PORTLAND HARBOR RI/FS

Round 3A FIELD SAMPLING PLAN STORMWATER SAMPLING

March 1, 2007

Prepared for:
The Lower Willamette Group

Prepared by:
Anchor Environmental, L.L.C. and Integral Consulting Inc.

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION

This Field Sampling Plan (FSP) presents the approach and procedures to implement stormwater sampling activities in early 2007 for the Remedial Investigation and Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site). This FSP describes the field sampling and the Quality Assurance Project Plan Addendum (QAPP Addendum; Integral 2007) provides the laboratory analysis procedures to accomplish the following types of data collection:

- Stormwater chemistry, total suspended solids (TSS), and associated conventionals
- Stormwater suspended sediment chemistry and associated conventionals.

The field study sampling procedures, methods, and analyses for stormwater are described in this document. This FSP is a companion document to the Round 3A Stormwater Sampling Rationale (Anchor and Integral 2007), which describes the reasoning behind the overall approach. The RI/FS project conducted by the Lower Willamette Group (LWG) is currently collecting Round 3A of sampling data in the river for various purposes, which will extend well into 2007. Therefore, this stormwater sampling is considered part of the Round 3A sampling.

1.1 BACKGROUND AND CONTEXT

Surface water chemicals are suspected to contribute to fish tissue burdens (and related risks) within the Site. The importance of various sources of surface water chemicals, particularly stormwater, is not well understood. The sources to the water column from resuspension of sediment versus other water borne sources (such as stormwater) must be known to develop sediment and surface water preliminary remediation goals (PRGs) that are intended to minimize fish tissue related risks for the Site.

Additionally, stormwater discharges have the potential to contribute to recontamination of sediments near outfalls (and/or potentially Site-wide for some chemicals) following cleanup when the discharge contains settleable solids with associated chemicals. The potential for this outcome must be assessed at an FS-appropriate level of detail to understand the general extent and need for stormwater source controls.

To understand the relative contribution of stormwater chemicals to fish tissue burdens and predict whether sediments would recontaminate at levels above PRGs eventually set for the Site, estimates of stormwater loads are needed for inputs to estimation tools and models (Hope 2006).

Existing stormwater quality data for the Site are sporadic and relatively limited (Integral et al. 2004). Consequently, estimation of stormwater loads to the river based on existing data or literature values would be highly uncertain. Site-specific stormwater sampling is needed to support stormwater chemical loading estimates for input into the fate and transport model and other estimation tools that will be used to understand the relative contribution of stormwater chemicals to fish tissue burdens and predict whether sediments would recontaminate at levels above PRGs eventually set for the site.

Since the draft RI report is due in spring 2008 this information needs to be collected in the 2006/2007 wet-weather season to prevent slippage of the RI/FS schedule. Additional information may be collected by individual upland sites to supplement this effort and included in the final RI report.

As a result of the lack of information on the stormwater pathway, a Stormwater Technical Team comprised of representatives of the Environmental Protection Agency (EPA), Oregon Department of Environmental Quality (DEQ), and the LWG was established in November 2006. The recommendations of the Team (Koch et al. 2006) were presented to the Portland Harbor Managers (also comprised of representatives of EPA, DEQ, Tribes and LWG) in December 2006 and are the basis of this FSP.

Additional background information is provided in the Stormwater Sampling Rationale (Anchor and Integral 2007).

1.2 SAMPLING PURPOSE

The purpose of the sampling is briefly described in Section 1.1 and is detailed in the Stormwater Sampling Rationale. In summary, the purpose of this sampling and analysis effort is to provide data for evaluating the potential risk related to in-river fish tissue chemical burdens and sediment recontamination from stormwater discharges to the river. These data will be used for understanding the relative magnitude of stormwater impacts to the harbor, developing the draft Site RI, identifying remaining stormwater data gaps, and eventually, evaluating remedial alternatives in the Site FS.

This FSP describes the approach for measuring the chemical concentrations in stormwater and for obtaining stormwater flow data at 31 locations around the Site to meet the above objectives. These data will be used, in conjunction with estimation and evaluation tools described in the Stormwater Sampling Rationale to assess the nature and extent of chemical loading from stormwater discharges to the Site. In summary, the sampling approach involves:

1. Flow-weighted composite water samples from three storm events including whole water for organic compound analyses and filtered/unfiltered pairs for metals analyses.

2. One additional set of grab stormwater samples at 10 of the 31 sampling locations for sampling of filtered/unfiltered pairs and analysis of selected organic compounds and associated conventionals.

3. Sediment trap deployment (to collect suspended sediment from stormwater and analyze for sediment chemistry)[1] for a minimum duration of 3 months.

4. Continuous flow monitoring at each sampling site for the duration of the sampling effort.

In addition, filtering of high volumes of stormwater may be conducted as a contingency measure to sediment trap method noted in Item 3. This contingency technique is discussed in this document but would only be employed as a last resort in the event that sediment traps are not providing adequate sediment volumes. All other contingencies for sediment traps discussed in this document (e.g., deploying more traps to collect additional volume) will be relied upon first to obtain sufficient material if at all possible.

1.3 DATA QUALITY OBJECTIVES

Sample collection will adhere to the Standard Operating Procedures (SOPs) contained in the Appendices A through F in this FSP and accepted analytical methods as described in the QAPP Addendum (Integral 2007) in an effort to limit sources of bias. An overview of the procedures for sample collection, processing, and analysis are presented in Sections 2 and 3. Every attempt will be made to achieve the reporting limit goals identified in Section 2. Issues related to analytical data quality objectives that apply to any Round 2 or 3 LWG sampling are discussed in QAPP Addendum, which references the specific data quality indicators and objectives detailed in the Round 2 QAPP (Integral and Windward 2004). This document discusses the specific PARCC parameters (i.e., precision, accuracy or bias, representativeness, completeness, comparability) that are commonly used to assess the quality of environmental data. Each of these parameters as they apply to this sampling effort is summarized briefly below.

1.3.1 Precision

Precision is a measure of scatter in the data due to random error from sampling and analytical procedures. Precision will be measured using relative percent difference (RPD) on laboratory duplicates and matrix spike duplicates. Acceptable limits and frequencies for these duplicates and other laboratory control samples are described in the Round 2 QAPP. These tests will allow estimates of the precision of the data set. Specific details regarding field and laboratory quality control samples (including batch frequency) are discussed in Section 3.8 including number of field replicate and duplicate samples.

[1] The term “sediment trap” refers to the process of collecting suspended sediments in stormwater by deploying traps within stormwater conveyance systems and later sampling those sediments for chemical analysis. This should not be confused with sediment traps that are deployed within the river, which is one type of Round 3A sampling currently underway for the Site.

1.3.2 Bias

Bias is a measure of the difference between the parameter result and the true value due to systematic errors. Possible sources of systematic errors are collection, sample instability (physical/chemical), interferences, calibration, contamination, etc.

Bias associated with sample matrix will be measured using the percent recovery (%R) on laboratory control samples (LCS), matrix spikes recoveries and surrogate recoveries. Matrix spikes may provide an estimate of bias for the entire analytical procedure. The acceptable recoveries and frequencies for LCS, matrix spikes, and surrogates for the parameters to be analyzed are listed in the Round 2 QAPP.

Bias associated with contamination will be assessed by analysis of equipment rinsate blanks and laboratory method blanks. The equipment rinsate blank is a measure of field contamination whereas the method blank is a measure of laboratory contamination. The handling and qualification of results based on blank contaminant information is detailed in the Round 2 QAPP. The frequency of laboratory method and field rinsate blanks is discussed in the Round 2 QAPP and Section 3.8, respectively.

A field duplicate sample for sediment traps will be deployed at two locations and analyzed with each sediment trap batch to provide an estimate of overall variability in the sediment data (Section 3.8). Certified Reference Materials (CRM) will be analyzed to monitor performance of the analytical systems. Information regarding CRM requirements for this project is included in the Round 2 QAPP.

1.3.3 Representativeness

1.3.3.1 Whole Water

This project will measure chemical concentrations in stormwater. With regard to stormwater, representativeness is achieved by selecting sample locations, methods and times so that the data describes the characteristics of stormwater runoff over the range of land use conditions in the drainage basins, the varying hydrologic conditions within an individual storm event (i.e., rising and falling portions of the hydrograph), and a representative cross-section of storm types. Additional details regarding representativeness of sample location, collection of storm flows, and the criteria used for sampling are presented in Sections 2.1.1 and 3.4.

Representativeness of Individual Storm Events. Stormwater (both whole water and filtered) samples will be flow-weighted composite samples representing the range of discharge conditions during the sampling event, including where possible the rising and falling portions of the runoff hydrograph.

Representativeness of Storm Types. Storm events are variable in nature by runoff volume, flow rate, antecedent rainfall, and season. This variability will be evaluated by comparing the magnitude and intensity of the runoff hydrographs, where samples were collected on the hydrographs, time between storm events, and time of year the samples were collected to determine whether a representative range of storm types was included in the monitoring program.

The LWG will evaluate data, progress, sampling methodology, and sample locations on an ongoing basis as data is analyzed and the project is implemented. While it is anticipated that a sufficient number of samples will be collected, the number of samples will be reevaluated at the end of the sampling project. Through the course of this sampling effort, the LWG may request from EPA modifications to the procedures in the FSP to help better represent storm types, if needed.

1.3.3.2 Sediment Traps

Sediment traps are useful monitoring tools to help identify chemical concentrations in suspended sediments in stormwater. There are several issues relevant to the representativeness of sediment trap samples, which are discussed in the Stormwater Sampling Rationale (Anchor and Integral 2007). In summary, this sampling method captures only the particulate fraction of the stormwater and provides little information on dissolved chemicals. Further, it is difficult to predict potential sampling biases that may occur during sediment trapping, but considering the perturbations in the flow field that the bottle creates, certain grain size fractions in the suspended load could be preferentially trapped.

In addition, the physical characteristics of each sediment trap sampling location vary such that a different range and/or type of flows, and therefore, storm conditions may be sampled. Because there is a minimum height at which the sediment trap is over topped and starts to collect sample, some sediment traps may not be collecting sample during smaller storms, and the frequency of such occurrence will vary from location to location.

The LWG will evaluate data, progress, sampling and analytical methodology, design of sample apparatus (bottle size, installation) and sample locations on an ongoing basis as data is analyzed and the project is implemented. Through the course of this sampling effort, the LWG may request from EPA modifications to the FSP procedures to help increase the representativeness of the sediment trap sampling, if necessary.

1.3.4 Completeness and Comparability

The completeness of the data will be maximized by using proven sampling techniques, packaging samples for transport to avoid breakage, and timely processing at the laboratory. The analytical requirements in sample volumes to achieve goals will be met to assure acceptable data. Where possible, excess sample will be archived until the laboratory results can be reviewed by the project manager. The goals for generation of usable data are provided in the Round 2 QAPP.

For comparability, the analytical chemistry methods were selected consistent with other data collection activities for the RI/FS, which also follow the Round 2 QAPP. It is realized that if reporting limits differ, it will limit the ability to make direct comparisons and may limit future cleanup decisions. It is further realized that modifications to sampling locations over the course of the project can also limit the ability to make comparisons. In addition, one field replicate (the sediment trap samples only and if there is enough sample available) will be collected and analyzed from two outfall locations (see Section 3.8). If a field replicate is not feasible, a field duplicate will be collected.

1.4 DOCUMENT ORGANIZATION

The remaining sections of this document describe the sampling field and analytical procedures that will be used to collect stormwater and sediment samples:

- Section 2 describes the sampling design.
- Section 3 summarizes stormwater sample collection, processing, and measurement procedures for stormwater samples, sediment samples, and stormwater flows.
- Section 4 describes the sampling implementation and schedule including contingency procedures that may be employed to collect data.
- Section 5 summarizes how the data will be reported.
- Section 6 provides references.

Detailed SOPs for sampling and flow measurements are provided in appendices. The appendices also contain a Chain of Custody SOP, field sampling forms, and health and safety procedures and are organized as follows:

- Appendix A Stormwater Composite Sampling SOP
- Appendix B Stormwater Grab Sampling SOP
- Appendix C-1 Sediment Trap Sampling SOP
- Appendix C-2 Stormwater Filtering for Sediment Collection (Back Up Procedure)
- Appendix D Flow Meter Measurements
- Appendix E Field Forms
- Appendix F Chain of Custody SOP
- Appendix G Confined Space Health and Safety Plan Addendum

2.0 SAMPLING DESIGN

The Stormwater Sampling Rationale (Anchor and Integral 2007) describes the general approach and rationale for the overall study to support RI/FS objectives described there and summarized in Section 1. This section describes the overall sampling design based on that rationale.

2.1 SAMPLE LOCATIONS, TYPES, AND NUMBERS

Tables 2-1 and 2-2 summarize the proposed stormwater sampling locations, types, numbers, and analyses. Sample locations are presented in Figure 2-1. Tables 2-3 and 2-4 summarize the priority order of sampling of analytes for each sample type and the approximate sample volumes that will be needed for these analyses. Table 2-5 provides the laboratories and methods that will be used for sample analysis. Table 2-6 presents the analytes, analytical concentration goals, method detection limits, and method report limits. The analytical concentration goals achievable with these sample volumes are discussed more in Section 2.2.

All sampling equipment will be deployed at locations that are as close to the point of discharge (for outfall locations) or the junction[2] associated with the land area of interest (for the land use based locations). In all cases, equipment will be placed at elevations sufficient to minimize the potential for river water to back up to the sample location and compromise flow data quality, the integrity of the sediment traps, and collection of quality stormwater samples. These locations were determined through field site visits, review of site drainage plans, and other research are shown in Figure 2-1. Additional reconnaissance of some locations is still ongoing and the exact locations to be sampled will be coordinated with the Stormwater Technical Team and may vary from those shown in Figure 2-1.

Four types of measurements will be conducted each station. Each measurement type is discussed further in the following sections.

2.1.1 Stormwater Composite Samples

Flow-weighted composite samples of three storm events from each location will be collected to obtain Event Mean Concentrations (EMCs) of chemicals. Flow-weighted, whole water (unfiltered) sample aliquots will be collected over the course of the storm event with Isco 6712 automatic samplers. The samplers will be located either within the junction being sampled (above the expected water levels) or at secure sites, on the ground surface immediately adjacent to the junction access (e.g., manhole). The sampling tube

[2] The term "junction" refers to any accessible location where two or more pipes are joined by a structure such as a manhole. This may include locations where drainage from surface runoff also enters the junction, such as catch basins that connect two or more pipes.

will be placed inside the junction with the intake screen for the tube close to but not in contact with the bottom of the junction.

The whole water samples will be collected by the sampling teams, identified in Section 4, and transported to the LWG Field Laboratory. At the LWG Field Laboratory, sampler performance will be evaluated and the water from the individual sample bottles will be combined and mixed in a single container. Whole water samples for organic compounds and TSS analyses as well as unfiltered/filtered water pairs for metals and total organic carbon (TOC)/dissolved organic carbon (DOC) analyses will be prepared by the sampling teams from the combined composite sample. Samples will be sent to analytical laboratories listed in Table 2-5b and analyzed for the chemicals shown in Tables 2-2 and 2-3. In addition, the priority order and list of chemicals analyzed will vary somewhat between locations as shown in Table 2-4a for reasons discussed in the Stormwater Sampling Rationale (Anchor and Integral 2007).

Sampling of composite water samples will be attempted whenever weather conditions present themselves in order to obtain three stormwater samples within the wet-weather season during storms that meet the acceptable target storm conditions. The target storm conditions for sampling are:

- Storms predicted to produce more than 0.2 inches rainfall over a minimum of a 3-hour period, not to exceed approximately 2.25 inches in a 24 hour period (equivalent to the 2-year event)

- And to have been preceded by at least a 24-hour dry period (less than 0.1 inches rainfall).

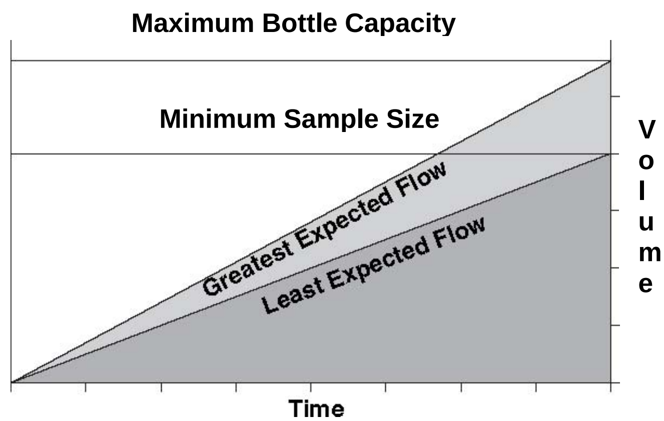
The objective is to get a composite sample that represents the water quality over the entire storm hydrograph. This is the primary reason to define the minimum and maximum of the target storm conditions. National Oceanic and Atmospheric Administration (NOAA) and Oregon Climate Service (OCS) storm forecasts will generally be used in the evaluation and identification of storms potentially meeting these criteria (http://www.wrh.noaa.gov/forecasts/graphical/sectors/pqrWeek.php#tabs and http://www.ocs.oregonstate.edu/index.html).

The described target storm conditions should be considered goals. Each event sampled will be evaluated relative to these goals but circumstances may arise where all these goals cannot be met. In that event, EPA and DEQ will be contacted to discuss sampling or storm conditions that substantially do not meet the target storm conditions prior to analyzing the samples. The justification for accepting samples that deviate from these target storm conditions will be provided in the Field Report.

For each sampling location, drainage basins will be evaluated for basin area and runoff characteristics to facilitate calculation of expected discharge volumes for a variety of storm conditions meeting the storm criteria. The samplers will initially be setup with four programs to cover storm events from 0.2 inches to 0.5 inches, 0.5 inches to 1.0

inches, 1.0 inches to 1.5 inches, and 1.5 inches to 2.25 inches. Based on the forecast, the samplers will be called and the appropriate program will be run. Samplers will be pre-programmed to collect aliquots of stormwater in a uniform paced variable-volume manner following the calculated "trigger flow rate" or "trigger depth" depending on the individual site conditions. The objective is to collect a flow proportional composite sample that represents the entire storm hydrograph (aliquots will be collected into seven of the eight 1.8 liter bottles over the storm event, the eighth bottle in the sampler will be used for a field blank for quality assurance/quality control [QA/QC]). However, this is only a guideline that will be considered in the evaluation of expected discharges and may be modified at one or more sampling locations. If storm volumes exceed expected volumes, the sampling period will be concluded when the sample bottles are full and thus in some cases, the falling limb of the storm hydrograph may not be sampled in its entirety.

The following graphic represents the sampling strategy. For the selected range of storm events, described previously, the minimum and maximum storm volumes will be calculated using the Santa Barbara Urban Hydrograph method (as described in the City of Portland's Stormwater Management Manual).



For each storm event, the sampler will be programmed so that at the least expected flow, the sampling rate will be set to ensure that the minimum sample volume is collected (4.85 liters as identified in Table 2-3). If too little sample volume is collected, there may not be enough volume for all analyses, although it is a representative composite sample. The sampler will also be programmed so that at the greatest expected flow, the sampling rate will be set to prevent filling the bottles before the end of the storm (total bottle capacity is 12.6 liters [7 x 1.8l]). An early full-bottle condition would result in a composite sample that is not representative of the entire flow period. By splitting the potential precipitation into several ranges, it reduces the likelihood of too little sample volume being collected or missing the runoff from the falling limb of the hydrograph due to a full bottle condition.

For each storm range at each sampling location there will be a series of calculations to determine the minimum and maximum pumping rates. At the maximum rate, the sampler will collect 10 ml per X_{max} units passed the flow meter:

X_{max}= Minimum Storm Volume/Minimum Sample Volume/10ml

At the minimum rate the sampler will collect 10 ml per X_{min} units passed the flow meter:

X_{min}= Maximum Storm Volume/Maximum Bottle Storage/10ml

A sampling rate between X_{min} and X_{max} will be selected to ensure the minimum sampling volume is collected and that the potential for a full bottle condition is minimized. The runoff calculations, trigger flows or levels, and sampling rates for each sampling location will be provided in the Field Report.

2.1.2 Stormwater Grab Samples

During one storm event, discrete stormwater "grab" samples will be collected from 10 locations where it is most likely that organics would be detected in water samples. Because the purpose of the grab samples is to collect partitioning (chemical dissolved phase/suspended sediment) rather than loading data, samples will be collected during storm periods expected to have higher chemical concentrations (e.g., first flush or rising limb), to increase the likelihood of detecting these chemicals. All samples will be analyzed for TOC/DOC in addition to chemical parameters. The sampling locations were selected based on general knowledge of site uses and potential chemical sources as described in the Stormwater Sampling Rationale (Anchor and Integral 2007). Table 2-4a describes the locations where stormwater grab sampling will occur and the chemicals that will be analyzed at each of these locations.

The sample teams will collect the stormwater from the automated samplers and transport it to the LWG Field Laboratory, where it will be composited and one aliquot will be filtered and distributed appropriately to sample bottles for laboratory analyses and a second aliquot will be distributed directly to sample bottles for laboratory analysis. The analytical methods and concentration goals are the same as those discussed above for composite water samples. Target storm conditions for grab sampling are the same as for composite sampling described above, with grab samples taken sometime in the rising limb of the hydrograph of a continuous storm meeting the above requirements.

2.1.3 Sediment Trap Samples

Sediment traps will generally be installed at each sampling location as close to the target junction as possible and downstream of the automatic sampler intake tube, but this may vary at some locations. Figure 2-2 presents a photograph of a sediment trap of the type that will be deployed. For large pipes draining larger areas (i.e., land use based locations) the sediment traps will be placed at the bottom of the junction or adjacent outlet pipe. For smaller pipes, the opening of the collection bottle will be placed as close as possible to the same elevation as the invert of the junction or outfall outlet. Some sampling locations may require the use of sandbags or structural modifications to generate flow conditions conducive to sediment trap sampling. The sediment traps will be deployed at each location for a minimum target period of 3 months during the wet-weather period.

Sediment traps will be inspected at a minimum on a monthly basis. When inspected, if the collection bottle is more than half full of sediments, the bottle will be capped with screw closures, removed from the mounting brackets, packaged and placed on ice in coolers for transport to the Field Laboratory to be archived. A clean empty collection bottle will then be placed in the trap. If the collection bottle is less than one third full at the first monthly inspection, options for repositioning or relocating the equipment or adding additional traps to obtain a higher collection rate will be considered.

Sediments will be collected and archived throughout the 3-month deployment period. At the end of the deployment period, all sediments for each location will be combined and homogenized and sampled for analyses in the priority order shown in Tables 2-3 and 2-4b as the available sediment volume allows.

In Tables 2-3 and 2-4b, analytes are ranked in priority order in the event that any collected sample size is insufficient to run all analyses. The Stormwater Sampling Rationale (Anchor and Integral 2007) describes the reasoning for this priority order. Grain size is the last priority analyte because it is unlikely that large enough sample volumes for grain size analysis will be obtained at most locations, and it is more important to obtain information on chemistry.

Also, due to physical constraints, it may be impossible to deploy sediment traps at some locations or obtain sufficient sample volume. Contingency procedures in the event of this problem are discussed more in Section 4.3. One possible contingency measure is to pump and actively filter sediments from large volumes of stormwater at some sites. This contingency technique is described in Section 3.5.2.

2.1.4 Flow Measurements

Isco Model 750 Area Velocity flow modules will be used in conjunction with the Isco automatic samplers to allow the collection of flow-weighted composites at each sampling location. The flow modules will also continuously record flow data for the duration of sediment trap deployment.

2.2 SAMPLE ANALYSIS

Stormwater and sediment samples will be analyzed as described below. Table 2-5 summarizes the analytes and methods of analysis for each analyte group for each sample type (sediment and stormwater).

2.2.1 Water Samples

The stormwater samples will be analyzed for pH, conductivity, turbidity, and temperature in the field. Stormwater samples will be analyzed at selected chemical laboratories for conventionals, metals, and organic parameters as summarized in Table 2-5b. It is anticipated that sufficient sample volume (as noted in Table 2-3) will be collected during each stormwater event to conduct all analyses listed in Table 2-5b. The specific analytes for each parameter group and the analyte concentration goals (ACGs) are included in Table 2-6b. Table 2-2 shows the number of natural samples and identifies the QA/QC samples for each sampling event. The QAPP Addendum (Integral 2007) summarizes the analytical program and provides details on the laboratory methods, QA procedures, and QA/QC requirements.

2.2.2 Sediment Trap Samples

The sediment samples will be analyzed at selected chemical laboratories for conventionals, metals, and organic parameters as summarized in Table 2-5a. The analytes are listed in the priority for analysis in Table 2-3. If sufficient mass (as shown on Table 2-3) is not available to complete all analyses, the analyses will be conducted by the laboratory in the priority order identified in this table. Any additional mass available will be used for laboratory quality control analyses (matrix spike samples, laboratory duplicate samples, matrix spike duplicate samples). The specific analytes for each parameter group and the ACGs are included on Table 2-6b. Table 2-2 shows the number of natural samples and identifies the QA/QC samples for each sampling event. The QAPP Addendum (Integral 2007) summarizes the analytical and provides details on the laboratory methods, sediment sample cleanup procedures, QA procedures, and QA/QC requirements.

3.0 SAMPLE COLLECTION AND PROCESSING PROCEDURES

This section describes the sampling procedures, record keeping, sample handling, storage, and field quality control procedures that will be used during stormwater and sediment sampling.

3.1 FIELD LOGBOOK AND FORMS

All field activities and observations will be noted in a field logbook. The field logbook will be a bound document containing individual field and sample log forms. Any changes that occur at the site (e.g., personnel, responsibilities, deviations from the 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. The following data will be included in the field logbook:

- General filed observations during location inspection or sample retrieval including, but not limited to, weather conditions, presence of other activities in the area, and any factors which may affect the quality of the data.
- Date and time of sample collection.
- Names of field coordinators and person(s) collecting and logging in the samples.
- Observations made during sample collection.
- A general description of the sample including color, odor, and presence of an oil sheen.

A sample collection checklist will be completed following sampling operations at each sample station. The checklist will include station designations, types of samples to be collected, and whether field replicates/duplicates, rinsate blanks, or additional sample volumes for laboratory QC analyses are to be collected. A set of field log forms for this purpose is included in Appendix E.

3.2 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., gloves, steel-toed boots) will be worn by field personnel as specified in the Health and Safety Plan (Appendix G; Integral 2004b).

A detailed list of sampling equipment and supplies are listed in SOP Appendices as follows:

- Stormwater composite sampling – Appendix A
- Stormwater grab sampling – Appendix B
- Sediment sampling – Appendix C
- Flow meter measurements – Appendix D

For water sampling, the primary equipment used will be 31 Isco 6712 samplers with flow monitoring modules, sampler base and support equipment (batteries, data modules, sampler tubs, strainers, glass sample containers, etc.). The samplers are composite samplers with sequential sampling capabilities. Each sampler base contains eight 1.8-liter glass sample containers. Teflon intake screen, Teflon intake tubing, silicone pump tubing, and glass sample containers will be used in all locations.

Once water from Isco sample containers is processed (per procedures below), the samples will be transferred to individual laboratory sample containers, will be submitted to the laboratory for analyses. The analytical laboratory will supply individual laboratory sample containers and preservatives, as well as coolers and packing material. Individual sample containers will be clearly labeled at the time each container is filled. 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 3.6.

3.3 EQUIPMENT DECONTAMINATION PROCEDURES

The following is a brief description of decontamination procedures for each set of equipment. Details of these procedures are described in Appendices A, B, and C.

For all samples, commercially available pre-cleaned sample containers will be used, and the laboratory will maintain a record of certification from the suppliers. The sample container shipment documentation will record batch numbers for the containers. With this documentation, containers can be traced to the supplier, and container wash analysis results can be reviewed. The container wash certificate documentation will be archived in the project file.

3.3.1 Water Sampling Equipment

All sampling equipment and containers will be prepared prior to the sampling event. Any portion of the Isco sampler (including intake screen, intake tubing, pump tubing, sample containers), filters, or other materials coming into contact with sampled stormwater will decontaminated prior to use or certified pre-cleaned from the equipment source. Appendices A and B contain detailed procedures and equipment material requirements to avoid potential contamination of samples. These procedures are summarized below. The sampler intake tubes and screens will be cleaned once prior to installation of the samplers using the decontamination procedure in Appendices A and B. They will be subsequently cleaned and/or decontaminated under conditions described in Appendix A. The laboratories listed in Table 2-5 will provide certified pre-cleaned (as described above and in Appendix A) containers for collecting processed samples at the Field Laboratory.

3.3.2 Sediment Sampling Equipment

Sediment Traps. The sediment trap bottles, and any portion of the sample collection, and homogenization equipment coming into contact with sediment samples will be decontaminated prior to use or certified pre-cleaned from the equipment source. Detailed decontamination procedures for sampling equipment and sample containers are included in the Appendix C-1.

Water Filtering for Sediment Collection (Back up Procedure). Any portion of the tubing, pump, filters, or other materials coming into contact with sampled stormwater will be decontaminated prior to use or certified pre-cleaned from the equipment source. Detailed decontamination procedures for sampling equipment and sample containers are included in Appendix C-2.

3.4 STORMWATER SAMPLE COLLECTION PROCEDURES

Stormwater collection procedures are described in detail in Appendices A and B. Two methods of stormwater collection will be used:

- Flow weighted composite sampling of organics, metals, and conventionals that will be collected using an automated Isco pump and sample container system and Teflon™ tubing (Appendix A).
- Grab water sampling of organics and conventionals using Isco pump, sample containers, and Teflon™ tubing (Appendix B).

The SOPs (Appendices A-C) for stormwater sampling follow the general concepts used in the sampling and analysis of trace metals in relatively clean surface waters. Examples, of these procedures are in EPA's Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996), and by the *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001). These methods use the "clean hand-dirty hand" (or CH/DH) approach to sample collection. Because this sampling effort does not involve sampling trace levels of chemicals in relatively clean surface waters there is no need for a strict CH/DH procedure. However, the general concept of separating equipment and sample handling jobs to minimize the potential for contamination of samples is employed throughout the SOPs. Detailed procedures for each type of sample collection that follow this general concept are described in Appendices A and B.

3.4.1 Composite Stormwater Sampling Methods

Automated Samplers. Stormwater samples for standard chemical and conventional analyses will be collected using a peristaltic pump through a Teflon-lined intake tube with a Teflon coated stainless steel pickup screen, which will feed to a silicon pump tube. The intake tube and screen will be attached to the bottom of the junction outlet along with the Area Velocity (AV) flow sensor (described more below). The pre-cleaned Isco sampler (following procedures discussed above) will be delivered to the sample site by the sampling team.

Sampler Installation and Initialization. Wherever possible, the sampler will be located above ground and next to the junction selected for sampling. The pick up screen and the AV flow sensor will be installed on the sensor carrier. Although there are tools that allow surface installation of sensors, confined space entry may be required to install the pickup screen and flow sensor. In addition, at some locations accessible to the public (e.g., manholes on streets), the actual sampler and battery case will be installed within the junction selected for sampling. The mounting specifications in these locations will vary by location, but in each case the sampler will be secured in such a fashion that is stable and will not be inundated by stormwater. If confined space entry is required for any location, it will follow procedures in the HSP Addendum (Appendix G).

The sample pickup screen and sensor will be attached to the inside the junction using a stainless steel plate or similar. The plate will be bolted using concrete bolts to the bottom of the pipe or junction. Hoses and electrical cords will be attached to the side of the pipe and manhole using concrete bolts and plastic ties or similar attachments.

After the pickup and sensor have been installed, the sampler will be powered up and allowed to go through the self check process. If the sampler check is acceptable, the clean sample containers will be installed. Once the sample container section of the sampler is closed, the sampler will be manually enabled. The sampler will then be lowered into the junction, if necessary, or otherwise secured above ground on the site. Care will be taken not to pinch or kink the pick up tube of the flow sensor cable.

