

Amazon Creek Sediment Sampling Evaluation

Abstract

Two sediment samples were taken from the main channel of Amazon Creek on June 10, 1998, approximately 125 – 175 feet south of Royal Ave bridge (see Figure 1). The samples were sent to Sound Analytical laboratory of Seattle, WA, for physical and chemical analyses, to include: metals total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs). The proposed dredge material from this project is acceptable for both in-water and upland disposal. No significant, adverse ecological impacts are expected from such disposal in terms of sediment toxicity. This evaluation was conducted following procedures set forth in the Inland Testing Manual developed jointly by the Corps and EPA to assess dredged material and according to 404 (b)(1) guidelines set forth in 40 CFR 230 developed to implement the Clean Water Act. The screening levels used are those adopted for use in the draft Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area (1998).

Introduction

The purpose of this report is to characterize the sediment of the proposed construction site, based on the sampling event described. Frequent reference will be made to the project Sampling and Analysis Plan (SAP) attached to this report. The project description, site history and assessment are detailed in section 1 of the SAP. The sampling and analysis objectives listed below are those stated in the (SAP) (sec. 2.0). This report will outline the procedures used to accomplish these goals.

SAMPLING AND ANALYSIS OBJECTIVES

The sediment characterization program objectives and constraints are summarized below:

- To characterize sediments in accordance with the draft regional dredge material testing manual, the Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area.
- Collect, handle and analyze representative sediment, surface samples, of the proposed dredging prism, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Characterize sediments to be dredged for evaluation of environmental impact.
- Only physical and chemical characterization will be conducted.

The Corps of Engineers, Portland District personnel, collected 2 composite surface samples, using a cylinder grab sampler on June 10, 1998. The first sample, AC-CG-01, was a composite of 2 surface grab samples taken approximately 125 –150 feet south of Royal Ave. on the West Side of the “main” Amazon Creek Channel. The second composite consisted of 3 surface grab samples taken approximately 150 – 175 feet south from Royal Ave. on the East Side on the “main” channel. The samples were sent to Sound Analytical laboratory of Seattle, WA, for physical and chemical analyses; to include metals, total organic carbon (TOC), pesticides/PCBs, phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs).

Historical Data

In May 1996 two sediment samples were taken from the “A” channel of Amazon creek south of Royal Ave. about 15 to 30 feet upstream of the road. They were subjected to physical and chemical analyses. Chemical tests measured metals, TOC, pesticides/PCBs, PAHs and phenols content. Under the screening levels (SL) in place in 1996 Zinc exceeded the SL by 8 ppb (ug/kg). Under the new SL, adopted in 1998 for Region 10 in the DMEF, none of the analyses were in excess of the SL.

Current Sampling Events

Methods/ Results of Physical and Chemical Sampling from June 10, 1998 Sampling.

Physical and Total Volatile Solids (TVS): Data for these analyses are presented in Table 1. Both of the samples submitted for Chemical analysis exceeded 20% fines, however, neither exceeded 5% volatile solids. Sample AC-CG-01 was classified as “clayey sand” (SC). Sample AC-CG-02 was classified as “sandy lean clay” (CL). Median grain size for the 01 sample is 0.12 mm, with 67.9 % sand and 31.8 % fines. The median grain size for the 02 sample is 0.04 mm, with 33.1 % sand and 66.9 % fines.

Metals and Total Organic Carbon (TOC): Data for these analyses are presented in Table 2. Low levels of 5 metals were found in both of the samples collected. These levels are well below the levels of concern and do not approach the SL. The highest level detected was for Zinc, which was only 18.5 % of the SL. The levels found in the “main” channel were slightly lower than those found in the sampling of “A” Channel in 1996.

Pesticide/PCBs, Phenols, Phthalates and Misc. Extractables: Data for these analyses are presented in Table 3. No pesticides or PCBs were found, at the detection levels. One phenol was detected in the 01 sample, at a very low level. Four phthalates were detected at low levels in the 01 sample and 2 were found in the 02 sample. Benzoic Acid was found in both samples at low levels. All levels were less than 4 % of the corresponding SL.

Polynuclear Aromatic Hydrocarbons (PAHs): Data for PAHs are presented in Tables 4 & 5. Two “low molecular weight” PAHs were found in the 01 sample, while none were detected in the 02 sample. The highest level detected was only 0.57 % of the SL. Low levels of some of the “high molecular weight” PAHs were found in both samples. The highest level was 3.7% of the SL.

