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*Final*

# **Sediment Sampling and Analysis Plan**

## **St. Johns Landfill Remedial Investigation**

Prepared for

**Metro**

September 2006

Prepared by

**CH2MHILL**



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# 1.0 Introduction

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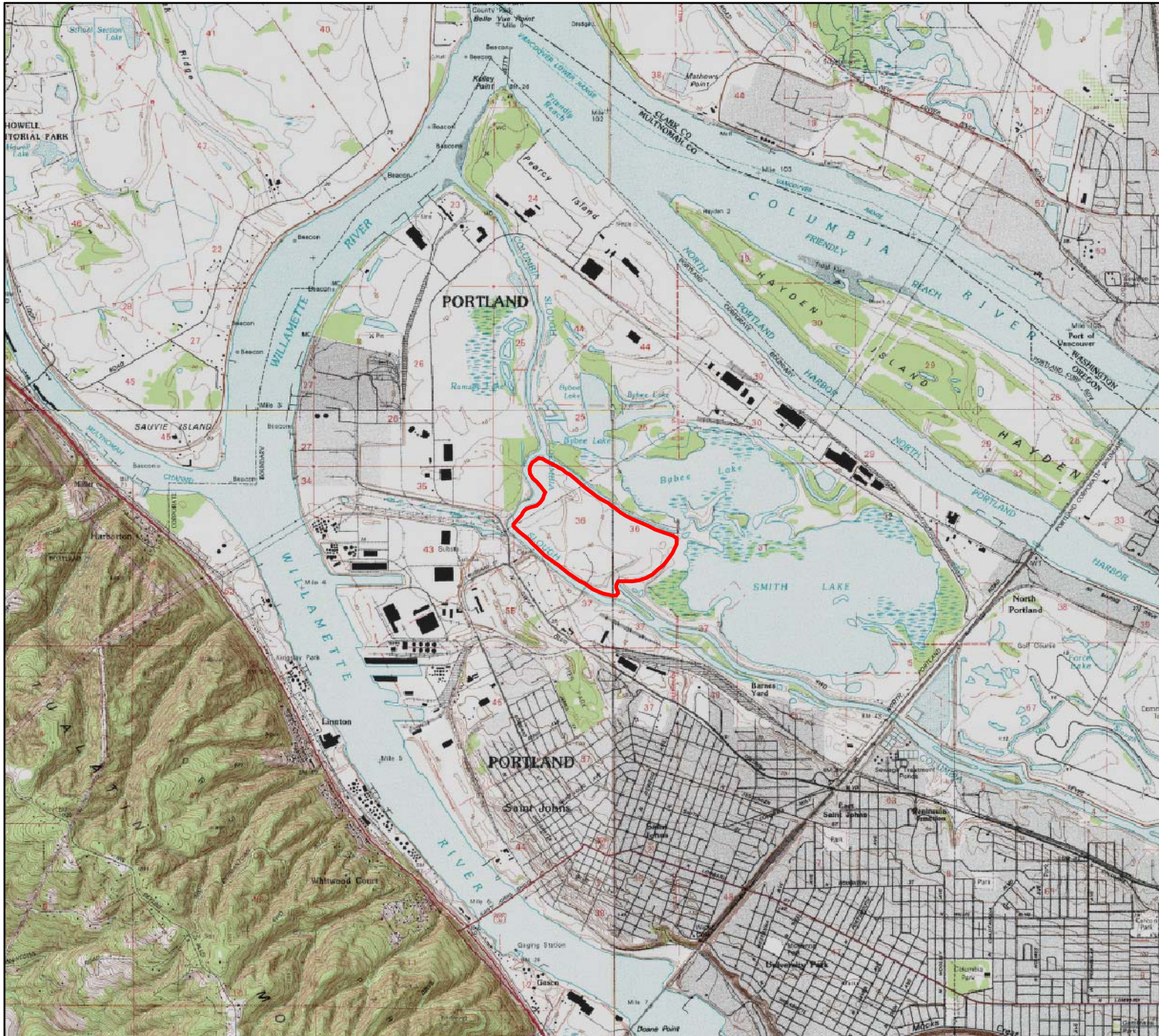
This Sampling and Analysis Plan (SAP) was prepared by CH2M HILL on behalf of Metro to address objectives of the St. Johns Landfill remedial investigation (RI). The purpose of this SAP is to provide a detailed description of the sampling program and directions for field and laboratory activities associated with the characterization of current sediment conditions.

## 1.1 Purpose and Background

The St. Johns Landfill is located at 9363 North Columbia Boulevard in north Portland, Oregon, and occupies approximately 236 acres (Figure 1). The site is bound by North Slough to the north and the Columbia Slough to the south and west. Smith and Bybee Wetlands (Lakes) are situated immediately east and northeast of the landfill, respectively. Blind Slough borders a portion of the southeast portion of the landfill (Figure 2).


The City of Portland operated the landfill from 1932 to 1982. The landfill stopped accepting municipal waste in 1991 and is currently under an Oregon Department of Environmental Quality (DEQ) Solid Waste Closure Permit. Metro has assumed responsibility for the site and has constructed several engineering controls to prevent landfill leachate migration.

This SAP provides the approach and rationale for collecting and analyzing sediment samples adjacent to the landfill site. Sampling will be conducted to obtain both surface and core sediment samples at representative locations. The analytical results for these samples will be used to characterize sediment quality in the vicinity of the landfill. This characterization will provide a basis for determining if contaminants that may be associated with the landfill pose potential risk (current or future) to human health or the environment. The characterization will also support the development of a St. Johns Landfill Feasibility Study (FS), if needed.