Once the sampler is deployed and the cover is closed, the sampling team leader, or designate, will call the sampler to disable it until an appropriate storm is forecasted. The automatic sampler, when enabled by calling the sampler, will be pre-programmed to initiate sampling once specified trigger conditions (e.g., flow depth and/or volume) have been met and will continue to sample until the conditions are no longer met within the 24-hour sampling duration or the bottle capacity is reached. The trigger conditions will be different for each sampling station due to differences in basin sizes, pipe/junction configurations, and runoff characteristics, as well as non-stormwater discharges such as base flow.

Flow Weighted Sampling Methods. The automated sampler will collect flow weighted samples into seven 1.8-liter glass bottles. The sampler will be programmed to collect flow proportional sample volumes. Samples will collected on a uniform time basis and the volume collected at each time step will be proportional to the volume of water that has passed the flow meter since the previous time step. The automated sampler collects the stormwater in 10-ml increments. The number of 10-ml increments collected at each time step is dependent on the flow rate and the sampler programming that is unique to each sampling site. The volume of stormwater water that passes the flow module per 10-ml sample increment will be estimated for each basin to maximize the likelihood that the minimum volume of water required for analysis is collected without exceeding the total volume capacity of the sampler. A complete sampling event would result in 7 1.8-liter bottles being filled or nearly filled over the duration of the storm such that most of the storm hydrograph is sampled.

Sampler Programming. As noted above, the volume collected at each time interval is dependent on the flow in the pipe, which is related to the storm magnitude. Each sampler will be pre-programmed with several sampling routines that include different proportional volume sampling rates so that an appropriate program can be selected based on the magnitude of the storm that is being predicted, the size of the basin, the pipe conditions, etc. For example, for a predicted small storm, a sampler program would be selected that collects relatively large flow proportional volumes at each time interval to achieve the necessary total volumes to perform the necessary analyses. Similarly, for a predicted large low intensity storm, a low flow proportional volume for each time interval will be selected to improve the chances that most of the hydrograph is sampled. For all sampling conditions, the samplers will be programmed to perform one pre-flush prior to taking a sample.

The minimum volume collected will be based on the minimum storm expected to generate runoff (0.2 inches). The maximum volume will be based on the forecasted precipitation with some allowance for under-predictions of rainfall associated with a storm.

Storm Watch Procedures. The Team Coordinator (see Section 4.1 for team organization) will monitor storm predictions from the NOAA website (http://www.wrh.noaa.gov/forecasts/graphical/sectors/pqrWeek.php#tabs) area rain gauges (e.g., City of Portland and Portland Airport). Once the required amount of dry weather is achieved, the team will be on “storm watch.” Isco samplers will remain at each location for the duration of the deployment period. When weather forecasts indicate that a storm is coming that may meet the target storm conditions, the weather and rainfall conditions will be monitored on a frequent basis. Samplers may be periodically polled via cell phone to determine if flow conditions at various locations are changing, indicating the local rainfall is starting. Once the appropriate height/volume conditions have been achieved at each location (as described above) and the storm appears to be likely to meet the target storm conditions, the samplers will be activated via cell phone to use a specified pre-program consistent with the type of storm occurring as discussed above. The samplers may be polled periodically during the sampling event to understand whether it is likely that the best program is underway for the storm conditions actually occurring and to determine when the sampling routine is likely to be complete.

Sample Collection. After the sampling event is completed, the sampling team leader will call the sampler and disable it if the storm event concludes prior to the 24-hour cutoff, to prevent additional stormwater from being collected. Isco sample containers will be recovered within a goal of 12 hours after the conclusion of the sampling event. The sampling team will retrieve the automatic sampler and remove sample containers and seal them with Teflon lined caps, label, and package them appropriately for transportation to the LWG Field Laboratory. The sampling team will install new clean containers and re-deploy the sampler as described previously. The Isco samplers will be decontaminated prior to the first installation and will not be subsequently decontaminated except as noted in Appendix A.

Flow Data Interpretation. It is possible during a given event that not all the sample containers are filled or that the container volume is exceeded due to differences between the forecasted precipitation and the actual precipitation at the site. The flow data collected at the time of sample collection will be examined to determine if the sample appears to be valid or needs special compositing considerations (as described below) before compositing and shipment to the analytical lab.

As part of the field sampling procedures, the sampling team will download the sampling report and flow data from the data logger to a desk top computer for data analysis using the manufacturer supplied software. The data will be reviewed to determine the flow hydrograph and where on that hydrograph samples were taken. The storm data will be compared to the target storm conditions to determine if the samples are representative of the storm. The Team Leaders in coordination with the Team Coordinator or his/her designee will determine whether the samples meet the sampling criteria, and which of the sample containers will be composited for analyses. The following criteria will be used to determine the acceptability of stormwater samples:

- Sufficient Sample for Analysis. The samples will be checked to determine if there are adequate sample aliquots and volume for analysis.
- Review Rainfall Data and Criteria. The total rainfall and antecedent dry weather period will be determined to see if the target storm conditions were met using data from the City of Portland and Portland Airport rainfall gauges.
- Review Flow Hydrograph, Sample Collection (time and number), and Storm Criteria. The Team Coordinator will determine which of the sample containers should be composited by reviewing the flow hydrograph, the discrete sampling times relative to storm flow.

If it appears that samples may not be reasonably representative of the storm or the target storm conditions and the issue cannot be resolved by using one of the contingency measures discussed below, the LWG will discuss the representativeness of the sample containers selected for compositing with EPA and DEQ. However, it should be noted that laboratory holding times will be in effect and decisions must be made in a timely manner.

Sample Processing and Compositing. At the LWG Field Laboratory, the sampling team will combine the stormwater samples into a single composite and samples will be filtered (for metals analyses only) and prepared for laboratory analyses. The compositing, filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. The compositing procedure and field filtering procedures for metals are described in detail in Appendix A. Throughout this process, the samples will be handled following the procedures described in the Chain of Custody SOP (Appendix F).

The field collected samples will be transported to the LWG Field Laboratory and held per requirements of Section 3.7 until the sampling report and flow data can be reviewed. If the sampling report and flow data indicate that there was no malfunction and all the sample bottles are intact, the compositing and sample preparation would continue as described in Appendix A. The samples would be emptied into a large sample container and mixed (i.e. using a churn splitter or other suitable apparatus) while samples are distributed to sample bottles for laboratory analyses.

No preservatives will be added in the pre-processed samples. All preservatives will be present in individual analytical sample bottles per Table 3-1 and Section 3.7. Thus, preservation will take place in the Field Laboratory at the time processed samples are placed into the individual sample containers for laboratory analyses.

After compositing, each sample container will be clearly labeled with the project name, sample identification, date and time of first aliquot collected that is used in the composite, initials of person(s) preparing the sample, analysis specification, and pertinent comments such as preservatives present in the sample. A laboratory analysis request form (see Appendix E) with the date and time of the first aliquot collected that is used in the composite will be generated. The sample analysis request form will be used by the analyst in performing the appropriate analyses for the sample.

Sample Compositing and Processing Contingencies. As discussed above, several problems could occur that may affect the viability of a sample collected. Common potential problems and their contingencies are as follows.

1. Sample volume is not adequate to conduct all of desired analyses. This may occur when the forecasted precipitation is substantially greater than the actual site precipitation. Under these sampling conditions, the sample will be composited as normal and samples for analyses will be prepared in the priority shown in Table 2-3.

2. Sample exceeds bottle capacity. The sampler report indicates that the bottle capacity was exceeded. This may occur when the forecasted precipitation is

substantially less than the actual site precipitation. In this case the flow data will be evaluated; if the collected volume represents 50 percent or greater of the total storm and encompasses some of the falling limb of the storm, the total volume will be composited and analyzed per normal procedure. If the sample volume represents less than 50 percent of the total storm volume, it should be composited and held at the LWG Field Laboratory under conditions shown in Table 3-1 for possible later analyses in the event that no further storm events can be successfully captured.

3. A portion of the sample is lost. This would occur when one or more of the sampling bottles were damaged or the sampler malfunctioned. In this situation, the sampling report and flow data will be reviewed to determine what representative portion of the storm volume is missing. In this situation, it may be possible that a significant portion of the storm was not sampled, and/or there is not adequate volume to complete the desired analyses. Following the process of the two previous scenarios, if the sample includes sample that represents 50 percent of the storm and both rising and falling limb conditions are included, then the sample will be used. If not, it will be archived at the Field Laboratory as described above. If the sample meets the above conditions but the volume is inadequate to conduct all analyses, the sample containers will be filled in the priority order of analyses shown in Table 2-3.

Laboratory Sample Receipt and Holding. Once samples are accepted at the laboratory, the laboratory will handle and store samples consistent with the QAPP Addendum (Integral 2007) and Table 3-1. After analysis, remaining sample will be archived according to the laboratory's SOP. The remaining sample will be kept at 4ºC and retained for 6 months beyond issue of the laboratory report.

3.4.2 Summary of Grab Stormwater Sampling Methods

Stormwater grab samples for standard chemical and conventional analyses will be collected using a peristaltic pump that is part of the Isco automatic sampler. The sampler case will be opened and the delivery tube will be removed from the bulk head fitting. A Teflon lined tube will be connected to the bulkhead fitting to collect the desired samples. The sampler will be put into "Grab" mode and the specified volume will be programmed into the sampler. Once activated, the sampler will purge and the grab sample will be collected into 1.8 liter glass containers.

The sampling team will seal the samples with Teflon lined caps, label, and package them appropriately for transportation to the LWG Field Laboratory. The sampling team will remove the grab sampling tube from the bulkhead fitting and reconnect the distribution tube and close up the sampler. The sampling team will re-deploy the sampler as described previously.

Samples will be generally transported and handled from field site, to Field Laboratory, to analytical laboratory per procedures described above for composite water samples. At the LWG Field Laboratory, the sampling team will combine the field samples into a single composite and samples will be filtered and prepared for laboratory analyses. The compositing, filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. Field filtering procedures for organic compounds are described in detail in Appendix B. The samples will be handled following the procedures described in the Chain of Custody SOP (Appendix F).

3.4.3 Flow and Rain Data Collection

Flow will be measured with the Teledyne/Isco 750 AV Module (module). The module is an add-on enhancement to the Teledyne/Isco's 6700 Series Samplers that are being used to collect stormwater samples. The module provides the ability to collect flow proportional sample volumes and flow-paced samples. The sampler displays the real-time level, velocity, flow rate, and total flow provided by the module. The sampler records this data for later analysis.

The module is designed to measure flow in open channels without a primary device. (A primary device is a hydraulic structure, such as a weir or a flume, which modifies a channel so there is a known relationship between the liquid level and the flow rate.) Area velocity flow conversion requires three measurements: water level, velocity, and pipe dimensions. The AV sensor provides the level and velocity measurements. The pipe dimensions will be measured in the field and entered during module programming. The flow calculation is made in two steps. First, the module calculates the pipe cross-section (or area) using the programmed pipe dimensions and the level measurement. Then, the module multiplies the channel cross section and the velocity measurement to calculate the flow rate.

The sampler will be programmed to use the customary U.S. measurement units, such as feet (depth), cubic feet per second or gallons per minute (flow, depending on size of the contributing basin), and gallons or millions of gallons (volume, depending on the size of the contributing basin). The sampler will be programmed to record flow data at 5-minute intervals. These data will be periodically downloaded throughout the course of the sampler deployment (as determined by data storage capacity) and entered into the project database.

In addition, data on rainfall will be obtained from various existing established rain gauge stations around the Portland area. These data will be used to make sampling decisions throughout the course of the sampling and to understand flow results for data reporting as described above.

3.5 SEDIMENT SAMPLE COLLECTION PROCEDURES

Collection procedures for stormwater sediments are detailed in Appendix C and summarized below.

3.5.1 Sediment Traps

Sediment traps will be used to collect stormwater suspended sediments. The sediment traps consist of a stainless steel bracket and a certified phthalate free HDPE bottle. Figure 2-2 presents a photograph of a sediment trap of the type that will be deployed. Sediment traps will be installed by bolting the steel base plate directly to the location junction or pipe (see example in Figure 2-2) with the orientation discussed in Section 2.1.3.

As described in Section 2.1, sediment traps will be deployed at each location for a minimum target period of 3 months. Sediment traps will be inspected on a monthly basis at a minimum. When inspected, if the collection bottle is half full, sediments will be collected and archived and a clean bottle will be returned to the trap. This process will be repeated, and sampled sediments archived at the LWG Field Laboratory for additional later compositing until the trap deployment period ends.

Sediment samples will be capped with Teflon lined lids, labeled, sealed and packaged appropriately for transport to the LWG Field Laboratory per the collection procedures presented in Appendix C-1 At the field laboratory, the samples will be removed from the sampler bottles and stored in wide-mouth jars in the freezer. Sediment removal from the sediment trap bottle to the sample containers will follow the procedures in Appendix C-1.

Once the deployment period has ended, all sampled sediments (including archived aliquots) will be combined and subsampled following the procedures in Appendix C-1.

Sample analysis containers will be filled in the priority order shown in Table 2-4b, until there is no more sample available. Any additional sediment will be collected into sample bottles for laboratory QA/QC analyses.

3.5.2 Water Filtering for Sediment Collection (Back up Procedure)

This procedure will be used in the event that a sediment trap cannot be deployed at a location because of limited space availability or other logistical reasons or insufficient sediment volume can be collected in sediment traps. To mimic the deployment of sediment traps, this procedure would be employed over several storm events at the location in question. The sediment samples obtained over several events will then be composited in the analytical laboratory to mimic the deployment of a sediment trap over 3 months.

Large volumes of water will be pumped through Teflon™ tubing to collect the particulate fraction from the water for subsequent analysis of the particulate fraction. Currently, two techniques are being evaluated as options for sediment collection: collection with a portable continuous flow centrifuge pump; and collection with a peristaltic pump system with sequential filters and glass fiber filter cartridges. The total volume of water pumped for each sample will be determined based on the analytes selected for the station. Table 3-2 provides estimates of stormwater sample volumes required for each of these sample collection techniques. The high volume collection procedure will follow methods detailed in Appendix C-2.

The portable continuous flow centrifuge pump system samples would be collected by pumping water from the sample location (junction) and sequestering the suspended particles in sample collection jar, which would avoid collecting and retaining large volumes of water for subsequent filtration. The accumulated sediment would then be transferred from the centrifuge pump sample collection vessel, homogenized, and subsampled into sample jars for chemical analysis. The peristaltic pump system would require a high pressure tubing setup and large volume capacity filters, in series, to extract the suspended particles. The large capacity filters would be connected in series with the smallest pore size of 4 or 5 µm, which is the low-end range for silt particles (ASTM 1985). The peristaltic system could be conducted by collection of water into a container (e.g., 20L carboy) and subsequent filtration. The reconnaissance survey will help determine whether the high-volume collection could be conducted directly from the sampling location without intermediate storage. The minimum filter pore size to be used will be 4-5 µm.

Samples will be collected using the using methods that minimize the potential for contamination through sample or sample equipment handling and will follow the general concept of the CH-DH approach described above. Once the desired volume is pumped, the glass fiber filters will be removed, placed in sample jars, and stored in a cooler containing wet ice. At the analytical laboratory, the filters will be archived until the last sampling event is conducted. Once filters from the last event arrive in the laboratory, the laboratory technicians will combine the sediments from all the filters at each location and homogenize using clean implements. The resulting homogenized sediment sample will be analyzed to determine the concentration of chemicals present within the collected particulates. Detailed procedures for this sampling technique are described in Appendix C-2.

3.6 SAMPLE IDENTIFICATION

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 LWG data management, validation chemists, and data users. The unique code will be assigned to each sample as part of the data record and will indicate the project phase, sampling location, sample type, sampling event, and level of replication/duplication. Sample identifiers will consist of two to three components separated by dashes. The first component, LW3, identifies the data as belonging to the Lower Willamette River RI/FS as a part of the Round 3 sampling. The second component will begin with the abbreviation “STW” to designate the stormwater sample, followed by a CW, GW, or S for composite water, grab water, or sediment, followed by a single-number code that designates the sampling event. The station number will complete the second component.

Additional codes may be adopted, if necessary, to reflect sampling equipment requirements. Leading zeros will be used for stations with numbers below 100 for ease of data management and correct sorting. The third component will be used to code field duplicate and replicate samples. A single digit number will be used to indicate field duplicates or splits in the third component of the sample identifiers. For equipment decontamination blanks, sequential numbers starting at 900 will be assigned instead of station numbers. The sample type code will correspond to the sample type for which the decontamination blank was collected.

Example sample identifiers are:

- LW3-STW-CW-1022: stormwater composite sample from Station 22 collected during the first sampling event.
- LW3-STW-CW-1022-1: stormwater composite sample from Station 22 collected during the first sampling event; field duplicate is associated with this sample.
- LW3-STW-CW-1022-2: field duplicate stormwater composite sample from Station 22 collected during first sampling event.

3.7 SAMPLE HANDLING AND STORAGE

The number, size, and type of sample containers needed for each sample are listed in Table 3-1. This table also includes the preservative and holding times for the various analyses. In general, preservatives will be added to the sample containers by the analytical laboratory prior to shipment to the field. The sampling team will confirm the presence or absence of preservative in the containers prior to filling. Any discrepancies with preservatives will be noted on the field sampling records, and corrective action will be initiated.

Once the sample is collected and preserved, the sample container will be capped, labeled, and placed in double-sealed polyethylene bags (except for phthalate water samples—see Appendix C for phthalate related procedures) and stored on ice or refrigerated until shipped to the laboratory under the chain-of-custody procedures outlined in Appendix F.

Each storage freezer or refrigeration unit in the LWG Field Laboratory will be monitored bi-weekly to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

3.8 QA/QC

3.8.1 Field Quality Control

Field QC samples are used to assess sample method variability (e.g., replicates) and sample variability (e.g., duplicates), evaluate potential sources of contamination (e.g., equipment rinsate and trip blanks), or confirm proper storage conditions (e.g., temperature blanks). The estimated numbers of field and QC samples are listed in Table 2-2. Details on field replicate samples and field QC samples are described in the QAPP Addendum (Integral 2007).

In summary, the QAPP Addendum describes QA/QC procedures that will be used to complete the stormwater investigation. The QAPP Addendum for the stormwater investigation was developed within the framework of the existing LWG Round 2 QAPP (Integral and Windward 2004) and Addenda (Integral 2004a) for the ongoing LWG investigations.

For sediment trap samples, the mass of material collected is anticipated to be limited. For sediment samples, the QAPP Addendum includes the collection of field QC samples and additional mass for laboratory QC samples (matrix spike, matrix spike duplicate or laboratory duplicate) as follows and per Table 2-2:

- Field replicate, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blank for phthalates, 1 per 20 samples

Field replicates will be generated by deploying sediment traps with additional sample collection vessels, and compositing the sediment from each half of the sediment trap collection vessels, separately, into two subsamples for analysis. Deployment of two vessels will only be possible at some of the locations, due to expected space limitations within the junctions. Consequently, after the location reconnaissance, the locations of the replicate trap deployment will be determined based on available space and other constraints noted above for sediment trap deployment. Replicate trap deployment will be conducted at sufficient locations to meet the 1 in 20 requirement. If this is not possible, the replicate analysis will be substituted with a duplicate analysis consisting of homogenizing sediment from one vessel and splitting into two equal aliquots for analyses, at locations where sufficient volume is present, so that the 1 in 20 requirement is met. Analysis for laboratory QC samples will be conducted by dividing the total sediment collected from one sediment trap vessel at select locations with sufficient volume into three aliquots of equal mass for the laboratory analysis of the sample, matrix spike, and matrix spike duplicate.

For water samples, the sampling program will be designed to collect additional volume for field and laboratory QC samples. The QC program for water samples includes:

- Field duplicates, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Field blank for all analyte groups, 1 per 20 samples
- Equipment rinsate blank for all analyte groups prior to field deployment of automated samplers.

The inclusion of phthalates in the analyte list requires careful consideration in the design of the sample collection program to ensure that the sediment and water samples do not come into contact with phthalate-containing material. Because the water samples require pumping and additional handling for compositing, the likelihood of field contamination from contact with phthalate-containing components increases and could result in qualification of the data if phthalates are detected in the associated field blank samples. The procedures detailed in Appendices A, B, and C include careful consideration of the materials and handling procedures used in order to avoid such sampling contamination if at all possible.

It is possible that the samplers may be deployed with open bottles for up to several weeks before a storm sample is collected. Airborne deposition of chemicals from the sampler bodies, which are made from various plastic materials, or ambient atmospheric urban sources may be potential source of contamination to the open bottles. Consequently, the bottle eventually used for the rinsate blanks will also be left un-capped inside the samplers during sampler deployment and will be handled identically to the actual samples during the sample collection process.

One equipment rinsate blank prior to deployment of the Isco samplers will be performed by pumping DI through the Isco sampler and into a clean sample bottle. This will include the full Isco sampler set up including intake screen, Teflon sampler hose, and silicone pump tube installed in the sampler. Sufficient volume will be collected to conduct all analyses in Table 2-4a, and the sample will be treated identical to any other water sample described in this FSP and QAPP Addendum in terms of storage, transport, analyses, and laboratory QA/QC procedures.

3.8.2 Laboratory Quality Control

Standard quality control procedures will be used by the laboratories for methods listed in Table 2-5 and following the QAPP Addendum (Integral 2007) and Round 2 QAPP (Integral and Windward 2004). In summary, laboratory quality control samples will include analysis of surrogates, replicates, duplicates, laboratory control samples, method blanks matrix spike and matrix spikes duplicates in each batch of samples where appropriate. Specific recommendations for QC samples and control limits are summarized in the QAPP Addendum.

3.9 EQUIPMENT MAINTENANCE

The primary equipment to be maintained during the course of this sampling program is the Isco samplers and the sediment traps. Both types of samplers will remain in the field for the duration of the deployment period (i.e., approximately March through May). The Isco samplers and sediment traps will be routinely inspected throughout the course of the deployment period on a frequency dictated by the need for Isco battery replacement. Upon each inspection the proper functioning of Isco samplers and sediment traps will be confirmed by visually inspecting the equipment both inside and outside of the junction or pipe (as relevant to the particular sampling location).

Sediment traps will be inspected to determine that the trap is still properly attached to the junction or pipe and that the bottles are properly seated within the sampler. Any debris will be cleared away from around the samplers.

For Isco samplers, the proper attachment and placement of the flow sensor and intake tube will be verified and any debris will be cleared from this equipment. Tubes will be inspected for bending or occlusions and cleared as necessary. The Isco sampler battery will be replaced as necessary and the proper power up and re-initialization of the sampler will be confirmed prior to leaving the site. The flow sensor will be calibrated as necessary. The flow log memory capacity will be checked and data will be downloaded to a lap top if the memory is near full. The sampler will be called to make sure the cell phone connection is properly working.

If either sediment traps or Isco samplers are damaged beyond field repair capability, they will be removed and replaced with a spare sampler. For Isco samplers, the sampler will be shipped to a company designated repair site and repaired as quickly as possible, so that it can be used as a potential spare in the future.

4.0 SAMPLING IMPLEMENTATION AND SCHEDULE

4.1 SAMPLING TEAMS AND ORGANIZATION

Successful completion of the sampling and analysis requires coordination and adherence to the FSP and QA/QC procedures. Staffing and responsibilities are outlined below; an organization chart is provided in Figure 4-1. The following discussion briefly outlines the duties of the key participants. The LWG will notify the Agencies if there are any changes in the project organization listed below.

4.1.1 Project Planning and Coordination

As shown on the organization chart (Figure 4-1) Anchor has the lead role in implementing the FSP. Carl Stivers will act as the overall Anchor project manager. As the manager, he will act as the primary contact to the Portland Harbor Stormwater Technical Team and the EPA/DEQ/LWG management team.

4.1.2 Field Sample Collection

Simon Page, Anchor Environmental, is overseeing the field program. Mr. Page will participate in the station reconnaissance and preparation, described in Section 4.2. He will direct the sampling teams in equipment installation, when to activate the automatic samplers, assist in troubleshooting equipment problems, and be available to act as an alternate on the sampling teams.

The sampling teams will be each lead by an Anchor water quality specialist familiar with the equipment operation. Each team will also have a specialist from Integral to oversee the collection, processing, and shipment of the samples to the laboratory. The team leader will have the responsibility to deploy and redeploy their automatic samplers as needed, activate their automatic samplers when notified of a storm meeting the sampling criteria is imminent, conduct collection the samples in a timely manner, download sampler storm event data, conduct or coordinate delivery of the samples to the LWG Field Laboratory, coordinate delivery of samples to the analytical laboratories, filling out all field forms and chain of custody forms, and ensure that all field work is conducted in accordance to the HSP (Appendix G and Integral 2004b).

The operations and maintenance team will be based in Portland and have responsibility to routinely inspect and repair the sediment traps, Isco samplers, and other equipment, calibrate flow meters and samplers as needed, download the flow data loggers, and rotate the batteries in the automatic samplers to ensure that they are ready at all times to initiate sampling. They may also deliver samples to the LWG Field Laboratory as needed.

The Field Laboratory Team will assist in the processing, tracking, and archiving of samples, maintain sample archives, conduct packing of coolers and filling out chain-of-custody forms for laboratory delivery, will coordinate with the laboratories for sample delivery and/or pickup, facilitate the tracking of samples, and coordinate with laboratories to ensure correct analyses following the QAPP addendum are conducted.

The laboratories used for the sampling program are listed in Table 2-5. The laboratories will be responsible for providing "certified clean" sample bottles and equipment to the sampling teams, coolers and packaging materials, labels, seals, and chain-of-custody forms. The laboratories will designate a project coordinator who will be responsible for receiving the samples from the field laboratory team and coordination of data reporting. The laboratory coordinator will also be responsible to ensure that the samples are analyzed according to the specified methodologies.

4.1.3 Chemical Analysis

The laboratories used for the sampling program are listed in Table 2-5. The samples will be analyzed for the analytes listed in Table 2-5 for the ACGs listed in Table 2-6. The laboratory coordinator will also be responsible to ensure that the samples are analyzed according to the specified methodologies.

4.1.4 Laboratory QA/QC Management

The laboratory designee will direct the QA/QC review of the data and produce the Quality Assurance Data Summary Package. Sandy Browning at Integral will oversee data validation as required by the RI/FS Work Plan (Integral et al. 2004) and the Round 2 QAPP (Integral and Windward 2004) and will serve as the overall Quality Assurance Manager for the Project.

4.1.5 Data Management

Sandy Browning at Integral will supervise data management and entering of the data into the RI/FS project database per the requirements of the project Work Plan (Integral et al. 2004).

4.1.6 Final Report

Carl Stivers at Anchor will be responsible for directing assembly of the Final Report describing sample locations; sampling, handling, and analytical methods; data reports including QA/QC chemistry and data validation, and database management.

4.2 STATION RECONNAISSANCE AND PREPARATION

Sample locations will be verified during a reconnaissance visit consisting of the sampling team leader for those sample locations and persons knowledgeable with the particular location in question. Conditions encountered in the field during implementation of this FSP may result in modifications to the sampling design at some or all locations. The

Stormwater Technical Team will be made aware of the conditions and will approve substantial location-specific modifications to the FSP.

During the reconnaissance survey, the teams will identify the targeted discharge point and inspect the site to identify the location where the equipment can be installed to meet the sampling objectives. At each site, the team will locate the junction or structure nearest the outfall where the equipment may be installed. At these locations, the team will:

- Attempt to determine the sampling location elevation from the site map as well as measuring down to the invert of the junction outlet and comparing known or measured relative elevations to observed elevations of shoreline features such as the limit of permanent vegetation (which is often approximately equivalent to ordinary high water mark within the Portland Harbor area)
- Verify that flow conditions are conducive to flow-paced sampling (e.g., orientation of incoming laterals, debris)
- Verify that there is space available within or adjacent to the site to secure the Isco automatic sampler
- Verify that there is space available to install the sediment trap and/or replicate traps for some locations
- Measure outlet pipe size to order or fabricate the appropriate mounting brackets for the sampler pick up tube, flow meter sensor, and the sediment trap.

The primary purpose of determining the sampling location elevation will be to determine whether back up of river water into the junction or adjoining pipes is reasonably likely. Such a condition will be avoided to prevent sampling of river water instead of, or in combination with, stormwater. Table 4-1 presents statistics on river heights based on USGS data from the Morrison Street Bridge gauge for the proposed months of sampling. This gauge is located 2.9 feet above City of Portland datum (i.e., add a value of 2.9 to the Morrison Street Bridge gauge height to obtain a value in City of Portland datum). As shown in Table 4-1, the upper range (i.e., above 80th percentile) statistics on the average monthly river height in this period is in the range of 10 to 14 feet as measured by the gauge. Because a monthly average does not explicitly capture daily highs that may have occurred within any given period, the daily 90th percentile statistics are also presented. The upper range (i.e., above 80th percentile) statistics on these values range from 11.9 to 17 feet in this period, as measured by the gauge.

No specific criteria for acceptable junction elevation are proposed here. Rather, the field reconnaissance information for each location (and potential alternate locations) should be compared to Table 4-1 to determine the relative likelihood of river backup at any particular location. The field crews will make determinations in coordination with the

Stormwater Technical Team of acceptable levels of risk for river backup at each sampling location. These decisions will also consider other factors such as the relative feasibility of moving to a nearby location (i.e., within the same basin) and the availability of any other alternate locations (i.e., in other basins entirely) that might also meet the objectives of the location in question. For example, where few if any nearby or alternative sampling locations exist that meet the intended objectives of the sampling location, then acceptance of a greater risk of river backup at a particular location may be warranted. Conversely, if an alternate location that meets all the location objectives can easily be found, there should be a relatively low tolerance for the potential of river backup at a given location.

Where the junction elevation of a particular location appears to have a reasonable potential for river backup based on the field reconnaissance information, more accurate surveys of the location elevation may be warranted and will be conducted as necessary to reach decisions consistent with the above framework.

Another key measurement that will be needed is the depth of the junction structure below the invert of the outlet. Ideally, sediment traps will be mounted adjacent to the outlet with the opening of the sampling bottle at the same elevation of the invert. If the bottle is located higher, it may not effectively collect the heavier fractions of the sediment or may introduce excessive turbulence that interferes with the function of the flow meter. In some situations, this ideal location may not be possible and alternate locations within the junction structure that would be expected to still capture substantial amounts of sediments and avoid excessive turbulence may need to be evaluated and determined.

In addition, the team will attempt to identify any non-stormwater flows that could enter the conveyance during the sampling period (e.g., groundwater, stream flows, sheet flow from adjacent sites, batch discharges). Depending on the source, the location-specific procedures may need to include collection of information on the nature, amount, and timing of those flows.

If the targeted sampling location is not adequate, the team will move upstream to the next available representative structure for evaluation. Anchor will report the identified sampling locations to the Stormwater Technical Team for approval. It is possible that a suitable monitoring station cannot be found and an alternative outfall will be needed to be selected to meet the study goals, see Section 4.3 for a discussion of the contingency process for selecting and alternative sampling location

4.3 BACKUP AND CONTINGENCY PROCESS FOR LOCATION SELECTION AND SAMPLING

If it is determined that a sediment trap or automated water sampler deployment is infeasible for the selected basin, or that available sampling locations within that basin will not meet location objectives (i.e., are not representative of targeted land uses or site activities), several alternatives may be implemented.

4.3.1 Land Use Based Sampling Sites

If it is a land use based sampling site, another representative outfall or basin could be selected; alternately, another location within the basin could be selected, as long as the remaining basin area is still representative of that land use. Based on the identification of a physically suitable site by the reconnaissance team, as described previously, the site will be re-evaluated in the office. The selected location will be first compared to the infrastructure maps to determine what areas will be captured by the sampling location. The land uses in the captured area will be evaluated to determine if they meet the sampling goal.

If the revised basin does not meet the land use selection criteria an alternative outfall will be selected and a reconnaissance survey will be conducted to determine if the equipment can be installed.