Discussion/Conclusion

Sampling and analysis were performed using proper quality control measures. Proper procedures for chain of custody, preservation (4°C.) and cooler receipt was carried out. A ten-percent replicate sample was not necessary, due to the size and nature of the project. The laboratory reported no quality control issues for the analytical procedures carried out on the sediment sampled in Amazon Creek.

The fine-grained nature of the sediments collected (31.8% fines for the 01 sample and 66.9% fines for the 02 sample) with 4.2 average volatile solids provide an environment conducive to enrichment of chemicals of concern. The 01 sample showed a higher level of all analyzed contaminants than the 02 sample, although sample 02 had over twice as many fines. It is unusual for finer grained material to show less contamination than coarser grained material. One explanation for this occurring could be that the 01 sample was a composite of loose sediment and hard packed material beneath. The 02 sample consisted of hard packed material only. It is likely that this hard packed material, though very fine grained, is native undisturbed, uncontaminated soil, while the loose sediment of the 01 sample contained contaminants that migrated from further up stream.

According to 404 (b)(1) guidelines and procedures in the Inland Testing Manual (ITM), and the Tiered testing approach adopted in the Dredged Material Evaluation Framework for the Lower Columbia River Management Area, this material is acceptable for both upland and in-water disposal with no adverse, unacceptable ecological consequences expected. The tiered testing approach requires that material in excess of 20 % fines and greater than 5 % volatile solids be subjected to chemical as well as physical analyses. If the chemical analysis results do not exceed the established screening levels, then it is cleared for in-water disposal. The ITM also uses a tiered approach in evaluating dredged material. The ITM describes procedures for evaluating the potential for adverse ecological impacts of disposal related to sediment toxicity. The evaluation proceeds through the tiers until “factual determinations” can be made regarding potential for toxicity. Factual determination was made at the Tier I level based on a review of sediment contamination data collected. The material is only slightly contaminated and water quality standards will not be exceeded during dredging and disposal. Tier I calls for a review of current and past data relevant to the site. Although a previous study indicated a “reason to believe” that contaminants may exist at the site, current data presented and that collected from Channel “A” show very little contamination. The “reason to believe” was based on the fact that upstream of the site, in Amazon Creek and the A-3 Channel, sediment contains typical urban runoff contaminants (ref. 2). The typical contaminants found in runoff are metals, pesticides, PCBs, PAHs and phenols. At the proposed dredge site none of these contaminants exceeded the established SL.

Material dredged from the project site will be placed at a nearby in-water or upland disposal site. In the case of in-water disposal, the material would be placed on similar material, either upstream or downstream of the dredged site. This satisfies an exclusionary criterion of the 404 (b)(1) guidelines described in Section 230.60 (c) of 40CFR 230. Section 230.69 (c) provides that where the proposed discharge and dredging sites are adjacent and comprised of

