be protected from absorbing oxygen from the atmosphere by using a low or zero-headspace container. In using a meter and probe, the system should be calibrated according to the manufacturer's procedure prior to use with a zero oxygen standard and a second standard of known oxygen content. The second standard should be checked by performing a Winkler titration. Other probes are calibrated by percent oxygen saturation in an enclosed container with a small amount of water. When measuring dissolved oxygen with certain polarographic-membrane probe in water samples held inside a zero-headspace containers, samples should be swirled or stirred constantly until the reading stabilizes and the measurement is recorded. Stirring of the sample is not necessary if a luminescent-sensor is used**.** Other probes are immersed in the water column and a constant measurement (dynamic measurement) is monitored until the readings are stabilized. Once the readings stabilize, the oxygen concentration readings can be recorded manually or digitally. For more detailed procedures, see discussion in Lewis (2006).

pH

The pH of a water column sample may be measured in the field using a pH meter. The meter should be calibrated according to manufacturer's specifications with at least two standards of known pH. The pH of these standards should bracket the expected pH at the sampling site. For example, if the pH at the sampling site is expected to be basic (pH 7 to 14), standards of pH 7.00 and 10.00 should be used to calibrate the meter. The pH of the buffer solution is temperature dependent. That is, pH 10 buffers change more per unit change in temperature than do pH 4 buffers. The temperature of buffer solutions must be measured, and temperature-correction factors must be applied before calibration adjustments are made. Calibration and operating procedures differ with instrument systems— check the manufacturer's instructions. If pH measurements at the sampling site do not fall within the initial calibration range, the meter should be recalibrated with appropriate standards and sample pH remeasured for those samples that fell outside the calibration range. For more detailed procedures, see discussion in Wilde et al. (2006).

Transparency

Water column transparency is measured with a Secchi disk, which is a weighted, black-and white or all-white disk that is lowered into the water body on a calibrated rope or line. Measurement should be performed from the side of the boat that faces away from the sun. The disk is lowered slowly until it is no longer visible and then raised until it is visible again. The depth, measured from the water surface, is recorded in feet or meters. The all-white disk may be preferable when the water transparency is high. Either disk, however, is acceptable to use.

Turbidity

Turbidity may be measured in the field on static water samples contained in jars with a field-portable nephelometer (turbidity meter) or *in situ* with a turbidity probe mounted in a multi probe device. The meter should be calibrated prior to use with at least two standards of different but known turbidity (in nephelometric turbidity units or NTUs). The two standards should bracket the range of turbidity measurements expected at the sampling site.

When performing field analysis for turbidity on static water samples, samples should be analyzed as soon as possible after collection. If immediate analysis is not possible, the sample should be agitated prior to analysis to resuspend any settled solid material. If the sample temperature increases, air bubbles may form and cause erroneous values.

When performing field analysis for turbidity *in situ*, the turbidity probe is constantly monitored with a remote display and data can be recorded manually or digitally.
For more detailed procedures, see Anderson (2005).

Conductivity or Salinity

Salinity may be measured in the field with a salinometer, and conductivity with a conductivity meter. There are two types of conductivity sensors as described below.

- **Contacting-type sensors with electrodes.** Electrodes contained in a dip cell can be suspended in the sample. The cell constant is the distance between electrodes (in centimeters) divided by the effective cross-sectional area of the conducting path (in square centimeters). A cell constant is chosen on the basis of the expected conductivity. The greater the cell constant, the greater the conductivity that can be measured.

- **Electrodeless-type sensors.** Conductivity is measured by inducing an alternating current in a closed loop of solution, and measuring the magnitude of the current. Measuring errors in this type of electrode are minimized because sensors do not have issues with electrode polarization or electrode fouling.

The conductivity meter should be calibrated prior to use according to the manufacturer's directions using a standard of known conductivity. The conductivity of the standard should

be close to the expected value at the sampling site. When measuring a sample for conductivity, the sample should be swirled or stirred until the meter is stabilized and a measurement is recorded. For more detailed procedures, see Radtke et al. (2005).

Salinity can be automatically calculated from conductivity, temperature and barometric pressure readings in the same multi probe and displayed on the meter of most models. Salinity may also be calculated from the measured conductivity and temperature of a sample according to Standard Method 2520B (APHA 1998). Gross salinity measurements may also be taken with a field-portable refractometer. This instrument will provide salinity measurements with an accuracy of 1 to 2 parts per thousand. For more detailed procedures, see APHA (1998).

ORP or Eh

Oxidation-Reduction Potential or Eh may be measured in the field with an inert metal electrode and read relative to a reference electrode that is immersed in the same medium. For most multi probe units, the inert metal electrode is a button or ring made of platinum and the Ag/AgCl reference electrode is the same one connected to the pH probe. The readout of the sensor is a voltage (relative to the reference electrode), with positive values (e.g., + 300 mV) indicating an oxidizing environment (ability to accept electrons) and negative values (e.g. -300 mV) indicating a reducing environment (ability to donate electrons) (YSI 2005).

ORP and Eh are the same parameters in that both measure the potential of the medium to transfer electrons. However, the ORP reference electrode is made of different material than the Eh standard reference hydrogen electrode (SHE) and therefore, there is a voltage offset that needs to be taken into account when converting ORP measurements to Eh values.

More detailed explanation on the theoretical concept, voltage offset conversions, method limitations and interferences can be found in the attached YSI Tech Note (2005) and in Nordstrom and Wilde (2005).

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YSI Environmental. 2005. Measuring ORP on YSI 6-Series Sondes: Tips, Cautions and Limitations. Tech Note 0201 T608, accessed *February 7, 2008* from https://www.ysi.com/DocumentServer/DocumentServer?docID=YSI_T608

Appendix G – EPA-LWG Communications

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Appendix G
LWG-EPA Communications

G-1. EPA 2007. Email from Eric Blischke to Jim McKenna, Bob Wyatt, Rick Applegate, and Carl Stivers dated October 17, 2007 regarding leachate testing to support the Portland Harbor FS. Environmental Protection Agency, Region 10. Seattle, Washington.