Time is of the essence to collect the stormwater samples in the 2006/2007 rainy season. From that perspective, selecting a truncated area of the original basin would be superior if the remaining area provided the land use characteristics desired. Deciding to look for an alternative basin and investigating it may result in not getting the desired number of water quality samples or the desired volume of sediment. However, because all the equipment will not be delivered and installed simultaneously, there may be a 2-week period during which an alternative site can be selected and approved by the Stormwater Technical Team without greatly affecting the implementation of the FSP.

If the primary issue is that a sediment trap cannot be installed, the high volume water filtering alternate technique could be employed at these sites without need for moving to alternate locations.

4.3.2 Industrial Sampling Sites

If it is not feasible to install the sampling equipment at an industrial sampling site, the same procedure described above for land use-based sites would be employed by moving the pipe up or to another site drainage basin to see if another sampling point that drains most of the desired site can be found. If such an on-site alternate location cannot be found, it may or may not be feasible to select another industrial site to fulfill the role of the desired site. Any such proposals to move sites would be closely coordinated with the Stormwater Technical Team to obtain approval.

It is difficult to speculate what problems may occur and what the solutions may be without the basic reconnaissance of the sites completed. Consequently, we do not attempt to discuss alternate procedures for all potential situations. In general, if an Isco sampler cannot be installed for any reason and selection of an alternate site is not acceptable, the alternate approach of manually collecting discrete or manual composites could be considered. If a sediment trap cannot be installed, high volume filtered sampling could be conducted.

4.3.3 Inadequate Sediment Collection

The sediment generation rate varies by land use, topography, implementation of best management practices (BMPs), and rainfall intensity. A well swept, nearly level, industrial area may not generate a significant quantity of sediment. Low intensity storms may not detach and mobilize sediments. Further, sediment traps may not collect sediments from low flow storm events. Consequently, if the collection bottle is less than one-third full at the first monthly inspection, the rainfall records will be evaluated to determine if there were storms likely to generate runoff, the sampler will be inspected to ensure that it was installed properly, the junction will be inspected to see if it is accumulating sediment, and the contributing basin will be visually surveyed to see if sediment is available to wash off. Based on the findings, it may be recommended that the sediment trap be repositioned or relocated to obtain better collection rate, additional bottles deployed, or that another sampling method be employed. An alternative sediment sampling method would be high volume filtered samples.

4.4 SITE SPECIFIC SAMPLING REPORTS

Site specific sampling reports will be developed for the Field Sampling Report (described in Section 5) based on the field reconnaissance surveys and decisions made in coordination with the Stormwater Technical Team. A description of each sampling site will be developed for the report that describes the specific details for implementation of this FSP at the each site. The specific details of the report will include:

1. Figure showing the drainage basin and actual sampling location within the basin.
2. The reconnaissance survey datasheets, notes, and photographs as necessary to describe the situation.
3. Diagram of sample equipment set up within the specific site pipe or junction noting key dimensions.
4. Photographs of the installation.
5. Calculations of estimated runoff quantity and responses for various ranges of storms for sampler programming.
6. Key parameters for sampler programming (i.e., number and size of bottles, sampling rate for various storm totals, trigger conditions, length of pickup tube, etc.).
7. Sample team leader responsible for sampler.
8. Sampler telephone number.
9. Any site specific considerations that will result in deviations from the FSP standard procedures.

10. Descriptions of any planned deviations from detailed procedures in this FSP including appendices that will be applied to this site.

11. Alternate or contingency procedures (as discussed above) that are proposed for that site.

4.5 PROJECT SCHEDULE

The actual start dates for the sampling will be determined following EPA approval of this Stormwater FSP. Other conditions that may affect the sampling schedule are weather and equipment conditions and availability. Currently, it is anticipated that the stormwater and sediment samples will be begin to be collected in late February through early March. Figure 4-2 shows the currently projected schedule. The most critical item beyond EPA approval is the acquisition and deployment of the water samplers. There is a 3 to 6 week lead time to acquire all the equipment. It is anticipated that each sampling crew will be able to install two sampling kits per day. Consequently, it will take approximately 4 to 7 weeks to deploy the first sampler from the time that it is ordered and approximately 8 weeks from the time the samplers are ordered for all of them to be deployed.

The automated samplers will be activated as soon as they are installed to record flow rates and will be enabled to collect samples during the first storm event that exceeds the predetermined precipitation conditions. The sediment traps will also begin functioning as soon as they are installed. While flow is present in the stormwater system the samplers will be trapping sediments. Based on the weather forecasts and anticipated precipitation, sampling teams will be notified to enable the samplers and deployed to collect samples following the storm events. Additionally, the sampling teams will be deployed based on forecasted weather to collect grab samples from selected locations.

5.0 REPORTING

5.1 LABORATORY AND CHEMICAL DATA

Preliminary data obtained from the laboratory will be validated following the Round 2 QAPP (Integral and Windward 2004) and QAPP Addendum (Integral 2007) procedures. These data will then be entered into the LWG database including any laboratory or validation assigned qualifiers. Validated analytical laboratory data from the LWG database will be provided to EPA in an electronic format within 120 days of completion of each sampling event. A sampling event will generally be considered complete when the last sample of that type described in this FSP has been collected.

5.2 FIELD MEASUREMENT DATA

Results of field parameters (e.g., pH) and flow data measurements at each location will be provided to EPA on schedule with and as a part of the Stormwater Site Characterization Summary Report described in Section 5.3. Field parameters will be validated consistent with the Round 2 QAPP and QAPP Addendum procedures (Integral and Windward 2004 and Integral 2007, respectively). Flow data results will be compiled into a separate project database. Rainfall data from publicly available area rain gauges will also be obtained and entered into the flow database.

Initially, these data will be reviewed against information obtained on the flow conditions and monitoring history at each site (e.g., structure and sensor placement issues, the presence of base flows, periods of known equipment malfunction) to identify and flag any periods of questionable or censored data. Data will also be reviewed for any questionable data in periods not associated with any of the above known issues and flagged accordingly (e.g., periods of very high recorded flow with no rainfall, highly erratic readings in small periods of time, periods of no flow during high intensity rain fall, etc.). Periods associated with chemistry sample collection will be identified and flagged within the flow database as well.

5.3 REPORTING

A Field Sampling Report will be prepared and submitted to EPA within 120 days of completing all stormwater and sediment field sample collection efforts described in this FSP. The Field Sampling Report will summarize field sampling activities, including sampling locations (i.e., information described in Section 4.4), requested sample analyses, sample collection methods, and any deviations from the FSP. At a minimum, the following will be included in the field report:

- Description of each sampling event including date, time, antecedent and rainfall data, river stage (as measured by the Morrison bridge USGS gauge), storm duration (water samples only).
- Comparison to rainfall event goals (water samples only).
- Description of sample collection and compositing at each location: plot of flow hydrograph and aliquot number subsample collection time, river stage, identify total number and which subsamples were composited, and Isco sampler program settings/sample results reports.
- Comparison to sampling criteria (water samples only).
- Description of each sampling event including dates if installation and retrieval and total rainfall during that period (sediment trap only)
- Field observations.
- Deviation from field procedures.

Stormwater and sediment chemistry results, field measurements, and storm flow data will be reported in tabular format in a Stormwater Site Characterization Summary Report that will be submitted to EPA within 120 days of completing sampling and analysis for all stormwater activities. The report will also include summaries of weather conditions (e.g., field observations), field observations associated with each location inspection and/or sampling event, and rain gauge data throughout the sampled period. Preliminary data evaluations relevant to the objectives of the study also will be included in the Stormwater Site Characterization Summary Report. However, the report will not include annualized loading estimates for use in modeling evaluations. This information will be developed and reported within the framework of the overall fate and transport modeling and data evaluations for the RI/FS.

.

6.0 REFERENCES

American Society for Testing and Materials, 1985, D 2487-83, Classification of Soils for Engineering Purposes: Annual Book of ASTM Standards. Vol. 04.08, pp 395-408.

Anchor Environmental and Integral Consulting. 2007. Portland Harbor RI/FS Round 3A Stormwater Sampling Rationale. Prepared for the Lower Willamette Group. Portland, Oregon.

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.

Hope, B. 2006. A Multi-Segment Rate Constant Model for Estimation of Chemical Fate in the Lower Willamette River, Oregon, U.S.A. Air Quality Division, Oregon Department of Environmental Quality. Portland, Oregon.

Integral. 2004a. Portland Harbor RI/FS Quality Assurance Project Plan Addendum for Surface Water Sampling. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

Integral. 2004b. Portland Harbor RI/FS Health and Safety Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

Integral Consulting. 2007. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan, Addendum 8: Round 3A Stormwater Sampling. Prepared for the Lower Willamette Group. Portland, Oregon.

Integral and Windward Environmental. 2004. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

Integral, Windward Environmental, Kennedy/Jenks Consultants, Anchor Environmental, and Groundwater Solutions. 2004. Portland Harbor RI/FS Programmatic Work Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

Koch, K., C. Stivers, L. Jones, D. Sanders, L. Scheffler, A. Koulermos, and K. Tarnow. 2006 Memorandum to Portland Harbor Management Group regarding Framework for Collecting Stormwater Data to Support the Portland Harbor RI/FS. December 13, 2006.

Tables

Table 2-1. Proposed Stormwater Sampling Locations.

Outfall(s)	Facility or Location	River Mile	Land Use	Industrial or Land Use Activities
Industrial Locations (11)				
WR-22	OSM	2.1	Heavy Industrial	Steel manufacturing
WR-121 or WR-123	Schnitzer International Slip	3.7	Heavy Industrial	Metals
WR-108	Schnitzer - Riverside	4	Heavy Industrial	Metals
WR-107	GASCO	6.4	Heavy Industrial	MGP
WR-96	Arkema	7.3	Heavy Industrial	Chemical manufacturing
WR-14	Chevron - Transportation	7.7	Heavy Industrial	Bulk Fuel
WR-161	Portland Shipyard	8.2	Heavy Industrial	Ship maintenance and repair
WR-4	Sulzer Pump	10.4	Heavy Industrial	Manufacturing
WR-145	Gunderson	8.9	Heavy Industrial	Barge and railroad car manufacturing
WR-147	Gunderson (former Schnitzer)	9	Heavy Industrial	Metals handling
Drains to OF-17	GE Decommissioning	9.7	Heavy Industrial	Transformer decommissioning
Land Use Locations (11)				
Hwy 30	Hwy 30	TBD	Major Transportation	Highways
OF-49	City - St. Johns Area	6.5	Residential	Local traffic/residential
WR-67	Siltronic	6.6	Heavy Industrial	Silicon wafer manufacturing
OF-22C, above Hwy 30	City - Forest Park Area	6.9	Open Space (Forest Park)	Forest land
OF-22B	City - Doane Lake Industrial Area	6.9	Heavy Industrial	Chemical manufacturing
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Lagoon	Light Industrial	Various light industrial uses
OF-M2	City - Mocks Bottom Industrial Area	Lagoon	Light Industrial	Trucking and distribution
OF-22	City - Willbridge Industrial Area	7.7	Heavy Industrial	Petroleum/Forest Park drainage
OF-16	City - Heavy Industrial	9.7	Heavy Industrial	Mixed industrial/highway
WR-218	UPRR Albina	10	Heavy Industrial	Railyard
St. Johns Bridge	Highway drainage	5.8	Major Transportation	Highways
Multiple Land Use Locations (2)				
OF-18	City - Multiple Land Uses	9.7	Open Space/Heavy Industrial	Also includes highway

Table 2-1. Proposed Stormwater Sampling Locations.

Outfall(s)	Facility or Location	River Mile	Land Use	Industrial or Land Use Activities
OF-19	City - Multiple Land Uses	8.4	Open Space/Heavy Industrial	Also includes highway
Terminal 4- Recontamination Evaluation (7)				
OF-52C	City - Terminal 4 Industrial Area	4.3	Light Industrial	Mixed industrial
OF-53	City - Residential above Terminal 4	5.1	Residential	Local traffic/residential
WR-183/Basin R	Terminal 4 - Slip 1	4.3	Heavy Industrial - Site Specific	Grains storage/transport
WR-181/Basin Q	Terminal 4 - Slip 1	4.3	Heavy Industrial - Site Specific	Vacant/former grain storage
WR-177/Basin M	Terminal 4 - Slip 1	4.3	Heavy Industrial - Site Specific	Car parking/liquid bulk storage
WR-20/Basin L	Terminal 4 - Wheeler Bay	4.5	Heavy Industrial - Site Specific	Kinder Morgan bulk storage
WR-169/Basin D	Terminal 4 (Toyota)	4.7	Light Industrial	Vacant/former petroleum storage

Table 2-2. Number of Samples Collected

Sediment Samples

Parameter	Natural Samples	Field Replicates	Field Rinsate Blank for Phthalates	Total Number of Samples
PCB Congeners	31	2	0	33
TOC	31	2	0	33
Percent Solids	31	2	0	33
Organochlorine pesticides	31	2	0	33
PAHs and Phthalates	31	2	2	35
Metals	31	2	0	33
Herbicides	31	2	0	33
Grain size	31	2	0	33

Stormwater Samples

Parameter	Natural Samples	Field Replicates	Field Rinsate Blanks	Total Number of Samples per Event	Total for 3 events
Stormwater Composite Samples					
TSS	31	2	2	35	105
TOC	31	2	2	35	105
Total Metals	31	2	2	35	105
Filtered Metals	31	2	2	35	105
PAHs	31	2	2	35	105
Phthalates*	11	1	1	13	39
PCB Congeners	31	2	2	35	105
Herbicides	31	2	2	35	105
Organochlorine pesticides	2	1	1	4	12
Stormwater Grab Samples [1]					
TSS	20	1	1	22	NA
TOC	20	1	1	22	NA
PAHs	20	1	1	22	NA
Phthalates*	7	1	1	9	NA
PCB Congeners	20	1	1	22	NA
Organochlorine pesticides	2	1	1	5	NA
Herbicides	20	1	1	22	NA

[1] These 10 grab samples will be analyzed for total and dissolved constituents to yield 20 samples for the laboratory. Each of these samples will be field filtered prior to analysis. Concentrations from the field filtered aliquots will be reported by the laboratory as dissolved concentrations. Does not yet include T-4 sampling sites (locations need to be confirmed).

*Phthalates are only sampled at potential source and a few selected non-potential source sites. Does not yet include T-4 phthalate sampling sites (locations need to be confirmed).

Table 2-3. Stormwater Analytes, Methods, Detection Limits, and Sample Size.

Priority	Analyte	Method Protocol	Method Procedure	Units	Min. Sample Size		Additional mass for Lab QC		Addl. MassField for field dup/rep	
Sediment Samples										
1A	PCB Congeners	EPA 1668A	HRGC/HRMS	pg/g	10	g	20	g	10	g
1B	TOC	Plumb 1981	Combustion: coulometric titration	percent	1	g	2	g	1	g
1C	Percent Solids	PSEP 1986	Gravimetric	percent	1	g	2	g	1	g
2	Organochlorine pesticides	EPA 8081A	GC/ECD	µg/kg	10	g	20	g	10	g
3	PAHs and Phthalates	EPA 8270C	GC/MS low-level LVI	µg/kg	20	g	40	g	20	g
4	Metals	EPA 6020/7471A	ICP/MS; CVAA for Hg	mg/kg	15	g	30	g	15	g
5	Herbicides	EPA 8151A	GC/ECD	µg/kg	10	g	20	g	10	g
6	Grain size	PSEP 1986	Sieves and pipette method	percent	100	g	200	g	100	g
Subtotal					167	g	334	g	167	g
Composite Water Samples										
1	TSS	EPA 160.1	Filtration and drying	mg/L	0.5	L	1	L	0.5	L
2	TOC	EPA 414.1	Chemical oxidation	mg/L	0.05	L	0.1	L	0.05	L
3	Metals	EPA 6020/7471A	ICP/MS; CVAA for Hg	µg/L	0.3	L	0.6	L	0.3	L
4	PAHs[1]	EPA 8270C	GC/MS SIM	µg/L	1	L	2	L	1	L
5	Phthalates[1]	EPA 525.2	GC/MS	µg/L	1	L	2	L	1	L
6	PCB Congeners[2]	EPA 1668A	HRGC/HRMS	pg/L	1	L	2	L	1	L
7	Herbicides	EPA 8151A	GC/ECD	µg/L	1	L	2	L	1	L
8	Organochlorine pesticides	EPA 8081A	GC/ECD	µg/L	1	L	2	L	1	L
Subtotal					4.85	L	9.7	L	4.85	L

For sediments for priority 1A, 1B, and 1C, the available sample mass will be split to conduct analyses for all 3 analytes if PCB congeners are analyzed.
Metals in sediment: Aluminum, antimony, arsenic, cadmium, chromium, copper, lead, nickel selenium, silver, zinc, mercury (Round 2)
Metals in water: Aluminum, antimony, arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver, zinc, mercury (Round 2A)
Organochlorine Pesticides in Water: Will only analyze for pesticides in stormwater samples on a site-specific basis, because the Round 2 data suggests data will be mostly non-detects for 1 or 2 Liter samples.

[1] The ACGs for selected organochlorine pesticides, PAHs, and phthalates cannot be met for all analytes by the available analytical methods However, these methods/MRLs provide consistency because they are being us for analysis of the Round 2 and 3 surface water data.

[2] The ACG (from LWG QAAP) is for total PCBs; there are no ACGs for individual congeners. One liter will be a sufficient sample size given where most detection limits are compared to the Total PCB congener results for the Round 2A surface water samples (in the 100 pg/L range). If stormwater sample concentrations are lower than that, they are effectively diluting the river water.

Table 2-4a. Composite and Grab Water Sample Analyses Priorities.

Outfall(s)	Facility or Location	TSS	TOC	Metals[1]	PAHs	Phthalates	PCB Congeners	Herbicides	Organochlorine Pesticides
WR-22	OSM	1,G	2,G	3	4,G	5,G	6,G	7,G	
WR-121 or WR-123	Schnitzer International Slip	1,G	2,G	3	4,G	5,G	6,G	7,G	
WR-108	Schnitzer - Riverside	1	2	3	4		5	6	
WR-107	GASCO	1,G	2,G	3	4,G		5,G	6,G	
Drains to OF-17	GE Decomissioning	1	2	3	4		5	6	
WR-96	Arkema	1,G	2,G	4,G	5,G	6,G	7,G	8,G	3,G
WR-14	Chevron - Transportation	1	2	3	4		5	6	
WR-161	Portland Shipyard	1,G	2,G	3	4,G	5,G	6,G	7,G	
WR-4	Sulzer Pump	1	2	3	4		5	6	
WR-145	Gunderson	1,G	2,G	3	4,G	5,G	6,G	7,G	
WR-148	Gunderson (former Schnitzer)	1	2	3	4	5	6	7	
Land Use Locations (11)									
Hwy 30	Hwy 30	1	2	3	4		5	6	
OF-49	City - St. Johns Area	1	2	3	4	5	6	7	
WR-67	Siltronic	1	2	3	4		5	6	
OF-22C, above Hwy 30	City - Forest Park Area	1	2	3	4	5	6	7	
OF-22B	City - Doane Lake Industrial Area	1,G	2,G	4,G	5,G		6,G	7,G	3,G
OF-M1, above Devine	City - Mocks Bottom Industrial Area	1	2	3	4		5	6	
OF-M2	City - Mocks Bottom Industrial Area	1	2	3	4	5	6	7	
OF-22	City - Willbridge Industrial Area	1,G	2,G	3	4,G		5,G	6,G	
OF-16	City - Heavy Industrial	1	2	3	4		5	6	
WR-218	UPRR Albina	1	2	3	4		5	6	
St. Johns Bridge	Highway drainage	1,G	2,G	3	4,G	5,G	6,G	7,G	
Multiple Land Use Locations (2)									
OF-18	City - Multiple Land Uses	1,G	2,G	3	4,G	5,G	6,G	7,G	
OF-19	City - Multiple Land Uses	1	2	3	4		5	6	
T-4- Recontamination Evaluation (7)[2]									
OF-52C	City - T-4 Industrial Area	1	2	3	4	?	5	6	
OF-53	City - Residential above T-4	1	2	3	4	?	5	6	
WR-183/Basin R	T-4, Slip 1	1	2	3	4	?	5	6	
WR-181/Basin Q.	T-4, Slip 1	1	2	3	4	?	5	6	
WR-177/Basin M	T-4, Slip 1	1	2	3	4	?	5	6	
WR-20/Basin L	T-4 - Wheeler Bay	1	2	3	4	?	5	6	
WR-169/Basin D	T-4 (Toyota)	1	2	3	4	?	5	6	

Number indicates priority order for analyses for composite water samples.

G - Indicates additional grab sampling for organic compounds that will also be conducted at these locations for filtered/unfiltered analyses.

1 - Metals analyses will be for filtered and unfiltered samples for composite sampling.

2 - T-4 composite water samples will include filtered and unfiltered samples for each chemical.

Table 2-4b. Sediment Sample Analyses Priorities

Outfall(s)	Facility or Location	PCB Congeners	TOC	Percent Solids	Organo-chlorine pesticides	PAHs and Phthalates	Metals	Herbicides	Grain size
WR-22	OSM	1A	1B	1C	3	2	4	5	6
WR-121 or WR-123	Schnitzer International Slip	1A	1B	1C	3	2	4	5	6
WR-108	Schnitzer - Riverside	1A	1B	1C	3	2	4	5	6
WR-107	GASCO	1A	1B	1C	3	2	4	5	6
Drains to OF-17	GE Decomissioning	1A	1B	1C	2	3	4	5	6
WR-96	Arkema	1A	1B	1C	2	3	4	5	6
WR-14	Chevron - Transportation	1A	1B	1C	3	2	4	5	6
WR-161	Portland Shipyard	1A	1B	1C	3	2	4	5	6
WR-4	Sulzer Pump	1A	1B	1C	3	2	4	5	6
WR-145	Gunderson	1A	1B	1C	2	3	4	5	6
WR-148	Gunderson (former Schnitzer)	1A	1B	1C	3	2	4	5	6
Land Use Locations (11)									
Hwy 30	Hwy 30	1A	1B	1C	2	3	4	5	6
OF-49	City - St. Johns Area	1A	1B	1C	2	3	4	5	6
WR-67	Siltronic	1A	1B	1C	2	3	4	5	6
OF-22C, above Hwy 30	City - Forest Park Area	1A	1B	1C	2	3	4	5	6
OF-22B	City - Doane Lake Industrial Area	1A	1B	1C	2	3	4	5	6
OF-M1, above Devine	City - Mocks Bottom Industrial Area	1A	1B	1C	2	3	4	5	6
OF-M2	City - Mocks Bottom Industrial Area	1A	1B	1C	2	3	4	5	6
OF-22	City - Willbridge Industrial Area	1A	1B	1C	2	3	4	5	6
OF-16	City - Heavy Industrial	1A	1B	1C	2	3	4	5	6
WR-218	UPRR Albina	1A	1B	1C	2	3	4	5	6
St. Johns Bridge	Highway drainage	1A	1B	1C	2	3	4	5	6
Multiple Land Use Locations (2)									
OF-18	City - Multiple Land Uses	1A	1B	1C	2	3	4	5	6

Table 2-4b. Sediment Sample Analyses Priorities

Outfall(s)	**Facility or Location**	**PCB Congeners**	**TOC**	**Percent Solids**	**Organo-chlorine pesticides**	**PAHs and Phthalates**	**Metals**	**Herbicides**	**Grain size**
OF-19	City - Multiple Land Uses	1A	1B	1C	2	3	4	5	6
T-4- Recontamination Evaluation (7)									
OF-52C	City - T-4 Industrial Area	1A	1B	1C	2	3	4	5	6
OF-53	City - Residential above T-4	1A	1B	1C	2	3	4	5	6
WR-183/Basin R	T-4, Slip 1	1A	1B	1C	2	3	4	5	6
WR-181/Basin Q.	T-4, Slip 1	1A	1B	1C	2	3	4	5	6
WR-177/Basin M	T-4, Slip 1	1A	1B	1C	2	3	4	5	6
WR-20/Basin L	T-4 - Wheeler Bay	1A	1B	1C	2	3	4	5	6
WR-169/Basin D	T-4 (Toyota)	1A	1B	1C	2	3	4	5	6

Table 2-5a. Laboratory Methods for Sediment Samples.

Analysis	Laboratory	Sample Preparation		Quantitative Analysis	
		Protocol	**Procedure**	**Protocol**	**Procedure**
Conventional Analyses	CAS Kelso				
Total solids		--	--	PSEP 1986	Balance
Grain size		--	--	PSEP 1986	Sieve and pipette method
Total organic carbon		Plumb 1981	Acid pretreatment	Plumb et al. 1981	Combustion; coulometric titration
Metals	CAS Kelso				
Antimony, arsenic[a], cadmium, lead, silver		EPA 3050	Strong acid digestion	EPA 6020	ICP/MS
Aluminum, chromium, copper, nickel, zinc		EPA 3050	Strong acid digestion	EPA 6010B	ICP/AES
Selenium		EPA 3050	Strong acid digestion	EPA 7742	AAS
		EPA 7742	Hydride generation		
Arsenic[a]		EPA 3050	Strong acid digestion	EPA 7062	AAS
Mercury		EPA 7471A	Acid digestion/oxidation	EPA 7471A	CVAA
Chlorinated herbicides	CAS Kelso	EPA 8151A	Solvent extraction	EPA 8151A	GC/ECD
			Esterification		
Organochlorine pesticides and selected SVOCs	CAS Kelso	EPA 3541	Soxhlet extraction	EPA 8081A	GC/ECD
		EPA 3620B	Florisil® cleanup		
		EPA 3660B	Sulfur cleanup		
Semivolatile organic compounds	CAS Kelso				
PAHs and phthalates		EPA 3541	Automated Soxhlet Extraction	EPA 8270C	GC/MS-LVI
		EPA 3640A	Gel permeation chromatography		
PCB Congeners[b]	Vista	EPA 1668A	Soxhlet/Dean Stark extraction	EPA 1668A	HRGC/HRMS
			Sulfuric acid cleanup		
			Silica column cleanup		

Notes:
[a] Arsenic will be analyzed by EPA Method 7062 if it is not detected at the MRL by EPA Method 6020.

Table 2-5a. Laboratory Methods for Sediment Samples.

[b] Analysis will be completed for all 209 PCB congeners.
AAS - Atomic absorption spectrometry
CAS - Columbia Analytical Services
CVAA - cold vapor atomic absorption spectrometry
EPA - U.S. Environmental Protection Agency
GC/ECD - gas chromatography/electron capture detection
GC/FID - gas chromatography/flame ionization detection
GC/MS - gas chromatography/mass spectrometry
HRGC/HRMS - high-resolution gas chromatography/high-resolution mass spectrometry
ICP/AES - inductively coupled plasma/atomic emission spectrometry
ICP/MS - inductively coupled plasma - mass spectrometry
LVI - large-volume injector
TPH - total petroleum hydrocarbon
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PSEP - Puget Sound Estuary Program
SIM - selected ion monitoring
STL - Severn Trent Laboratories
SVOC - semivolatile organic compound

Table 2-5b. Laboratory Methods for Water Samples.

Analytes	Laboratory	Sample Preparation		Quantitative Analysis	
		Protocol	Procedure	Protocol	Procedure
Conventional Analyses	CAS				
Total Suspended Solids		EPA 160.2	Filtration and drying	EPA 160.2	Balance
Total Organic Carbon		EPA 415.1	Chemical oxidation	EPA 415.1	Infrared detector
Metals	CAS				
Aluminum, antimony, cadmium, total chromium, copper, lead, nickel, selenium, silver, zinc		EPA 3005	Acid digestion	EPA 200.8	ICP/MS
Arsenic		EPA 3005A (Modified)	Acid Digestion/pre-concentration	EPA 200.8	ICP/MS
Mercury		EPA 7470	Acid digestion/oxidation	EPA 7470	CVAA
Phthalate Esters	CAS	EPA 525.2	Solid-phase extraction	EPA 525.2	GC/MS
Chlorinated Herbicides	CAS	EPA 8151A	Solvent extraction	EPA 8151A	GC/ECD
			Esterification		
Organochlorine pesticides and selected SVOCs	CAS	EPA 3545	Pressurized fluid extraction	EPA 8081A	GC/ECD
		EPA 3640A	Gel permeation chromatography		
		EPA 3630C	Florisil® cleanup		
		EPA 3660B	Sulfur cleanup (as needed)		
Polycyclic Aromatic Hydrocarbon	CAS	EPA 3520C	Continuous liquid-liquid extraction	EPA 8270C	GC/MS-SIM
PCB congeners[2]	Axys	EPA 1668A	Florisil® cleanup	EPA 1668A	HRGC/HRMS
			Extract fractionation		
			Layered Acid/Base SiO_3 Alumina		

CAS - Columbia Analytical Services
EPA - U.S. Environmental Protection Agency
GC/ECD - gas chromatography/electron capture detection
GC/MS - gas chromatography/mass spectrometry
HRGC/HRMS - high resolution gas chromatography/high resolution mass spectrometry
ICP/MS - inductively coupled plasma - mass spectrometry
LVI - large-volume injector
SIM - selected ion monitoring
SOP - standard operating procedures

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
Conventional Analyses				
Total solids (percent of whole weight)		*	0.01	0.01
Grain size (percent)[c]		*	0.1	0.1
Total organic carbon (percent)		*	0.02	0.05
Metals, mg/kg dry wt				
Aluminum		*	10.0	10.0
Antimony		*	0.02	0.05
Arsenic		*	0.07	0.5
Cadmium		*	0.007	0.05
Chromium		*	0.6	2.0
Copper		*	2.0	2.0
Lead		*	0.02	0.05
Mercury		*	0.008	0.02
Nickel		*	3.0	4.0
Selenium		*	0.2	1
Silver		*	0.003	0.02
Zinc		*	0.5	2.0
Chlorinated Herbicides, µg/kg dry wt				
2,4,5-T		**2.8**	5.9	50
2,4,5-TP (Silvex)		**2.2**	3.9	50
2,4-D		**2.8**	8	50
2,4-DB		**2.2**	9.7	50
Dalapon		*	7	50
Dicamba		*	5.4	50
Dichlorprop		*	9.5	50
Dinoseb		*	3.5	50
MCPA		*	520	10000
MCPP		*	530	10000
Organochlorine Pesticides and Selected SVOCs, µg/kg dry wt				
2,4'-DDD		*	0.02	0.13
2,4'-DDE		*	0.009	0.13
2,4'-DDT		*	0.01	0.13
4,4'-DDD		**0.083**	0.012	0.13
4,4'-DDE		**0.0588**	0.01	0.13
4,4'-DDT		**0.0588**	0.021	0.13
Total DDT		*****	--	--
Aldrin		**0.00038**	0.031	0.13
alpha-BHC		**0.001**	0.01	0.13
beta-BHC		**0.0036**	0.028	0.13
delta-BHC		*	0.018	0.13
gamma-BHC (Lindane)		**0.005**	0.012	0.13
alpha-Chlordane		*	0.008	0.13
gamma-Chlordane		*	0.005	0.13
Oxychlordane		*	0.012	0.13