**Figure 1**  
**St. Johns Landfill**  
**Site Location**

**LEGEND**

 St. Johns LF



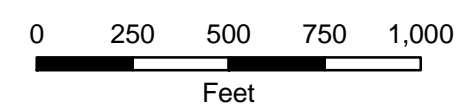
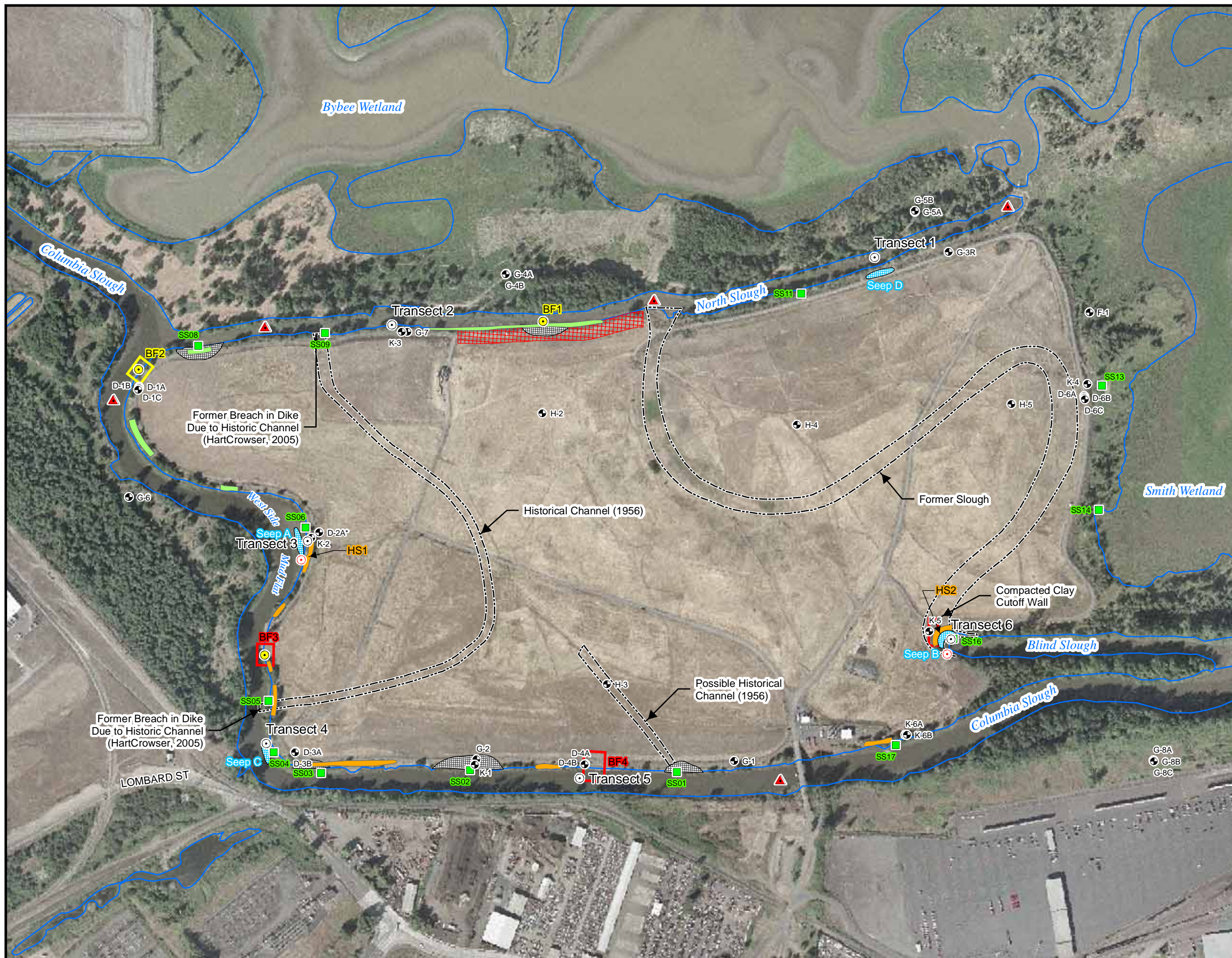
0 2,000 4,000  
 Feet



## Figure 2 Sediment Sample Locations

### Legend

- Active Well Locations
- ⊖ Historical Drainage Channels (HartCrowser, 2005)
- ⊖ Water Feature Boundary
- 2006 Proposed Sediment Samples**
- ▲ Surface Sample Locations (City, 2006)
- ⊖ Core at Transect Locations (METRO, 2006)
- Core at Bank Failure Locations (METRO, 2006)
- ⊖ Core at Historical Seep
- 2005 Soil/Sediment Samples**
- Sediment Soil Sample Location on Landfill Rim (METRO, 2005)
- Bank Failure Areas**
- Bank Failure (HartCrowser, 2005)
- 1996 Bank Failure (METRO Personal Comm, 2006)
- ▨ Cutoff Wall Installed and Rim Soil Replaced (HartCrowser, 2005)
- Recent Seep Areas**
- ⊖ HartCrowser, 2005
- Historical Seep Areas**
- Cornforth, 1991
- Cornforth 1991, and METRO, 1994
- ⊖ HartCrowser, 2005



# 2.0 Project Description

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## 2.1 Objectives

The objective of the sediment characterization program is to determine if constituents of potential concern are present in sediments adjacent to the landfill at concentrations that may pose unacceptable risks to humans or the environment. This objective will be achieved using an iterative, or “observational”, approach. The first step of this approach, described in this document, will consist of the following:

- Evaluating current sediment/soil sample locations and data collected from the landfill perimeter in 2005 as part of this RI
- Collecting sediment samples from both surface and subsurface locations
- Collecting surface and subsurface sediment samples in twelve areas of observed or historical seeps to evaluate “worst case” conditions involving possible seepage from the landfill
- Collecting five surface sediment samples at mid-channel of the Slough consistent with the City of Portland’s current monitoring program for the Columbia Slough
- Obtaining analytical results for the baseline risk assessment.

The need for additional sediment sampling will be determined based on a review of data collected under this plan and in previous sampling efforts. Further evaluation of sediments may be needed to support the RI/FS if constituents of potential concern are present at levels of concern. The sediment component of the RI/FS will be considered complete if laboratory data from sediment sampling indicates that constituents of potential concern are below:

1. detection limits described by this SAP, and or
2. concentrations described in the DEQ Level II screening-level values for freshwater sediments

The need for additional sediment sampling will be determined in coordination with DEQ, following review of analytical data from sampling conducted under this SAP and other relevant data.

## 2.2 Existing Data and Data Gaps

Available sediment data from previous studies conducted in the lower Columbia Slough were evaluated for potential use in characterizing sediments near the landfill. Results of this evaluation were summarized in a memorandum prepared by CH2M HILL dated May 3, 2006. This evaluation addressed the potential for historical data to meet RI/FS project objectives. The results are summarized in the following subsections.

## 2.2.1 Existing Data

The evaluation of historical data identified existing datasets that were potentially useful in characterizing the sediments at St. Johns Landfill.

### Metro Dataset

Surface sediment samples have been collected annually from 1993 to the present (except 2004) as part of Metro's voluntary sediment monitoring program. Five locations adjacent to the landfill have been routinely sampled (see Attachment A):

- S-13 (located in Columbia Slough)
- S-17 (located in Blind Slough)
- S-3, S-12, S-4 (located in North Slough)

These samples were analyzed for metals, SVOCs, herbicides, pesticides, and PCB Aroclors. These samples provide a useful time series in specific locations.