G-2. Anchor 2007. Email and attachments from Carl Stivers to Eric Blischke and Chip Humphrey dated December 17, 2007 regarding LWG's proposal for mobility testing. Anchor Environmental LLC. Seattle, Washington.

G-3. EPA 2008. Email and attachments (from December 17 Anchor email) from Chip Humphrey to Jim McKenna, Rick Applegate, and Bob Wyatt approving LWG's proposal for mobility testing and requesting a Field Sampling Plan within 30 days. Environmental Protection Agency, Region 10. Seattle, Washington.

G-4. Anchor 2008. Email from Carl Stivers to Eric Blischke and Chip Humphrey dated February 2, 2008 regarding the LWG Proposal Mobility Testing and requesting an extension of the FSP deadline to March 24, 2008. Anchor Environmental LLC. Seattle, Washington.

G-5. EPA 2008 Email from Chip Humphrey to Jim McKenna, Rick Applegate, Bob Wyatt, and Carl Stivers dated February 19, 2008 approving LWG's request to extend the deadline for submittal of the Mobility Testing FSP. Environmental Protection Agency, Region 10. Seattle, Washington.

G-6. Anchor 2008. Email from Carl Stivers to Chip Humphrey, Eric Blischke, and Kristine Koch dated March 24, 2008 regarding submittal of the LWG Sediment Chemical Mobility FSP for EPA Review. Anchor Environmental LLC. Seattle, Washington.

G-7. Anchor 2008. Email from Carl Stivers to Chip Humphrey, Eric Blischke dated April 18, 2008 regarding Sediment Chemical Mobility QAPP for EPA review. Anchor Environmental LLC. Seattle, Washington.

From: Blischke.Eric@epamail.epa.gov
Sent: Wednesday, October 17, 2007 3:25 PM
To: Jim McKenna; Bob Wyatt; Rick Applegate; Carl Stivers
Cc: Humphrey.Chip@epamail.epa.gov
Subject: Leachate Testing to Support Portland Harbor FS

All, here is a draft request from EPA regarding leachate testing to support the Portland Harbor FS. This should be used as talking points for our planned discussion on Friday. I was not sure whether a time had been agreed upon but the morning works best.

Eric

EPA requests the LWG provide a proposal for performing leachbility testing to support the Portland Harbor FS. This information is needed to determine which sediments are suitable for in-water disposal within a confined disposal facility (CDF) or a confined aquatic disposal (CAD) unit, to evaluate capping as a remedial action alternative, to help develop cost estimates for in-water disposal of confinement, and evaluate upland disposal options. This information could also be used to evaluate whether contaminated site sediments are suitable for disposal in into the proposed Terminal 4 confined disposal facility (T4 CDF). Background, rationale and methodologies are provided below.

Background

Sediment remedies typically consist of a combination of dredging, capping and monitored natural recovery. Remedies that require the containment of contaminated sediments within or adjacent to the aquatic environment will require an evaluation of contaminant mobility. This information may be used to evaluate disposal within a confined disposal facility (CDF) or a confined aquatic disposal (CAD) unit and to evaluate capping. Sediments that leach contaminants above concentrations that are protective of human health or exceed criteria, may not be suitable for in-water confinement or may require engineered solutions (e.g., liners and cap amendments) at increased cost. In addition, remedies that require upland disposal will require leachate evaluate suitability for upland disposal.

Rationale

Considerable sediment characterization has been performed on contaminated sediments at the Portland Harbor site. However, comparable leachate testing has not occurred. This lack of Portland Harbor sediments leachability data is a limitation to moving forward with the evaluation of remedial action alternatives at the Portland Harbor site. Certain known highly or uniquely contaminated locations (e.g., Gasco and Arkema) are likely to be excluded from certain types of in-water disposal based on existing information (e.g., in-water sediment data, upland leachate testing, the known presence of non-aqueous phase liquids) suggesting that the contaminated sediments are highly leachable. However, this information is based on a presumed precaution rather than based on the known leachable characteristics of the sediments themselves. Leachability characterization of a variety of potential Portland Harbor contaminated sediment locations is required to design environmentally-safe disposal sites, whether the T4 CDF, other CDFs,

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or CADs. In addition, sediment leachability may be the determining characteristic whether a contaminated sediment matrix could be adequately remediated by capping or would need to be removed and confined and/or whether it would be suitable for subtitle D or C landfill. Additional information on each data use is summarized below:

Confined Disposal Facilities: The generation and management of leachate is recognized as a critical path component to an adequate and functional CDF. While a CDF can be designed to contain nearly any level of contamination, the characteristics of the specific waste must be understood first. High bulk chemistry alone is a good indicator of general risk to human health and the environment; however, high chemistry does not mean highly leachable, nor is it specific to the degree of or pathway at risk.

Capping and Confined Aquatic Disposal: Advective groundwater transport has the potential to transfer contamination through a cap or CAD cover. As stated above, high bulk chemistry is a good indicator of general risk to human health and the environment, however, it does not necessarily assess the potential for contaminated sediments to contaminate the cap surface as a result of advective groundwater transport. This is information is needed to evaluate elements of cap construction such as cap thickness, cap construction material and the need for the addition of cap amendments such as ogano-clay.

Upland Disposal: The toxicity characteristic leaching procedure (TCLP) was developed to determine the suitability of material for disposal in municipal (subtitle D) landfills. Material that fails the toxicity characteristic leaching procedure may require treatment to eliminate the “toxicity characteristic” or disposal in a hazardous waste (subtitle C) landfill. Either option will have a direct impact on the cost of upland disposal and must be considered in the feasibility study.

Suggested Methodologies:

EPA requests that the LWG develop a proposal for collecting and furnishing necessary leachability data on several areas of Portland Harbor sediments. Ongoing leachability testing is currently underway at the T4 location is expected to be furnished to EPA when the effort is complete. This testing is separate from this request. The following specific recommendations represent first-cut consideration on the scope and magnitude of the data collection effort, but do not represent a full integration of the Round 2 Data Submittal. These data should be strongly considered in development of the LWG’s proposal.

Samples: Several short (4- to 8-foot) cores to be composited into a single sample for each location. The intention is to collect cores that would result in a “representative sample” that is on the high side of contamination, but does not represent a “worst case” contamination condition.