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
cis -Nonachlor		*	0.005	0.13
trans -Nonachlor		*	0.004	0.13
Total chlordane[d]		**0.057**	--	--
Dieldrin		**0.0004**	0.01	0.13
Endosulfan I		1.7	0.014	0.13
Endosulfan II		*	0.008	0.13
Endosulfan sulfate		*	0.026	0.13
Endrin		**0.084**	0.03	0.13
Endrin aldehyde		*	0.02	0.13
Endrin ketone		*	0.007	0.13
Heptachlor		**0.0014**	0.012	0.13
Heptachlor epoxide		**0.0007**	0.018	0.13
Methoxychlor		1.4	0.024	0.13
Mirex		**0.056**	0.007	0.13
Toxaphene		**0.0059**	0.9	10
Hexachlorobenzene		0.33	0.02	0.2
Hexachlorobutadiene		0.6	0.12	0.2
Hexachloroethane		2.0	0.12	0.2
Semivolatile Organic Compounds, µg/kg dry wt				
Polycyclic Aromatic Hydrocarbons				
2-Methylnaphthalene		*	1.2	10
Acenaphthene		72	1	10
Acenaphthylene		*	1.4	10
Anthracene		360	1.4	10
Benz(a)anthracene		**0.038**	1.4	10
Benzo(a)pyrene		**0.0038**	1.6	10
Benzo(b)fluoranthene		**0.038**	2.5	10
Benzo(g,h,i)perylene		*	2.3	10
Benzo(k)fluoranthene		**0.38**	2.5	10
Chrysene		**3.8**	1.4	10
Dibenz(a,h)anthracene		**0.0038**	2.2	10
Dibenzofuran		8.2	1.3	10
Fluoranthene		48	2.2	10
Fluorene		48	1.7	10
Indeno(1,2,3-cd)pyrene		**0.038**	1.9	10
Naphthalene		24	1.3	10
Phenanthrene		*	1.3	10
Pyrene		36	1.3	10
Phthalates				
Bis(2-ethylhexyl) phthalate		**3.4**	1.7	200
Butylbenzyl phthalate		400	1.5	10
Dibutyl phthalate		204	2.6	10
Diethyl phthalate		*	3.5	10

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
Dimethyl phthalate		20000	1.8	10
Di-n-octyl phthalate		40.9	1.2	10
PCB congeners				
Dioxin-like PCB congeners (WHO list)	**Congener number**			
3,3',4,4'-TetraCB	PCB-77	10	1.1	5
3,4,4',5-TetraCB	PCB-81	10	1.0	5
2,3,3'4,4'-PentaCB	PCB-105	10	0.9	5
2,3,4,4',5-PentaCB	PCB-114	2	0.7	5
2,3',4,4',5-PentaCB	PCB-118	10	2.1	5
(coelution with 2,3,3',4,5-PentaCB)	(coelution with PCB 106)			
2',3,4,4',5-PentaCB	PCB-123	10	0.9	5
3,3',4,4',5-PentaCB	PCB-126	0.01	0.6	5
2,3,3',4,4',5-HexaCB	PCB-156	2	0.8	5
2,3,3',4,4',5'-HexaCB	PCB-157	2	0.6	5
2,3,4,4',5,5'-HexaCB	PCB-167	100	0.5	5
3,3',4,4',5,5'-HexaCB	PCB-169	0.1	0.8	5
2,3,3',4,4',5,5'-HeptaCB	PCB-189	10	0.3	5
Other PCB congeners				
2-MonoCB	PCB-1		0.5	2.5
3-MonoCB	PCB-2		0.6	2.5
4-MonoCB	PCB-3		0.6	2.5
2,2'-DiCB/2,6-DiCB	PCB-4/10		4.3	2.5
2,3-DiCB/2,4'-DiCB	PCB-5/8		4.4	2.5
2,3'-DiCB	PCB-6		2.2	2.5
2,4-DiCB/2,5-DiCB	PCB-7/9		4.6	2.5
3,3'-DiCB	PCB-11		5.0	2.5
3,4-DiCB/3,4'-DiCB	PCB-12/13		6.1	2.5
3,5-DiCB	PCB-14		3.0	2.5
4,4'-DiCB	PCB-15		2.8	2.5
2,2',3-TriCB/2,4',6-TriCB	PCB-16/32		2.5	2.5
2,2',4-TriCB	PCB-17		1.3	2.5
2,2',5-TriCB	PCB-18		1.4	2.5
2,2',6-TriCB	PCB-19		1.0	2.5
2,3,3'-TriCB/2,3,4-TriCB/2,3,5-TriCB	PCB-20/21/33		1.4	2.5
2,3,4'-TriCB	PCB-22		0.9	2.5
2,3,5-TriCB	PCB-23		0.7	2.5
2,3,6-TriCB/2,3',6-TriCB	PCB-24/27		2.5	2.5
2,3',4-TriCB	PCB-25		0.8	2.5

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
2,3',5-TriCB	PCB-26		0.8	2.5
2,4,4'-TriCB	PCB-28		1.5	2.5
2,4,5-TriCB	PCB-29		0.6	2.5
2,4,6-TriCB	PCB-30		0.9	2.5
2,4',5-TriCB	PCB-31		1.2	2.5
2',3,5-TriCB	PCB-34		0.9	2.5
3,3',4-TriCB	PCB-35		0.4	2.5
3,3',5-TriCB	PCB-36		0.9	2.5
3,4,4'-TriCB	PCB-37		0.6	2.5
3,4,5-TriCB	PCB-38		0.9	2.5
3,4',5-TriCB	PCB-39		0.6	2.5
2,2',3,3'-TetraCB	PCB-40		1.2	5
2,2',3,4-TetraCB/2,3,4',6-TetraCB/2,3',4',6-TetraCB/2,3',5,5'-TetraCB	PCB-41/64/71/72		3.5	5
2,2',3,4'-TetraCB/2,3,3',6-Tetra	PCB-42/59		2.0	5
2,2',3,5-TetraCB/2,2',4,5'-Tetra	PCB-43/49		2.2	5
2,2',3,5'-TetraCB	PCB-44		5.3	5
2,2',3,6-TetraCB	PCB-45		1.3	5
2,2',3,6'-TetraCB	PCB-46		1.1	5
2,2',3,4'-TetraCB	PCB-47		3.4	5
2,2',4,5-TetraCB/2,4,4',6-Tetra(	PCB-48/75		1.8	5
2,2',4,6-TetraCB	PCB-50		1.5	5
2,2',4,6'-TetraCB	PCB-51		1.1	5
2,2',5,5'-TetraCB/2,3',4,6-Tetra	PCB-52/69		3.3	5
2,2',5,6'-TetraCB	PCB-53		1.0	5
2,2',6,6'-TetraCB	PCB-54		1.9	5
2,3,3',4'-TetraCB	PCB-55		1.0	5
2,3,3',4'-TetraCB/2,3,4,4'-Tetra	PCB-56/60		2.5	5
2,3,3',5-TetraCB	PCB-57		1.2	5
2,3,3',5'-TetraCB	PCB-58		1.2	5
2,3,4,5-TetraCB	PCB-61		1.2	5
2,3,4,6-TetraCB	PCB-62		0.9	5
2,3,4',5-TetraCB	PCB-63		1.1	5
2,3,5,6-TetraCB	PCB-65		1.3	5
2,3',4,4'-TetraCB	PCB-66		1.8	5
2,3',4,5-TetraCB	PCB-67		1.2	5
2,3',4,5'-TetraCB	PCB-68		1.3	5
2,3',4',5-TetraCB	PCB-70		1.4	5
2,3',5',6-TetraCB	PCB-73		0.7	5
2,4,4',5-TetraCB	PCB-74		1.1	5

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
2',3,4',5-TetraCB	PCB-76		2.3	5
3,3',4,5-TetraCB	PCB-78		2.8	5
3,3',4,5'-TetraCB	PCB-79		1.7	5
3,3',5,5'-TetraCB	PCB-80		0.9	5
2,2',3,3',4-PentaCB	PCB-82		1.3	5
2,2',3,3',5-PentaCB	PCB-83		0.9	5
2,2',3,3',6-PentaCB/2,2',3,5,5'-P	PCB-84/92		1.6	5
2,2',3,4,4'-PentaCB/2,3,4,5,6-Pe	PCB-85/116		1.3	5
2,2',3,4,5-PentaCB	PCB-86		1.8	5
2,2',3,4,5'-PentaCB/2,3,4',5,6-PentaCB/2',3,4,5,6'-PentaCB	PCB-87/117/125		1.8	5
2,2',3,4,6-PentaCB/2,2',3,4',6-P	PCB-88/91		1.6	5
2,2',3,4,6'-PentaCB	PCB-89		0.7	5
2,2',3,4',5-PentaCB/2,2',4,5,5'-P	PCB-90/101		1.5	5
2,2',3,5,6-PentaCB	PCB-93		1.5	5
2,2',3,5,6'-PentaCB	PCB-94		0.4	5
2,2',3,5',6-PentaCB/2,2',3',4,6-PentaCB/2,2',4,5,6'-PentaCB	PCB-95/98/102		6.4	5
2,2',3,6,6'-PentaCB	PCB-96		0.5	5
2,2',3',4,5-PentaCB	PCB-97		1.3	5
2,2',4,4',5-PentaCB	PCB-99		1.0	5
2,2',4,4',6-PentaCB	PCB-100		0.3	5
2,2',4,5,6'-PentaCB	PCB-103		0.4	5
2,2',4,6,6'-PentaCB	PCB-104		0.5	5
2,3,3',4',5-PentaCB/2,3,3',4,6-PentaCB	PCB-107/109		1.3	5
2,3,3',4,5'-PentaCB/2,3,3',5,6-PentaCB	PCB-108/112		1.0	5
2,3,3',4',6-PentaCB	PCB-110		1.8	5
2,3,3',5,5'-PentaCB/2,3,4,4',6-PentaCB	PCB-111/115		1.7	5
2,3,3',5',6-PentaCB	PCB-113		1.0	5
2,3',4,4',6-PentaCB	PCB-119		0.9	5
2,3',4,5,5'-PentaCB	PCB-120		1.0	5
2,3',4,5,6-PentaCB	PCB-121		0.9	5
2',3,3',4,5-PentaCB	PCB-122		1.0	5
2',3,4,5,5'-PentaCB	PCB-124		1.1	5
3,3',4,5,5'-PentaCB	PCB-127		0.8	5

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
2,2',3,3',4,4'-HexaCB/2,3,3',4',5,5'-HexaCB	PCB-128/162		1.2	5
2,2',3,3',4,5-HexaCB	PCB-129		0.8	5
2,2',3,3',4,5'-HexaCB	PCB-130		0.8	5
2,2',3,3',4,6-HexaCB	PCB-131		2.5	5
2,2',3,3',4,6'-HexaCB/2,3,3',4,5',6-HexaCB	PCB-132/161		1.0	5
2,2',3,3',5,5'-HexaCB/2,2',3,4,5,6-HexaCB	PCB-133/142		3.9	5
2,2',3,3',5,6-HexaCB/2,2',3,4,5,6'-HexaCB	PCB-134/143		4.1	5
2,2',3,3',5,6'-HexaCB	PCB-135		1.4	5
2,2',3,3',6,6'-HexaCB	PCB-136		1.2	5
2,2',3,4,4',5-HexaCB	PCB-137		1.0	5
2,2',3,4,4',5'-HexaCB/2,3,3',4',5,6-HexaCB/2,3,3',4',5',6-HexaCB	PCB-138/163/164		2.1	5
2,2',3,4,4',6-HexaCB/2,2',3,4',5',6-HexaCB	PCB-139/149		1.8	5
2,2',3,4,4',6'-HexaCB	PCB-140		1.0	5
2,2',3,4,5,5'-HexaCB	PCB-141		0.6	5
2,2',3,4,5',6-HexaCB	PCB-144		1.7	5
2,2',3,4,6,6'-HexaCB	PCB-145		1.1	5
2,2',3,4',5,5'-HexaCB/2,3,3',5,5',6-HexaCB	PCB-146/165		1.7	5
2,2',3,4',5,6-HexaCB	PCB-147		0.7	5
2,2',3,4',5,6'-HexaCB	PCB-148		1.1	5
2,2',3,4',6,6'-HexaCB	PCB-150		1.3	5
2,2',3,5,5',6-HexaCB	PCB-151		1.5	5
2,2',3,5,6,6'-HexaCB	PCB-152		1.3	5
2,2',4,4',5,5'-HexaCB	PCB-153		1.2	5
2,2',4,4',5',6-HexaCB	PCB-154		1.1	5
2,2',4,4',6,6'-HexaCB	PCB-155		0.9	5

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
2,3,3',4,4',6-HexaCB/2,3,3',4,5,6-HexaCB	PCB-158/160		1.3	5
2,3,3',4,5,5'-HexaCB	PCB-159		0.5	5
2,3,4,4',5,6-HexaCB	PCB-166		0.6	5
2,3',4,4',5',6-HexaCB	PCB-168		0.4	5
2,2',3,3',4,4',5-HeptaCB	PCB-170		0.4	5
2,2',3,3',4,4',6-HeptaCB	PCB-171		0.6	5
2,2',3,3',4,5,5'-HeptaCB	PCB-172		0.5	5
2,2',3,3',4,5,6-HeptaCB	PCB-173		0.7	5
2,2',3,3',4,5,6'-HeptaCB	PCB-174		1.4	5
2,2',3,3',4,5',6-HeptaCB	PCB-175		1.2	5
2,2',3,3',4,6,6'-HeptaCB	PCB-176		0.4	5
2,2',3,3',4',5,6-HeptaCB	PCB-177		0.7	5
2,2',3,3',5,5',6-HeptaCB	PCB-178		0.6	5
2,2',3,3',5,6,6'-HeptaCB	PCB-179		0.3	5
2,2',3,4,4',5,5'-HeptaCB	PCB-180		0.7	5
2,2',3,4,4',5,6-HeptaCB	PCB-181		0.8	5
2,2',3,4,4',5,6'-HeptaCB/2,2',3,4,5,5',6-HeptaCB	PCB-182/187		1.1	5
2,2',3,4,4',5',6-HeptaCB	PCB-183		0.6	5
2,2',3,4,4',6,6'-HeptaCB	PCB-184		0.5	5
2,2',3,4,5,5',6-HeptaCB	PCB-185		0.6	5
2,2',3,4,5,6,6'-HeptaCB	PCB-186		0.8	5
2,2',3,4',5,6,6'-HeptaCB	PCB-188		0.5	5
2,3,3',4,4',5,6-HeptaCB	PCB-190		0.7	5
2,3,3',4,4',5',6-HeptaCB	PCB-191		0.5	5
2,3,3',4,5,5',6-HeptaCB	PCB-192		0.8	5
2,3,3',4',5,5',6-HeptaCB	PCB-193		0.5	5
2,2',3,3',4,4',5,5'-OctaCB	PCB-194		0.9	7.5
2,2',3,3',4,4',5,6-OctaCB	PCB-195		2.1	7.5
2,2',3,3',4,4',5,6'-OctaCB/2,2',3,4,4',5,5',6-OctaCB	PCB-196/203		2.3	7.5
2,2',3,3',4,4',6,6'-OctaCB	PCB-197		0.9	7.5
2,2',3,3',4,5,5',6-OctaCB	PCB-198		1.4	7.5
2,2',3,3',4,5,5',6'-OctaCB	PCB-199		1.5	7.5
2,2',3,3',4,5,6,6'-OctaCB	PCB-200		1.2	7.5
2,2',3,3',4,5',6,6'-OctaCB	PCB-201		1.1	7.5
2,2',3,3',5,5',6,6'-OctaCB	PCB-202		0.6	7.5

Table 2-6a. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Sediment Samples.

Analytes	**Congener number (PCBs only)**	**ACG[a]**	**MDL**	**MRL[b]**
2,2',3,4,4',5,6,6'-OctaCB	PCB-204		0.7	7.5
2,3,3',4,4',5,5',6-OctaCB	PCB-205		1.2	7.5
2,2',3,3',4,4',5,5',6-NonaCB	PCB-206		0.5	7.5
2,2',3,3',4,4',5,6,6'-NonaCB	PCB-207		0.5	7.5
2,2',3,3',4,5,5',6,6'-NonaCB	PCB-208		0.7	7.5
DecaCB	PCB-209		0.9	7.5

Notes: Sed table

* A risk-based ACG has not been established.

[a] Values are provided in bold font when the MRL is not expected to meet the ACG.

[b] 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 represents the level of lowest calibration standard (i.e., the practical quantitation limit).

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

Gravel	Fine sand	Fine silt
Very coarse sand	Very fine sand	Very fine silt
Coarse sand	Coarse silt	Clay, phi size >8
Medium sand	Medium silt	

[d] Total chlordane will be calculated as the sum of the five components listed above this entry.

ACG = Analytical concentration goal; ACGs were established by EPA during *ad hoc* meeting with LWG on May 10, 2002
MDL = Method detection limit
MRL = Method reporting limit
PCB - polychlorinated biphenyl

Notes: Congener table

[1] ACGs for the dioxin-like congeners are based on the ACG of 0.01 pg/g dry wt for PCB-126 from the Round 1 QAPP and adjusted using the WHO TEFs.

[2] The MRLs and MDLs are provided on a dry-weight basis and assume 50% moisture in the samples and a sample weight of 10 or 50 g, as noted.
The MRL represents the level of lowest calibration standard (i.e., the practical quantitation limit).
Sample-specific MDLs are reported with the final data and will vary based on sample size and characteristics.

ACG = Analytical concentration goal

MDL = Method detection limit
MRL = Method reporting limit
tbd = to be determined
TEF = Toxicity equivalent factor

WHO = World Health Organization

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

		Ecological Screening		**Human Health Screening Values**			**Analytical Concentration Goals**			**Laboratory MDLs and MRLs**	
Analytes	**Congener number (PCBs only)**	**AWQC [1]**	**ORNL [2]**	**EPA Region 9 Tap water PRG [3]**	**Fish Consumption Only [4]**	**Site-Specific Fish Consumption Only [5]**	**Level 1 ACG [6]**	**Level 2 ACG [7]**	**Level 3 ACG [8]**	**MDL**	**MRL**
Conventional Analyses, mg/L (ppm)											
Total suspended solids							1 [9]	1 [9]	1 [9]	1	1
Total organic carbon							NE	NE	NE	0.07	0.5
Metals/Inorganics, mg/L (ppm)											
Aluminum		0.087	0.46	36			0.087	0.087	0.087	0.0007	0.002
Antimony			0.61	0.015	0.64	0.064	0.015	0.015	0.015	0.00002	0.00005
Arsenic		0.15	0.914	0.000045	0.00014	0.000014	0.000045	0.000045	0.000014	TBD	0.00005
Cadmium [10]		0.000094	0.00015	0.018			0.000094	0.000094	0.000094	0.00001	0.00002
Chromium, total							NE	NA	NA	0.00006	0.0002
Copper [10]		0.00274	0.00023	1.5			0.00023	0.00023	0.00023	0.00004	0.0001
Lead [10]		0.000541	0.012				0.000541	0.000541	0.000541	0.00001	0.00002
Mercury		0.00077	<0.00023	0.011			<0.00023	<0.00023	<0.00023	0.0001	0.0002
Nickel [10]		0.016	<0.005	0.73	4.6	0.46	<0.005	<0.005	<0.005	0.00004	0.0002
Selenium		0.005	0.0883	0.18	4.2	0.42	0.005	0.005	0.005	0.0002	0.001
Silver			0.00012	0.18			0.00012	0.00012	0.00012	0.00001	0.00002
Zinc [10]		0.0365	0.03	11	26	2.6	0.03	0.03	0.03	0.0002	0.0005
Chlorinated Herbicides, µg/L (ppb)											
Dalapon				1100			1100	1100	1100	0.06	0.4
Dicamba				1100			1100	1100	1100	0.071	0.4
MCPA							NE	NE	NE	24	100
Dichlorprop							NE	NE	NE	0.061	0.4
2,4-D				360			360	360	360	0.079	0.4
2,4,5-TP (Silvex)				290			290	290	290	0.085	0.2
2,4,5-T				360			360	360	360	0.017	0.2
2,4-DB				290			290	290	290	0.13	0.4
Dinoseb				36			36	36	36	0.091	0.2
MCPP				360			360	360	360	23	100
Organochlorine Pesticides, µg/L (ppb)											
2,4'-DDD							0.28	0.28	0.28	TBD	0.0005
2,4'-DDE							0.2	0.2	0.2	TBD	0.0005
2,4'-DDT							0.2	0.2	0.2	TBD	0.0005
4,4'-DDD			0.011	0.28	0.00031	0.0000	0.280	0.00031	0.000031	TBD	0.0005
4,4'-DDE				0.2	0.00022	0.0000	0.2	0.00022	0.000022	TBD	0.0005
4,4'-DDT		0.001	0.013	0.2	0.00022	0.0000	0.001	0.00022	0.000022	TBD	0.0005
Total DDT				0.2			NE	NE	NE	NE	NE
Aldrin				0.004	0.00005	0.000005	0.004	0.00005	0.000005	TBD	0.0005
alpha-BHC			2.2	0.011	0.0049	0.00049	0.004	0.0049	0.00049	TBD	0.0005

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

Analytes	Congener number (PCBs only)	Ecological Screening		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs	
		AWQC [1]	ORNL [2]	EPA Region 9 Tap water PRG [3]	Fish Consumption Only [4]	Site-Specific Fish Consumption Only [5]	Level 1 ACG [6]	Level 2 ACG [7]	Level 3 ACG [8]	MDL	MRL
beta-BHC				0.037	0.017	0.0017	0.004	0.017	0.0017	TBD	0.0005
delta-BHC				0.037			0.004	0.004	0.004	TBD	0.0005
gamma-BHC (Lindane)		0.08		0.052	1.8	0.18	0.052	0.052	0.0063	TBD	0.0005
alpha-Chlordane							0.0043	0.00081	0.000081	TBD	0.0005
gamma-Chlordane							0.0043	0.00081	0.000081	TBD	0.0005
Oxychlordane				0.19			0.19	0.19	0.19	TBD	0.0005
cis -Nonachlor				0.19			0.19	0.19	0.19	TBD	0.0005
trans -Nonachlor				0.19			0.19	0.19	0.19	TBD	0.0005
Total Chlordane [a]		0.0043		0.19	0.00081	0.000081	NE	NE	NE	NE	NE
Dieldrin		0.0019	0.051	0.0042	0.000054	0.0000054	0.0042	0.000054	0.0000054	TBD	0.0005
Endosulfan I		0.056	0.051	220	89	8.9	0.051	0.051	8.9	TBD	0.0005
Endosulfan II		0.056		220	89	8.9	0.051	0.051	0.051	TBD	0.0005
Endosulfan sulfate					89	8.9	NE	89	8.9	TBD	0.0005
Endrin		0.0023	0.061	11	0.06	0.006	0.036	0.036	0.006	TBD	0.0005
Endrin aldehyde					0.3	0.03	NE	0.3	0.03	TBD	0.0005
Endrin ketone							NE	NE	NE	TBD	0.0005
Heptachlor		0.0038	0.0069	0.015	0.000079	0.0000079	0.0038	0.000079	0.0000079	TBD	0.0005
Heptachlor epoxide		0.0038		0.0074	0.000039	0.0000039	0.0038	0.000039	0.0000039	TBD	0.0005
Methoxychlor		0.03	0.019	180			0.019	0.019	0.019	TBD	0.0005
Mirex							NE	NE	NE	NE	NE
Toxaphene		0.0002		0.061	0.00028	0.000028	0.0002	0.0002	0.000028	TBD	0.025
Hexachlorobenzene							0.042	0.00029	0.000029	TBD	0.0005
Hexachlorobutadiene							0.86	0.86	0.86	TBD	0.001
Hexachloroethane											
Semivolatile Organic Compounds, µg/L (ppb)											
Polycyclic Aromatic Hydrocarbons											
Naphthalene			620	6.2			6.2	6.2	6.2	0.014	0.02
2-Methylnaphthalene							NE	NE	NE	0.012	0.02
Acenaphthylene							NE	NE	NE	0.0089	0.02
Acenaphthene		23	74	370	990	99	23	23	23	0.0097	0.02
Fluorene		3.9		240	5300	530	3.9	3.9	3.9	0.011	0.02
Phenanthrene		6.3	200				6.3	6.3	6.3	0.013	0.02
Anthracene		0.73	0.09	1800	40000	4000	0.09	0.09	0.09	0.01	0.02
Fluoranthene		6.2	15	1500	140	14	6.2	6.2	6.2	0.013	0.02
Pyrene				180	4000	400	180	180	180	0.012	0.02
Benz(a)anthracene		0.027	0.65	0.092	0.018	0.0018	0.027	0.018	0.0018	0.013	0.02
Chrysene				9.2	0.018	0.0018	9.2	0.018	0.0018	0.012	0.02

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

Analytes	Congener number (PCBs only)	Ecological Screening AWQC [1]	ORNL [2]	Human Health Screening Values EPA Region 9 Tap water PRG [3]	Fish Consumption Only [4]	Site-Specific Fish Consumption Only [5]	Analytical Concentration Goals Level 1 ACG [6]	Level 2 ACG [7]	Level 3 ACG [8]	Laboratory MDLs and MRLs MDL	MRL
Benzo(b)fluoranthene				0.092	0.018	0.0018	0.092	0.018	0.0018	0.0098	0.02
Benzo(k)fluoranthene				0.92	0.018	0.0018	0.92	0.018	0.0018	0.011	0.02
Benzo(a)pyrene		0.14	0.3	0.0092	0.018	0.0018	0.0092	0.0092	0.0018	0.0087	0.02
Indeno(1,2,3-cd)pyrene				0.092	0.018	0.0018	0.092	0.018	0.0018	0.0087	0.02
Dibenz(a,h)anthracene				0.0092	0.018	0.0018	0.0092	0.0092	0.0018	0.0079	0.02
Benzo(g,h,i)perylene							NE	NE	NE	0.009	0.02
Phthalate Esters, µg/L (ppb)											
Dimethylphthalate		3		360000	1100000	110000	3	3	3	0.015	0.5
Diethylphthlalate		3	85,600	29000	44000	4400	3	3	3	0.007	0.5
Di-n-butylphthalate		1.0		3600	4500	450	1	1	1	0.013	0.6
Butylbenzylphthalate		3		7300	1900	190	3	3	3	0.013	0.5
Di-n-octylphthalate		3		1500			3	3	3	0.005	0.1
Bis-(2-ethylhexyl) phthalate		0.12	912	4.8	2.2	0.22	0.12	0.12	0.12	0.049	0.5
PCB congeners, pg/L (ppq)											
2-MonoCB	PCB-1									2.4	5.0 - 10
3-MonoCB	PCB-2									1.1	5.0 - 10
4-MonoCB	PCB-3									2.0	5.0 - 10
2,2'-DiCB	PCB-4									1.7	5.0 - 10
2,3-DiCB	PCB-5									1.4	5.0 - 10
2,3'-DiCB	PCB-6									2.0	5.0 - 10
2,4-DiCB	PCB-7									4.0	5.0 - 10
2,4'-DiCB	PCB-8									2.7	5.0 - 10
2,5-DiCB	PCB-9									2.4	5.0 - 10
2,6-DiCB	PCB-10									4.0	5.0 - 10
3,3'-DiCB	PCB-11									9.5	5.0 - 10
3,4-DiCB/3,4'-DiCB	PCB-12/13									5.1	5.0 - 10
3,5-DiCB	PCB-14									3.1	5.0 - 10
4,4'-DiCB	PCB-15									2.2	5.0 - 10
2,2',3-TriCB	PCB-16									1.4	5.0 - 10
2,2',4-TriCB	PCB-17									2.0	5.0 - 10
2,2',5-TriCB/2,4,6-TriCB	PCB-18/30									3.4	5.0 - 10
2,2',6-TriCB	PCB-19									2.8	5.0 - 10
2,3,3'-TriCB/2,4,4'-TriCB	PCB-20/28									3.9	5.0 - 10
2,3,4-TriCB/2,3,5-TriCB	PCB-21/33									3.9	5.0 - 10
2,3,4'-TriCB	PCB-22									2.7	5.0 - 10
2,3,5-TriCB	PCB-23									3.9	5.0 - 10
2,3,6-TriCB	PCB-24									2.6	5.0 - 10
2,3',4-TriCB	PCB-25									3.3	5.0 - 10
2,3',5-TriCB/2,4,5-TriCB	PCB-26/29									4.7	5.0 - 10

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

Analytes	Congener number (PCBs only)	Ecological Screening		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs	
		AWQC [1]	ORNL [2]	EPA Region 9 Tap water PRG [3]	Fish Consumption Only [4]	Site-Specific Fish Consumption Only [5]	Level 1 ACG [6]	Level 2 ACG [7]	Level 3 ACG [8]	MDL	MRL
2,3',6-TriCB	PCB-27									2.5	5.0 - 10
2,4',5-TriCB	PCB-31									4.5	5.0 - 10
2,4',6-TriCB	PCB-32									2.2	5.0 - 10
2',3,5-TriCB	PCB-34									2.1	5.0 - 10
3,3',4-TriCB	PCB-35									4.3	5.0 - 10
3,3',5-TriCB	PCB-36									4.0	5.0 - 10
3,4,4'-TriCB	PCB-37									2.8	5.0 - 10
3,4,5-TriCB	PCB-38									2.5	5.0 - 10
3,4',5-TriCB	PCB-39									3.5	5.0 - 10
2,2',3,3'-TetraCB/2,2',3,4-TetraCB/2,3',4',6-TetraCB	PCB-40/41/71									5.3	5.0 - 10
2,2',3,4'-TetraCB	PCB-42									3.7	5.0 - 10
2,2',3,5-TetraCB	PCB-43									5.2	5.0 - 10
2,2',3,5'-TetraCB/2,2',4,4'-TetraCB/2,3,5,6-TetraCB	PCB-44/47/65									5.1	5.0 - 10
2,2',3,6-TetraCB/2,2',4,6'-TetraCB	PCB-45/51									3.5	5.0 - 10
2,2',3,6'-TetraCB	PCB-46									1.5	5.0 - 10
2,2',4,5-TetraCB	PCB-48									2.8	5.0 - 10
2,2',4,5'-TetraCB/2,3',4,6-TetraCB	PCB-49/69									6.4	5.0 - 10
2,2',4,6-TetraCB/2,2',5,6'-TetraCB	PCB-50/53									6.2	5.0 - 10
2,2',5,5'-TetraCB	PCB-52									3.7	5.0 - 10
2,2',6,6'-TetraCB	PCB-54									2.2	5.0 - 10
2,3,3',4'-TetraCB	PCB-55									6.0	5.0 - 10
2,3,3',4'-TetraCB	PCB-56									5.1	5.0 - 10
2,3,3',5-TetraCB	PCB-57									4.0	5.0 - 10
2,3,3',5'-TetraCB	PCB-58									6.9	5.0 - 10
2,3,3',6-TetraCB/2,3,4,6-TetraCB/2,4,4',6-TetraCB	PCB-59/62/75									7.0	5.0 - 10
2,3,4,4'-TetraCB	PCB-60									4.4	5.0 - 10
2,3,4,5-TetraCB/2,3',4',5-TetraCB/2,4,4',5-TetraCB/2',3,4',5-TetraCB	PCB-61/70/74/76									10.1	5.0 - 10
2,3,4',5-TetraCB	PCB-63									2.4	5.0 - 10
2,3,4', 6-TetraCB	PCB-64									3.3	5.0 - 10
2,3',4,4'-TetraCB	PCB-66									6.5	5.0 - 10
2,3',4,5-TetraCB	PCB-67									5.8	5.0 - 10