Sediment/soil samples around the landfill perimeter were collected by Metro in summer 2005. Sampling was conducted to obtain data on potential contamination that may be present in the sediment/soil around the landfill at strategic locations. Samples were collected at 13 locations between the vegetation line and the water's edge when water levels in the slough were at seasonal low levels. Locations of the 2005 perimeter sediment/soil samples are shown in Figure 2.

### Union Carbide Dataset

Union Carbide collected and analyzed 21 surficial and three sediment core (e.g., 0- to 3-foot depth interval) samples in 2001 from the Columbia Slough adjacent to its facility outfalls (Attachment A). The sampling area was located in Columbia Slough adjacent to the south side of the St. Johns Landfill site. The samples were analyzed for metals, cyanide, SVOCs, PCB Aroclors, pesticides, and conventional sediment parameters. The proximity to the landfill and the use of core samples may provide some value for the Metro landfill investigation.

### Columbia Slough Columbia Slough Sediment RI/FS

In 1994, the City conducted a detailed characterization of sediments in Columbia Slough, collecting samples at 124 locations. During that study, a number of samples were collected immediately upstream, adjacent to, and downstream of the landfill (Attachment A). These samples were analyzed for metals, SVOCs, herbicides, pesticides, and PCB Aroclors. This data set is now 12 years old, and potential changes that have occurred during intervening flooding events make these data questionable for inclusion in the present investigation. However, the spatial coverage makes them useful in assessing patterns over space and time.

## 2.2.2 Data Gaps

The following conclusions were drawn from the historical data evaluation:

- The primary limitations in the existing data sets are the lack of temporal and spatial representativeness; sample results do not allow a characterization of current, representative sediment conditions. Given recent flooding events and numerous potential sources of contamination to the Columbia Slough, a current data set representative of the St. Johns Landfill is needed.

- Existing surface sediment data are limited in spatial distribution and are not adequate to characterize the current nature and extent of sediment concentrations and/or potential sources of sediment constituents in the vicinity of the St. Johns Landfill.
- Existing sediment core data are limited in number and in spatial distribution and are not adequate to characterize the nature and extent of sediment contamination and/or potential sources of sediment contamination in the vicinity of the St. Johns Landfill.

The following sampling program is based on the evaluation of historical data, an observational approach for sediment sampling discussed by the Metro and DEQ project teams in a meeting held May 11, 2006 and subsequently on September 7, 2006, and discussions between Metro and City of Portland staff responsible for the City's sediment monitoring program for Columbia Slough.

## 3.0 Sampling Program

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This section provides a description of the proposed sampling program. The program involves two primary activities:

- Collection of surface sediment samples to determine the presence or absence of contamination associated with the landfill and whether there is a potential for unacceptable risk under current conditions.
- Collection of subsurface sediment samples to determine the presence or absence of contamination associated with the landfill and whether there is a potential for unacceptable risk under future conditions (i.e., in the event that deeper sediment becomes exposed), or for subsurface sediments to affect pore water quality now or in the future.

Samples will be collected at the locations shown in Figure 2.

### 3.1 Sample Location Selection Criteria

The following factors were used to select locations for surface and core sediment samples.

**Current Seeps:** Areas where seepage has been observed since completion of the landfill cover project. Core and surface samples will be collected at each of the current seep locations at St. Johns Landfill. Seeps at Blind Slough and the Westside Mudflat have been identified as areas of concern by DEQ, and two surface and core samples will be collected at each of these areas. These paired samples will be located parallel to the shoreline and the new (non-transect) sample will be located in the field to provide representative coverage of historical and current seep areas.

**Historical Seeps:** Areas where seepage was observed prior to completion of the landfill cover project. Virtually all historical seep areas were sampled in 2005 or will be sampled in this effort.

**Bank Failures:** Areas where the perimeter dike slumped. In some of these areas land filled materials were exposed prior to dike repair. Core and surface samples will be collected at each of the bank failure/repair areas.

**Shallow Groundwater Wells:** Core and surface sediment samples will be collected adjacent to most shallow groundwater wells.

**Historical Channel Intersection:** Areas of potential preferential flow pathways and potential indicators of weak areas in the dike. Core and/or surface samples will be collected in these areas.

**Pore Water Sampling Stations:** Locations where pore water samples were obtained for laboratory analysis in fall 2005 and spring 2006. Core and surface samples will be collected at all locations with the exception of Transect 7 in Smith Wetlands, where there is standing water for only a few months of the year, if at all.

**Geographic Coverage:** Areas where sediment samples have not been collected and no known potential release mechanisms are present. Surface samples will be collected to achieve balanced geographic coverage.

## 3.2 Surface Sediment Sample Collection

A total of 16 surface samples will be collected around the landfill. Five of the 16 surface samples will be collected by the City of Portland in accordance with the City's *Sampling and Analysis Plan for the Collection and Processing of Bulk Sediment Samples in Columbia Slough* (June 2006). The City's plan identifies five surface sediment sample locations in mid-channel of the lower Slough adjacent to the landfill (Figure 2).

The remaining surface samples will be collected by CH2M HILL on behalf of Metro in accordance with this SAP. These samples will be co-located with core sediment samples as described in Section 3.3.

Surface samples will be collected from the top ten centimeters (cm) of the sediment for both the mid-channel samples collected by the City and the locations closer to the landfill to be collected by Metro. The top ten cm is a "reasonable estimate of the biologically-active zone" (PSEP, 1997).

Methods to be used for collecting surface samples are detailed in Section 4.

## 3.3 Core Sediment Sample Collection

A total of eleven subsurface locations will be sampled at two depth intervals (2-4 feet and 4-6 feet below mudline) each by CH2M HILL. These samples will be collected at previous transect locations described in Section 3.3.1 and at specific points of historical seeps or bank failures, as shown in Figure 2.

Table 3-1 identifies the sample selection criteria applicable to each sample location.

The method for subsurface sampling will involve advancing coring device to six feet below the mudline at each sampling location. Details of subsurface sampling methods are provided in Section 4.

TABLE 3-1  
Core Sediment Sample Selection Criteria

	Location	Seeps		Bank Failure	Proximity to Shallow GW wells	Historical Channel Intersection
		Historical	Current			
Core at Transect*	T1		✓			
	T2				✓	
	T3	✓	✓		✓	
	T4		✓			
	T5			✓	✓	
	T6	✓	✓	✓	✓	✓
Core at Historical Seep	HS1	✓	✓			
	HS2	✓	✓	✓	✓	✓
Core at Bank Failure	BF1	✓		✓	✓	
	BF2			✓	✓	
	BF3		✓	✓		

\* Sample is co-located with pore water sampling station.