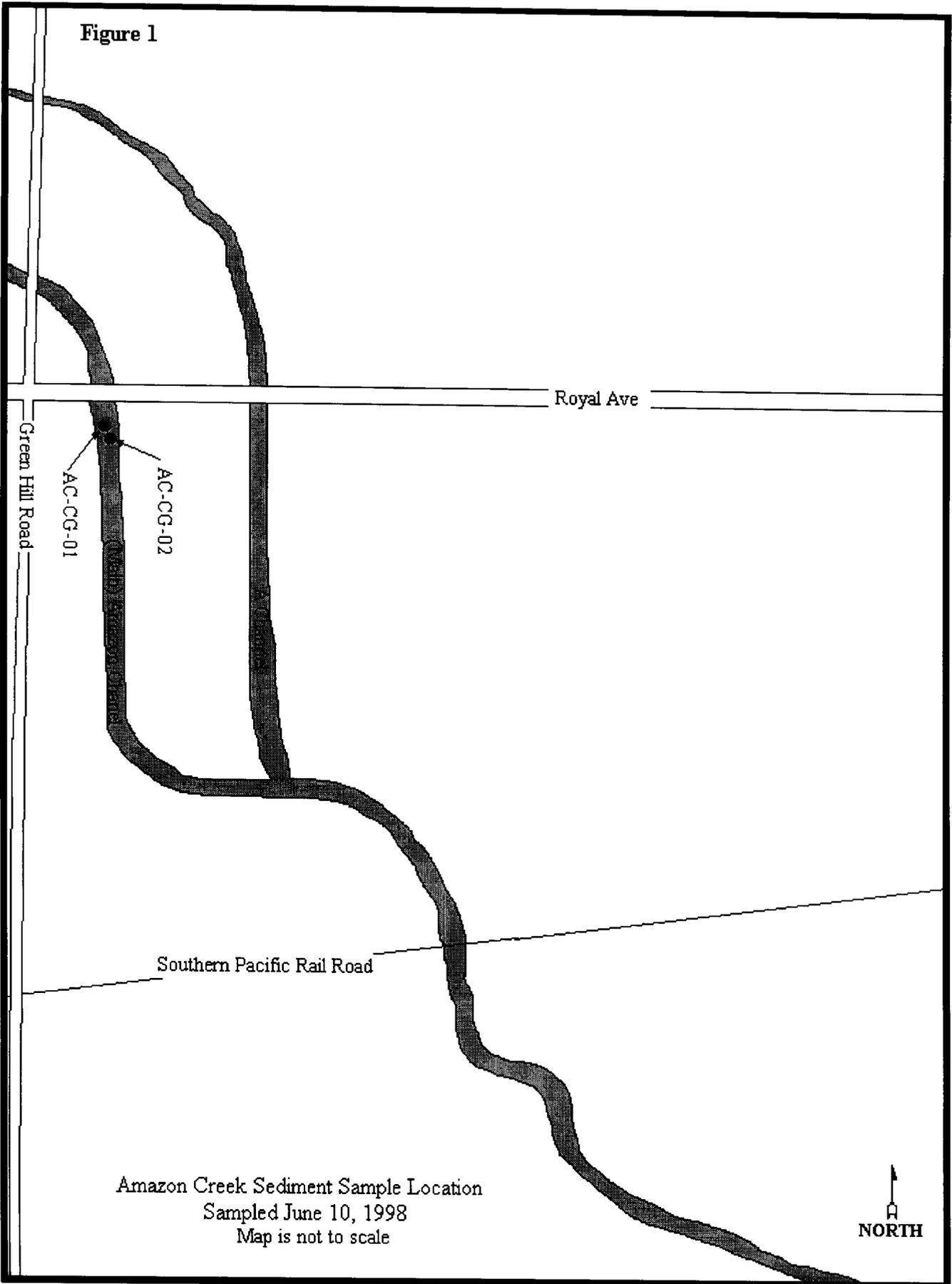
similar materials and subject to the same sources(s) of contaminants, disposal may be conducted without further testing. No further testing is required, as the discharge is not likely to result in degradation of the discharge site.

The proposed dredged material project should qualify for “state water quality certification” since the sediment is relatively low in organic material content and relatively free of contaminants of concern. It is highly unlikely that acute or chronic water quality criteria will be exceeded by contaminants dissolving into the water column during the dredging and disposal process.

References

1. U.S. Army Corps of Engineers, Portland District, Seattle District, U.S. Environmental Protection Agency, Region 10, Oregon Department of Environmental Quality, Washington State Department of Natural Resources. April 1998 (draft document). Dredge Material Evaluation Framework Lower Columbia River Management Area.
2. Rinella F. U.S. Geological Survey. September 1993. Evaluation of Organic Compounds and Trace Elements in Amazon Creek Basin, Oregon, September 1990.
3. U. S. Environmental Protection Agency and U. S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters – Testing Manual, dated (referred to as the “Inland Testing Manual”).
4. Britton, James, U.S. Army Corps of Engineers, Portland District. May 1996. Amazon Creek Sediment Evaluation. Portland, Oregon.