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

Analytes	Congener number (PCBs only)	Ecological Screening: AWQC [1]	Ecological Screening: ORNL [2]	Human Health Screening Values: EPA Region 9 Tap water PRG [3]	Human Health Screening Values: Fish Consumption Only [4]	Human Health Screening Values: Site-Specific Fish Consumption Only [5]	Analytical Concentration Goals: Level 1 ACG [6]	Analytical Concentration Goals: Level 2 ACG [7]	Analytical Concentration Goals: Level 3 ACG [8]	Laboratory MDLs and MRLs: MDL	Laboratory MDLs and MRLs: MRL
2,3',4,5'-TetraCB	PCB-68									4.6	5.0 - 10
2,3',5,5'-TetraCB	PCB-72									4.3	5.0 - 10
2,3',5',6-TetraCB	PCB-73									1.9	5.0 - 10
3,3',4,4'-TetraCB	PCB-77									2.8	5.0 - 10
3,3',4,5-TetraCB	PCB-78									3.2	5.0 - 10
3,3',4,5'-TetraCB	PCB-79									4.2	5.0 - 10
3,3',5,5'-TetraCB	PCB-80									3.7	5.0 - 10
3,4,4',5-TetraCB	PCB-81									3.0	5.0 - 10
2,2',3,3',4-PentaCB	PCB-82									2.2	5.0 - 10
2,2',3,3',5-PentaCB/2,2',4,4',5-PentaCB	PCB-83/99									4.0	5.0 - 10
2,2',3,3',6-PentaCB	PCB-84									1.9	5.0 - 10
2,2',3,4,6-PentaCB/2,2',3,4',6-PentaCB	PCB-88/91									3.8	5.0 - 10
2,2',3,4,6'-PentaCB	PCB-89									1.5	5.0 - 10
2,2',3,5,5'-PentaCB	PCB-92									2.3	5.0 - 10
2,2',3,5,6'-PentaCB	PCB-94									4.0	5.0 - 10
2,2',3,5',6-PentaCB/2,2',3,5,6 -PentaCB/2,2',4,4',6 -PentaCB/2,2',4,5,6'-PentaCB	PCB-95/100/93/102									9.7	5.0 - 10
2,2',3,6,6'-PentaCB	PCB-96									2.0	5.0 - 10
2,2',4,5,6'-PentaCB	PCB-103									3.9	5.0 - 10
2,2',4,6,6'-PentaCB	PCB-104									3.2	5.0 - 10
2,3,3'4,4'-PentaCB	PCB-105									0.9	5.0 - 10
2,3,3'4,5-PentaCB	PCB-106									4.1	5.0 - 10
2,3,3',4',5-PentaCB/2',3,4,5,5'-PentaCB	PCB-107/124									1.9	5.0 - 10
2,3,3',4,5'-PentaCB/2,3',4,4',6-PentaCB/2,2',3,4,5-PentaCB/2,2',3',4,5-PentaCB	PCB-108/119/86/97									8.4	5.0 - 10
2,3,3',4,6-PentaCB	PCB-109									2.9	5.0 - 10

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

		Ecological Screening		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs	
Analytes	**Congener number (PCBs only)**	**AWQC [1]**	**ORNL [2]**	**EPA Region 9 Tap water PRG [3]**	**Fish Consumption Only [4]**	**Site-Specific Fish Consumption Only [5]**	**Level 1 ACG [6]**	**Level 2 ACG [7]**	**Level 3 ACG [8]**	**MDL**	**MRL**
2,3,3',4',6-PentaCB/2,3,4,4',6-PentaCB	PCB-110/115									2.7	5.0 - 10
2,3,3',5,5'-PentaCB	PCB-111									2.0	5.0 - 10
2,3,3',5,6-PentaCB	PCB-112									1.7	5.0 - 10
2,3,3',5',6-PentaCB	PCB-113									5.1	5.0 - 10
2,3,4,4',5-PentaCB	PCB-114									1.6	5.0 - 10
2,3,3',5',6-PentaCB/2,3,4,5,6-PentaCB/2,2',3,4,4'-PentaCB	PCB-117/116/85									7.2	5.0 - 10
2,3',4,4',5-PentaCB	PCB-118									2.4	5.0 - 10
2,3',4,5,5'-PentaCB	PCB-120									2.5	5.0 - 10
2,3',4,5,6-PentaCB	PCB-121									2.1	5.0 - 10
2',3,3',4,5-PentaCB	PCB-122									4.7	5.0 - 10
2',3,4,4',5-PentaCB	PCB-123									3.2	5.0 - 10
3,3',4,4',5-PentaCB	PCB-126									1.5	5.0 - 10
3,3',4,5,5'-PentaCB	PCB-127									3.5	5.0 - 10
2,2',3,3',4,4'-HexaCB/2,3,4,4',5,6-HexaCB	PCB-128/166									3.2	5.0 - 10
2,2',3,3',4,5'-HexaCB	PCB-130									1.3	5.0 - 10
2,2',3,3',4,6-HexaCB	PCB-131									1.9	5.0 - 10
2,2',3,3',4,6'-HexaCB	PCB-132									2.5	5.0 - 10
2,2',3,3',5,5'-HexaCB	PCB-133									2.4	5.0 - 10
2,2',3,3',5,6-HexaCB/2,2',3,4,5,6'-HexaCB	PCB-134/143									3.3	5.0 - 10
2,2',3,3',6,6'-HexaCB	PCB-136									2.3	5.0 - 10
2,2',3,4,4',5-HexaCB	PCB-137									2.5	5.0 - 10
2,2',3,4,4',5'-HexaCB/2,3,3',4',5,6-HexaCB/2,2',3,3',4,5 -HexaCB/2,3,3',4,5,6-HexaCB	PCB-138/163/129/160									4.5	5.0 - 10
2,2',3,4,4',6-HexaCB/2,2',3,4,4',6'-HexaCB	PCB-139/140									3.9	5.0 - 10
2,2',3,4,5,5'-HexaCB	PCB-141									1.5	5.0 - 10

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

Analytes	Congener number (PCBs only)	Ecological Screening		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs	
		AWQC [1]	ORNL [2]	EPA Region 9 Tap water PRG [3]	Fish Consumption Only [4]	Site-Specific Fish Consumption Only [5]	Level 1 ACG [6]	Level 2 ACG [7]	Level 3 ACG [8]	MDL	MRL
2,2',3,4,5,5'-HexaCB	PCB-142									3.9	5.0 - 10
2,2',3,4,5',6-HexaCB	PCB-144									2.0	5.0 - 10
2,2',3,4,6,6'-HexaCB	PCB-145									2.0	5.0 - 10
2,2',3,4',5,5'-HexaCB	PCB-146									1.3	5.0 - 10
2,2',3,4',5,6-HexaCB/2,2',3,4',5',6 -HexaCB	PCB-147/149									2.3	5.0 - 10
2,2',3,4',5,6'-HexaCB	PCB-148									2.7	5.0 - 10
2,2',3,4',6,6'-HexaCB	PCB-150									2.5	5.0 - 10
2,2',3,5,5',6-HexaCB/2,2',3,3',5,6'-HexaCB/2,2',4,4',5',6-HexaCB	CB-151/135/154									6.8	5.0 - 10
2,2',3,5,6,6'-HexaCB	PCB-152									1.5	5.0 - 10
2,2',4,4',5,5'-HexaCB/2,3',4,4',5',6-HexaCB	PCB-153/168									3.8	5.0 - 10
2,2',4,4',6,6'-HexaCB	PCB-155									3.1	5.0 - 10
2,3,3',4,4',5-HexaCB/2,3,3',4,4',5'-HexaCB	PCB-156/157									1.2	5.0 - 10
2,3,3',4,4',6-HexaCB	PCB-158									1.3	5.0 - 10
2,3,3',4,5,5'-HexaCB	PCB-159									2.3	5.0 - 10
2,3,3',4,5',6-HexaCB	PCB-161									1.6	5.0 - 10
2,3,3',4',5,5'-HexaCB	PCB-162									2.8	5.0 - 10
2,3,3',4',5',6-HexaCB	PCB-164									1.7	5.0 - 10
2,3,3',5,5',6-HexaCB	PCB-165									3.1	5.0 - 10
2,3,4,4',5,5'-HexaCB	PCB-167									1.5	5.0 - 10
3,3',4,4',5,5'-HexaCB	PCB-169									1.2	5.0 - 10
2,2',3,3',4,4',5-HeptaCB	PCB-170									2.0	5.0 - 10
2,2',3,3',4,4',6-HeptaCB/2,2',3,3',4,5,6-HeptaCB	PCB-171/173									2.1	5.0 - 10
2,2',3,3',4,5,5'-HeptaCB	PCB-172									2.3	5.0 - 10
2,2',3,3',4,5,6'-HeptaCB	PCB-174									2.9	5.0 - 10
2,2',3,3',4,5',6-HeptaCB	PCB-175									1.7	5.0 - 10
2,2',3,3',4,6,6'-HeptaCB	PCB-176									2.7	5.0 - 10
2,2',3,3',4',5,6-HeptaCB	PCB-177									3.4	5.0 - 10
2,2',3,3',5,5',6-HeptaCB	PCB-178									0.8	5.0 - 10

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

		Ecological Screening		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs	
Analytes	**Congener number (PCBs only)**	**AWQC [1]**	**ORNL [2]**	**EPA Region 9 Tap water PRG [3]**	**Fish Consumption Only [4]**	**Site-Specific Fish Consumption Only [5]**	**Level 1 ACG [6]**	**Level 2 ACG [7]**	**Level 3 ACG [8]**	**MDL**	**MRL**
2,2',3,3',5,6,6'-HeptaCB	PCB-179									2.3	5.0 - 10
2,2',3,4,4',5,5'-HeptaCB/2,3,3',4',5,5',6-HeptaCB	PCB-180/193									6.2	5.0 - 10
2,2',3,4,4',5,6-HeptaCB	PCB-181									3.7	5.0 - 10
2,2',3,4,4',5,6'-HeptaCB	PCB-182									2.4	5.0 - 10
2,2',3,4,4',5',6-HeptaCB/2,2',3,4,5,5',6-HeptaCB	PCB-183/185									2.3	5.0 - 10
2,2',3,4,4',6,6'-HeptaCB	PCB-184									2.7	5.0 - 10
2,2',3,4,5,6,6'-HeptaCB	PCB-186									2.3	5.0 - 10
2,2',3,4,5,5',6-HeptaCB	PCB-187									1.9	5.0 - 10
2,2',3,4',5,6,6'-HeptaCB	PCB-188									2.6	5.0 - 10
2,3,3',4,4',5,5'-HeptaCB	PCB-189									2.0	5.0 - 10
2,3,3',4,4',5,6-HeptaCB	PCB-190									3.7	5.0 - 10
2,3,3',4,4',5',6-HeptaCB	PCB-191									2.8	5.0 - 10
2,3,3',4,5,5',6-HeptaCB	PCB-192									3.7	5.0 - 10
2,2',3,3',4,4',5,5'-OctaCB	PCB-194									0.8	5.0 - 10
2,2',3,3',4,4',5,6-OctaCB	PCB-195									2.8	5.0 - 10
2,2',3,3',4,4',5,6'-OctaCB	PCB-196									3.6	5.0 - 10
2,2',3,3',4,4',6,6'-OctaCB/2,2',3,3',4,5,6,6'-OctaCB	PCB-197/200									2.4	5.0 - 10
2,2',3,3',4,5,5',6-OctaCB/2,2',3,3',4,5,5',6'-OctaCB	PCB-198/199									5.1	5.0 - 10
2,2',3,3',4,5',6,6'-OctaCB	PCB-201									2.6	5.0 - 10
2,2',3,3',5,5',6,6'-OctaCB	PCB-202									2.1	5.0 - 10
2,2',3,4,4',5,5',6-OctaCB	PCB-203									2.5	5.0 - 10
2,2',3,4,4',5,6,6'-OctaCB	PCB-204									1.7	5.0 - 10
2,3,3',4,4',5,5',6-OctaCB	PCB-205									2.9	5.0 - 10
2,2',3,3',4,4',5,5',6-NonaCB	PCB-206									3.5	5.0 - 10
2,2',3,3',4,4',5,6,6'-NonaCB	PCB-207									2.2	5.0 - 10
2,2',3,3',4,5,5',6,6'-NonaCB	PCB-208									1.9	5.0 - 10
DecaCB	PCB-209									2.8	5.0 - 10

Notes:

[1] AWQC based on NRWQC freshwater aquatic life criteria (EPA 2002c).

[2] ORNL based on Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao

Table 2-6b. Analytes, Analytical Concentration Goals, Method Detection Limits, and Method Reporting Limits for Water Samples.

		Ecological Screening		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs	
Analytes	Congener number (PCBs only)	AWQC [1]	ORNL [2]	EPA Region 9 Tap water PRG [3]	Fish Consumption Only [4]	Site-Specific Fish Consumption Only [5]	Level 1 ACG [6]	Level 2 ACG [7]	Level 3 ACG [8]	MDL	MRL

[3] Based on EPA Region 9 Preliminary Remediation Goals (PRGs) (EPA 2002b).

[4] Based on NRWQC human health criteria (EPA 2002c) and The Revised Human Health Water Quality Criteria (EPA 2003).

[5] Based on Portland Harbor site-specific fish consumption rates in HHRA work plan of up to 175 g/day.

[6] Level 1 ACGs are the lowest of the EPA Region 9 PRGs for Tap Water (EPA 2002b), NRWQC freshwater aquatic life criteria (EPA 2002c), or ORNL values (Suter and Tsao 1996).

[7] Level 2 ACGs are the lowest of the EPA Region 9 PRGs for Tap Water (EPA 2002b), NRWQC freshwater aquatic life criteria and human health criteria (EPA 2002c), ORNL values (Suter and Tsao 1996), and the fish consumption criteria from the Revised Human Health Water Quality Criteria (EPA 2003).

[8] Level 3 ACGs are the lowest of the EPA Region 9 PRGs for Tap Water (EPA 2002b), NRWQC freshwater aquatic life criteria and human health criteria (EPA 2002c), ORNL values (Suter and Tsao 1996), the subsistence fish consumption criteria from the Revised Human Health Water Quality Criteria (EPA 2003), and site-specific subsistence fish consumption criteria.

[9] Required for natural attenuation evalutaion (Anchor Environmental 2004).

[10] Parameters for calculating freshwater dissolved metals criteria that are hardness-dependent are from NRWQC (EPA 2002c). Hardness dependent criteria based on average hardness of 25 mg/L ($CaCO_3$) (USGS database from 1974 to 1990).

Table 3-1. Sample Containers and Preservation Requirements for Sediment Trap and Stormwater Samples

Container [1] Type	Container [1] Size	Laboratory	Analysis	Preservation	Holding Time
Sediment Trap Samples					
WMG	8 oz.	Alta	PCB Congeners	Deep Frozen (-20°C)	1 year
WMG	16 oz. [2]	CAS	Total organic carbon	4 ± 2°C	28 days [3]
			Percent solids		6 months [3]
			Metals		6 months [3]
			Mercury		28 days [3]
WMG	16 oz.	CAS	Organochlorine pesticides	4 ± 2°C	1 year
			PAHs and Phthalates		1 year
WMG	8 oz.	CAS	Chlorinated herbicides	4 ± 2°C	1 year
WMG	8 oz.	CAS	Grain size	4 ± 2°C	6 months
Stormwater Samples					
HDPE	1 liter	CAS	Total suspended solids	4 ± 2°C	7 days
HDPE	250 mL	CAS	Total organic carbon	H_2SO_4 to pH < 2; 4 ± 2°C	28 days
HDPE	1 liter	CAS	Total metals	5 mL of 1:1 HNO_3; 4 ± 2°C	6 months/60 days [4]
AG	1 liter	CAS	Organochlorine pesticides	4 ± 2°C	7/40 days [5]
AG	1 liter	CAS	PAHs	4 ± 2°C	7/40 days [5]
AG	1 liter	CAS	Phthalates	4 ± 2°C	7/40 days [5]
AG	1 liter	Alta	PCB Congeners	4 ± 2°C	7/40 days [5]
AG	1 liter	CAS	Chlorinated herbicides	4 ± 2°C	7/40 days [5]

Notes:

AG - amber glass
CAS - Columbia Analytical Services
HDPE - high density polyethylene
WMG - wide mouth glass

[1] The size and number of containers may be modified by the analytical laboratories. Archive samples will be collected for all of the sediment samples.

[2] An additional 8 oz. to 16 oz. jar needed for lab QC for 5% of samples.

[3] Holding times for frozen samples are as follows: Total organic carbon, 1 year; metals (except mercury) and percent solids, 2 years.

[4] The holding time for mercury is 60 days, based on CRITFC study (EPA 2002a) and EPA Method 1631 revision D (EPA 2001a). The holding time for the remaining metals is 6 months.

[5] The holding time is 7 days from collection to extraction, and 40 days from extraction to analysis.

Table 3-2. Estimates of stormwater sample volumes needed to meet minimum mass requirements.

Priority	Analyte	Units	Minimum Sample Size	Additional Mass for Lab QC	Addl. MassField for field dup/rep	If sediment traps cannot be deployed			
						Estimated Particle load (min. - median)	Estimated Min. Sample Volume	Additional Vol. for Lab QC	Additional Vol. For field dup/rep
Sediment Samples									
1A	PCB Congeners	pg/g	10 g	20 g	10 g	(50mg/L - 80mg/L)	200L / 130L	400L / 250L	200L / 130L
1B	TOC	percent	1 g	2 g	1 g	(50mg/L - 80mg/L)	20L / 13L	40L / 25L	20L / 13L
1C	Percent Solids	percent	1 g	2 g	1 g	(50mg/L - 80mg/L)	20L / 13L	40L / 25L	20L / 13L
2	Organochlorine pesticides	µg/kg	10 g	20 g	10 g	(50mg/L - 80mg/L)	200L / 130L	400L / 250L	200L / 130L
3	PAHs and Phthalates	µg/kg	20 g	40 g	20 g	(50mg/L - 80mg/L)	400L / 260L	800L / 500L	400L / 260L
4	Metals	mg/kg	15 g	30 g	15 g	(50mg/L - 80mg/L)	300L / 188L	600L / 375L	300L / 188L
5	Herbicides	µg/kg	10 g	20 g	10 g	(50mg/L - 80mg/L)	200L / 130L	400L / 250L	200L / 130L
6	Grain size	percent	100 g	200 g	100 g	(50mg/L - 80mg/L)	2,000L / 1,300L	4,000L / 2,600L	2,000L / 1,300L
		Subtotal	167 g	334 g	167 g		3,340L / 2,164L	6,680L / 4,328L	3,340L / 2,164L

Estimates of sampling times per analyte group priorities using two sampling methods.

Priority	Analyte Groups	Min. Sample Size	Estimated Min. Sample Volume (50mg/L - 80mg/L)	Sampling Method	Pumping Rates	Estimated Sampling Time
1A-C	PCB Congeners, TOC Percent Solids	12 g	200L / 130L	Peristaltic	1.7L/min	2 h / 1h 20min
				PCF Centrifuge	4L/min	50min / 30 min
1 - 2	Group 1 + pesticides	22 g	440L / 275L	Peristaltic	1.7L/min	4h 20min / 2h 40min
				PCF Centrifuge	4L/min	1h 50min / 1h 10min
1 - 3	Group 1, 2 + PAHs and Phthalates	42 g	840L / 546L	Peristaltic	1.7L/min	8h 15min / 5h 20min
				PCF Centrifuge	4L/min	3h 30min / 2h 15min
1 - 4	Group 1, 2, 3 + Metals	57 g	1,140L / 734L	Peristaltic	1.7L/min	11h 10min / 7h 12 min
				PCF Centrifuge	4L/min	4h 45min / 3h
1 - 5	Group 1,2, 3, 4, + herbicides	67 g	1,340L / 864L	Peristaltic	1.7L/min	13h 10 min / 8h 30min
				PCF Centrifuge	4L/min	5h 40min / 3h 40min
1 - 6	All analytes	167 g	3,340L / 2,164L	Peristaltic	1.7L/min	32h 45min / 21h 10 min
				PCF Centrifuge	4L/min	14h / 9h

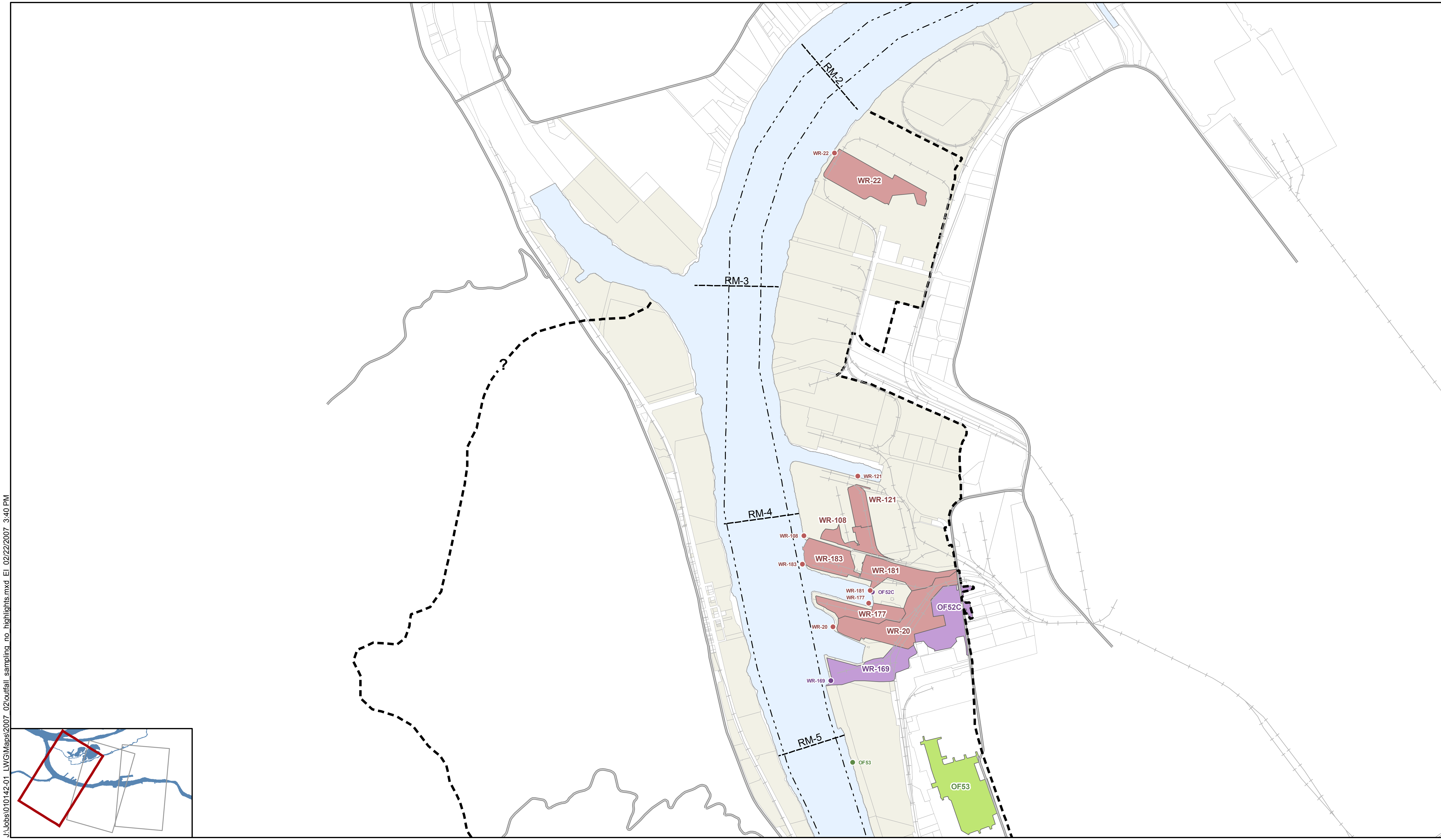
Note
PCF Centrifuge = Portable continuous flow centrifuge
Peristaltic = standard volume peristaltic pump
Pumping rates are low estimates. Sampling times may decrease as better suited sampling equipment is identified.

Table 4-1. River Height Statistics (in feet USGS Morrison Street Bridge Gauge*) for Comparison to Sampling Location Elevations.

Statistic	February	March	April	May
Monthly Average				
95th Percentile	14.0	10.9	11.1	13.6
90th Percentile	11.2	10.3	10.9	11.8
80th Percentile	10.1	9.7	8.7	10.2
70th Percentile	8.4	6.6	7.7	9.4
Average	7.6	6.7	6.9	8.3
Daily 90th Percentile Values				
95th Percentile	17.5	13.0	16.6	15.9
90th Percentile	16.5	12.7	16.0	15.7
80th Percentile	15.1	11.9	14.5	15.1
70th Percentile	14.3	11.6	11.9	14.4
Average	13.6	11.3	11.5	13.3

* Morrison Street Bridge Gauge Zero Value Equals:
2.93 ft City of Portland Data (add 2.93 ft to table values to obtain values in COP datum)
1.55 ft NGVD 1929 (add 1.55 ft to table values to obtain values in NGVD 1929 datum)
5.03 ft NAVD 1988 (add 5.03 ft to table values to obtain values in NAVD 1988 datum)

Figures



J:\Jobs\010142-01 LWG\Maps\2007 02\outfall sampling no highlights.mxd EI 02/22/2007 3:40 PM

ANCHOR ENVIRONMENTAL, L.L.C.

N

0 500 1,000 1,500 2,000 Feet

LWG LOWER WILLAMETTE GROUP

Map Features:

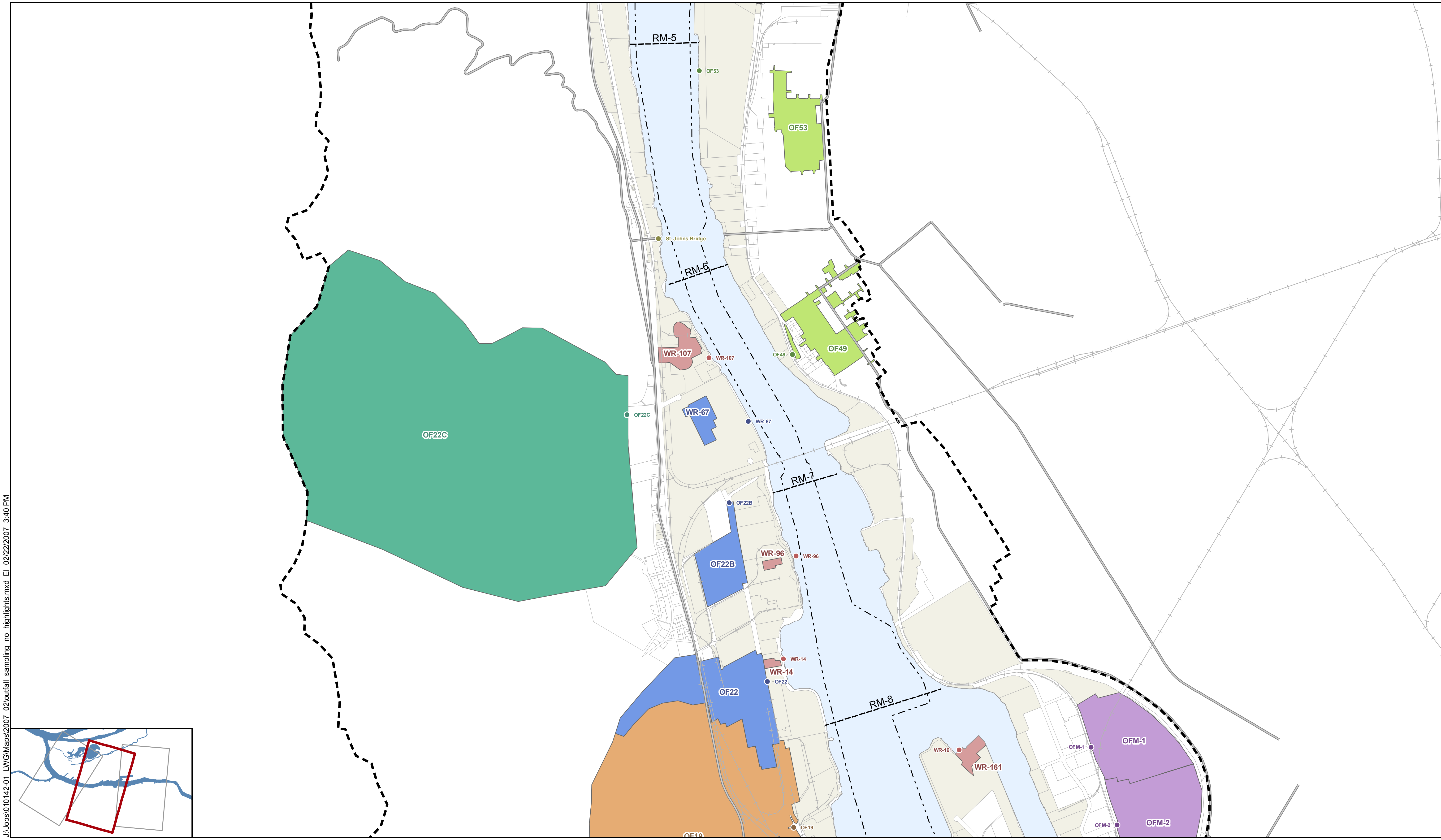
Stormwater Sampling Locations
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Open Space
- Residential

Outfall Drainage basins
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Approx. Drainage Boundary
- Navigation Channel
- Waterfront Taxlots
- Waterfront Ownership
- River miles

FEATURE SOURCES:
Land Use/Zoning, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

Figure 2-1a
Draft Round 3A Stormwater Field Sampling Plan
Lower Willamette Group
River Mile 02 to 05



J:\Jobs\010142-01 LWG\Maps\2007 02\outfall sampling no highlights.mxd EI 02/22/2007 3:40 PM

ANCHOR ENVIRONMENTAL, L.L.C.

LWG LOWER WILLAMETTE GROUP

0 500 1,000 1,500 2,000 Feet

Map Features:

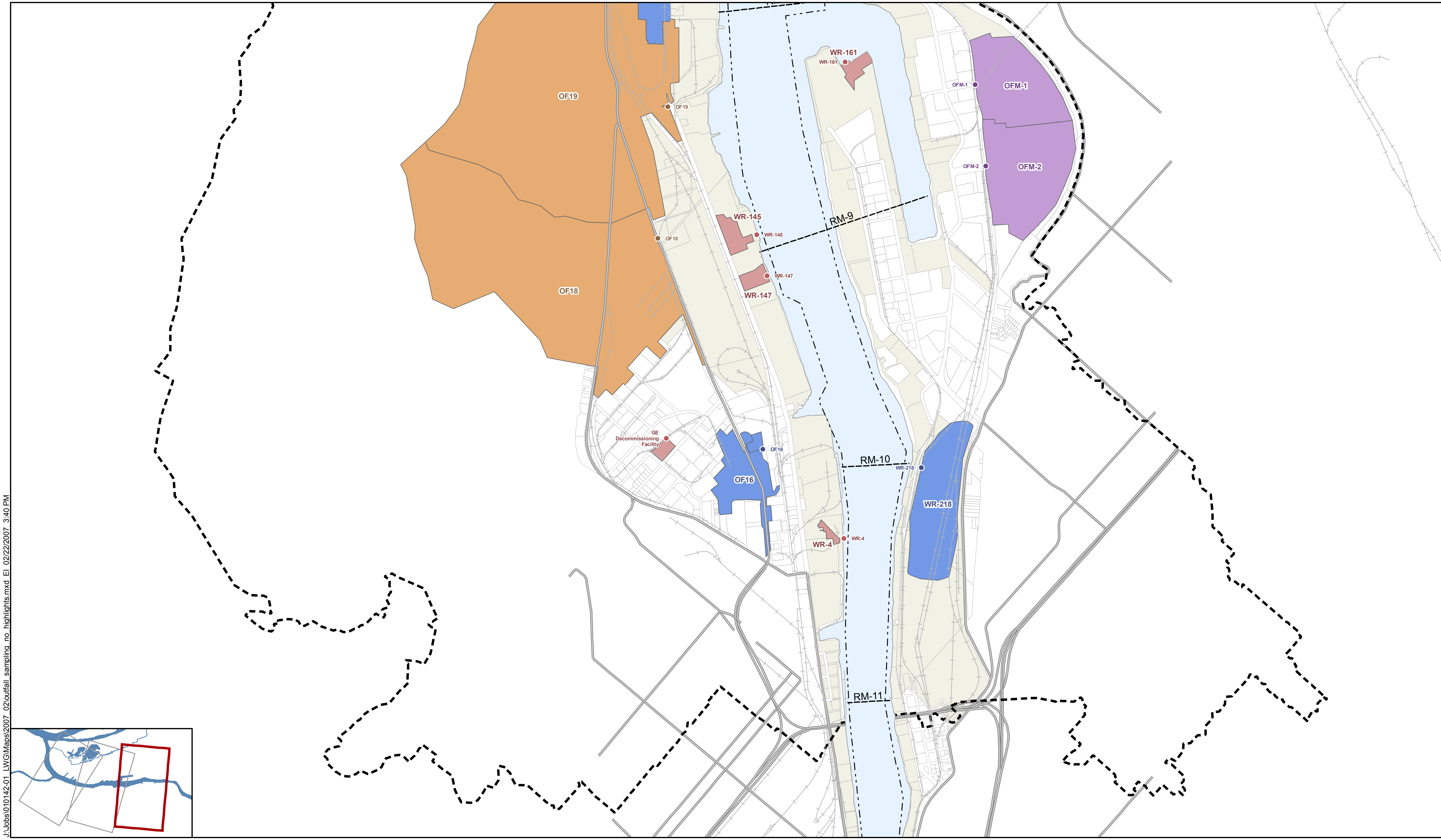
Stormwater Sampling Locations
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Open Space
- Residential

Outfall Drainage basins
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Approx. Drainage Boundary
- Navigation Channel
- Waterfront Taxlots
- Waterfront Ownership
- River miles

FEATURE SOURCES:
Land Use/Zoning, Streets, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

Figure 2-1b
Draft Round 3A Stormwater Field Sampling Plan
Lower Willamette Group
River Mile 05 to 08



J:\Jobs\010142-01 LWG\Maps\2007_02\outfall_sampling_no_highlights.mxd EI 02/22/2007 3:40 PM

ANCHOR ENVIRONMENTAL, L.L.C.