### 3.3.1 Pore Water Sampling Stations

Six core samples will be collected at locations previously sampled for pore water at low and high water conditions in fall 2005 and spring 2006. During both high water and low water conditions, pore water parameters (conductivity, temperature, dissolved oxygen, redox potential and pH) were analyzed from three locations within a transect of the slough: shoreline (Point A); mid-channel (Point C); and half-way between shoreline and mid-channel (Point B). Pore water parameters were measured approximately two and a half feet below the sediment surface. Water samples were collected for laboratory analysis from the point at each transect, during both low and high water conditions, where conductivity was highest (indicating the greatest potential for leachate to be present).

Results from pore water conductivity and laboratory analysis were evaluated to determine which point should be sampled for sediment quality. No apparent correlation was evident between results of either conductivity or laboratory data and water levels (or points sampled at low and high water level conditions). Absent an apparent correlation, sampling points for sediment were selected based on the previously-sampled points closest to the landfill. In the absence of other indicators, sampling points closer to the landfill are considered more likely to identify potential releases of landfill constituents. Selected sediment sampling stations and the corresponding pore water sampling events are shown in Table 3-2.

TABLE 3-2  
Pore Water Sample Stations

Location	GIS Coordinates		Transect	Point	Pore water Sampling Event
North Slough	45.615689	122.746610	T1	A	Low water
North Slough	45.619317	122.755146	T2	B	High water
Columbia Slough	45.617673	122.759273	T3	A	High water
Columbia Slough	45.615795	122.762552	T4	B	Low water
Columbia Slough	45.612567	122.758023	T5	A	Low water
Blind Slough	45.610744	122.750333	T6	B	High water

### 3.4 Sediment Sample Analysis

Table 3-3 identifies the constituents to be analyzed for this investigation. The list of analytes included in the City's sampling program, as proposed to DEQ in their June 2006 SAP, is also presented for comparison. Discussions between Metro and DEQ regarding this SAP also addressed several analytical parameters not included in the analyte list. These parameters are discussed further below.

Volatile organic compounds (VOCs) were analyzed in pore water samples collected during both seasonal low and high water conditions, in 2005 and 2006 respectively, at six locations (sampling in 2006 also included a seventh location at Smith wetland.) Analytical results showed that VOCs were largely not detected in pore water. Of three detections, two (1,4-dichlorobenzene and chlorobenzene) were well below DEQ's screening values for ecological risk. The third detection (toluene) was slightly above the aquatic SLV, but exhibits several characteristics of a false positive detection. Pore water sampling provides a representative method of assessing VOC mobility in sediment, and if necessary will be used in conjunction with data from nearby groundwater wells to further assess shallow groundwater quality.

Cyanide was detected in the 2005 and 2006 pore water sampling, and was detected in six sediment samples collected by Metro in conjunction with City of Portland sampling in 1994 around the St. Johns landfill and Smith and Bybee Wetlands. Cyanide concentrations were similar at all six of Metro's sampling locations. The reducing environment of sediments in the area is conducive to the natural formation of cyanide, and experience with sampling for cyanide at another site (Reynolds Metals Company, Troutdale) demonstrates the strong likelihood for cyanide to be present in the nontoxic metal-complexed form. Cyanide issues will be addressed through evaluation of representative pore water sampling data and relevant leachate and shallow groundwater data. Additional data will be collected, if necessary, by sampling pore water and/or shallow groundwater.

Iron and manganese were analyzed in pore water samples as indicators of reducing conditions that could be created by the degradation of organic compounds in the landfill (but can also be present at elevated levels by naturally-occurring reducing conditions), and

were detected at levels above screening values. Dissolved iron and manganese at elevated levels can be water quality concerns, and are best addressed by evaluating pore water and/or shallow groundwater data.

TABLE 3-3  
Analytes for Surface Sediment Samples Collected by the City and Metro

	<b>City</b>	<b>Metro</b>
<b>Metals:</b>		
Antimony	X	X
Arsenic	X	X
Cadmium	X	X
Chromium	X	X
Copper	X	X
Lead	X	X
Mercury		X
Nickel	X	X
Silver		X
Zinc	X	X
PCB Aroclors	X	X
Pesticides	X	X
Herbicides		X
Total Solids	X	X
Total Organic Carbon (TOC)	X	X
Semi Volatiles (PAHs and Phthalates)	X	X
Petroleum Hydrocarbons	X	X
Grain Size	X	X
Field Measurements (Eh and pH)	X	X

# 4.0 Sampling Procedures

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This section describes sampling location and identification, sampling methodology, decontamination procedures, field quality control, sample handling and custody, field schedule, and documentation associated with this project.

The procedures and methods described below for sampling surface sediments are applicable to the samples that will be collected by CH2M HILL and are generally consistent with those described in the City's SAP for the Columbia Slough.

## 4.1 Sampling Location / Identification

Sediment sampling locations are shown in Figure 2. As described in section 3 surface samples to be collected by the City will be located and identified consistent with the City's SAP for Columbia Slough.

Sampling locations will be logged with a sub-meter global positioning system (GPS) with differential correction. Whenever possible, measured distances from identifying features will also be included to help define sampling locations. Sample locations will be identified consistent with previous pore water sampling; in other words, the location identified as Transect 1 for pore water sampling will also be named as Transect 1 for surface and subsurface sediment sampling.

## 4.2 Sample Collection

Sediment sampling locations will be reached by the method most practical for each location, including using a boat, wading, or access from land depending on site conditions and the water level of the slough.

The following procedures apply to all samples:

- Decontaminate all sampling equipment before, and all non-disposable sampling equipment before and after use, to prevent cross-contamination of the samples.
- Label the filled sample containers with the project name, sample number, date and time of collection, and sample collector's initials.
- Place the labeled sample in a cooler maintained at a temperature not to exceed 4°C throughout the sampling and transportation period. All ice shall be double-bagged in Ziploc® bags.
- A chain-of-custody form will be completed, sealed in a plastic bag, and taped to the inside lid of the cooler. The cooler will be sealed with fiber-reinforced tape and delivered to the laboratory within 24 hours of sample collection. To retain sample custody, the samples are to remain in sight of field personnel or in a locked location at all times until

they are shipped or delivered to the laboratory. The cooler will be sealed with signed custody seals such that the seal would be broken should the cooler be opened.