Locations: EPA has identified a tentative list of locations where composite samples should be created for testing. This list uses names of areas shown on the LWG's Proposed Surface & Subsurface Samples maps, dated September 21, 2007.

AOPC 1: OSM

AOPC 3: International Slip/Schnitzer (near the head of slip)

AOPC 4: Schnitzer

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AOPC 7: Marcom Areas 6A and 5H south of St John's Bridge
Marina and US Moorings

AOPC 13 and area 6H: Willamette Cove

AOPC 16 and area 7B: Triangle Park

AOPC 21: Port

AOPC 23: Near Port side at high PCB area
Lagoon

AOPC 19: Gunderson

AOPC 24: Fireboat area

AOPC 26: Near tank farm sites

In addition, (1) two additional composited samples could be created for the Gasco and Arkema sites to allow re-evaluation of the decision to exclude these sediments from the T4 CDF or any future CDF; (2) two composited samples could be created in relatively clean sediments upriver and down river from the 5.5 mile primary Superfund study area to provide a reference for interpretation of test results.

Analyses: The following analyses should be considered for each composited sample:

Bulk Analysis for Portland Harbor Chemicals of Concern (CoC) and any other parameters of interest, grain size, and TOC.

Dredging Elutriate Test (DRET) Corps Upland Testing Manual. Results will be used to determine if specialized dredging equipment/techniques will be necessary.

Modified Elutriate Test (MET) Corps Upland Testing Manual. Results will be used to determine whether special design/treatment requirements for return effluent from confined aquatic or confined upland disposal sites are necessary.

Sequential Batch Leachate Test (SBLT) Corps Upland Testing Manual. Results in a desorption isotherm that can be used in a leachate attenuation model. Model results can be used to design containment dike(s) for in-water or upland disposal sites. Highly leachable sediments maybe screened as poor candidates for capping.

Pancake Column Leachate Test (PCLT) Corps Upland Testing Manual. Results in an elution curve that is used with a dispersion-advection model. Model results can be used to design containment dike(s) for in-water or upland disposal sites. Highly leachable sediments maybe screened as poor candidates for capping.

TCLP. Typically required for solid waste and/or hazardous waste landfills in Oregon, results may be useful to determine the degree of management the material would need in an upland environment (e.g., subtitle C versus D).

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From: Valerie Oster
Sent: Monday, December 17, 2007 10:54 AM
To: Blischke.Eric@epamail.epa.gov; Humphrey.Chip@epamail.epa.gov
Cc: Carl Stivers; Bob Wyatt; david.ashton@portofportland.com; Fred G. Wolf (wolffg@plu.edu); J Betz; Jessica Pisano (jpisano@anchorenv.com); Jim.McKenna@portofportland.com; Patty Dost (Schwabe); Rick Applegate; Valerie Oster
Subject: FW: LWG Proposal Mobility Testing
Attachments: 2007_12_17_Mobility Testing Memo.doc; 2007_12_17_Mobility Test Tables.xls

Chip, Eric,

Please see below and attached.

Thank you,
valerie

Valerie Thompson Oster
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From: Carl Stivers
Sent: Monday, December 17, 2007 10:49 AM
To: Valerie Oster
Cc: Jessica Pisano
Subject: LWG Proposal Mobility Testing

Valerie – Please pass this on to EPA.

Eric and Chip –

Please find attached the LWG's proposal for mobility testing. We look forward to discussing this with you in the near future. Thanks.

Carl

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Memorandum

To: Eric Blischke, USEPA Region 10
Chip Humphrey, USEPA Region 10

From: Carl Stivers, Anchor Environmental

CC: LWG Managers (Bob Wyatt, Jim McKenna, and Rick Applegate)

Date: December 17, 2007

Re: Preliminary Proposal for Feasibility Study (FS) Mobility Testing

In an email dated October 17, 2007 from Eric Blischke regarding "Leachate Testing to Support Portland Harbor FS", EPA requests further discussion of potential leachate or mobility testing and a proposal from the LWG for such testing. This memo presents a preliminary description of such a proposal for mobility testing.

EPA's email provides their reasoning for considering the following mobility tests at 15 Site locations and 2 "reference" areas:

- Dredging Elutriate Test (DRET)
- Modified Elutriate Test (MET)
- Sequential Batch Leachate Test (SBLT)
- Pancake Column Leachate Test (PCLT)
- Toxicity Characteristic Leaching Procedure (TCLP) described in hazardous waste regulations
- Bulk sediment analyses for Portland Harbor Chemicals of Concern (COC) and any other parameters of interest (e.g., grain size and TOC) in support of these tests.

All of these tests are described in the Corps Upland Testing Manual (USACE 2003) except TCLP, which is described in federal regulations (40 CFR §261.24).

Rationale for Selection of Mobility Tests for the FS

We have reviewed EPA's stated rationale and purpose for each test in the email. One logistical complication with conducting these tests at this time is that they are designed to be conducted on the material that is proposed for dredging and disposal. At this time in the RI/FS process we

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do not know the exact areas and volumes to be potentially removed or the range of locations and conditions where those materials might be disposed (although we do have one example in the proposed T-4 facility). However, we have reviewed the mobility tests that EPA is considering in an effort to identify those tests that we think would provide the most value at the FS stage of the project as well as those tests that are expected to have relatively little value because 1) identification of dredge material and disposal options is too preliminary at this time and/or 2) other useful methods exist to evaluate issues related to these tests at an FS-appropriate level of detail.

DRET

The DRET test is a bench-scale elutriate test that is intended to estimate the chemical concentrations in the water column near the point of dredging. Often this test is used as a screen against water quality criteria to determine if any exceedances of such criteria are likely, even very close to the point of dredging. These results can also be used in some models to estimate the mixing zone distances needed to meet criteria if they are expected to be exceeded near the point of dredging.