Figure 1



AC-CG-01

AC-CG-02

Green Hill Road

Royal Ave

Southern Pacific Rail Road

Amazon Creek Sediment Sample Location
Sampled June 10, 1998
Map is not to scale



SEDIMENT
SAMPLING & ANALYSIS PLAN
FOR AMAZON CREEK

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Portland District
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1.0 PROJECT DESCRIPTION, SITE HISTORY AND ASSESSMENT

1.1 Project Site Description and Location: Amazon Creek Wetlands Restoration Project is located in Eugene, Oregon. The current project would restore a historical wetland southeast of the intersection of Royal Avenue and Greenhill road by removing existing levees along the banks of “A” Channel and Amazon Channel with relocated levees on the north, northeast and northwest perimeter of the wetland. The project plan calls for removing the existing weirs near the intersection of “A” Channel and Amazon Channel. It also provides a flood control weir on “A” Channel and a water control weir on Amazon Channel in the newly created levee just prior to crossing Royal Avenue. The proposed weir site, on “A” Channel, was sampled in March of 1996. The current sampling even will sample the proposed weir site on Amazon Channel. The construction of the weirs will require dredging approximately 2,000 cys at each site.

1.2 Site History: Construction on the current levees, to control flooding of Amazon Creek, was completed in 1959. The project consists of an eight mile open-earth and concrete-lined channel which extends through urban Eugene ending at a weir which diverts nearly all flows into Fern Ridge Lake, a Corps reservoir, 3.8 miles below the Amazon channel diversion structure.

1.3 Previous Sediment Sampling: Two sediment samples were taken March 22, 1996 at the proposed site of the flood control weir on “A” Channel of Amazon Creek. The samples were subjected to physical testing to determine the grain size and volatile solids content. They were also subjected to chemical tests that measured heavy metals, acid volatile sulfides (AVS), total organic carbon (TOC), pesticides, polychlorobiphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and phenols. All proposed dredge material was deemed acceptable for in-water and upland disposal according to 404 (b)(1) guidelines set forth in 40 CFR 230.

2.0 SAMPLING AND ANALYSIS OBJECTIVES

- To characterize sediments in accordance with the draft Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area manual.
- Collect, handle and analyze representative sediment, core samples of the proposed dredging prism in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Characterize sediments to be dredged for evaluation of environmental impact.
- Only physical and chemical characterization will be conducted.

3.0 SAMPLING AND ANALYSIS REQUIREMENTS

3.1 Project Ranking: The project area, included in the DMEF Management Area as part of the Willamette River Basin, will be ranked for future reference. The past sampling event data collected in the area would require future collected sediment to be subjected to chemical testing on the Tier IIB level, due volatile solids greater than 5% and a potential for contamination due to its proximity to “source” contamination from urban runoff upstream.

3.2 Sampling and Analysis Requirements: Material to be dredged from the project site on Amazon Channel will be sampled using a cylindrical “surface drag” grab sampling device. This system collects a surface profile of sediments along a short length of top sediment. All samples will be subjected to both physical and chemical analyses. Laboratory quality control will be conducted as stated on page 5 of this report.

4.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

4.1 Sampling Locations and Numbering: Figure 1 shows the project area and sample locations. Sampling sites are located for the best characterization of the material within the dredging prism as possible. Proper QA/QC procedures as outlined in this section will be followed. Any deviation from these procedures shall be noted in the field log. Sample identification shall follow the following convention:

AC-XX-YY (Z)

Where, AC denotes samples collected from Amazon Creek, "XX" denotes the type of sampling device such as CG – cylindrical grab; "YY" denotes the numeric sample number and will consist of two digits for all samples (i.e. 01, 05, 15, etc.).

4.2 Field Sampling Schedule: Sampling is planned for June 10, 1998.

4.3 Field Notes: Field notes will be maintained during sampling and compositing operations. Included in the field notes will be the following:

- Names of the person(s) collecting and logging in the samples.
- Weather conditions.
- Date and time of collection of each sediment sample.
- The sample station number and individual designation numbers assigned for each individual sample.
- Descriptions of sediment.
- Any deviation from the approved sampling plan.

4.4 Positioning: Sampling locations will be recorded in the field using a hand held GPS. Horizontal coordinates will be referenced to the Washington Coordinate System for proper North or South Zones NAD 83 (North American Datum 1983). Horizontal coordinates will be identified as latitude and longitude to the nearest 0.1 second.

4.5 Decontamination: All sampling devices and utensils will be thoroughly cleaned prior to use according to the following procedure:

- Wash with brush and Alconox soap
- Rinse with distilled water
- Rinse with 10% HCl acid solution
- Rinse with distilled water

Sampling devices will be washed down before each sampling event. However, they will not require the cleaning procedure listed above as long as samples collected for chemical analyses are not in contact with the sampler walls. All utensils used to collect chemical samples will require decontamination prior to each use. All hand work for chemical analyses will be conducted with disposable latex gloves which will be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between samples or composites to prevent cross contamination between samples.