Field measurement for reduction-oxidation (redox) potential (Eh) and pH will be obtained and recorded for each sample collected. These field measurements will support the understanding of the mobility of metals and the fate of organic materials at the sample location.

Sediment Eh and pH will be measured at each sample location using a modification of EPA Method 9045D.

1. A volume of sediment equal to approximately 20 grams (g) will be collected and placed into a 50 milliliter (ml) beaker.
2. A volume of 20 ml of deionized water will be added to the beaker. If the sample contains greater than approximately 20% by volume of liquid, the volume of deionized water in the beaker will be adjusted to compensate for the volume of collected pore water.
3. The beaker will be stirred for approximately 5 minutes then allowed to settle for a minimum of 15 minutes.
4. A calibrated multimeter probe will be lowered into the solution. The pH and Eh reading will be recorded in the field notebook.

#### **4.2.1 Surface Sediment Sample Methodology**

Sampling locations will be recorded with a sub-meter GPS unit with differential correction. Whenever possible, measurements to nearby reference points will also be made.

Surface sediment samples will be collected in the top 10 cm of the sediment. Bulk surface sediment grab samples will be collected using either a Ponar dredge sampler, sampling spoon, or hand auger depending on the depth of the water at the time of sampling. If the Ponar sampler is used, it will be checked when recovered to determine if it closed completely or if a complete sediment sample is present – if not, the sampling will be repeated at a location slightly upstream.

The depth of the water column, time, and date will be noted in a field notebook for each sample. Sample material will be placed in a stainless steel bowl where it will be allowed to sit for two minutes, and then excess water will be decanted from the bowl. The sample will be thoroughly homogenized and placed into properly labeled laboratory-supplied sampling containers. Non-disposable equipment will be thoroughly decontaminated between sampling locations. To avoid sediment carry-over between locations, sampling will commence at the downstream sample locations and proceed in an upstream direction.

#### **4.2.2 Core Sediment Sample Methodology**

Coring will yield samples from depth intervals of 2 to 4 feet and 4 to 6 feet below mudline. A representative sample will be collected from material obtained in the 2- to 4-foot and 4- to 6-foot intervals.

Sediment sampling conditions at each of the sample location may vary from dry to moist sediments above the current waterline to wet sediments below the waterline. The field methodologies for sample collections under each of these conditions are as follows:

- Dry or moist sediment above the waterline will be accessed from the shoreline and the samples will be collected using a hand auger.
- Wet sediment above or near the current waterline will be accessed from the shoreline and the samples will be collected using 3- or 4-inch-diameter PVC pipe as a coring device. The pipe will be decontaminated and inserted vertically into sediment to a depth of 6 feet. A cap will then be placed on the top end of the pipe and the pipe and sediment core will be removed.
- Wet sediment below the waterline will be accessed by wading or by boat and the samples will be collected using a hand auger in a 3- or 4-inch PVC pipe as a boring casing. The pipe will be inserted vertically into the sediment. Water will be pumped or bailed out of the casing. A decontaminated hand auger will then be used to bore into the sediments. The PVC pipe will be advanced to hold the boring open. Alternately, a smaller diameter PVC pipe may be inserted in the casing, capped, and the sediment core removed.

The depth of the water column, time, and date will be noted in a field notebook for each sample. Sample material will be placed in a stainless steel bowl where it will be allowed to sit for two minutes, and then excess water decanted from the bowl. The sample will then be thoroughly homogenized and then placed into properly labeled laboratory-supplied sampling container bottles. Non-disposable equipment will be thoroughly decontaminated between sampling locations. To avoid sediment carry-over between locations, sampling will commence at the downstream sample locations and proceeded in an upstream direction.

### 4.3 Equipment Decontamination

To prevent cross-contamination between samples, all reusable sampling equipment will be decontaminated before each use and before demobilization and between uses (specifically between collection of discrete new samples).

Whenever practicable, new, disposable sampling equipment will be used to collect each sample to eliminate the need for decontamination.

Sampling equipment (i.e. Ponar, spoons, bowls) will be decontaminated as follows:

1. Wash visible soil and material from equipment with tap water.
2. Scrub equipment with a brush using non-phosphate detergent (Alconox) solution in tap water.
3. Rinse with thoroughly with tap water
4. Rinse with methanol.
5. Rinse with tap water.

6. Rinse with deionized water.
7. Rinse with *in situ* water by repeatedly submersing the sampling device overboard.

After decontamination, sampling equipment will be protected from recontamination. Any sampling equipment suspected of recontamination will be decontaminated again or rejected. Because core sampling is being conducted, extra sampling tubes will be available onsite to prevent interruption of operations if contamination of a sampling tube occurs.

## 4.4 Field Quality Control Samples

### 4.4.1 Duplicate Samples

To ensure quality control, approximately 10 percent of the samples collected will be split and submitted to the lab under different sample identification numbers as field duplicates. Supplemental sample material will be collected at locations or intervals where duplicates will be obtained to ensure adequate material is available. Duplicate samples will be collected and handled as any other sample. The samples will be thoroughly homogenized before being placed in laboratory-supplied jars. The duplicate samples will be analyzed for the full suite of analytes identified in Table 3-1.

### 4.4.2 Equipment Blanks

One equipment blank of rinsate will be collected from the sampling equipment to ensure proper decontamination of equipment and maintain an appropriate level of quality control.

After decontamination but just prior to collecting a sample, the sampling equipment will be rinsed with distilled water. This rinse water will be collected and placed in a laboratory-supplied sample jar for analysis, and the jar will be labeled appropriately and treated as any other sample.

## 4.5 Sample Handling and Custody

The sampling container, preservation, and holding time requirements are listed by analyte in Table 4-1. Pre-cleaned containers, laboratory-prepared with preservation, will be procured from the analytical laboratory. All samples will be held at 4°C in a cooler until delivery to the laboratory.

A chain-of-custody form will be completed, sealed in a plastic bag, and taped to the inside lid of the cooler. The cooler will be sealed with fiber-reinforced tape and delivered to the laboratory within 24 hours of sample collection. To retain sample custody, the samples are to remain in sight of field personnel or in a locked location at all times until they are shipped or delivered to the laboratory. The cooler will be sealed with signed custody seals such that the seal would be broken should the cooler be opened.