LWG LOWER WILLAMETTE GROUP

0 500 1,000 1,500 2,000 Feet

Map Features:

Stormwater Sampling Locations
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Open Space
- Residential

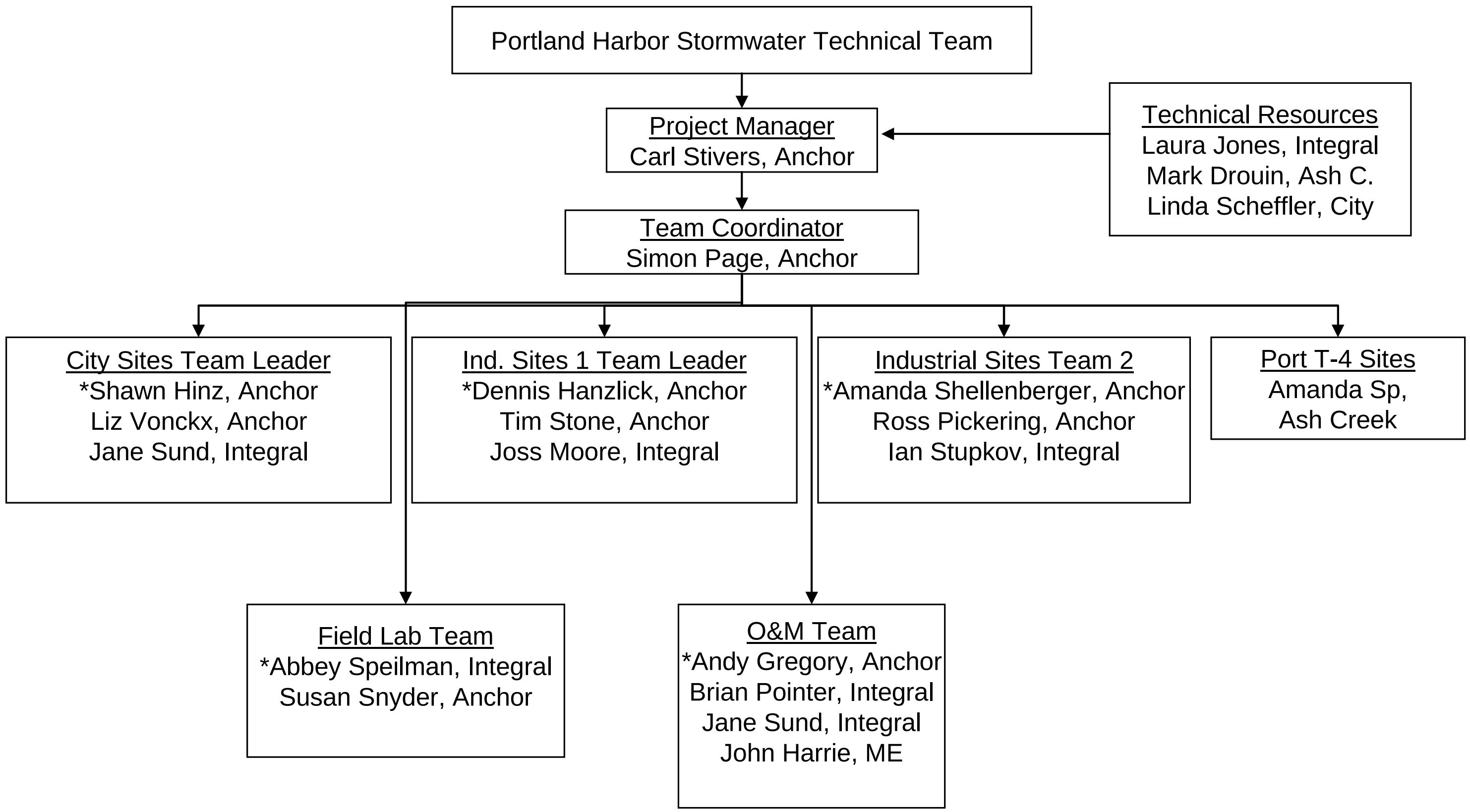
Outfall Drainage basins
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Approx. Drainage Boundary
- Navigation Channel
- Waterfront Taxlots
- Waterfront Ownership
- River miles

FEATURE SOURCES:
Land Use/Zoning, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

Figure 2-1c
Draft Round 3A Stormwater Field Sampling Plan
Lower Willamette Group
River Mile 08 to 11

Figure 2-2
Photo of Sediment Trap
Round 3A Stormwater Field Sampling Plan



* Denotes team leader

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4-1
Stormwater Sampling Team Organizational Chart
Round 3A Stormwater Field Sampling Plan

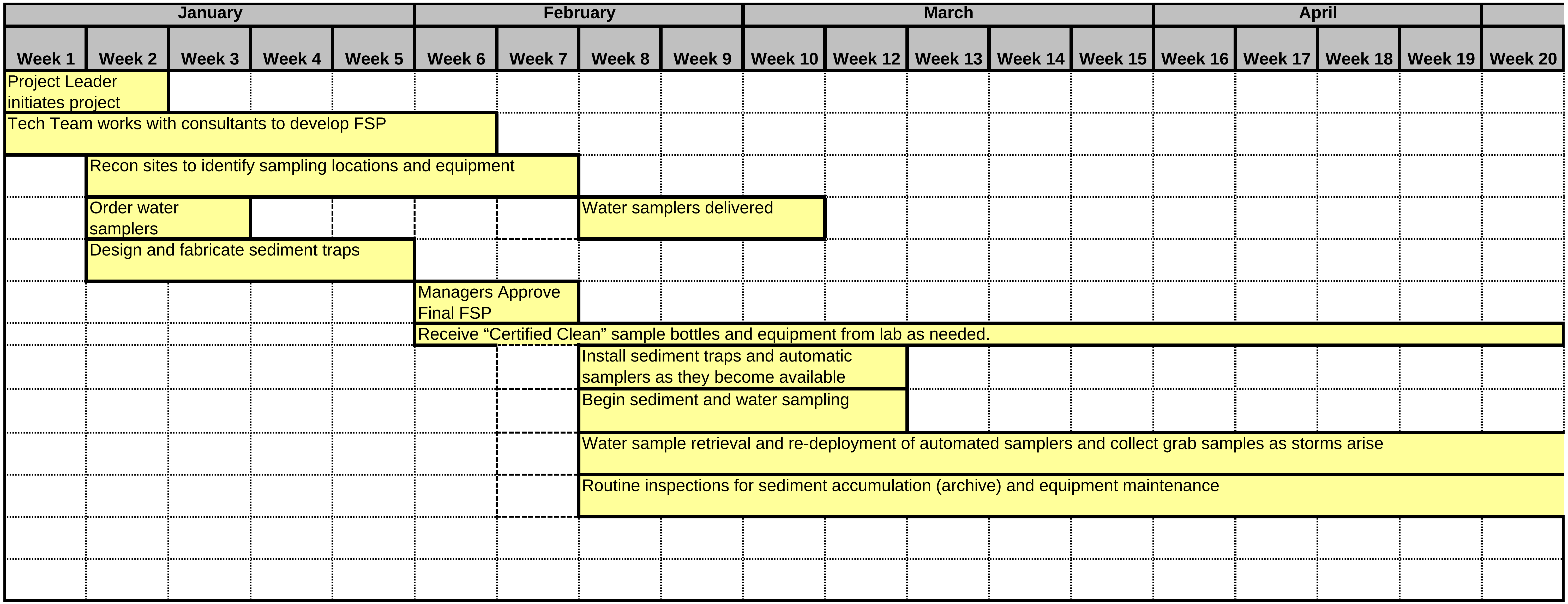


Figure 4-2
Stormwater Sampling Schedule
Round 3A Stormwater Field Sampling Plan

ANCHOR ENVIRONMENTAL, L.L.C.

APPENDIX A
STORMWATER COMPOSITE SAMPLING SOP

STORMWATER SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting flow weighted composite stormwater samples from freshwater environments using a Teledyne/Isco (Isco) automatic sampler.

This SOP utilizes and augments some of 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). While some of these exact procedures are not used, because they are not necessary for this FSP, the clean techniques described in this guidance were used to assist in developing a series of procedures that will minimize the possibility of sample contamination. The 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 programs that follow these guidelines.

Though the above procedures are intended for sampling of trace metals, these procedures will provide a means to minimize the possibility of sample contamination in general for stormwater sampling of organic compounds as well as conventionals [such as total suspended solids (TSS), dissolved organic carbon (DOC), and total dissolved solids (TDS)].

SUMMARY OF METHOD

Flow-weighted composite samples of three storm events from each location will be collected to obtain Event Mean Concentrations (EMCs) of chemicals and conventionals. Flow-weighted, whole water (unfiltered) sample aliquots will be collected over the course of the storm event with automatic samplers. These whole water samples will be collected by the sampling teams, identified in Section 4 of the FSP, and transported to the LWG Field Laboratory. Samples will be collected from the sampler using two-person clean sampling techniques, similar in concept to the "clean hands – dirty hands" method (EPA 1996).

At the LWG Field Laboratory, sampler performance will be evaluated, and water from the individual samplers will be composited in a single container. Following sample compositing, sample bottles for individual chemicals will be filled using a peristaltic pump. Each sample will be analyzed for the chemicals shown in Tables 2-2 and 2-3 of the FSP.

Once the sample is collected and preserved (if applicable), the sample container will be capped, labeled, and placed on ice or refrigerated until shipped to the laboratory. Each field storage refrigeration unit will be monitored bi-weekly to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information. Samples will be handled following the procedures described in the Chain of Custody SOP (Appendix F).

In general, any procedures not specifically detailed in this Appendix will be in conformance with the FSP, the QAPP Addendum (Integral 2007), and the Round 2 QAPP (Integral and Windward 2004).

SUPPLIES AND EQUIPMENT

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

An Isco Model 6712 automated sampler unit will be deployed at each sampling location. The sampler will be equipped with glass collection vessels, a Teflon® screen, and a Teflon® sampling tube. Each sampler will be equipped with a cellular modem and area/velocity (AV) type flow meter. Power will be supplied to each sampler using a minimum 50-amp hour GSM deep cycle battery. In addition, stainless steel mounting brackets will be used to mount the flow sensor and sampling tube, and hang the battery and sampler in the catch basin.

Table A-1. Stormwater Sampling Equipment Required per Sampling Site

Equipment Item	**Number Required**
Isco 6712 Sampler	1
Sampler base to hold eight 1.8-liter collection vessels	1
Isco 1.8 liter collection vessels and Teflon® lined caps	24
Teflon®-coated stainless steel pick up screen	1
Teflon® intake tube	1
750 Flow module	1
Cell phone modem package	1
Remote power supply cable	1
12-volt 50-amp hour GSM deep cycle battery	1
Mounting hardware (varies by site) to secure flow probe and pick up screen.	1
Mounting hardware to Isco sampler and battery (varies by site)	1
Box nitrile gloves	1

Cooler with foam dividers	1

Additional equipment for the processing and filtering (as appropriate) of samples in the Field Laboratory are noted in the collection procedures sections below.

PROCEDURES

EQUIPMENT DECONTAMINATION

Each sampling team will be responsible for preparing their equipment prior to the sampling event. Sampling bottles and equipment will be decontaminated either by commercial laboratories noted in the FSP or decontaminated at the Field Laboratory by the field teams, as necessary. Commercial laboratories will follow their internal procedures for equipment decontamination, resulting in "certified clean" equipment to be used in the field. Equipment decontamination procedures are described below.

Teledyne Isco Glass Collection Vessels

- Wash with soapy water and rinse with tap water
- Rinse with reagent-grade acetone
- Rinse with 20% hydrochloric acid (HCl)
- Rinse three times with deionized (DI) water
- Replace in covered Teledyne Isco tubs.

Teflon® Suction Line

- Rinse twice with reagent-grade acetone
- Rinse thoroughly with hot tap water using a brush to remove particulate matter and surface film
- Rinse thoroughly three times with tap water
- Rinse with 20% hydrochloric acid (HCl)
- Rinse thoroughly three times with tap water
- Rinse thoroughly three times with DI water
- Rinse thoroughly with petroleum ether and dry by pulling air through the line

- If possible, dry overnight in a warm oven (use an oven temperature of lower than 150° F)
- Cap ends with aluminum foil.

Teledyne Isco Pump Tube

- Pump hot tap water through the tube for at least 2 minutes
- Rinse tube with 20% hydrochloric acid (HCl) for at least 2 minutes
- Rinse by pumping hot tap water through the tube for at least 2 minutes
- Rinse by pumping DI water through the tube for at least 2 minutes.

Teledyne Isco Sampler

The sampler top cover, center section, retaining ring, and tub of the automatic sampler will be cleaned with warm soapy water and rinsed with tap water. The two pump drain holes will be checked to see that they are open and free of debris or buildup.

During implementation of the FSP, it is not anticipated that screens and intakes tubes will be removed for cleaning between sampling events. The sampler will be programmed to purge the intake tubes several times before and after each stormwater sample is collected, which should ensure that any contamination from previous events is removed or sufficiently diluted to be unimportant. If upon routine inspection, it is observed that algae is growing in the intake tube, debris is blocking the tube, or any other gross contamination issues may exist, contaminated screens and intake tubes will be replaced with screens and intake tubes decontaminated using the methods described above. The silicon pump tubing will be decontaminated (using procedures noted above) or replaced with new decontaminated tubing after each sampling event.

Sampler Mounts and Other Equipment

Mounting equipment such as slip rings, nuts, bolts, and brackets will be washed with warm soapy water using a brush to remove any oil, grease or other residue from the manufacturing process. They will then be rinsed with reagent-grade acetone followed by DI water and allowed to dry. If available, a warm oven could be used to speed drying.

Installation of the brackets at the sampling sites may create debris that could become a contaminant source (i.e., drilling holes, using powder-actuated tools to set studs and/or welds). After the brackets have been installed, the work site will be scrubbed with a brush to remove any debris and rinsed with DI water before the sampling hardware (intake screen) is mounted.

Coolers used to transport samples will be washed with warm soapy water using a brush to remove any residue and rinsed with tap water.

Sample Containers

Sample containers will be certified pre-cleaned containers obtained through the laboratory. Containers will be pre-cleaned according to laboratory SOPs and consistent with the Round 2 QAPP (Integral and Windward 2004) and QAPP Addendum (Integral 2007). Certification information will be kept at the laboratory and will be available for review at any time. The containers will be certified to the detection limits of this project per the FSP.

Phthalate-Free Procedures

For locations where phthalates will be sampled the procedures followed will be identical to those noted above with the following exceptions. During all decontamination procedures equipment will be handled with powder and phthalate-free vinyl gloves and will not be placed on any plastic or rubber surfaces (decontaminated stainless steel surfaces are preferred). Once decontaminated, Isco samplers will be placed in phthalate free containers before placing in coolers for transport.

Isco sampler tube and pumping connection systems will be checked for any plastic components that might come into contact with sample water and will be removed from the collection system to the extent practicable and/or replaced with either non-contact systems or alternative materials. Any potential sources of plastic or rubber contact that cannot be removed will be noted in the sampling report.

During field sampling procedures, bottles and any equipment potentially coming into contact with sample water will be handled with powder and phthalate-free vinyl gloves. Sample bottles will not be placed on any plastic or rubber surfaces during sample processing (decontaminated stainless steel surfaces are preferred). Once the sample bottles are filled after sample processing, they will be capped with Teflon® lids and placed in phthalate free containers before placing in coolers for transport.

STORMWATER SAMPLE COLLECTION

Clean Handling Techniques

The clean handling techniques are modeled after the “clean hands – dirty hands” method (EPA 1996) for collecting samples. It has been found that when working in the rain or other inclement weather and in confined spaces, it is not always possible to fully implement the EPA procedures. The clean/dirty hands technique requires two or more people working together. At the field site, one person is designated as "clean hands” (CH) and a second person as "dirty hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless gloves (including phthalate-free vinyl gloves for any locations where phthalates will be sampled) during the entire sampling operation and change gloves frequently, usually with each change in task.

CH takes care of all operations that involve equipment that comes into contact with the sample, and is responsible for the following:

- Handles the stormwater collection vessels (removes and replaces from Isco sampler)
- Handles collection vessels until they are placed and sealed into coolers
- Prepares a clean workspace in LWG Field Laboratory
- Sets the equipment (i.e., the sample bottles, filtration and preservation equipment) inside the laboratory

DH takes care of all operations that involve contact with potential sources of contamination, and is responsible for the following:

- Works exclusively exterior to the samplers
- Removes samplers from catch basins, if necessary, and releases catches and lifts off sampler cover for CH
- Replaces cover and latches sampler covers
- Handles the tools, such as hammers, wrenches, keys, and locks
- Handles the single or multi-parameter instruments for field measurements
- Sets up and calibrates the field measurement instruments
- Measures and records the water depths and field measurements
- Seals coolers.

Stormwater Sampling Procedures

Two people are needed to conduct the sampling, and a third person is responsible for sample logging and processing, and assisting with lifting the sampler in and out of the catch basin. In addition, the third person may be responsible for recording stormwater parameters.

When collecting the water samples from the Isco samplers, DH and assistant will remove the manhole or catch basin lid and CH will clear a work space and lay down a plastic sheet. DH will place the sampler on the plastic sheeting, release the catches on the sampler, and lift away the cover, thus standing it on the plastic sheeting. CH will inspect the inside of the sampler for signs of wear or debris. CH will then install Teflon®-lined caps on each of the collection vessels. CH will remove each collection vessel in turn, label it with a waterproof label, and place it a cooler with foam dividers. Phthalate samples will be placed in phthalate free containers prior to placement in coolers.

After the collection vessels have been removed from the Isco sampler, CH installs new "Certified Clean" collection vessels in the sampler. DH replaces the cover and catches. DH and assistant will place the Isco sampler in the catch basin and close and lock the lid, if applicable.

SAMPLE PROCESSING

Samples from the Isco sampler collection vessels are stored in sealed coolers with wet ice and transferred to the LWG Field Laboratory at the conclusion of the sampling event. The field leader is responsible for maintaining sample integrity throughout the event. Once at the field lab, sample contamination is avoided by handling the collection vessels with clean non-contaminating gloves (including use of phthalate-free vinyl gloves for samples from any location requiring phthalate analyses), and transferring the collection vessels into clean refrigerators immediately after they are brought back from the field.

Storage Temperature Quality Control

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

Sample Compositing and Processing

As part of the field sampling procedures, the sampling team will download the sampling report and flow data from the data logger, and review the data upon arrival at the LWG Field Laboratory. If the sampling report and flow data indicate that there was no malfunction and all the sample bottles are intact, the sample compositing and preparation will continue as follows.

The contents of the Isco sampler collection vessels will be emptied into a large mixing container, decontaminated in the same manner as described previously for the Isco glass collection vessels and composited (i.e., using a churn splitter or other suitable apparatus). Samples for phthalate analyses will be mixed manually with a decontaminated stainless-steel rod held by a person wearing phthalate-free vinyl gloves. Following sample compositing in the mixing containers, composited water will be transferred to analytical sample bottles, with preservative if applicable, using a peristaltic pump (the pump tube will be decontaminated in the same manner as described previously for the Isco pump tube). The analytical sample bottles will be capped, labeled, and placed inside a cooler with foam dividers for transport to the analytical laboratory. Samples for phthalate analysis will be placed in phthalate free containers prior to placement in the cooler.

Whole water samples for organic compounds, and unfiltered/filtered water pairs for metals and TOC/DOC will be prepared by the sampling teams from the composite sample. Each sample will be analyzed for the chemicals shown in Tables 2-2 and 2-3 of the FSP. Filtered metals and DOC samples will be prepared by pumping composite water by means of a peristaltic pump (using the same clean tube as described above) through a 0.45-micron filter, dispensing directly into analytical sample bottles dedicated for filtered metals and DOC sample bottles. New decontaminated equipment for sample compositing and processing (i.e., mixing containers, pump tubing, and filters) will be used for samples collected from each location to prevent cross contamination between samples.

FIELD QUALITY CONTROL PROCEDURES

Field QC samples will be collected at the frequencies presented in the Section 3.8 of the FSP. The sampling program is designed to collect additional volume for field and laboratory QC samples at the following frequencies:

- Field duplicates - 1 per 20 samples
- Laboratory QC samples - 1 per 20 samples
- Field blank for all analyte groups – 1 per 20 samples
- Equipment rinsate blank for all analyte groups - prior to deployment of automated samplers.

The types of field QC sample collection are described below (USGS 2000).

Rinsate Blank. Prior to the start of sample collection activities for each sampling event, a rinsate blank will be generated by the laboratory that conducts decontamination of the sampling equipment to ensure that the decontamination procedure is adequate. To the extent that field decontamination procedures are necessary, some of the rinsate blanks collected will be of these field procedures so that the overall frequency noted above is attained. Per the FSP, the rinsate blank will be held open in the sampler so it is exposed to the same conditions as the sample bottles.

Field Duplicate. A field duplicate sample consists of aliquots of the same composited sample that are equally distributed in two sets of sample containers. These samples will be analyzed identically to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

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.

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.

Integral Consulting. 2007. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan, Addendum 8: Round 3A Stormwater Sampling. Prepared for the Lower Willamette Group. Portland, Oregon.

Integral and Windward Environmental. 2004. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

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.

APPENDIX B
STORMWATER GRAB SAMPLING SOP

STORMWATER SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting stormwater grab samples from freshwater environments using a Teledyne/Isco (Isco) automatic sampler in conjunction with a peristaltic pump and Teflon® tubing.

This SOP utilizes and augments some of 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). While some of these exact procedures are not used, because they are not necessary for this FSP, the clean techniques described in this guidance were used to assist in developing a series of procedures that will minimize the possibility of sample contamination. The 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 programs that follow these guidelines.

Though the above procedures are intended for sampling of trace metals, these procedures will provide a means to minimize the possibility of sample contamination in general for stormwater sampling of organic compounds as well as conventionals [such as total suspended solids (TSS), dissolved organic carbon (DOC), and total dissolved solids (TDS)].

SUMMARY OF METHOD

Stormwater grab samples for standard chemical and conventional analyses will be collected using a peristaltic pump that is part of the Isco automatic sampler. The Isco sampler will be removed from the sampling location by the sampling team. The sampler case will be opened and the delivery tube will be removed from the bulkhead fitting. A clean Teflon®-lined tube (using the procedures described in Appendix A for the Isco intake tube) will be connected to the bulkhead fitting to collect the desired samples. The sampler will be put into "Grab" mode and the specified volume will be programmed into the sampler. Once activated, the sampler will purge and the grab sample will be collected into four 1-gallon jars.

The sampling team will seal the 1-gallon sample jars with Teflon® lined caps, label, and package them as described in Appendix A for transportation to the LWG Field Laboratory. The sampling team will remove the grab sampling tube from the bulkhead fitting and reconnect the distribution tube and close up the sampler. The sampling team will re-deploy the sampler as described previously.

At the LWG Field Laboratory, the sampling team will combine the samples into a single composite for each event and samples will be filtered and prepared for laboratory analyses. The compositing, filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. The samples shall be handled following the procedures described in the Chain of Custody SOP (Appendix F).

In general, any procedures not specifically detailed in this Appendix will be in conformance with the FSP, the QAPP Addendum (Integral 2007), and the Round 2 QAPP (Integral and Windward 2004).

SUPPLIES AND EQUIPMENT

The general types of equipment that are required are described in this section. The grab samples will be collected with the peristaltic pumps built into the Isco sampler deployed at sampling site. Only sampling containers and a short length of Teflon® tubing will be required to collect the samples. Additionally, a cooler will be required to transport the samples to the LWG Field Laboratory. Additional equipment for the processing and filtering of samples is noted in the procedures and collection sections below.

PROCEDURES

EQUIPMENT DECONTAMINATION

Each sampling team will be responsible for preparing their equipment prior to the sampling event. The procedures described in Appendix A will be used to decontaminate sample tubing, mixing containers, and sampling jars; including special procedures for locations where phthalate sampling is required.

STORMWATER SAMPLE COLLECTION

Clean Handling Techniques

The clean handling techniques are modeled after the “clean hands – dirty hands” method (EPA 1996) for collecting samples. It has been found that when working in the rain or other inclement weather and in confined spaces, it is not always possible to fully implement the EPA procedures. The clean/dirty technique requires two or more people working together. At the field site, one person is designated as "clean-hands" (CH) and a second person as "dirty-hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless gloves (phthalate-free vinyl gloves for locations where phthalate sampling is required) during the entire sampling operation and change gloves frequently, usually with each change in task.

CH takes care of all operations that involve equipment that comes into contact with the sample, and is responsible for the following:

- Handles the stormwater collection vessels (removes and replaces from Isco sampler)
- Handles collection vessels until they are placed and sealed into coolers
- Prepares a clean workspace in LWG Field Laboratory
- Sets the equipment (i.e., the sample bottles, filtration and preservation equipment) inside the laboratory

DH takes care of all operations that involve contact with potential sources of contamination, and is responsible for the following:

- Works exclusively exterior to the samplers
- Removes samplers from catch basins, if necessary, and releases catches and lifts off sampler cover for CH
- Replaces cover and latches sampler covers
- Handles the tools, such as hammers, wrenches, keys, and locks
- Handles the single or multi-parameter instruments for field measurements
- Sets up and calibrates the field measurement instruments
- Measures and records the water depths and field measurements
- Seals coolers.

Stormwater Sampling Procedures

Two people are needed to conduct the sampling, and a third person is responsible for sample logging and processing, and assisting with lifting the sampler in and out of the catch basin. In addition, the third person may be responsible for recording stormwater parameters.

The following procedures will be followed when collecting the water samples from the Isco samplers.

While the DH and assistant remove the manhole or catch basin lid, CH will clear a work space and lay down a plastic sheet. DH will place the sampler on the plastic sheeting, release the catches on the sampler, and lift away the cover, thus standing it on the plastic sheeting. CH will inspect the inside of the sampler for signs of wear or debris. CH will then remove the distribution line form the bulkhead fitting and install a Teflon® line.

DH or assistant will re-glove to operate the Isco sampler. The program running on the Isco sampler will be interrupted and the sampler placed into "Grab" mode. DH will program the volume of water desired (1 gallon) and start the sampler. The sampler will purge the lines several times and pause before delivering the sample. The process will be repeated to collect the additional 3 gallons required for analysis.

CH will direct the flow of water into the sample containers. When complete, CH will then cap and label the sample bottle and place it a cooler with foam dividers. Once the samples have been properly secured, CH will remove the sampling tube and re-attach the distribution tube to the bulkhead fitting and return the sampler to standby mode.

DH will replace the cover and latch the fasteners. DH and assistant will replace the sampler in the catch basin and close and lock the lid, if applicable.

SAMPLE PROCESSING

All samples are stored in sealed coolers with wet ice and transferred to the LWG Field Laboratory at the conclusion of the sampling event. The field leader is responsible for maintaining sample integrity throughout the event. Once at the field lab, sample contamination is avoided by handling the sample containers with clean gloves (and phthalate-free vinyl gloves in the case of phthalate samples), and transferring the samples into clean refrigerators immediately after samples are brought back from the field.

Storage Temperature Quality Control

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

Sample Compositing, Filtering, and Transfer to Sample Bottles for Laboratory Analysis

At the LWG Field Laboratory, the sampling team will combine the samples into a single composite for each event following the transfer and mixing procedures described in Appendix A. The compositing, filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample collection.

Filtering will be conduced using disposable 0.2-micron glass fiber filters. Clean Teflon® peristaltic tubing will be used to pump samples from the composite container through the filter, then through a similar outlet tube and directly into sample bottles. The glass fiber filters and tubing will be replaced with clean equipment between sampling locations to prevent any cross contamination between locations. It is anticipated that Teflon® tubing will be decontaminated following procedures in Appendix A and then re-used for later locations or sampling events. Glass fiber filters will be discarded once they have been used.

FIELD QUALITY CONTROL PROCEDURES

Field QC samples will be collected during sampling following the frequency in the Section 3.8 of the FSP. The types field QC sample collection are the same as those for composite water sampling as described in Appendix A.

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.

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.

Integral Consulting. 2007. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan, Addendum 8: Round 3A Stormwater Sampling. Prepared for the Lower Willamette Group. Portland, Oregon.

Integral and Windward Environmental. 2004. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

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.

APPENDIX C
SEDIMENT TRAP SAMPLING SOP

SEDIMENT SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting sediment samples from a catch basin using a sediment trap. A goal of this SOP is to ensure that the highest quality, most representative data be collected consistent with EPA guidelines.

SUMMARY OF METHOD

Sediment traps will be deployed at each location for a minimum target period of 3 months. Sediment traps will be inspected at a minimum on a monthly basis. When inspected, if the collection bottle is half full, sediments will be collected and archived and a clean bottle will be returned to the trap. This process will be repeated, and sampled sediments archived at the LWG Field Laboratory for additional later compositing until the trap deployment period ends.

Sediment samples will be capped with Teflon®-lined lids, labeled, sealed, and packaged appropriately for transport to the LWG Field Laboratory. At the field laboratory, the samples will be stored in the refrigerator.

Once the deployment period has ended, all sampled sediments (including archived aliquots) will be combined in one decontaminated stainless-steel bowl using decontaminated stainless-steel implements and thoroughly homogenized and subsampled in sample containers for chemical analysis.

In general, any procedures not specifically detailed in this Appendix will be in conformance with the FSP, the QAPP Addendum (Integral 2007), and the Round 2 QAPP (Integral and Windward 2004).

SUPPLIES AND EQUIPMENT

The equipment required for the sediment sampling includes:

- Sediment sampler constructed of stainless-steel and mounting hardware.
- 1-liter HDPE sample bottle with Teflon®-lined lid.
- Cooler with foam dividers for transporting samples.

Additional equipment may be required depending on the sampling location. Additional equipment for sample processing and homogenization are noted below in the procedures and collection sections.

PROCEDURES

EQUIPMENT DECONTAMINATION

Sediment Sampling Equipment Preparation

The sediment trap and mounting hardware will be constructed of stainless steel. Prior to installation, it will be cleaned using a scrub brush and lab-grade detergent, then rinsed in tap water, and allowed to dry. The sample bottles will be provided from the laboratory "Certified Clean".

The HDPE sediment trap bottles will be obtained certified clean from the laboratory and certified phthalate free.

When installing the brackets in the field at the sampling sites, it may be necessary to drill holes or use powder actuated tools to set studs, weld, or use other means to attach the sampling hardware that may create some debris that could become a contaminant source. After the studs are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with deionized water before the sampling hardware (sample bottle holder) is mounted.

Sediment Extraction and Compositing Equipment

The following equipment will be used to extract sediment from trap bottles and homogenize them for subsampling into sample containers: glass flask, stainless-steel implements (e.g., spoons), glass funnel, and stainless-steel mixing bowls. This equipment will be decontaminated as follows:

- Wash with soapy water and rinse with tap water
- Rinse with reagent-grade acetone
- Rinse with 20% hydrochloric acid (HCl)
- Rinse three times with DI water.