The DRET test is not recommended for the FS. The Army Corps has developed the DREDGE model, which mimics potential water quality impacts based on bulk sediment chemistry and other basic information about the sediments and water column (Hayes and Chung-Hwan 2000). The model is set up for input of bulk sediment chemical concentrations as inputs parameters not DRET results. Since the model was originally developed, techniques to apply DRET results to this model have been developed, but they are not a pre-requisite for using this model. We would propose that bulk sediment chemistry can be used in conjunction with the DREDGE model or similar models for the evaluation of this issue at an FS-appropriate level of detail.

MET

The MET (more recently known as the Effluent Elutriate Test or EET) is intended to estimate potential chemical concentrations in confined disposal facility or temporary dewatering facility effluents discharged during construction. The MET, along with several potential models available from the Army Corps, can be used to assess the sizing and filling requirements for such facilities.

The MET test will have some influence on the size, and therefore, cost of some confined disposal and dewatering options. Without MET data, bulk sediment chemistry, literature partitioning coefficients, and conservative assumptions about TSS levels in effluents (based on grain size information) can be used to approximately estimate the chemical concentrations in disposal facility effluents under different sized facilities per the Upland Testing Manual guidance. However, select MET testing would provide a means to refine these estimates and reduce the range of estimated disposal facility sizes and other basic features that may affect the cost criterion of the FS evaluation.

SBLT and PCLT

The SBLT and PCLT tests are intended as methods to estimate groundwater leachate concentrations and characteristics from confined disposal facilities. Per the Upland Testing Manual, "Since the SBLT test is a simpler procedure and is more cost and time effective than the PCLT, the SBLT test would normally be preferred for freshwater sediments." The only exception to this in the manual is for NAPL containing sediments, in which case the manual indicates the PCLT may be a better test. Also, over the history of the PCLT it has been modified in a number of respects for actual application to various projects. This generally includes using disposal site groundwater (or artificial water intended to mimic disposal site specific conditions) and setting a flow rate through the PCLT column based on the expected subsurface conditions at the disposal site. Given that the range of disposal site conditions potentially applicable for this project is unknown at this time, this would make the more advanced, and generally more accurate, application of the PCLT test impossible. Also, the cost of the PCLT is an order of magnitude higher than the SBLT, and it is not unusual for the PCLT to take 3 to 6 months to complete. For all these reasons, of the two tests, the SBLT is clearly the more applicable and feasible for consideration in the FS.

The SBLT is also in many respects a more generalized test that relies less closely on disposal site specific conditions and can establish a general desorption isotherm that is potentially applicable or useful in a wide range of situations, including a variety of confined disposal options as well as in-situ capping of sediments. Given that volumes and areas of remediation have not been determined yet, a broad screening of site sediments to understand the variation of potential leachate characteristics would be much more cost effective using the SBLT both in terms of cost to conduct the test and the wider usefulness of the results. One caution per the guidance is that

sediments with high levels of product such as NAPL may result in potentially inapplicable results using the SBLT. Thus, SBLT results from any such samples would need to be evaluated carefully. However, given the screening nature of these tests and that most Portland Harbor sites probably do not fall into this category, this is appears to be a reasonable level of uncertainty for use of the leachate results.

Consequently, it appears reasonable that conducting select SBLT tests may provide additional site specific information to refine evaluations of both disposal facilities and in-situ caps for the project. Particularly for in-situ capping evaluations, Transition Zone Water data available at some locations within Portland Harbor should also be used to estimate the effectiveness of caps.

TCLP

The TCLP is a standardized simple leaching procedure that is promulgated in federal regulation to determine whether a material is a "hazardous waste". Hazardous wastes generally have to be disposed of in Subtitle C landfills, which have more robust groundwater leachate controls resulting in higher disposal costs. An EPA promulgated screening calculation can be used to assess the need for TCLP testing. The calculation assumes that the entire bulk sediment concentration would leach into the test water during the TCLP test. If the calculated water concentrations are below the TCLP criteria, exceedance during an actual TCLP test is impossible.

Table 1 contains a preliminary screening calculation using the maximum sediment chemical concentrations from the Site. Site sediments exceed the TCLP screen at several locations shown in Table 1. Given that there is the potential for some Site sediments to exceed TCLP test criteria, it appears that select TCLP testing should be conducted to determine if any Site sediments may need to be handled as hazardous waste.

Preliminary LWG Proposal for Mobility Testing

Per the rationale above, there appears to be some value for the FS in conducting select MET, SBLT, and TCLP sampling.

MET and SBLT Testing

For the MET and SBLT tests, sampling should take place in likely removal areas. The potential removal areas will be defined in the FS and are not known at this time. However, it is reasonable to assume that areas with higher chemical concentrations will be more likely to have removal as at least an evaluated option in the FS. Table 2 summarizes the site-wide 95th percentile chemical concentrations for the Round 2 Report iCOCs and identifies those iAOPCs where concentrations above those levels occur. Table 3 further summarizes the iAOPCs that exceed these 95th percentile chemical levels and for which chemicals. The result in Table 3 is a selection of 11 areas where MET and SBLT samples would be collected. We believe this is a good method for identifying areas for mobility testing that is based on known sediment chemistry versus EPA's email which identifies 15 areas on an unexplained basis. Table 3 also compares the locations of the LWG proposal to the locations discussed in EPA's email. Note that these locations are preliminary and may be further refined during development of the actual Field Sampling Plan (FSP) for this work.

The sampling methods for MET and SBLT tests would be to collect approximately four vibracores from each of these 11 areas. The four cores at each location would range across the currently identified area of potential concern as identified on both LWG and EPA maps. These four cores would then be composited into one sample for submittal to the laboratory, for a total of 11 samples. The exact locations for each of these cores and compositing scheme has not yet been determined, but would be identified the FSP for this work. Methods for testing the samples would follow the Upland Testing Manual, with details provided in the FSP.

Note that EPA also discusses the concept of conducting mobility tests for relatively clean sediments to provide a "reference" for other results. We are unaware of any purpose of mobility testing in clean sediments or any guidance suggesting that such an approach is warranted or useful in test result evaluations. Consequently, we would not recommend collecting or testing any "reference" sediments.