TABLE 4-1  
Sediment Sample Method, Container, Preservation, and Holding Times

Minimum Volume Parameter	Analyte	Method	Sample Container	Preservative	Holding Time (days)
Metals (100g)	Ag, As, Cd, Cr Cu, Ni, Pb, Sb, Zn	EPA 6020	8 oz jar	4° C	180
	Mercury	EPA 7471A	8 oz jar	4° C	28
PCBs (250g)	For analyte list see Table 6-1	EPA 8082	8 oz jar	4° C	14
PAHs (250g)	For analyte list see Table 6-1	EPA 8270M-SIM	8 oz glass jar/PTFE seal	4° C	14
Phthalates (250g)	For analyte list see Table 6-1	EPA 8270M-SIM	16 oz jar	4° C	14
Pesticides (250g)	For analyte list see Table 6-1	EPA 8081A	8 oz jar	4° C	14
Herbicides (100 g)	For analyte list see Table 6-1	EPA 8151A (modified)	8 oz jar	4° C	14
TOC (50 g)		EPA 9060M	8 oz jar	4° C	28
TPH (250g)*	For analyte list see Table 6-1	NWTPH HCID	8 oz jar	4° C	14
SVOCs (250g)	For analyte list see Table 6-1	EPA 8270C	8 oz glass jar/PTFE seal	4° C	14
Grain Size			32 oz jar	default	180

\* = NWTPH-Gx or NWTPH-Dx if detect.

#### 4.5.1 Sample Volumes

Approximately three quarts of sediment material will be necessary to fill the required containers at each sampling station. Adequate sample material should be obtained before homogenization to ensure that all analytical procedures are conducted on the same mixed material. If sediment volumes are not adequate to meet volume requirements, additional material should be obtained adjacent to the first sample location until an adequate volume of material is available. Homogenization should then follow. Decontamination between sampling grabs before homogenization is not necessary.

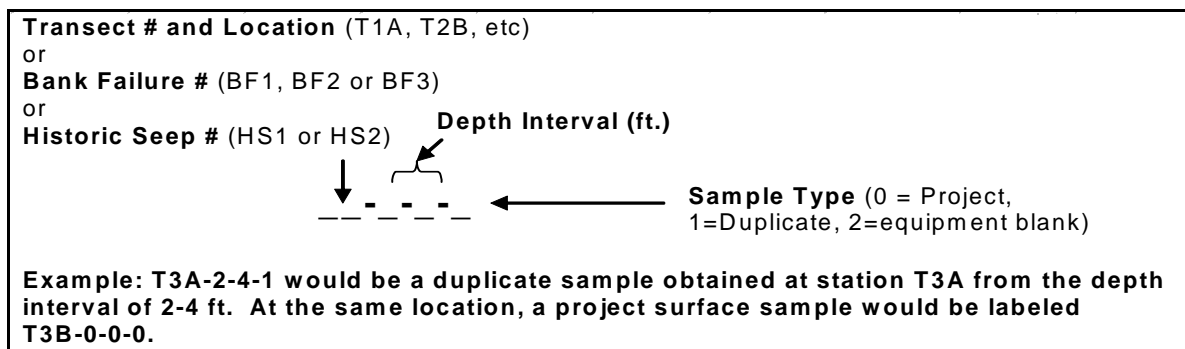
#### 4.5.2 Sample Labels

Before collection of a particular sample, all the containers needed for the different parameters to be analyzed should be properly labeled.

The following information should be included on the sample label:

- Project name (St. Johns Landfill)
- Sample ID – unique identification for each sample (see below)
- Date sampled
- Time sampled (in military time)
- Initials of sampler(s)

Sample ID for this investigation will adhere to the following nomenclature:



### 4.5.3 Chain-of-Custody Record

The chain-of-custody form is a vital document for all samples collected and must be properly completed. It serves as a record of sample collection information, analysis requests, and sample tracking. It is a crucial record from the time of sample collection to final reporting and decision-making. Chain-of-custody forms will be obtained from the laboratory receiving the samples at the same time as the sample jars. Information that must be recorded on the chain-of-custody form at the time of sample collection includes:

- Project name
- Project number
- Project manager's name
- Sample date
- Sample time
- Sample ID – unique for each sample
- Number of containers for each sample
- Analysis to be run for each sample
- Special analytical requests – i.e., fast turnaround requirements
- Sampler's name
- Laboratory name
- Special reporting requests – attach the list of analyte reporting limits requested for each method" (Table 6-1)

### 4.5.4 Sample Custody

Sample possession will be traceable from the time of sample collection until receipt of the samples at the analytical laboratory. Sample possession will be documented according to the chain-of-custody procedures outlined below.

### Field Custody

Samples will be in the custody of the field sampler from the time of collection until the samples are packaged and sealed for shipping. Samples will be packed in coolers with inert packing material (such as bubble wrap or plastic netting) to prevent breakage. At the end of the sampling effort each day, the field team will inventory the samples in each cooler against the chain-of-custody form.

### Sample Transfer of Custody and Shipment

Before shipment, the individuals relinquishing the samples will sign, date, and note the time of transfer on the chain-of-custody form(s).

Before any cooler leaves the site by means other than field personnel, the chain-of-custody form will be placed in a sealed Ziploc® bag and taped to the inside of the cooler. The cooler will then be sealed with fiber tape, and a custody seal will be signed and dated by the relinquishing party and placed on the cooler so that the cooler cannot be opened without the custody seal being broken.

Any changes to the analyses that are requested on the chain-of-custody form should be noted, initialed, and dated on the chain-of-custody form. Upon completion of analysis, the analytical laboratory will send copies of the appropriate chain-of-custody form with the analytical report.

The laboratories that will be used for these analyses are:

Test America Analytical Testing Corporation  
9405 SW Nimbus Avenue  
Beaverton, OR 97008-7132  
Phone number: 503-906-9200

Analytical results will be sent to:

Paul Burnet  
CH2M HILL  
2020 SW 4<sup>th</sup> Avenue  
Portland, OR 97201

## 4.6 Project Documentation

During the course of the investigation, all field activities will be documented using one or more of the following methods:

- Project notebooks
- GPS (discussed in previous section)
- Sample labels (discussed in previous section)
- Chain-of-custody forms (discussed in previous section)

### 4.6.1 Project Notebook

Field personnel will use a project notebook to record any pertinent information and note any deviations from these sampling procedures. Bound Rite-in-the-Rain® field survey

books will be used as project notebooks. Personnel will update the project notebooks daily during field activities. Notes will include:

- sketches of actual sampling locations
- visual and olfactory characteristics of the sediment sampled
- time of sample collection
- other relevant information

In addition to the investigation data, the following site activity records will be recorded in the project notebooks:

- Time of arrival and departure from the site
- Project personnel and subcontractor personnel onsite
- Equipment calibration records
- GPS reference datum used
- Health and safety monitoring records
- Station location and station name or number
- Sample ID and analyses to be completed
- Date and time of each entry
- Time and duration of sampling activities
- Meteorological and water conditions
- Water depth at each station location
- Gross characteristics of the sediment, such as texture, color, biological structures, presence of debris, presence of oily sheen, and odors
- Comments on sample cohesiveness
- Volume of sample return
- Variations from sampling protocol, if any
- Signature of recorder

All notebook entries will be made in indelible ink, signed and dated each day, and no erasures will be made. If an incorrect entry is made, the information will be crossed out using a single strike mark and signed and dated by the recorder. When not in use, the logbook will be stored in the permanent project file. After completion of the sampling activities, the field notebooks will be in the custody of the CH2M HILL task manager.