SEDMENT SAMPLE COLLECTION

Clean Handling Technique

The clean handling techniques are modeled after the "clean hands – dirty hands" method (EPA 1996) for collecting samples. It has been found that when working in the rain or other inclement weather and in confined spaces, it is not always possible to fully implement the EPA procedures. The clean handling technique requires two or more people working together. At the field site, one person is designated as "clean-hands"

(CH) and a second person as "dirty-hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless, and phthalate-free vinyl gloves during the entire sampling operation and change gloves frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes). CH takes care of all operations that involve equipment that comes into contact with the sample, including the following responsibilities:

- Handles the sediment sample bottle
- Prepares a clean workspace

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

- Works exclusively exterior to the sampler
- Prepares the sampling equipment
- Handles the tools, such as hammers, wrenches, keys, and locks
- Measures and records the water depths and field measurements.

To control phthalate equipment contamination phthalate-free vinyl gloves will be used and all other equipment coming into contact with samples will be glass or stainless steel. No additional procedures to minimize phthalate contamination will be employed, because any trace amounts of contamination caused would be unlikely to be measurable in urban sediment samples.

Sediment Sampling Procedures

Two persons are needed to conduct the sampling. To set up the sediment collection system and process the samples, DH will remove the catch basin/manhole lid and the Isco sampler, if necessary, to provide access to the sediment trap. Using the confined space procedures in Appendix H, CH will double glove and enter the catch basin, if necessary, to retrieve the sediment sample. After entering the catch basin CH will discard the outer gloves and cap the sediment sample bottle with a Teflon®-lined cap. CH will remove the sample bottle. CH will pass the sediment sample to DH, who will pack it a cooler for transport.

DH will hand a new “Certified Clean” sample bottle to CH. CH will place it the sampler and remove the cap. CH will exit the catch basin and DH and assistant shall redeploy the Isco sampler and reinstall the catch basin lid.

SAMPLE PROCESSING

All samples are stored in sealed coolers with wet ice and transferred to the LWG field laboratory at the conclusion of sampling. The field leader is responsible for maintaining sample integrity throughout the sampling event. Once at the field lab, sample contamination is avoided by handling the double-bagged sample containers with clean gloves and transferring the samples into clean refrigerators immediately after samples are brought back from the field.

Storage Temperature Quality Control

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

Sample Compositing and Transfer to Sample Bottles for Laboratory Analysis

At the LWG field laboratory, the samples will be removed from the sediment trap bottles and transferred to wide-mouth jars for storage in the freezer until the end of the sampling period. Due to the holding times, the samples must be frozen. The Boston 1-liter sediment trap bottles are susceptible to breakage if frozen with the sample as collected from the field. Transferring the sample, although risking potential contamination, will allow much more reliable storage of the sediment sample by preventing breakage under freezing temperatures.

Sediment removal from the sample bottles will require several steps as the bottle opening is approximately 1/2 inch in diameter. The sampling technician will decant most of the water from each sample bottle into a decontaminated flask. The technician will then swirl or stir the remaining water with a decontaminated stainless-steel implement to mobilize the sediments. The technician will then pour the slurry into a decontaminated funnel with 2-5-micron filter paper and allow the leachate to drain to a decontaminated flask. Once the sediment has drained to a consistency allowing homogenization with a stainless-steel spoon, the sample can be lifted out by the filter material and placed into the decontaminated mixing bowl. The leachate water and the decanted water then can be used to rinse the sample bottle and remove the last of the sediments. Once the sample bottle have been emptied and the sediments have been added to the wide-mouth storage jar, a stainless-steel spoon can be used to scrape off any sediments that have adhered to the filter material into the wide-mouth storage jar. The leachate water or decanted water can be used to rinse the filter material. Note that water content of the sediment trap samples is not a critical parameter, because the sediment trap does not represent any ambient condition in terms of water content. Any water extracted from the trap or added back will be inconsequential to the objectives of this FSP.

Once the deployment period has ended, all sampled sediments (including archived aliquots, which have been allowed to thaw in the refrigerator) will be combined in one decontaminated stainless-steel bowl using decontaminated stainless-steel implements and thoroughly homogenized and subsampled in sample containers for chemical analysis.

Sample analysis containers will be filled in the priority order shown in Table 2-3 of the FSP, except for the alternate priority for some locations as described in Section 2.3 of the FSP, until the bowl is empty.

FIELD QUALITY CONTROL PROCEDURES

Field QC samples and frequencies are described in the FSP including:

- Field replicate, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blank for phthalates, 1 per 20 samples.

The types of field QC sample collection are described below (USGS 2000).

Rinsate Blank. Prior to the start of sample collection activities for each sampling event, a rinsate blank will be generated by the laboratory that conducts decontamination of the peristaltic pump sampling equipment to ensure that the decontamination procedure is adequate. To the extent that field decontamination procedures are necessary (e.g., for homogenization and sample processing equipment), some of the rinsate blanks collected will be of these field procedures so that the overall frequency noted above is attained.

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.

Per the FSP, field replicates will be generated by deploying sediment traps with additional sample collection vessels, and compositing the sediment from each half of the sediment trap collection vessels, separately, into two subsamples for analysis. Deployment of two vessels will only be possible at some of the locations, due to expected space limitations within the junctions. Consequently, after the location reconnaissance, the locations of the replicate trap deployment will be determined based on available space and other constraints noted above for sediment trap deployment. Replicate trap deployment will be conducted at sufficient locations to meet the 1 in 20 requirement. If this is not possible, the replicate analysis will be substituted with a replicate analysis consisting of homogenizing sediment from one vessel and splitting into two equal aliquots for analyses, at locations where sufficient volume is present, so that the 1 in 20 requirement. Analysis for laboratory QC samples will be conducted by dividing the total sediment collected from one sediment trap vessel at select locations with sufficient volume into three aliquots of equal mass for the laboratory analysis of the sample, matrix spike, and matrix spike replicate.

REFERENCES

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.

Integral Consulting. 2007. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan, Addendum 8: Round 3A Stormwater Sampling. Prepared for the Lower Willamette Group. Portland, Oregon.

Integral and Windward Environmental. 2004. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

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.

APPENDIX C-2
STORMWATER FILTERING FOR SEDIMENT COLLECTION
(BACK UP PROCEDURE)

HIGH-VOLUME STORMWATER FILTERING

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of sediments in filter media from high-volume water samples. Samples are collected to quantify sediment concentrations of targeted organic chemicals (e.g., PCBs, and pesticides) that are present and that could not be collected with the preferred sampling methods.

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 these same guidelines.

SUMMARY OF METHOD

Large volumes of water will be pumped through glass fiber filter cartridges, retaining particulates on the filters. A total volume of 1,000 liters will be pumped at each high-volume sample station at a flow rate of 2 liters per minute.

The water intake will be placed near the outlet of the catch basin with a long pole. Once the required volume for a particular analyte is established, the operator will run the pump at a fixed rate to collect a composite sample by setting the appropriate flow rate (i.e., 2 liters per minute) and then monitor the system during the time period necessary for sample collection. The operator will also monitor the in-line pressure and replace filters when necessary. Samples will be collected using the "clean hands– dirty hands" method. Once the desired volume is pumped, the column assembly will be removed and any residual water will be drained out. The glass fiber filters will be removed as needed and placed in appropriate containers, labeled, placed in a polyethylene bag, and stored in a cooler containing ice.

At the analytical laboratory, filters will be extracted and analyzed individually. Extraction of filters will follow the laboratory SOP as provided in the QAPP Addendum for Surfacewater Sampling (Integral 2004).

In general, any procedures not specifically detailed in this Appendix will be in conformance with the FSP, the QAPP Addendum (Integral 2007), and the Round 2 QAPP (Integral and Windward 2004).

SUPPLIES AND EQUIPMENT

The general types of equipment that are required are described in this section. The equipment used for sediment sampling consists of a peristaltic pump and a sample tubing system composed of Teflon® tubing and Swageloc™ stainless-steel fittings. The filter unit is a high capacity spun glass fiber filter, 1 micron specified, manufactured by PALL Industries and pre-cleaned by Axys Laboratories. Other than the filters used for sampling particulates, no containers are used for sample collection. Additional equipment may be required depending on site requirements. Filters for sampling particulates will be prepared in the laboratory.

For each sampling station, glass fiber filters from the laboratory are prepared. The sample intake requires a length of Teflon® tubing approximately 4-meters long. The nominal filter pore size used will be selected in consultation with EPA and its partners prior to mobilizing to the field sampling location. A portable 3000-watt power generator will be used if 120 VAC electricity is not available at the sample site to operate the pump.

PROCEDURES

EQUIPMENT PREPARATION

Before sample collection begins, the outside of sample containers and coolers are cleaned with a phosphate-free soap, rinsed with methanol, and finally rinsed with DI water. Sample containers are labeled with the date, sampling location, and a unique sample identification number using a permanent marker. Once cleaned and labeled, the sample containers are placed in coolers to keep from being contaminated during the sampling event. Date, site location, and sample identification numbers are noted on the field data sheet. A detailed site description with references to landmarks also is also provided.

Initial Setup

Prior to sampling, a clean Teflon® intake line is connected to an intake structure anchored in the stream of flow near the outlet of the catch basin. The discharge from the pump is discharged to the ground surface, down-gradient of the intake to prevent mixing of the waste water with the sampled water. The sampling unit can then be plugged into the generator for power.

Decontamination Procedures

Before sample collection begins, the sampler is completely cleaned and tested for leaks and other mechanical problems. The sampler is cleaned chemically after every sampling day. Clean phthalate-free vinyl gloves are worn during equipment decontamination. Once equipment has been cleaned, care should be taken to avoid touching or otherwise contaminating any surfaces that will come in contact with the sample water (e.g., inside surface of filter housings). Decontamination procedures are provided for the sampling unit, which also includes the filter housings and Teflon® coated O-rings, as well as tongs and forceps.

Sampling Unit Decontamination

Decontaminating the sampling unit includes not only the pump unit but also the filter housings and O-rings. Procedures for decontaminating each of these parts are provided below.

Filter Housings and O-rings

- Remove filter housings from unit
- Wash housings and O-rings using a scrub brush and a phosphate-free soap
- Rinse housings and O-rings with methanol
- Rinse housings and O-rings with deionized water. Use cleaned forceps to hold O-rings while rinsing.
- Allow cleaned items to air dry on aluminum foil. Place O-rings in filter housings, and re-connect housings to sampling unit.

Sampling Unit

- Plug unit in (generator or wall outlet) and power up the sampling unit using the main toggle switch.
- Check that the flow control valves on top of the unit both point in the same direction. The arrows on the valve handles point to the filter housing that water will be drawn through.
- With the intake line submerged in phosphate free soap, press the <ON> button on the control panel to start the pump.
- Increase the RPMs of the pump until the pump is primed and water is flowing through the unit.
- Draw 20 liters of soapy water through the system, followed by 5 liters of deionized water.
- Place the end of the intake line in a wash bottle with approximately 3 L of methanol. Continue pumping until all of the solvent has been drawn into the tubing.
- Following the acetone rinse, place the end of the intake line in a wash bottle with approximately 3 L of deionized water.
- Continue pumping until all of the water has been drawn through the tubing.
- Place the intake line into water to be sampled (effluent stream) to push the solvent and deionized water through the unit. Continue

pumping water for approximately 1 minute through the filter housing to thoroughly flush the system.

Tong and Forceps Decontamination

- Use a scrub brush with phosphate-free soap to thoroughly clean the tongs and forceps.
- Rinse with deionized water, then with a small amount of acetone.
- After cleaning, store the tongs and forceps in a clean storage container until needed. Once used, place the utensils in a separate container used only for contaminated items that need to be cleaned before use.

SAMPLE COLLECTION

Clean Handling Technique

The clean handling techniques are modeled after the "clean hands – dirty hands" method (EPA 1996) for collecting samples. It has been found that when working in the rain or other inclement weather and in confined spaces, it is not always possible to fully implement the EPA procedures. The clean handling technique requires two or more people working together. At the field site, one person is designated as "clean-hands" (CH) and a second person as "dirty-hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless, phthalate-free vinyl gloves during the entire sampling operation and change gloves frequently, usually with each change in task.

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

- Handles the glass fiber filters
- Handles the discharge end of the stormwater sample tube or line
- Prepares a clean workspace
- Sets the equipment (i.e., the filtration equipment)

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

- Prepares and operates the sampling equipment, including the pumps and discrete samplers, peristaltic pump switch, and pump controller

- Handles the generator or other power supply for samplers
- Handles the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds
- Handles the single or multi-parameter instruments for field measurements.
- Sets up and checks the field-measurement instruments
- Measures and records the water depths and field measurements.

Stormwater Sampling Procedures

Two people are needed to conduct the sampling and a third person is responsible for sample logging and sample processing. Samples are collected using the clean handling techniques.

Step 1 – Insert Glass Fiber Filter.

- Unwrap pre-cleaned PALL glass fiber filter. Do not directly touch any exposed surfaces of the filter. If the exposed filter comes in contact with anything other than the interior of the filter housing, the filter is discarded, and a new filter is used
- Insert glass fiber filter into filter housing
- Once the filter is in place, reconnect the filter housing to the sampling unit and tighten housing with a wrench.

Step 2 – Reset Volume Meter

- Press <RESET> on the volume totalizer until the display reads 0.0.

Step 3 – Check Control Unit Settings

- Check the control unit to make sure the RPM light is on. If light is not on, press <STOP/RESET>
- Make sure the FORWARD direction light is on. If the REVERSE light is on, press the <FORWARD/REVERSE> button
- Make sure the PROGRAM light is NOT on. The pump will not operate in PROGRAM mode. If the PROGRAM light is on, press the <STOP/RESET> button
- Use the UP and DOWN arrows to control the RPMs. A good initial starting point is the target flow rate of 2 liters per minute.

Step 4 – Begin Pumping

- Press <ON> to begin pumping. It may be necessary to increase the RPMs to get the pump started. It takes a few moments to get water flowing through the entire system
- The moment that water is observed in the post-column line, reset the volume totalizer to 0.0. This is necessary to get an accurate volume measurement, because the totalizer will measure the water that was already in the lines from the cleaning process even though this water did not pass through the filter
- Adjust the RPMs until the flowmeter indicates that the unit is operating at the optimum pumping rate of 2 liters/minute
- Check all fittings to make sure there are no leaks
- Note on the field data sheet the start time, pumping rate, and initial pressure on the system.

Step 5 – Check System

- Check the sampling unit periodically (at least every hour) to ensure unit is operating correctly. Check and record the volume filtered, flow rate, and pressure
- If the pressure exceeds 15 psi, the glass fiber filter must be changed
- If the flow rate has decreased, increase the RPMs to maintain the optimum pumping rate of 2 liters/minute. If increasing the RPMs does not help, the glass fiber filter must be changed.

Step 6 – Complete Sample Collection

- Operate the sampling unit continuously until the desired volume of water has been filtered. For most in-stream samples, 1,000 liters of water are pumped through the system. However, smaller samples may be collected, depending on expected chemical concentrations
- Once desired volume has been filtered, cease pumping by pressing <STOP> on the control unit
- Record stop time and volume filtered on the data sheet
- Turn main switch on unit to off.

Changing the Glass Fiber Filter

The glass fiber filter must be changed if the pressure exceeds 15 psi, or if adjusting the RPMs does not increase the flow rate, by using the following procedure:

- Insert a glass fiber filter in the unused filter housing as described in Step 1
- Press <STOP/RESET> to temporarily cease pumping
- Record the stop time and volume filtered
- Switch both directional flow valves to point in the direction of the filter housing containing the clean filter
- Press <START> to resume pumping. See Sample Handling Procedures (below) to remove the used filter from the filter housing.

SAMPLE HANDLING PROCEDURES

The following procedures describe how the used filters must be handled once sampling is complete.

Glass Fiber Filters

- Remove the lower filter housing unit while being careful not to spill any of the particulate laden inside
- Use clean tongs to remove the used filter from the housing and place the filter in aluminum foil. Note that more than a single filter and jar may be required if the sampled water is turbid
- Label the aluminum foil wrapped filter with date and sample ID number
- Place container on ice in a cooler
- Record sample identification number on field data sheet.

SAMPLE PROCESSING

All samples are stored in sealed coolers with wet ice and transferred to the Field Laboratory at the conclusion of the sampling event. The field leader is responsible for maintaining sample integrity throughout the event. Once at the field lab, sample contamination is avoided by handling the sample containers with clean gloves, and transferring the samples into clean refrigerators immediately after samples are brought back from the field.

Storage Temperature Quality Control

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

FIELD QUALITY CONTROL PROCEDURES

Field QC samples and frequencies described in the FSP for sediment trap samples will be used including:

- Field replicates, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blanks, 1 per 20 samples.

Rinsate Blank. Prior to the start of sample collection activities for each sampling event, a rinsate blank will be generated by the laboratory that conducts decontamination of the pump and filtering equipment to ensure that the decontamination procedure is adequate. To the extent that field decontamination procedures are necessary (e.g., for homogenization and sample processing equipment), some of the rinsate blanks collected will be of these field procedures so that the overall frequency noted above is attained.

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 duplicate 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.

REFERENCES

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.

Integral. 2004. Portland Harbor RI/FS Quality Assurance Project Plan Addendum for Surface Water Sampling. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

Integral Consulting. 2007. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan, Addendum 8: Round 3A Stormwater Sampling. Prepared for the Lower Willamette Group. Portland, Oregon.

Integral and Windward Environmental. 2004. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting, Inc., Mercer Island, WA.

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.

Appendix D
Flow Measurements

FLOW MEASUREMENTS

The purpose of this standard operating procedure (SOP) is to describe the procedures for installation of the Isco Area/Velocity Flow modules. The 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 these same guidelines.

SUMMARY OF METHOD

Flow will be measured with the Teledyne/Isco 750 AV Module (module). The module is an add-on enhancement to the Teledyne/Isco's 6700 Series Samplers that are being used to collect stormwater samples. The module provides the ability to collect flow proportional sample volumes or flow-paced samples. The sampler displays the real-time level, velocity, flow rate, and total flow provided by the module. The sampler records this data for later analysis.

The module is designed to measure flow in open channels without a primary device (a primary device is a hydraulic structure, such as a weir or a flume, which modifies a channel so there is a known relationship between the liquid level and the flow rate). Area velocity flow conversion requires three measurements: water level, velocity, and pipe dimensions. The AV sensor provides the level and velocity measurements. The pipe dimensions will be measured in the field and entered during module programming. The flow calculation is made in two steps. First, the module calculates the pipe cross-section (or area) using the programmed pipe dimensions and the level measurement. Then, the module multiplies the channel cross-sectional area and the velocity measurement to calculate the flow rate.

The sampler will be programmed to use the customary U.S. units, such as feet (depth), cubic feet per second or gallons per minute (flow, depending on size of the contributing basin), and gallons or millions of gallons (volume, depending on the size of the contributing basin). The sampler will be programmed to record flow data at 5-minute intervals. These data will be periodically downloaded throughout the course of the sampler deployment (as determined by data storage capacity) and entered into the project database.

In addition, data on rainfall will be obtained from various existing established rain gauge stations around the Portland area. These data will be used to make sampling decisions throughout the course of the sampling and to understand flow results for data reporting.

SUPPLIES AND EQUIPMENT

The equipment consists of a flow meter module, a sensor and carrier bracket to attach the sensor to the outlet pipe.

PROCEDURES

EQUIPMENT PREPARATION

Mounting equipment such as slip rings, nuts and bolts, brackets will be washed with warm soap water using a brush to remove any oil, grease or other residue from the manufacturing process. They will then be rinsed with reagent-grade acetone and then with tap water and allowed to dry. If available, a warm oven could be used to speed drying.

Installation of the brackets at the sampling sites may create debris that could become a contaminant source (i.e., drilling holes, using powder-actuated tools to set studs and/or welds). After the brackets have been installed, the work site will be scrubbed with a brush to remove any debris and rinsed with DI water before the sampling hardware (intake screen) and AV sensor is mounted.

The sensor carrier bracket will be installed into the outlet pipe with an expandable ring so that the sensor will be located at the bottom of the pipe. The diameter of the pipe will be measured and noted for programming the Isco sampler. The flow meter sensor will be connected to the carrier and the cable will secured so that when the sampler is installed in the catch basin, the cable does not become kinked. The sampler will be turned on and allowed to self check. The installer will enter the programming mode and enter the diameter of the pipe. The installer will measure the depth of water in the pipe and adjust the sampler offset to match the measured value. The sampler will be prepared for the sampling team to install the clean sample bottles and deploy the sampler as described in Appendix A.

DATA COLLECTION

Data will be downloaded when water quality samples are collected. When the sampler is removed from the catch basin and the cover is removed a Rapid Transfer Module will be plugged in and data collected. The data will also be downloaded prior to disconnecting the power source when batteries must be changed. The data can also be downloaded via the cellular modem module. The data will not be erased and will be allowed to overwrite, in case there is a problem downloading the data (the sampler has adequate memory such that there should be capacity to store the entire data record for the sampling period).

Data will be downloaded from the Rapid Transfer Module at the LWG field laboratory and imported into a database using the Isco data management software.

Appendix E
Field Forms

t

STORMWATER SAMPLING CHECKLIST

Date:	**Sampling Site:**
Weather:	**Sampling Team Leader:**
Prepare Field Equipment at LWG Field Laboratory Prior to Sampling	
Wash and Rinse Cooler ☐	Fill Cooler with Ice ☐
Latex Gloves ☐	Plastic Sheet ☐
Plastic Bags ☐	Trash Bags ☐
Replacement Sample Bottles ☐	
Procedures at Field Sampling Site	
Inspect Outside of Sampler and Note Any Damage:	☐
Prepare Sampling Site	☐
Remove Sampler Cover	☐
Record Displayed Flow Information **Depth:** **Flow:** **Volume:**	☐
Record Error Messages (if any, if none write "none"):	☐
Cap Sample Bottles	☐
Remove Sample Bottle	☐
Label Sample Bottle	☐
Bag Sample Bottle	☐
Place Sample Bottle in Cooler for Transport to LWG Field Laboratory	☐
Seal Cooler When All Samples Have Been Collected	☐
Fill Out Chain of Custody Form (note time on form)	☐
Plug in Rapid Download Module and Capture Data from Sampler	☐
Check Battery Voltage and Record **Volts:**	☐
Notify O&M Team to Replace Battery if Below 12 Volts	☐
Reset Sampler and Confirm Self Check (If self check fails notify O&M Team and Program Manager)	☐
Install New Sample Bottles	☐
Reinstall Sampler Cover	☐
Redeploy Sampler	☐
Call Sampler and Disable	☐
Police Site and Put All Used Gloves, Bags, and Other Materials in Trash Bag	☐
Procedures at LWG Field Laboratory	
Deliver Samples to the LWG Field Lab	☐
With the Lab Technician Unpack the Samples Verifying that They are Properly Labeled and Not Damaged	☐
Relinquish Custody of the Samples to the Laboratory Technician	☐
Sign Chain-of-Custody Form	☐
Have Laboratory Technician Sign Chain-of-Custody Form (note time on form)	☐
Retain Carbon Copy with this Sampling Checklist	☐
Notify Program Manager and O&M Team if Necessary	☐

SEDIMENT SAMPLING CHECKLIST

Date:		**Sampling Site:**	
Weather:		**Sampling Team Leader:**	
Prepare Field Equipment at LWG Field Laboratory Prior to Sampling			
Wash and Rinse Cooler	☐	Fill Cooler with Ice	☐
Latex Gloves	☐	Plastic Sheet	☐
Plastic Bags	☐	Trash Bags	☐
Replacement Sample Bottle	☐		
Procedures at Field Sampling Site			
Inspect Outside of Sampler and Note Any Damage:			☐
Prepare Sampling Site			☐
Cap Sample Bottle			☐
Remove Sample Bottle			☐
Label Sample Bottle			☐
Bag Sample Bottle			☐
Place Sample Bottle in Cooler for Transport to LWG Field Laboratory			☐
Fill Out Chain of Custody Form (note time on form)			☐
Install New Sample Bottle			☐
Police Site and Put All Used Gloves, Bags, and Other Materials in Trash Bag			☐
Procedures at LWG Field Laboratory			
Deliver Samples to the LWG Field Lab			☐
With the Lab Technician Unpack the Samples Verifying that They are Properly Labeled and Not Damaged			☐
Relinquish Custody of the Samples to the Laboratory Technician			☐
Sign Chain-of-Custody Form			☐
Have Laboratory Technician Sign Chain-of-Custody Form (note time on form)			☐
Retain Carbon Copy with this Sampling Checklist			☐
Notify Program Manager and O&M Team if Necessary			☐

ANCHOR ENVIRONMENTAL, L.L.C.

1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131
www.anchorenv.com

Outfall Recon Form – Lower Willamette Group

Outfall ID:	**Date:**	**Start Time:**
Elevation (NAD 83):	**Latitude:**	**Longitude:**

Site Access

Security clearance:	
Traffic control:	
Site training:	
Site specific PPE:	

Outfall access

Lid diameter:	
Depth to invert of basin:	
Inlet & outlet basin:	
Confined space:	
Sediment trap location:	
Iskco sampler location:	
Cellular reception:	

Comments & Drawings:

Recorded by:

Chain of Custody Record & Laboratory Analysis Request

Page ___ of ____ Turnaround Requested: ______________________

Anchor Contact: ____________________

ANCHOR ENVIRONMENTAL, L.L.C.
6650 SW Redwood Lane, Suite 110
Portland, Oregon 97224
Ph: (503)670-1108 Fax: (503)670-1128

Lab Contact:		Proj. Name:			Analyses Requested										Notes/ Comments:
Lab:		Proj. Number:													
Address:		Sampler:													
Phone:		Shipping Method:													
Fax:		AirBill:													
Sample ID	Sample Date	Sample Time	Sample Martix	# Containers											

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

Appendix F
Chain of Custody SOP

CHAIN OF CUSTODY

The sampling team leader or other designated field sample custodian is responsible for all sample tracking and chain-of-custody procedures until sample custody is transferred to the laboratory.

Custody procedures in the field are as follows:

- Record all field and sample collection activities (including sample identification number, collection time and date) in the field logbook. While being used in the field, the logbook remains with the field team at all times. Upon completion of the sampling effort, the logbook should be reproduced and then kept in a secure area.
- Complete a chain-of-custody form whenever samples are being transferred or removed from the custody of field sampling personnel. A sample form is provided in Appendix E. Record each individual sample on the form. Include additional information to assist in sample tracking such as collection date and time, number of containers, and sample matrix. The chain-of-custody may also serve as the sample analysis request form, with the required analysis indicated for each individual sample.
- Sign the form and ensure that the samples are not left unattended unless secured.
- Store, pack, or ship samples as described in the appropriate SOP. Place the original completed chain-of-custody form in a sealed plastic bag inside the shipping container. A copy is retained by the shipping party.
- Complete a separate custody form for each individual shipping container or a single form for all samples in multiple shipping containers in a single shipment, with the number of containers noted on the custody form.
- Attach completed custody seals to any shipping container that will be sent to the laboratory by delivery service or courier. Delivery personnel are not required to sign the custody form if custody seals are used. Custody seals are used to detect unauthorized tampering with the samples. Gummed paper or tape should be used so that the seal must be broken when the container is opened. The laboratory sample custodian (or other sample recipient) will establish the integrity of the seals.
- The laboratory custodian (or other sample recipient) acknowledges receipt of the samples by signing, dating, and noting the time of transfer on the chain-of-custody form. The condition of the samples and any problems or irregularities (e.g., cracked or broken bottles,

loose caps, evidence of tampering) should also be recorded. Return a copy of the completed custody form to the project manger or designated sample coordinator.

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

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

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

Quality control procedures include the following:

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

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

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

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

- Use a leak-proof, sturdy cooler that can withstand rough treatment during shipping. The cooler's drain should be securely plugged and sealed with duct tape.
- Place the sample bottles tightly inside the in the shipping container:
- Fill any empty space in the shipping cooler or box with packing material so that the jars are held securely.
- Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. The form should be securely taped to the inside of the cooler's lid.
- If required to meet sample storage requirements, fill the cooler with wet ice or blue ice packs. A temperature blank (provided by the laboratory) should be packed in each cooler.
- Seal shipping containers securely with packing or duct tape.
- If the shipping containers will be transported by anyone other than the person who completed and signed the chain-of-custody form, attach completed custody seals so that the shipping containers cannot be opened without breaking the seal.
- A Fragile label may also be attached to reduce rough handling of the samples.
- Label the shipping container with all appropriate information (name of project, time and date, responsible person and company name, address and phone) to enable positive identification.

Packed containers may be delivered to the laboratory or storage facility by field personnel, courier, or common carrier (FedEx, UPS). However, any outside carrier or courier service must provide a delivery receipt. The carrier or courier must also ensure delivery time, if holding time and storage conditions are critical. Unless arranged in advance, shipping charges should be prepaid by sender to avoid confusion and possible rejection of the package by the laboratory.

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

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

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

Appendix G
Confined Space Health and Safety Plan Addendum

Anchor Environmental L.L.C., has officially accepted the Integral Round 2 health and safety plan (acceptance letter on June 18, 2004); Anchor intends to continue to use it for general health and safety measures. The following sections provide supplemental details of confined space entry policy and procedures.

ANCHOR ENVIRONMENTAL, L.L.C.

CONFINED SPACE ENTRY – OREGON
POLICY & PROCEDURES

I. OBJECTIVE

To establish safe standard operating procedures for Anchor employees who engage in Confined Space Entry* work (Non-Permit or Permit). Entering a Confined Space* presents numerous occupational risks/hazards, therefore every precaution shall be taken. Anchor is committed to a safe and healthy workplace and will provide the necessary resources to protect its employees.

A. USING THIS DOCUMENT

This document contains technical information with very specific language. The important terms have been placed in the Definitions Section and marked with an asterisk (*) throughout the document. Each person reading this Policy is responsible for reading these definitions as well as the document itself.

II. POLICY STATEMENT

It shall be the policy of Anchor that all Confined Space Entry work be approved by a management representative and/or designee, and that all entries into Permit Required Confined Spaces (PRCS) be assessed and authorized by the Entry Supervisor*

It is every Anchor employee's responsibility to perform work in a safe and thoughtful manner.

Failure to comply with this policy could result in injury, illness or death. Additionally, non-compliance with this policy is a violation of OAR 437, Division 2/J, Permit-Required Confined Spaces (1910.146), which could result in regulatory fines by OR-OSHA.

III. SCOPE

This policy contains the necessary procedures and precautions to protect Anchor employees from hazards while working in Permit Required Confined Spaces and Non-Permit Confined Spaces. Any unusual confined entry or circumstance not covered under the procedural guidelines shall be discussed with the Anchor Health and Safety Manager (HSM) (see Responsibility Section) before work begins.

IV. TRAINING

Under no circumstances shall Anchor employees be allowed to work in Confined Spaces, until they have been *sufficiently trained* as an Authorized Entrant*, Attendant* and Entry

Supervisor*. Anchor shall certify that each employee who works in Confined Spaces has the essential knowledge, skills and abilities to identify, evaluate and control Confined Space hazards.

Sufficient training shall include a curriculum that reviews OR-OSHA Standards and Regulations, and identification of hazards typically encountered in confined spaces: physical; atmospheric; and abatement techniques; in addition to a basic knowledge of monitoring instruments, shall be included. A portion of the required training shall include "hands-on" instruction when actual entries are performed / observed by participants.

V. STANDARDS AND REGULATIONS

1. OAR 437, Division 2/J
2. OR OSHA 1910.146 Permit Required Confined Space

VI. DEFINITIONS

Attendant - an individual stationed outside a permit space who monitors the authorized entrant(s) and who performs all attendant's duties assigned in Anchor's permit space program. An entry attendant can also serve as a supervisor.

Authorized Entrant - an employee who is authorized by Anchor to enter a permit space.

Confined Space – A space that is large enough and so configured that an employee can bodily enter and perform assigned work; and

- Has limited or restricted means for entry or exit (example: tanks, sewers, wells, pipelines, vaults and pits)
- Is not designed for continuous employee occupancy.