TCLP Testing

Per the above screening analysis, we recommend TCLP testing at the 10 locations shown in Table 1. These locations were chosen based on samples that were greater than five times the TCLP screening level. Again, these locations are preliminary and may be refined in the actual

FSP. Because there will likely be some ability to segregate materials into hazardous and non-hazardous dredge management units within individual areas of concern, we suggest that the TCLP cores focus on zones of higher chemical levels within each general area identified in Table 1. It is important to note that this is a somewhat conservative approach and that if any locations exceed actual TCLP test criteria, further work will be needed in the design phase to delineate areas of hazardous vs. non-hazardous waste within these areas of concern.

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Table 1. Comparison of All Site Sediment Data to TCLP Screening Levels and Selection of TCLP Testing Locations.

Contaminant	TCLP Regulatory Level (mg/L)	Concentration needed to be above TCLP screening level	iAOPC		Maximum Detected Concentration (mg/kg)	# of Samples = or above Screen	Ratio of Max. over Screening Level	Station Number for TCLP Testing
Arsenic	5.00	100.00	1		132.00	1	1.3	
Chromium	5.00	100.00	1		819.00	12	8.2	**1**
Lead	5.00	100.00	1		166.00	7	1.7	
Chromium	5.00	100.00	3		117.00	1	1.2	
Lead	5.00	100.00	3		310.00	7	3.1	
Chromium	5.00	100.00	5		103.00	1	1.0	
Lead	5.00	100.00	5		120.00	1	1.2	
Lead	5.00	100.00	6		330.00	1	3.3	
Arsenic	5.00	100.00	7		105.00	1	1.1	
Chromium	5.00	100.00	7		249.00	6	2.5	
Lead	5.00	100.00	7		577.00	12	5.8	**2**
Mercury	0.20	4.00	7		4.84	1	1.2	
Chromium	5.00	100.00	9	adjacent to	130.00	1	1.3	
Lead	5.00	100.00	9		232.00	1	2.3	
Lead	5.00	100.00	9	adjacent to	416.00	2	4.2	
Lead	5.00	100.00	9	adjacent to	117.00	1	1.2	
Chromium	5.00	100.00	10		212.00	6	2.1	
Lead	5.00	100.00	10		332.00	5	3.3	
Benzene	0.50	10.00	11		270.00	12	27.0	**3**
Benzene	0.50	10.00	11	adjacent to	11.00	1	1.1	
Chromium	5.00	100.00	11	adjacent to	175.00	1	1.8	
Lead	5.00	100.00	11		684.00	4	6.8	
Lead	5.00	100.00	11	downstream of	331.00	2	3.3	
Trichloroethylene	0.5	10.00	11	adjacent to	1900	2	190.0	**4**
Vinyl Chloride	0.2	4.00	11	adjacent to	4	1	1.0	
Lead	5.00	100.00	13		238.00	2	2.4	
Mercury	0.20	4.00	13		4.14	1	1.0	
Barium	100.00	2000.00	14		5950.00	1	3.0	
Chromium	5.00	100.00	14		270.00	4	2.7	
Hexachlorobenzene	0.13	2.60	14		14.00	1	5.4	**5**
Hexachlorobutadiene	0.50	10.00	14		34.00	2	3.4	
Lead	5.00	100.00	14		1290.00	12	12.9	
Lead	5.00	100.00	14	adjacent to	3330.00	1	33.3	**6**
Chromium	5.00	100.00	15		184.00	3	1.8	
Lead	5.00	100.00	15		516.00	2	5.2	**7**
Lead	5.00	100.00	16	adjacent to	204.00	1	2.0	
Chromium	5.00	100.00	18		774.00	1	7.7	**8**
Lead	5.00	100.00	18		350.00	3	3.5	
Lead	5.00	100.00	18	downstream of	242.00	1	2.4	
Chlordane	0.03	0.60	19		2.33	1	3.9	
Chromium	5.00	100.00	19		157.00	3	1.6	
Lead	5.00	100.00	19		1080.00	15	10.8	**9**
Lead	5.00	100.00	19	downstream of	164.00	2	1.6	
Arsenic	5.00	100.00	21		140.00	1	1.4	
Lead	5.00	100.00	21		330.00	14	3.3	
Chromium	5.00	100.00	22		148.00	2	1.5	
Lead	5.00	100.00	22		116.00	2	1.2	
Cadmium	1.00	20.00	23		46.20	1	2.3	
Lead	5.00	100.00	23		936.00	2	9.4	**10**
Selenium	1.00	20.00	23		20.00	1	1.0	
Lead	5.00	100.00	26		178.00	2	1.8	
Lead	5.00	100.00	26	upstream of	348.00	2	3.5	
1,1-Dichloroethylene	0.70	14.00	NA		ND		NA	
1,2-Dichloroethane	0.50	10.00	NA		0.0004		0.0	
1,4-Dichlorobenzene	7.50	150.00	NA		0.73		0.0	
2,4,5-TP (Silvex)	1.00	20.00	NA		0.01		0.0	
2,4,5-Trichlorophenol	400.00	8000.00	NA		0.20		0.0	
2,4,6-Trichlorophenol	2.00	40.00	NA		1.40		0.0	
2,4-D	10.00	200.00	NA		3.25		0.0	
2,4-Dinitrotoluene	0.13	2.60	NA		2.10		0.8	
Carbon Tetrachloride	5.00	100.00	NA		ND		NA	
Chlorobenzene	100.00	2000.00	NA		35.00		0.0	
Chloroform	6.00	120.00	NA		0.14		0.0	

Contaminant	TCLP Regulatory Level (mg/L)	Concentration needed to be above TCLP screening level	iAOPC	Maximum Detected Concentration (mg/kg)	# of Samples = or above Screen	Ratio of Max. over Screening Level	Station Number for TCLP Testing
Cresol	200.00	4000.00	NA	ND		NA	
Endrin	0.02	0.40	NA	0.03		0.1	
Heptachlor(and its epoxide)	0.01	0.16	NA	0.01		0.0	
Hexachloroethane	3.00	60.00	NA	1.60		0.0	
Lindane	0.40	8.00	NA	0.43		0.1	
m-Cresol	200.00	4000.00	NA	0.30		0.0	
Methoxychlor	10.00	200.00	NA	0.51		0.0	
Metyl Ethyl Ketone	200.00	4000.00	NA	0.05		0.0	
Nitrobenzene	2.00	40.00	NA	ND		NA	
o-Cresol	200.00	4000.00	NA	0.29		0.0	
p-Cresol	200.00	4000.00	NA	2.50		0.0	
Pentachlorophenol	100.00	2000.00	NA	8.41		0.0	
Pyridine	5.00	100.00	NA	ND		NA	
Silver	5.00	100.00	NA	14.80		0.1	
Tetrachloroethylene	0.70	14.00	NA	0.01		0.0	
Toxaphene	0.50	10.00	NA	1.90		0.2	

NA No Locations exceeded the TCLP screening value

Table 2. Analysis of Peak Concentrations in Bulk Sediment by General Site Area.