4.6 Sample Logging: Each discrete core section will be inspected and described. For each sample, the following data will be recorded in the log:

- Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, color)
- Odor (e.g., hydrogen sulfide, petroleum products)
- Visual stratification and lenses
- Vegetation
- Debris
- Biological Activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Any other distinguishing characteristics or features

4.7 Field Replicates: Blind field replicates will not be prepared and submitted along with the rest of the samples to the laboratory. This project is not a HTRW remediation project and therefore does not require field blind duplicates.

4.9 Sample Transport and Chain-of-Custody Procedures: After sample containers have been filled they will be packed on ice in coolers. Chain-of-custody procedures will commence in the field and will track delivery of the samples. Sample holding times and storage requirements are presented in Table 1. Specific procedures are as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24 or delivered directly to the testing laboratory.
- Individual sample containers will be packed to prevent breakage.
- The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler and office name and address) to enable positive identification.
- A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.

Upon transfer of sample possession to the laboratory, the persons transferring custody of the coolers will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the coolers will be inspected and the receiver will record the condition of the samples.

Table 1, Sample Volume and Storage

Sample Type	Holding Time	Sample Size (a)	Temperature (b)	Container
Particle Size	6 Months	200 g	4°C	1-1 Quart Plastic Bag
8270 BNA	14 Days	10g	4°C	1-Liter Glass (combined)
Total Volatile Solids	14 Days	125 g	4°C	
Total Organic Carbon	14 Days	125 g	4°C	
Mercury	28 Days	5g	4°C	
Metals (except Mercury)	6 Months	50 g	4°C	
Pesticides and PCBs	14 Days	10 g	4°C	

- a. Required sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retest.
- b. During transport to the lab, samples will be stored on blue ice.

5.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

5.1 Laboratory Analyses Protocols. Laboratory testing procedures will be conducted in accordance with the DNEF. The samples will be analyzed for all the parameters listed in sections 5.1.3 and 5.1.4 as requested on the chain-of-custody record. Private contract analytical chemical laboratories will conduct all physical and chemical analyses.

5.1.1 Chain-of-Custody: A chain-of-custody record for each set of samples will be maintained throughout all sampling activities and will accompany samples and shipment to the laboratory. Information tracked by the chain-of-custody records in the laboratory include sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

5.1.2 Limits of Detection: Detection limits of all chemicals of concern must be below screening levels. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-detection below the screening levels. Sediments or extracts will be kept under proper storage conditions until the chemistry data is deemed acceptable.

5.1.3 Sediment Chemistry: Private analytical laboratories will conduct all chemical analyses. Chemical analyses will include metals (As, Sb, Cd, Cu, Pb, Hg, Ni, Ag and Zn) (6010/7000 or 6020 series, Hg by CVAA). Total organic carbon (TOC) by method 9060. Phenols, phthalates, extractables, and polynuclear aromatic hydrocarbons (PAHs) by method 8270 and Pesticides/PCBs by method 8081. SIM method or other

low level detection method to be used, if required to reach requested detection limits. All detection limits must be lower than SL indicated in draft DMEF for the Lower Columbia River Management Area.

5.1.4 Sediment Conventional: The private analytical laboratories will analyze physical parameters. Particle grain size distribution for each sample will be determined. Sieve analysis will use a geological sieve series, which will include the sieve sizes U.S. NO. 5, 10, 18, 35, 60, 120, and 230. Hydrogen peroxide will not be used in preparations for grain-size analysis. Hydrometer analysis will use for particle sizes finer than the 230 mesh. Water content will be determined using ASTM D 2216. Sediment classification designation will be made in accordance with U.S. Soil Classification System, ASTM D 2487.

5.1.5 Holding Times: To the maximum extent practicable all chemical results will be provided within 30 days of receipt. All samples for physical and chemical testing will be maintained at the testing laboratory at the temperatures specified in Table 1 and analyzed within the holding times shown in the table.