Emergency – Any occurrence (including any failure of hazard control or monitoring equipment) of event internal or external to the permit space that could endanger entrants.

Engulfment – The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling the respiratory system or that can exert enough force on the body to cause death by suffocation, constriction or drowning.

Entry - The action by which a person passes through an opening into a permit-required confined space. Entry includes work activities in that space and is considered to have occurred as soon as *any* part of the entrant's body breaks the plane of the opening into the space.

Entry Permit – The written or printed document that is provided by the employer to allow controlled entry into a permit space

Entry Supervisor - The person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required.

Note: An entry supervisor may also serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required, for each role he or she fills. Also, duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

Hazardous Atmosphere – An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is escape unaided from a permit space), injury, or acute illness.

Hot Work – The employer's written authorization to perform operations (for example riveting, welding, cutting, burning and heating) capable of providing a source of ignition.

Immediately Dangerous to Life or Health (IDLH) – Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse effects or that would interfere with an individual's ability to escape unaided from a permit space.

Inerting – The displacement of the atmosphere in a permit space by noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible. Note – This procedure produces an IDLH oxygen-deficient atmosphere.

Isolation – The process by which a permit space is removed from service and completely protected against release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, piping or ducts; a double lock and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

LEL - lower explosive level.

Line Breaking – The intentional opening of a pipe, line or a duct that is or has been carrying flammable, corrosive or toxic material, an inert gas, or any fluid at a volume, pressure or temperature capable of causing injury.

Non-Permit Confined Space – A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

Outside Personnel – Any persons working at the proposed sites, including, but not limited to employees of vendors, contractors, and of other LWG members.

Oxygen deficient atmosphere – An atmosphere containing less than 19.5 percent oxygen by volume.

<u>Oxygen enriched atmosphere</u> - An atmosphere containing more than 23.5 percent oxygen by volume.

<u>Permit Required Confined Space</u> – (permit space) A confined space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere;

2. Contains a material that has the potential for engulfing an entrant;

3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

4. Contains any other recognized serious safety or health hazard.

<u>Permit Required Confined Space Program</u> - The employer's overall program for controlling and where appropriate, protecting employees from permit space hazards, and for regulating employee entry into permit spaces.

<u>Permit System</u> – The employer's written procedure for preparing and issuing permits for entry and for returning permit space to service following entry.

<u>Prohibited condition</u> – Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

<u>Rescue Service</u> – The personnel or outside agency designated to rescue employees from permit spaces.

<u>Retrieval system</u> – The equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

<u>Testing</u> – The means by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

Note: testing enables employers both to devise and implement adequate control measures for the protection of entrants.

VII. RESPONSIBILITIES

A. SENIOR MANAGEMENT (PARTNERS and GROUP MANAGERS)

1. Provide commitment, leadership, staffing and financial resources necessary to enable adherence to the requirements of this policy.

2. Establish performance criteria holding Middle Managers accountable for the compliance of this policy.

3. Continue to promote and reinforce individual responsibility and accountability as it relates to Occupational Safety and Health.

B. ANCHOR HEALTH AND SAFETY MANAGER

1. Ensure that all personnel who perform Confined Space Entry work are educated as to the contents of this policy.

2. Ensure that all employees, including those newly-assigned to work in confined spaces, (Entrants, Attendants and Entry Supervisors) are adequately trained and certified to perform Confined Space Entry work, and that training records are properly maintained according to Anchor policy.

3. Ensure that proper pre-entry protocols are completed prior to entry and maintained during entry. A designated employee (Entry Supervisor) may be assigned the responsibility of seeing that all Confined Space Entries are made in compliance with Anchor policies and procedures.

4. Ensure that Confined Space Entry equipment and personal protective equipment (PPE) are included in budgetary planning.

5. Ensure all appropriate safety equipment is available and used during Confined Space Entries.

6. Ensure that affected employees and their authorized representatives are consulted on the development and implementation of all aspects of Confined Space Entry Policy and Procedure.

7. Establish communication procedures to inform employees and employee representatives of pre-entry air monitoring results, certification of safe entry, and any hazard identified while working in Confined Spaces (e.g., atmospheric alarm).

8. Coordinate the activities of Contractors/outside personnel who will be working in or near PRCS spaces.

9. Review the effectiveness of this policy and procedure annually, using the cancelled permits to evaluate the confined space work done throughout the year, and revise the program to correct deficiencies if necessary.

C. FIELD TEAM LEADERS

1. Field team leaders shall ensure that the necessary resources are available to address provisions for compliance with the approved confined space procedures.

Note: All Confined Spaces are to be considered Permit-Required until the Entry Supervisor has researched and verified the historical data to down-grade the PRCS to Non-Permit.

2. Coordinate the activities of Contractors and/or outside personnel who will be working in or near PRCS spaces and ensure their compliance with OAR 437 Division 2/J, Permit-Required Confined Spaces (1910.146). Complete authorization form (Attachment A) of this document. After the Authorization Form has been completed and reviewed with the Contractor, the Project Manager and/or designee shall:

   a.) Give a copy to the outside personnel

   b.) Give a copy to the Entry Supervisor

   c.) File a copy in the Project file.

Note: No entry shall occur until the Entry Authorization form has been completed.

3. Inform the outside personnel* that the work they are performing requires entry into a Confined Space and that they are responsible for the safety and health of their employees and must comply with OAR 437 Division 2/J, Permit-Required Confined Spaces (1910.146).

4. Inform the outside personnel of any hazards Anchor has identified and past experience with that particular space:

Note: Authorization Form (Attachment A) can be used as a guide for Potential Hazard and the Safety Precaution/Personal Safety.

5. Inform the outside personnel of any precautions or procedures that Anchor has taken to protect its employees.

6. Coordinate entry operations with the outside personnel if Anchor employees will also be entering the space. When an entry is made by both Anchor and contract employees working together, procedures must be documented and the Anchor Health and Safety Manager notified.

7. Debrief the outside personnel to determine if any problems were encountered requiring a change in procedure.

8. Review outside personnel’s work periodically and issue a stop work order if safety procedures are not followed.

D. OUTSIDE PERSONNEL

Outside Personnel\Contractors Shall

1. In addition to complying with permit space requirements, all outside personnel shall:

    a.) Obtain all information regarding confined space hazards and entry operations from Anchor's HSM; and

    b.) If Anchor employees are entering the same confined space then the Contractor shall coordinate entry operations with those employees.

    c.) Employers of outside personnel shall provide all equipment necessary to comply with safety standards.

    d.) Employers of outside personnel shall be responsible for all training of their employees.

Note: Additionally, the prime contractor shall coordinate entries of contractor's vendors and/or sub-contractors.

2. The contractor shall submit their procedures for entering confined space to Anchor's HSM for approval.

E. ENTRY PERSONNEL AND STAFF

1. All Personnel

    a.) Shall have a trained person as their attendant.

    b.) Shall follow the appropriate Confined Space Entry Procedures (confined space & Non-Permit) and ensure that equipment is used properly.

    c.) Be held responsible and accountable for personal safety.

2. Entrant(s) Duties (Permit space only)

    a.) Knows the hazards that may be faced (e.g., possible LEL conditions) during entry, including information on the mode, signs or symptoms, and consequences that might occur due to lack of oxygen or exposure to toxic air contaminants.

    b.) roperly use of all safety equipment provided for the job.

c.) Communicates frequently with Attendant to enable Attendant to monitor Entrant(s) status.

d.) Alerts Attendant immediately when a hazardous condition or problem develops, or when leaving the space.

e.) Exits the space immediately if ordered to by the Attendant, or if a prohibited condition or hazardous situation develops (e.g., atmospheric alarm).

3. Entrants Shall: (Non-Permit)

a.) Know the hazards that may be faced (e.g., possible LEL conditions) during entry, including information on the mode, signs or symptoms, and consequences that might occur due to lack of oxygen or exposure to toxic air contaminants.

b.) Ensure that the only hazard posed by the Confined Space is a potential for hazardous atmosphere* and that ventilation alone can be sufficient to maintain the space safe for entry.

c.) Test atmosphere prior to entry and record results. Continuously monitor the atmosphere during entry.

d.) Ensure barriers or other guards are in place around the space opening.

e.) Exit immediately from the space upon any atmospheric alarm.

f.) Adhere to the duty requirements of the Entry Supervisor.

Note: An employee shall meet the training requirements of an Entrant and Entry Supervisor to perform Non-Permit Entries.

4. Attendants Shall: (Permit space only)

a.) Be First Aid and CPR certified.

b.) May simultaneously serve as an entry supervisor.

c.) Know the hazards that may be faced (e.g., possible LEL conditions) during entry, including information on the mode, signs or symptoms, and consequences that might occur due to lack of oxygen or exposure to toxic air contaminants

d.) Remain outside the permit space during the full operation.

e.) Monitor activities inside and outside the space for safety.

f.) Maintain active communication with Entrant.

g.) Maintain a correct count of authorized Entrants, if there is more than one.

h.) Keep unauthorized persons from entering the space.

i.) Perform no duties that might interfere with Attendant's primary duty. (i.e. flagging and miscellaneous distractions)

j.) Order Entrant to evacuate if a dangerous situation develops.

k.) Perform non-entry rescue* only.

l.) Summon rescue and other emergency* services if Entrant needs assistance to escape in an emergency.

Note: Anchor has the authority to designate any employee (non-represented or represented) to be the Entry Supervisor, provided the training and certification requirements have been met.

5. Entry Supervisor Duties

a.) May simultaneously serve as and entry attendant.

b.) Have received *current* CSE training.

c.) Know the hazards that may be faced (e.g., possible LEL conditions) during entry, including information on the mode, signs or symptoms, and consequences that might occur due to lack of oxygen or exposure to toxic air contaminants.

d.) Evaluate Confined Space hazards and ensure controls are in place.

e.) Determine the responsibility for permit requirements, hazard controls and permit sign-off.

f.) Terminate the entry and cancel the permit.

g.) Verify that rescue procedures are in place and rescue services are available.

h.) Remove unauthorized individuals who enter or attempt to enter.

i.) Review Confined Space work in progress to ensure that acceptable entry conditions are maintained and workers are following the procedure.

VIII. PROCEDURES

A. PRE-ENTRY EVALUATION

The Entry Supervisor Shall:

1. Evaluate whether the Confined Space must be entered. Explore whether other controls/procedures could be used to prevent someone from entering the Confined Space. Explore every possible alternative to prevent the initial entry.

2. Conduct a visual survey of the Confined Space to identify any potential hazards (e.g., hazardous atmosphere, physical hazards, history and location of the space, etc).

Note: The Entry Supervisor must determine what safety equipment, including personal protective equipment is needed for the job, and ensure that the gas monitor has been calibrated, and fresh air checked.

3. If the Entry Supervisor is unclear whether a Confined Space is PRCS or non-permit, then the Pre-Entry Checklist (Attachment C) must be completed. The Entry Supervisor's determination is based on the identified hazards, and evaluation of those hazards eliminated and/or control measures to ensure safe entry. See Sections B & C for specific Non-Permit and Permit procedures.

Note: All Confined Spaces are to be considered Permit-Required until the Entry Supervisor has researched and verified the historical data to down-grade the PRCS to Non-Permit.

4. Review work to be done in the Confined Space to evaluate its potential to create a hazardous atmosphere or other hazard.

5. After the Confined Space determination has been made, the Entry Supervisor must ensure that the Entrant and Attendant are trained and certified to enter the Confined Space. When an entry supervisor and attendant duties are combined, he/she must ensure that that all entrants are trained and certified to enter the confined space.

B. PERMIT-REQUIRED SPACE PROCEDURE

Note: All Confined Spaces* are to be considered Permit-Required until the Entry Supervisor determines otherwise.

1. Pre-Entry. The Entry Supervisor shall conduct the pre-entry procedure and determine if the Confined Space is to be Permit-Required.

    a.) The Entry Supervisor shall ensure that the Attendant has current CPR/First Aid certification.

    b.) Entry Supervisors, Entrants and Attendants shall have received current CSE training.

2. Inspection. The Entry Supervisor* shall ensure that all safety equipment is visually inspected prior to each use or entry, and is in a "ready state." Equipment includes, but is not limited to:

   - Ladders (where applicable)
   - Tripods and winches
   - Safety Harness/Life Lines/Lanyards
   - Gas Monitors (calibrated, properly zeroed, field-checked and/or bump tested)
   - Communication Systems
   - Explosion-proof equipment if needed

3. External. The perimeter of the Confined Space shall be barricaded or roped off to prevent unauthorized personnel from entering the space. Additionally, if entrance covers are removed, the opening shall be promptly guarded by a railing or temporary cover, until work in the confined space resumes.

   Manholes may be guarded or blocked by the van or an Attendant. One person at all times is responsible for keeping people away.

4. Environmental Survey. The Entry Supervisor and other on-site personnel shall survey the surrounding work environment to ensure that:

   - all external controls are in place (traffic control, barricades);
   - all physical hazards have been eliminated or controlled;
   - the Confined Space opening is guarded by a railing or temporary barrier;
   - all isolating devices are in place (lockout, blanking lines, etc.); and
   - all ventilating equipment is operating.

5. Air Testing. Air test the Confined Space for oxygen, flammability (LEL), hydrogen sulfide (H2S), carbon monoxide (CO), and any other possible contaminants based on pre-entry survey. The test shall occur:

- prior to entry
- during entry/continuous
- prior to reentering the space after work is suspended for any reason

Note: Air contaminants might be introduced into the space during work activities, additional air testing for these air contaminants will be needed during entry.

Entry is prohibited until initial testing of the atmosphere is done from outside the space and determined to be safe. Under no circumstances shall entries occur if the meter detects (by alarming) a hazardous atmosphere, or if there is other information that indicates a hazardous atmosphere may exist.

If the pre-entry survey indicates the potential for flammable atmosphere, an initial test must be taken through the small holes in the manhole cover prior to removal. For manholes that are solid the testing will be done after cracking open the cover. Eliminate all ignition sources, and use only tools that will not emit sparks, such as power drills, to open the cover.

If the alarm sounds while working in the space, all Entrants must exit from the space immediately!

Training and certification in atmospheric testing for all Confined Spaced personnel must include the ability to correctly interpret gas monitor readings.

6. Personal. Personal protective equipment required for entry includes, but is not limited to:

- Hard hats
- Eye wear (glasses or goggles depending on the hazard)
- Gloves
- Protective clothing (coveralls, raingear, chemical suits)

Each Entrant or his authorized representative must be provided the opportunity to observe and obtain results of pre-entry monitoring or other testing of a PRCS. If a request is made by an employee to reevaluate the Confined Space, then the Entry Supervisor will comply with that request before proceeding with the entry.

7. Entry Permit.*The Entry Supervisor shall obtain an "Entry Permit" and complete each section prior to entry (See Attachment B). The following rules apply:

   a.) Permits shall be completed at the Confined Space location

   b.) Permits are only valid for the duration of work.

      1.) If Entrants exit from the space for short periods (breaks, lunches, etc.) a new permit does not have to be issued provided that the Entry Supervisor conducts atmospheric testing prior to re-entry, documents the readings on the permit, and double checks that all potential hazards are controlled.

   c.) The Entry Supervisor terminates permits when:

   - work is temporarily postponed,
   - work is completed, or
   - a hazardous condition develops during entry

   d.) All terminated permits shall be forwarded to the Anchor HSM.

   e.) Permits shall be kept for one year.

   f.) Permits shall be posted at the job site.

   g.) If duties are transferred to new personnel, the new entry supervisor/ attendant shall completely re-evaluate the hazard potential of the confined space.

8. Respiratory Protection. The Entry Supervisor shall consider potential inhalation exposures (ammonia, sewage mists/vapors etc.) prior to each entry and determine the need for respiratory protection. The supervisor shall also define the specific respirator protection for the entry. Half-face respirators equipped with organic vapor cartridges in conjunction with N 100 particulate filters will protect against low level organic solvents and particulate mists from sewage.

Note: Air contaminants might be introduced into the space during work activities. Additional air testing for these air contaminants will be needed during entry.

Under no circumstances shall entries be made with an SCBA or airline respirator with auxiliary escape bottle.

9. Fall Protection. The Entry Supervisor shall ensure that Entrant uses fall protection when working from any unguarded surface greater than 6 feet elevation. Under some circumstances, retrieval systems may be used for Fall Protection. All equipment used in confined spaces shall be consistent with manufacturer's specifications.

10. Communication. The Attendant must remain in continuous contact with the Entrant(s) and be prepared to retrieve the Entrant(s) whenever a prohibited condition occurs (i.e., Entrant exhibits behavior changes, gas monitor alarms, etc.). If visual contact can not be maintained, portable radios or some other reliable, pre-approved means must maintain effective communication.

11. Rescue. The Entry Supervisor shall ensure that rescue procedures are discussed with the Entrant and Attendant prior to each entry. At a minimum, the following rescue rules shall apply on all entries:

    a.) The entrant shall wear a full-body harness.

    b.) A mechanical lifting device shall be available at the job site to remove personnel from any vertical space more than 5 feet deep. When feasible the entrant will be attached by lifeline to a mechanical lifting device.

    Note: If a lifeline is <u>not</u> feasible, then prior arrangements need to be made with the Anchor HSM.

    c.) All rescue attempts shall occur from outside the Confined Space.

    d.) Under no circumstances shall the Attendant enter the Confined Space to perform a rescue.

    e.) The Attendant will have a two-way radio or cellular phone to notify dispatch or 911.

    f.) Outside rescue service (i.e. Portland Fire Bureau) shall assume full authority during the rescue procedure. The attendant shall remain at the entry point until relieved of this duty.

12. Ventilation. If any alarms occur, or the supervisor determines that a source of fresh air is needed, the ventilation shall be used to provide adequate levels of oxygen, to dilute toxic and flammable gases, and to improve general air quality. Ventilation equipment shall be explosion proof and be set at 100% outside air. To increase air circulation open additional manholes and other sources of fresh air on the upside/downside of the Confined Space.

    All "closed" Confined Spaces (vaults, wet/dry wells, manholes, etc.) may require the use of forced, mechanical ventilation, if fixed ventilation systems are not present. The Entrant will determine the need for ventilation. Natural ventilation should be sufficient in all "open" Confined Spaces (clarifiers). However, if there is any doubt about the air quality, then mechanical ventilation shall be used.

If ventilation is needed:

- Introduce fresh air near the bottom of the immediate area where the Entrant will be present; and
- Position the fresh air intake in a clean air zone away from all combustion sources (i.e. vehicle exhaust).
- Retest Air

13. Electric. The Entry Supervisor must ensure that only double insulated electric tools or tools on a ground fault circuit interrupter system are used and all portable lights and tools are explosion proof where a potential flammable atmosphere exists.
14. Lockout. The Entry Supervisor and the Entrant shall ensure that all Potential Energy Sources have been adequately disconnected/ isolated from power source and locked out, and stored energy sources are controlled, prior to entry. This includes blocking lines and locking out valves.
15. Traffic. The Entry Supervisor shall ensure that employees working in roadways/walkways have the proper controls for traffic and access to manholes. All necessary barriers and traffic control devices shall be used. This includes ensuring that employees handling traffic are trained in flagging and traffic control.
16. Records. At completion of the entry, the Entrant shall retain the checklist and written certification of air testing for ultimate transfer to the project file.

C. NON-PERMIT SPACE PROCEDURE

A Non-Permit Space does not contain (with respect to atmospheric hazards), or have the potential to contain, any hazard capable of causing death or physical harm. The space has sufficient ventilation (forced or natural) to maintain a safe entry, all physical hazards (e.g., mechanical equipment) can be controlled from outside the space prior to entry, and there is no chance for engulfment.

Note: Work activities shall not introduce a hazardous atmosphere into the space.

1. Training. Entrant must be trained to the Entry Supervisor level to enter the Confined Space.

Note: Training and certification in atmospheric testing for all Confined Spaced personnel must include the ability to correctly interpret gas monitor readings.

2. Pre-Entry. If Entrant completes the Pre-Entry Checklist, the checklist must be posted outside the entry portal or another visible location at the entry site. The Pre-Entry Checklist cannot extend beyond the initial job purpose, or one shift, whichever is of the shortest duration

3. External Controls. The Entrant shall survey the surrounding work environment to ensure that all external controls are in place (traffic control, barricades) and that all physical hazards have been eliminated or controlled. The Entrant shall guard the Confined Space opening by a railing, or temporary barrier and will double check to ensure that all isolating devices are in place (lockout/tagout, blanking lines, etc). Industrial sampling manholes may be guarded or blocked by a van or an Attendant. One person at all times is responsible for keeping people away.

4. Inspection. Entrant shall inspect and ensure that all safety equipment is in good condition. If the job requires travel to a satellite work location, proper safety equipment must be in the vehicle. Use the Entry Permit as a checklist. (Attachment B)

5. Entrant. Non-Permit entries do not require an Attendant, therefore the Entrant must notify their manager/supervisor/lead person prior to entering a space and when the entry is complete.

6. Air TestingPrior to entry, the Entrant shall conduct atmospheric readings for oxygen, flammability, carbon monoxide and hydrogen sulfide, and any other possible contaminants based on pre-entry survey. If initial pre-planning identifies the potential for a flammable atmosphere (methane), then the under-side of the Confined Space cover shall be "sniffed" prior to opening. If all atmospheric tests indicate the atmosphere is safe then proceed with the entry.

Note: Gas Meter Chart - Appendix B

Note: Training and certification in atmospheric testing for all Confined Spaced personnel must include the ability to correctly interpret gas monitor readings.

Any employee who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing. Test results must be documented by a written certification before entry takes place.

7. Continuous Monitoring. All entries must be monitored continuously. The gas monitor shall be attached to the Entrant during entry and if, at any time, the meter goes into alarm mode, the Entrant shall exit from the space immediately.

   The Non-Permit Confined Space will then be reclassified into a PRCS and no entry shall occur until the atmospheric hazard has been eliminated.

8. Ventilation. All "closed" Confined Spaces (vaults, wet/dry wells, manholes, etc.) may require the use of forced, mechanical ventilation, if fixed ventilation systems are not present. The Entrant will determine the need for ventilation. Natural ventilation should be sufficient in all "open" Confined Spaces (clarifiers). However, if there is any doubt about the air quality, then mechanical ventilation shall be used.

   If ventilation is needed:

   - Introduce fresh air near the bottom of the immediate area where the Entrant will be present; and
   - Position the fresh air intake in a clean air zone away from all combustion sources (i.e. vehicle exhaust).
   - Retest Air

9. Respiratory Protection. The Entrant should consider potential inhalation exposures (only at a nuisance level, e.g., sewage mists/vapors etc.) prior to each entry and may decide to use respiratory protection. The filtering respirators shall eliminate most odors and filter out particulate mists.

10. Electric. The Entrant must ensure that only double insulated electric tools or tools on a ground fault circuit interrupter system are used and all portable lights and tools are explosion proof where a potential flammable atmosphere exists

11. Records. At completion of the entry, the Entrant shall retain the checklist and written certification of air testing for ultimate transfer to the project file.

CONFINED SPACE ENTRY POLICY – January 2007

Revised By: ______________________________ Date: _____________

Dennis Hanzlick, Anchor Health and Safety Manager

Reviewed By: ______________________________ Date: ______________

David Templeton, Anchor Partner

Approved By: ______________________________ Date: _____________

David Templeton, Anchor Partner

Appendix A – Gas Meter Chart

	Oxygen	Methane	HydrogenSulfide	Carbon Monoxide
Meter Reading	% O_2	LEL CH_4	ppm H_2S	ppm CO
Safe Level	Normal = 20.9% Minimum = 19.5% Maximum = 23.5%	< 10% of LEL	< 10 ppm	< 35 ppm
Hazard/Health Effects	16% - fast breathing, drowsiness, nausea 12% - unconscious 6% - death	Explosive	50 ppm – eye irritation, headache, fatigue 100 ppm – deadens sense of smell in 3 min.; coughing, burning eyes & respiratory tract. 500 ppm – respiratory disturbances in 2-15 min.; strong irritation of eyes; dizziness, collapse 1000 ppm - immediate unconsciousness after 1 breath, death in 3-5 minutes	50 ppm – increases risk of heart attack esp. in people working hard 500-1000 ppm – Headache, rapid breathing, nausea, weakness, dizziness, mental confusion 4000 ppm - coma

Attachment A – Example of Multiple Copy Form – Do not Use

ANCHOR ENVIRONMENTAL, L.L.C.
CONFINED SPACE ENTRY AUTHORIZATION

Date:__________________ Permit Duration: From ___________ to ___________ Project # ______________________________

Project Manager: __________________________________ Project Inspector: ____

Contractor Name: __________________________________ Contractor Rep: ____

Space Location: ____

Brief Description of Work: ____

____

____

CHECKLIST OF SAFEGUARDS: *(Check those that are applicable.)*

POTENTIAL HAZARDS FOR THIS PROJECT

Biohazard	Engulfment	Industrial Area	*Other Hazards/Exposures*
Toxic (H_2S,CO)	Stored Energy	Falls	____________________
Corrosive/Chemicals	Electrical Hazards	Noise	____________________
Flammable (LEL)	Mechanical Hazards	Traffic	____________________
Oxygen Levels	Structural Hazards	Hot Work	____________________
Radioactive			

SAFETY PRECAUTIONS/PERSONAL SAFETY

Procedures	*Personal Safety Equip.*	*Energy Isolation*	*Fire Safety*
Bureau Procedure	Hard Hat	Tag and Lockout	Fire Hose Laid Out
Communication	Eye Protection	Lines/Valves Blocked	Extinguisher Available
Entry Coordination	Hearing Protection	Public Access	
Contractor Debrief	Foot Protection		*Other Precautions*
Permit Posted	Hand Protection		____________________
Atmosphere Tests	Protective Clothing	*Electrical Safety*	____________________
Ventilation	SCBA	Explosion Proof	____________________
Traffic Control	Respirator	Sparkless Tools	____________________
Pedestrian Safety	Tripod/Harness	Welding Protection	____________________
Rescue Plan	Lighting	G.F.C.I.	____________________

NOTE: There may be additional hazards associated with this confined space not covered by this checklist. This document is advisory only! The contractor shall be responsible for the safety of his/her employees and must comply with OR-OSHA 1910.146 Confined Space Entry Standards.

NOTES:____

____

____

____

Signatures: ____ ____

(Project Manager) (Contractor)

COPIES: White: Project Manager Yellow: Contractor Pink: Mike Reiner B310

Attachment B - Example of Multiple copy Form – Do not Use

ANCHOR ENVIRONMENTAL, L.L.C.
CONFINED SPACE ENTRY PERMIT

Date:_________________

Entry Notifications:
☐ Operations ☐ Maintenance ☐ Contractor ☐ Other

Time:________________ am / pm

Description of Work Area and Work to be Performed ______________________________

Work Group/Division ______________________________

POTENTIAL HAZARDS FOR THIS ENTRY

			Other Hazards/Exposures
☐ Biohazard	☐ Engulfment	☐ Industrial Area	☐ ________________
☐ Toxic (H_2S,CO)	☐ Stored Energy	☐ Falls	☐ ________________
☐ Corrosive/Chemicals	☐ Electrical Hazards	☐ Noise	☐ ________________
☐ Flammable (LEL)	☐ Mechanical Hazards	☐ Traffic	☐ ________________
☐ Radioactive	☐ Structural Hazards	☐ Hot Work	

SAFETY PRECAUTIONS/PERSONAL SAFETY

Procedures	*Personal Safety Equip.*	*Energy Isolation*	*Fire Safety*
☐ Emergency Rescue Plan	☐ Hard Hat	☐ Tag and Lockout	☐ Fire Hose Laid Out
☐ Communication	☐ Eye Protection	☐ Blanking/Bleeding	☐ Extinguisher Available
☐ Entry Coordination	☐ Hearing Protection	☐ Disconnecting	
☐ Attendant	☐ Foot Protection	☐ Pumping	*Other Precautions*
☐ Permit Posted	☐ Hand Protection		☐ Traffic Control
☐ Atmosphere Tests	☐ Protective Clothing	*Electrical Safety*	☐ Public Access
☐ Ventilation	☐ Respirator	☐ Explosion Proof	☐ Barricades/Cones
☐ Traffic Control	Type:_______________	☐ Sparkless Tools	☐ Opening Guarded
☐ Pedestrian Safety	☐ Fall Protection/Block	☐ Welding Protection	☐ Radio/Cellular Phone
☐ Training	☐ Tripod	☐ G.F.C.I.	available
☐ CPR/First Aid	☐ Harness/Lifeline		
☐ Hot Work			

CONFINED SPACE ATMOSPHERE ANALYSIS

METER #:___________ EXPIRATION DATE:________________ CHECK FOR ANY ALARM:_______

PARAMETER		TEST LOCATIONS				EXPOSURE		METER	ALARMS
		Sniff	Top	Middle	Bottom	Dose	Peak	Alarm Pts.	YES/NO
Oxygen	(%)	_____	_____	_____	_____	______	______	(+)or(-)19.5%	__________
Explosivity	(LEL)	_____	_____	_____	_____	______	______	(>)or(=)10%LEL	______
Carbon Monoxide	(ppm)	_____	_____	_____	_____	______	______	(>)or(=)35ppm	________
Hydrogen Sulfide	(ppm)	_____	_____	_____	_____	______	______	(>)or(=)10ppm	________

ENTRY SUPERVISOR: (Print) Name/Title______________________________ Date____________

ENTRANTS: Name(s)______________________________

ATTENDANTS: Name(s)______________________________

ENTRY SUPERVISOR SIGNATURE:______________________________

EMERGENCY NOTIFICATION:

☐ Call 911 ☐ Division Mgr. Ph.# ________________

☐ Safety/Loss Control Ph# 823-5509 ☐ Source Control Duty Officer Ph.# 823-7180

***COPIES**: **White**: Post at job site **Yellow**: Submit to Daily Lead **Pink**: Submit to Records/B310*

Attachment C

Pre-Entry Checklist

Date & Time of Entry: Location of Entry:

CHECKLIST	Y	N	N/A
1. Has the gas monitor been calibrated within the last 30 days?			
2. Did you fresh-air calibrate the monitor prior to conducting atmospheric tests?			
3. When monitored, was the atmosphere acceptable (no alarms given)? Please note levels. _______O_2 Level _______LEL Level _______H_2S Level _______CO Level			
4. Will the atmosphere be continuously monitored while space is occupied?			
5. Is there sufficient ventilation to keep the atmospheric conditions safe?			
6. Could the atmosphere change based on the nature of the work being conducted in the space (hot work, painting, coatings, etc.)?			
7. Are openings adequately guarded against accidental falls into the space?			
8. Are there barriers around the opening to prevent unauthorized entry?			
9. Have all energy sources been locked and tagged?			
10. Are pumps, valves, and lines disconnected, bled, or blocked?			
11. Have attendants/entrants/entry supervisor been trained and understand their duties/responsibilities?			
12. Is the appropriate safety equipment being used? (PPE, lighting, safety block, etc.)			
13. Have communication procedures been reviewed and understood by everyone?			
14. Have rescue procedures been reviewed and understood by everyone?			
15. Are adequate traffic control measures being taken?			
16. Is access/egress into the confined space **less** than 20 ft. in height?			
17. Has a review of the history for the confined space revealed a potential for sudden changes that could lead to sudden unexpected hazardous conditions?			
18. Can all the identified hazards be controlled?			

NOTE: If you checked any shaded area of the checklist, the space is automatically Permit-Required.

Non-Permit
Permit-Required

Print Name:____

Signature: ____
(Entry Supervisor)

PERMIT-REQUIRED: Complete Entry Permit as outlined in Procedures.
NON-PERMIT: Post Checklist at Job site. If entering space without an attendant contact your supervisor prior to entry and inform them when you should be out of the space. When entry is complete, contact your supervisor and forward checklist to Admin, Front Office at B31

Note for construction activities: If an entry is made in an area where contract personnel or members of the public could impact the safety of entrants an attendant must be present. Revised Aug 2000