## 4.7 Field Sampling Schedule

The field sampling schedule is constrained by the shortest sample holding time (14 days). Based on the site conditions, it is expected that two sediment core locations can be sampled per sampling day. The entire sediment sampling event with 1 day for mobilization and demobilization is expected to be completed within 5 working days.

# 5.0 Sample Analysis

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Sediment samples will be analyzed at the laboratories listed in Table 5-1 using the proposed analytical methods.

TABLE 5-1  
Sediment Sample Analysis

<b>Constituent</b>	<b>Method</b>	<b>Laboratory</b>
Metals (Ag, As, Cd, Cr, Cu, Ni, Pb, Sb, Zn)	EPA 6020	Test America
Metals (Hg)	EPA7471A	Test America
Polychlorinated Biphenyls (PCBs)	EPA 8082	Test America
PAHs	8270 SIM PAH	Test America
Pesticides	EPA 8081	Test America
Phthalates	8270 SIM Pthalates	Test America
Herbicides	EPA 8151mod	Test America
Semivolatile Organic Compounds (SVOCs)	EPA 8270	Test America
Total Organic Carbon (TOC)	EPA 960m	Test America
Total Petroleum Hydrocarbons (TPH)	NWTPH HCID	Test America
Grain Size	ASTM D422	ARI

# 6.0 Quality Assurance Measures

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The quality of all analytical data shall be assessed to ensure that the data quality objectives for this project have been achieved. The accuracy, precision, and completeness of the analytical data will conform to the project quality controls.

All generated analytical data will be checked and reviewed at the laboratory by the analyst generating the data and by an experienced data reviewer before the data are released to CH2M HILL.

The analyst shall review the data to ensure that:

- Sample preparation information is correct and complete.
- Sample analysis information is correct and complete.
- The appropriate analytical procedures were followed.
- Analytical results are correct and complete.
- QC samples are within established control limits.
- Documentation is complete.

The CH2M HILL data reviewer shall review the data package to ensure that:

- Calibration data are scientifically sound and appropriate.
- Qualitative and quantitative results are correct.
- Documentation is complete.
- The data package is complete and ready for document archiving.

## 6.1 Reporting Limits

To ensure the analytical data provide information that can be used to assess the contaminant concentrations down to the levels of concern, it is necessary that the laboratory calibrate equipment appropriately for the proposed project. Therefore, the detection and reporting limits listed in Table 6-1 are requested.

Results of chemical testing will be compared to the DEQ Level II screening level values for freshwater/bioaccumulation and the DEQ Baseline Slough Criteria. The detection and reporting limits for most constituents meet both criteria. However, for some constituents (e.g., chromium) the laboratory detection limit would not meet the DEQ Level II screening level for bioaccumulation. In these cases, fish tissue data will be reviewed to assess potential bioaccumulation.

TABLE 6-1

## Analyte Detection and Reporting Limits

Chemical	Method	Detection Limit	Reporting Limit
<b>Total Petroleum Hydrocarbon (mg/kg dry weight)</b>			
Gasoline Range Hydrocarbon	NW-TPH HCID	6.44	20.0
Diesel Range Hydrocarbon	NW-TPH HCID	17.3	50.0
Heavy Oil Range Hydrocarbon	NW-TPH HCID	30.6	100
1-Chlorooctadecane	NW-TPH HCID		
<b>Metals (mg/kg)</b>			
Antimony	EPA 6020	0.675	0.500
Arsenic	EPA 6020	0.451	0.500
Cadmium	EPA 6020	0.0995	0.500
Chromium	EPA 6020	0.226	0.500
Copper	EPA 6020	0.325	2.00
Lead	EPA 6020	0.102	0.500
Mercury	EPA 7471A	0.00654	0.100
Nickel	EPA 6020	0.160	1.00
Silver	EPA 6020	0.0560	0.500
Zinc	EPA 6020	0.407	2.00
<b>PAHs (µg/kg)</b>			
Acenaphthylene	8270 SIM	3.30	13.4
Acenaphthene	8270 SIM	3.30	13.4
Anthracene	8270 SIM	3.30	13.4
Benz(a)anthracene	8270 SIM	3.30	13.4
Benzo(k)fluoranthene	8270 SIM	3.30	13.4
Benzo(a)pyrene	8270 SIM	3.30	13.4
Benzo(g,h,i) perylene	8270 SIM	3.30	13.4
Chrysene	8270 SIM	3.30	13.4
Dibenz(a,h)anthracene	8270 SIM	3.30	13.4
Fluoranthene	8270 SIM	3.30	13.4
Fluorene	8270 SIM	3.30	13.4
Indeno(1,2,3-cd)pyrene	8270 SIM	3.30	13.4
Napthalene	8270 SIM	3.30	13.4
Phenanthrene	8270 SIM	3.30	13.4
Pyrene	8270 SIM	3.30	13.4
<b>Herbicides (µg/kg)</b>			
2,4-D	8151 mod	4.39	20.0