5.1.6 Quality Assurance/Quality Control: The chemistry QA/QC procedures found in Table 2 will be followed.

5.2 Laboratory Written Report: The analytical laboratory documenting all the activities associated with sample analyses will prepare a written report. As a minimum, the following will be included in the report:

- Results of the laboratory analyses and QA/QC results.
- All protocols used during analyses.
- Chain of custody procedures, including explanation of any deviation from those identified herein.
- Any protocol deviations from the approved sampling plan.
- Location and availability of data.

As appropriate, this sampling plan may be referenced in describing protocols.

Table 2, Minimum Laboratory QA/QC

Analytical Type	Method Blank ²	Duplicate ²	RM ^{2,4}	Matrix Spikes ²	Surrogates ⁷
Semivolatiles ¹	X	X ³	X ⁵	X	X
Pesticides/PCBs ¹	X	X ³	X ⁵	X	X
Metals	X	X	X ⁶	X	
Total Organic Carbon	X	X	X ⁶		
Total Solids		X			
Total Volatile Solids		X			
Particle Size		X			

1. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria. Ongoing calibration required at the beginning of each work shift, every 10-12 samples or every 12 hours (whichever is more frequent), and at the end of each shift.

2. Frequency of Analysis = one per batch

3. Matrix spike duplicate will be run

4. Reference Material

5. Canadian standard SRM-1

6. NIST certified reference material 2704

7. Surrogate spikes will be included with every sample, including matrix-spiked samples, blanks and reference materials

6.0 BIOLOGICAL TESTING

6.1 Biological Testing: No biological testing will be conducted under this study, however the need for biological testing will be assessed per the DMEF.

7.0 REPORTING

7.1 QA Report: The laboratory QA/QC reports will be incorporated by reference. This report will identify any laboratory activities that deviated from the approved protocols and will make a statement regarding the overall validity of the data collected.

7.2 Sediment Evaluation Report: A written discussion of findings shall be prepared documenting the physical and chemical character of potential material to be dredged. The physical and chemical reports will be included as reference; individual copies will be furnished as requested. As a minimum, the following will be included in the

- Previous sampling and analyses.
- Locations where the sediment samples were collected.
- A plan view of the project showing the actual sampling location.
- Description of sampling.
- Chemical testing data, with comparisons to screening levels guidelines.

APPENDIX A

PARAMETERS AND METHODS

1. Recommended Sample Preparation Methods, Cleanup Methods, Analytical Methods and Detection Limits for Sediment Management Standards, Chapter 173-204 WAC, Draft - July 1996.
2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, March 1986.
3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May, 1993.
4. Units: ug = microgram, mg = milligram, kg = kilogram, dw = dry weight, oc = organic carbon.
5. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 3050, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.2, Rev 1. Office of Solid Waste and Emergency Response, Washington, DC.
6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
8. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 7471, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.3. Office of Solid Waste and Emergency Response, Washington, DC.
9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.
10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
11. Purge and Trap Extraction and GCMS Analysis - Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
12. Soxhlet Extraction and Method 8081, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
13. Total PCBs BT value in mg/kg oc.

QA2 DATA REQUIREMENTS

CHEMICAL VARIABLES

ORGANIC COMPOUNDS

The following documentation is needed for organic compounds:

A cover letter referencing or describing the procedure used and discussing any analytical problems

Reconstructed ion chromatograms for GC/MS analyses for each sample

Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra

GC/ECD and/or GC/flame ionization detection chromatograms for each sample

Raw data quantification reports for each sample

A calibration data summary reporting calibration range used [and decafluorotriphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses]

Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit

Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified)

Quantification of all analytes in method blanks (ng/sample)

Method blanks associated with each sample

Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data)

Data qualification codes and their definitions.

METALS

For metals, the data report package for analyses of each sample should include the following:

Tabulated results in units as specified for each matrix in the analytical protocols, validated and signed in original by the laboratory manager

Any data qualifications and explanation for any variance from the analytical protocols

Results for all of the QA/QC checks initiated by the laboratory

Tabulation of instrument and method detection limits.

All contract laboratories are required to submit metals results that are supported by sufficient backup data and quality assurance results to enable independent QA reviewers to conclusively determine the quality of the data. The laboratories should be able to supply legible photocopies of original data sheets with sufficient information to unequivocally identify:

Calibration results

Calibration and preparation blanks

Samples and dilutions

Duplicates and spikes

Any anomalies in instrument performance or unusual instrumental adjustments.