Analytes of Concern from Table 10.5-1	Units	Sitewide Surface 95th	Sitewide Subsurface 95th	Sitewide Surface Riparian Zone 95th	Sitewide Subsurface Riparian Zone 95th	Sitewide maximum 95th	iAOPCs exceeding max. 95th w/ (max concentration)
Total PCB Aroclors (calc'd)	ug/kg	810	843	9.1	13500	**13500**	3 (26,000), 19 (27,400)
Total PCB Congeners (calc'd)	ug/kg	972	2830	25900	NA	**25900**	19 (35,400)
PCB congener TEQ (calc'd)	pg/g	41.7	48.8	NA	NA	**48.8**	3 (161), 7 (86.7), 19 (324)
Dioxin/Furan TCDD toxicity equivalent	pg/g	75.8	54.7	NA	NA	**75.8**	1 (140), 13 (102), 14 (16,600)
Sum DDD (calc'd)	ug/kg	136	282	7.13	NA	**282**	11 (2,220), 14 (690,000), 17 (385), 19 (2,980)
Sum DDE (calc'd)	ug/kg	55.6	51	3.34	NA	**55.6**	14 (24000), 19 (2830)
Sum DDT (calc'd)	ug/kg	193	342	25.8	NA	**342**	11 (1,110), 14 (3,500,000)
alpha-BHC	ug/kg	2.2	7.37	1.78	NA	**7.37**	19 (98.9)
beta-BHC	ug/kg	7.3	12.3	NA	NA	**12.3**	11 (318), 14 (120)
delta-BHC	ug/kg	2.2	5.8	2.23	NA	**5.8**	11 (45.4)
Aldrin	ug/kg	11.4	92	NA	NA	**92**	14 (1,340), 19 (637)
Dieldrin	ug/kg	9.17	15.6	NA	NA	**15.6**	19 (356)
Endrin Ketone	ug/kg	4.57	8.65	4.48	NA	**8.65**	3 (16), 11 (263), 19 (90.1)
Ammonia	mg/kg	**225**	522	NA	NA	522	11 (334), 18 (481), 19 (352)
Sulfide	mg/kg	96.3	72	NA	NA	**96.3**	11 (998), 14 (445)
Mercury	mg/kg	0.276	0.5	0.18	0.09	**0.5**	6 (0.74), 13 (4.14), 14 (0.72), 19 (2.01)
Arsenic	mg/kg	9	6.95	54.8	7.65	**54.8**	15 (83.5)
Silver	mg/kg	1.13	0.924	0.876	NA	**1.13**	7 (5.65), 14 (4.24), 19 (4.44)
Cadmium	mg/kg	**1.135**	0.803	1.02	5.92	5.92	19 (5.41)
Lead	mg/kg	110	102	516	251	**516**	NL
Zinc	mg/kg	374	288	2650	**1530**	2650	21 (1,930)

Table 2. Analysis of Peak Concentrations in Bulk Sediment by General Site Area.

Analytes of Concern from Table 10.5-1	Units	Sitewide Surface 95th	Sitewide Subsurface 95th	Sitewide Surface Riparian Zone 95th	Sitewide Subsurface Riparian Zone 95th	Sitewide maximum 95th	iAOPCs exceeding max. 95th w/ (max concentration)
Dibutyl phthalate	ug/kg	136	91	34	NA	**136**	1 (180), 3 (1800), 14 (1500), 19 (185), 21 (230)
Benzo(a)antrhacene	ug/kg	5570	9900	168	200	**9900**	11 (760,000),
Benzo(a)pyrene	ug/kg	3800	12000	196	279	**12000**	11 (940,000)
Benzo(b)fluoranthene	ug/kg	6400	9900	170	266	**9900**	11 (590,000)
dibenzo(a,h)anthracene	ug/kg	1000	1500	47.1	845	**1500**	11 (67,000)
Indeno(1,2,3-cd)pyrene	ug/kg	6000	11000	224	430	**11000**	11 (610,000)
Diesel Range Hydrocarbons	mg/kg	1900	3400	92.2	11600	**11600**	11 (190,000), 19 (12,000)
Residual Range Hydrocarbons	mg/kg	2640	3200	640	NA	**3200**	3 (11,000), 11 (110,000), 13 (6,000), 19 (25,000)

Notes:
*Sum DDD calculated by totaling 2,4' and 4,4'-DDD
**Sum DDE calculated bytotaling 2,4' and 4,4'-DDE
***Sum DDT calculated by totaling 2,4' and 4,4'-DDT
****-BHC reports values for -hexachlorocyclohexane
*****NA - Not available
****** The 95th value was selected from an ascending ranked list of all results. Where n = the number of samples, the actual sample result corresponding to the ra
closest integer to n * 0.95 (95th percentile) or n * 0.50 (median) is presented.
NL - Chemical not listed as an iCOC for any iAOPC on Table 11.3 Summary Statistics for Sediment
Bold - Indicates the 95th percentile concentration used to screen the iAOPCs

Table 3. Summary of Stations for Sequential Batch Leach Test Sampling

iAOPC	PCBs	Dioxins	DDx	Pesticides	Metals	Phthalate	PAH	TPH	Sum	Sample No.	EPA Locations*
1		1				1			2	1	1
2									-		
3	1			1		1		1	4	2	2
4									-		3
5									-		
6					1				1	3	
7	1				1				2	4	4
8									-		
9									-		
10									-		
11			1	1			1	1	4	5	5
12									-		
13		1			1			1	3	6	6
14		1	1	1	1	1			5	7	7
15					1				1	8	
16									-		8
17			1						1	9	
18									-		
19	1		1	1	1	1		1	6	10	9
20									-		
21					1	1			2	11	10
22									-		
23									-		11
24									-		12
25									-		
26									-		13
27									-		

1 - Indicates this area above 95th percentile value (per Table 1) for this chemical.
* EPA also identified locations at EPA areas 6A and 5H for a total of 15 locations.