TABLE 6-1

## Analyte Detection and Reporting Limits

Chemical	Method	Detection Limit	Reporting Limit
2,4-DB	8151 mod	6.08	20.0
2,4,5-T	8151 mod	6.05	20.0
2,4,5-TP (Silvex)	8151 mod	5.56	20.0
Dalapon	8151 mod	3.99	20.0
Dicamba	8151 mod	4.44	20.0
Dichlorprop	8151 mod	4.09	20.0
Dinoseb	8151 mod	6.00	20.0
MCPA	8151 mod	473	2000
MCPP	8151 mod	548	2000
<b>Semi-volatile Organic Compounds (mg/kg)</b>			
4-Bromophenyl phenyl ether	EPA 8270C	---	0.04
4-Chloro-3-methylphenol	EPA 8270C	---	0.06
4-Chloroaniline	EPA 8270C	---	0.2
Bis(2-chloroethoxy)methane	EPA 8270C	---	0.06
Bis(2-chloroethyl)ether	EPA 8270C	---	0.1
Bis(2-chloroisopropyl)ether	EPA 8270C	---	0.1
2-Chloronaphthalene	EPA 8270C	---	0.04
2-Chlorophenol	EPA 8270C	---	0.07
4-Chlorophenyl phenyl ether	EPA 8270C	---	0.04
Carbazole	EPA 8270C	---	0.02
Dibenzofuran	EPA 8270C	---	0.04
1, 2-Dichlorobenzene	EPA 8270C	---	0.120
1, 3-Dichlorobenzene	EPA 8270C	---	0.140
1, 4-Dichlorobenzene	EPA 8270C	---	0.140
2,4-dichlorophenol	EPA 8270C	---	0.05
2,4-Dimethylphenol	EPA 8270C	---	0.200
4,6-Dinitro-2-methylphenol	EPA 8270C	---	0.200
2,4-Dinitrophenol	EPA 8270C	---	0.4
2,4-dinitrotoluene	EPA 8270C	---	0.05
2,4-Dinitrotoluene	EPA 8270C	---	0.06
Bis(2-ethylhexyl) phthalate	EPA 8270C	---	2
Hexachlorobenzene (HCB)	EPA 8270C	---	0.06
Hexachlorobutadiene	EPA 8270C	---	0.2
Hexachlorocyclopentadiene	EPA 8270C	---	0.160
Hexachloroethane	EPA 8270C	---	0.06

TABLE 6-1

## Analyte Detection and Reporting Limits

Chemical	Method	Detection Limit	Reporting Limit
Isophorone	EPA 8270C	---	0.06
2-Methylnaphthalene	EPA 8270C	---	0.08
2-Methylphenol	EPA 8270C	---	0.08
3,4-Methylphenol	EPA 8270C	---	0.08
1,2,4-Trichlorobenzene	EPA 8270C	---	120
2-Nitroaniline	EPA 8270C	---	0.1
3-Nitroaniline	EPA 8270C	---	0.2
4-Nitroaniline	EPA 8270C	---	0.150
Nitrobenzene	EPA 8270C	---	0.07
2-Nitrophenol	EPA 8270C	---	0.05
4-Nitrophenol	EPA 8270C	---	0.2
N-Nitrosodi-n-propylamine	EPA 8270C	---	0.06
N-Nitrosodiphenylamine	EPA 8270C	---	0.06
Pentachlorophenol	EPA 8270C	---	0.160
Phenol	EPA 8270C	---	0.07
1,2,4-Trichlorobenzene	EPA 8270C	---	0.120
2,4,5-trichlorophenol	EPA 8270C	---	0.04
2,4,6-Trichlorophenol	EPA 8270C	---	0.04
<b>Phthalates (<math>\mu\text{g}/\text{kg}</math>)</b>			
Dimethyl phthalate	8270 SIM	13.4	26.8
Diethyl phthalate	8270 SIM	13.4	26.8
Di-n-butyl phthalate	8270 SIM	13.4	26.8
Butyl benzyl phthalate	8270 SIM	13.4	26.8
Bis(2-ethylhexyl) phthalate	8270 SIM	13.4	26.8
Di-n-octyl phthalate	8270 SIM	13.4	26.8
<b>Polychlorinated biphenyls (PCBs) (<math>\mu\text{g}/\text{kg}</math>)</b>			
Aroclor 1016	EPA 8082	2.66	25
Aroclor 1221	EPA 8082	13.3	50
Aroclor 1232	EPA 8082	5.76	25
Aroclor 1242	EPA 8082	2.08	25
Aroclor 1248	EPA 8082	1.78	25
Aroclor 1254	EPA 8082	1.49	25
Aroclor 1260	EPA 8082	3.80	25
Aroclor 1262	EPA 8082	1.46	25
Aroclor 1268	EPA 8082	6.20	25

TABLE 6-1

## Analyte Detection and Reporting Limits

Chemical	Method	Detection Limit	Reporting Limit
<b>Pesticides (<math>\mu\text{g}/\text{kg}</math>)</b>			
Aldrin	EPA 8081C	0.247	1.00
Alpha-BHC	EPA 8081C	0.167	1.00
Beta-BHC	EPA 8081C	0.140	2.00
Delta-BHC	EPA 8081C	0.214	1.00
BHC (gamma) Lindane	EPA 8081C	---	1.00
Chlordane	EPA 8081C	---	10.0
Alpha-Chlordane	EPA 8081C	0.0960	1.00
Gamma-Chlordane	EPA 8081C	0.314	1.00
DDD	EPA 8081C	0.099	2.00
DDE	EPA 8081C	0.120	2.00
DDT	EPA 8081C	0.141	2.00
Dieldrin	EPA 8081C	0.125	2.00
Endosulfan I	EPA 8081C	0.207	1.00
Endosulfan II	EPA 8081C	0.127	2.00
Endosulfan sulfate	EPA 8081C	0.099	2.00
Endrin	EPA 8081C	0.144	2.00
Endrin aldehyde	EPA 8081C	0.103	2.00
Endrin ketone	EPA 8081C	0.157	2.00
Heptachlor	EPA 8081C	0.143	1.00
Heptachlor epoxide	EPA 8081C	0.108	1.00
Methoxychlor	EPA 8081C	0.144	2.00
Toxaphene	EPA 8081C	3.12	50.0

<sup>1</sup>Chemical Abstract Service Registry Number.

## 7.0 References

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ATTACHMENT A

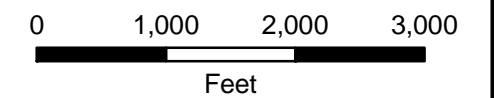
# Previous Studies' Sampling Locations

**Figure 1**  
**Location of Historic**  
**Sediment Samples**  
**(Post-2000 Data)**



**Legend**

- Metro Dataset
- Mile Markers
- Union Carbide Dataset
- Water Feature Boundary



**Figure 2**  
**Location of Historic**  
**Sediment Samples**  
**(Pre-2000 Data)**



**Legend**

- City of Portland Columbia Slough Sediment Project (Sampled 1994)
- Mile Markers
- Wapato Wetland Sediment Project (Sampled 1996)
- ⬭ Water Feature Boundary