From: Humphrey.Chip@epamail.epa.gov
Sent: Thursday, January 24, 2008 6:49 PM
To: Jim McKenna; Rick Applegate; Bob Wyatt
Cc: Carl Stivers; Valerie Oster; Blischke.Eric@epamail.epa.gov
Subject: Re: FW: LWG Proposal Mobility Testing

Attachments: 2007_12_17_Mobility Testing Memo.doc; 2007_12_17_Mobility Test Tables.xls

2007_12_17_Mobility Testing Me... 2007_12_17_Mobility Test Table...

Jim, Bob and Rick

This is in response to your Preliminary Proposal for Feasibility Study (FS) Mobility Testing, which was provided via email on December 17th (below) as a memorandum and table from Carl Stivers, Anchor Environmental. The LWG's proposal includes obtaining core samples and performing the following tests:

1) Modified Elutriate Test (MET) on sediment samples from 11 locations
2) Sequential Batch Leachated Test (SBLT) on sediment samples from 11 locations
3) TCLP on sediment samples from 10 locations

The proposal indicates that 4 cores would be obtained and composited into a sample for each location. Preliminary location of the cores and compositing scheme was described in the proposal with the understanding that they would be refined in a subsequent Field Sampling Plan.
Although not speciically stated in the LWG's proposal, we assume that each composited sample will be characterized (ie, bulk analysis for chemical and physical paramters) as that is the standard protocol.

The LWG's proposal is generally acceptable to EPA and we request that the LWG prepare and submit a Field Sampling Plan within 30 days for EPA review and approval.

Please let us know if you have any questions.

Chip Humphrey
EPA

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From: Valerie Oster

Sent: Saturday, February 02, 2008 1:32 PM

To: Blischke.Eric@epamail.epa.gov; Humphrey.Chip@epamail.epa.gov

Cc: Soniya Ziegler; Gerald George; Stuart Dearden; C Reive; Nanci Klinger; Rick Applegate; William Earle; Terry Lauck; A Seger; Patty Dost (Schwabe); Fred G. Wolf (wolffg@plu.edu); Julie Wilson; D Livesay; Bill Joyce; B Ferguson; M Miller; kparrett@gsiwatersolutions.com; C Powers; J Betz; Mark Lewis; T McCue; Kim Stafford; J Snyder; D Sanders; D Deetz Silva; S Brown; John Gootherts; John Ashworth; F Wolf; S Gardner; Mark Leece; Bob Wyatt; Brigitte ; Jessica Pisano (jpisano@anchorenv.com); Carl Stivers; Sean Gormley; Mark Schneider; M Chandler; J Kincaid; Andy Davis; valerie; R Gresh; Loren Dunn; James Peale; L Paretchan; Drew Gilpin; david.ashton@portofportland.com; G Koschal; T Gold; Jim.McKenna@portofportland.com; S David; K Koehl; Garrick Jauregui; A Gladstone; Tom Sass; Robert Truedinger; D Vallance; J Benedict

Subject: FW: FW: LWG Proposal Mobility Testing

Chip, Eric,

Please see below from Carl on behalf of LWG.

Thanks
Valerie

Valerie Thompson Oster
Anchor Environmental, L.L.C
6650 SW Redwood Lane, Suite 333
Portland, OR 97224
Phone: 503-670-1108 x19
Fax: 503-670-1128

This communication is made under the framework of the LWG Participation Agreement and in the parties' common interests in meeting LWG member obligations under the Administrative Order on Consent and in anticipation of litigation concerning liability for the Portland Harbor Superfund site. This communication is intended and believed by the parties to be part of an ongoing and joint effort to develop and maintain a common legal strategy and contains strategies, work product and legal advice within the "common interest" extension of the attorney-client privilege and the work product doctrine. This communication may include attorney-client communications. With respect to communications by private LWG members to public members, those communications are with the expectation that they will be kept confidential by the public entities. The information is intended to be for the use of the individual or entity named above. If you are not the intended recipient, please be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. If you have received this electronic transmission in error, please notify us by electronic mail at voster@anchorenv.com.

From: Carl Stivers
Sent: Fri 2/1/2008 11:16 AM
To: Valerie Oster
Subject: RE: FW: LWG Proposal Mobility Testing

Valerie – Please pass on to EPA with copy to Exec. Thanks.

Chip and Eric -

The LWG is requesting an extension of the deadline stated in the EPA approval message below. We would like 60 days for this submittal given that the mobility tests contain many new procedures for the project and will require coordination with potentially new labs. Thus, we would plan to submit a draft FSP to EPA by March 24, 2008. We see no impact from this extension on the overall project schedule given that these data will not be used until we are well into the FS development process. Thanks much.

Carl

Carl Stivers
Anchor Environmental, L.L.C.
23 South Wenatchee Avenue, Suite 120
Wenatchee, WA 98801
Phone: 509-888-2070
Fax: 509-888-2211

cstivers@anchorenv.com

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From: Humphrey.Chip@epamail.epa.gov [mailto:Humphrey.Chip@epamail.epa.gov]
Sent: Thu 1/24/2008 6:49 PM
To: Jim McKenna; Rick Applegate; Bob Wyatt
Cc: Carl Stivers; Valerie Oster; Blischke.Eric@epamail.epa.gov
Subject: Re: FW: LWG Proposal Mobility Testing

Jim, Bob and Rick

This is in response to your Preliminary Proposal for Feasibility Study (FS) Mobility Testing, which was provided via email on December 17th (below) as a memorandum and table from Carl Stivers, Anchor Environmental. The LWG's proposal includes obtaining core samples and performing the following tests:

1) Modified Elutriate Test (MET) on sediment samples from 11 locations
2) Sequential Batch Leachated Test (SBLT) on sediment samples from 11 locations
3) TCLP on sediment samples from 10 locations

The proposal indicates that 4 cores would be obtained and composited into a sample for each location. Preliminary location of the cores and compositing scheme was described in the proposal with the understanding that they would be refined in a subsequent Field Sampling Plan. Although not speciically stated in the LWG's proposal, we assume that each composited sample will be characterized (ie, bulk analysis for chemical and physical paramters) as that is the standard protocol.

The LWG's proposal is generally acceptable to EPA and we request that the LWG prepare and submit a Field Sampling Plan within 30 days for EPA review and approval.

Please let us know if you have any questions.

Chip Humphrey
EPA

"Valerie Oster"
<voster@anchorenv.com>
12/17/2007 10:54 AM

To
Eric Blischke/R10/USEPA/US@EPA,
Chip Humphrey/R10/USEPA/US@EPA

cc
"Carl Stivers" <cstivers@anchorenv.com>, "Bob Wyatt" <rjw@nwnatural.com>, <david.ashton@portofportland.com>, <wolffg@plu.edu>, "J Betz" <jbetz@ci.portland.or.us>, <jpisano@anchorenv.com>, <Jim.McKenna@portofportland.com>, "Patty Dost \(Schwabe\)" <Pdost@Schwabe.com>, "Rick Applegate" <RICKA@BES.CI.PORTLAND.OR.US>, "Valerie Oster" <voster@anchorenv.com>

Subject
FW: LWG Proposal Mobility Testing

Chip, Eric,

Please see below and attached.

Thank you,
valerie

Valerie Thompson Oster
Anchor Environmental, L.L.C
6650 SW Redwood Lane, Suite 333
Portland, OR 97224
Phone: 503-670-1108 x19
Cell: 503-577-0254
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From: Carl Stivers
Sent: Monday, December 17, 2007 10:49 AM
To: Valerie Oster
Cc: Jessica Pisano
Subject: LWG Proposal Mobility Testing

Valerie – Please pass this on to EPA.

Eric and Chip –

Please find attached the LWG's proposal for mobility testing. We look forward to discussing this with you in the near future. Thanks.

Carl

Carl Stivers
Anchor Environmental, L.L.C.
23 South Wenatchee Avenue, Suite 120
Wenatchee, WA 98801
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Fax: 509-888-2211
cstivers@anchorenv.com
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(See attached file: 2007_12_17_Mobility Testing Memo.doc)(See attached file: 2007_12_17_Mobility Test Tables.xls)

From: Humphrey.Chip@epamail.epa.gov
Sent: Tuesday, February 19, 2008 1:08 PM
To: Carl Stivers; Jim McKenna; Rick Applegate; Bob Wyatt
Cc: Valerie Oster; Humphrey.Chip@epamail.epa.gov
Subject: Re: Mobility Testing FSP Extension

Carl

EPA approves the LWG's request to extend the deadline for submittal of the Mobility Testing FSP. It is our understanding that this extension is needed to develop the test procedures and coordinate with the labs, and the extension will not impact the project schedule.

The new deadline for the FSP submittal is March 24, 2008.

Chip Humphrey

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From: Valerie Oster

Sent: Monday, March 24, 2008 1:14 PM

To: koch.kristine@epa.gov; humphrey.chip@epa.gov; blischke.eric@epa.gov

Cc: Rick Applegate; Patty Dost (Schwabe); Fred G. Wolf (wolffg@plu.edu); J Betz; Bob Wyatt; Carl Stivers; valerie; Keith Pine; david.ashton@portofportland.com; Jim.McKenna@portofportland.com

Subject: LWG Sediment Chemical Mobility FSP for EPA Review

Chip, Eric, Kristine -

Please see below from Carl.

thanks

valerie

Valerie Thompson Oster
Anchor Environmental, L.L.C
6650 SW Redwood Lane, Suite 333
Portland, OR 97224
Phone: 503-670-1108 x19
Fax: 503-670-1128

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Chip and Eric –

The Draft Sediment Chemical Mobility FSP has been posted to the collaboration portal at the following location:

PHCP Files | Documents Under Review | **2008-03-24_Sediment Chemical Mobility Testing FSP**

The FSP references a QAPP Addendum that is currently under preparation and we expect to submit by mid-April, as noted in previous Monthly Progress Reports. The QAPP development process may indicate the need for some revisions to some of the FSP tables, but any such changes are expected to be very minor.

Thanks. Carl

Carl Stivers
Anchor Environmental, L.L.C.
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cstivers@anchorenv.com

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From: Valerie Oster
Sent: Friday, April 18, 2008 3:35 PM
To: humphrey.chip@epa.gov; blischke.eric@epa.gov
Cc: Rick Applegate; Patty Dost (Schwabe); Fred G. Wolf (wolffg@plu.edu); J Betz; Bob Wyatt; valerie; Keith Pine; david.ashton@portofportland.com; Jim.McKenna@portofportland.com; mtritt@integral-corp.com
Subject: FW: Sediment chemical mobility QAPP | For EPA review

Chip, Eric,

Please see below.

thanks
Valerie

Valerie Thompson Oster
Anchor Environmental, L.L.C
6650 SW Redwood Lane, Suite 333
Portland, OR 97224
Phone: 503-670-1108 x19
Fax: 503-670-1128

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From: Maja Tritt [mailto:mtritt@integral-corp.com]
Sent: Fri 4/18/2008 3:30 PM
To: Valerie Oster
Cc: Bob Wyatt; Christine Hawley; David Ashton; Gene Revelas; Jim McKenna; Keith Pine; Rick Applegate; Patty Dost (Schwabe)
Subject: Sediment chemical mobility QAPP | For EPA review

Valerie, please provide the following to EPA.

Eric and Chip,

The sediment chemical mobility testing QAPP will be delivered to you today for your review. The electronic files are located on the Portland Harbor portal at:

Content | PHCP Files | Documents Under Review | **2008-04-18_R2 QAPP Addendum 11: Sediment Chemical Mobility Testing**

Thanks.
Maja

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