

King County Marine Ambient Monitoring Program

Intertidal Sediment Monitoring 2010 Sampling Event

Sampling and Analysis Plan

Prepared for the

King County Department of Natural Resources and Parks
Water and Land Resources Division

by the

King County Department of Natural Resources and Parks
Marine and Sediment Assessment Group

July 2010



King County Marine Ambient Monitoring Program

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1 INTRODUCTION

This sampling and analysis plan (SAP) presents project information and sampling and analytical methodologies that will be employed to perform intertidal sediment sampling for King County's Marine Ambient Monitoring Program. This work is being performed as part of a long-term sediment monitoring program designed to assess sediment quality at marine beaches in King County. The SAP includes a description of the project, sampling and analytical methodologies, and reporting requirements. This SAP has been prepared in accordance with Washington State Department of Ecology (Ecology) sampling and analysis plan preparation guidance (Ecology 2008) as well as Chapter 173-204 WAC, the Washington State Sediment Management Standards (Ecology 1995).

2 PROGRAM DIRECTIVES

King County's Marine Ambient Monitoring Program gathers water, sediment, and biota data in the Central Basin of Puget Sound, including Elliott Bay and the Duwamish River. These data are used to provide an understanding of water and sediment quality issues – both to assess the general health of the Puget Sound marine environment within King County and as a comparative tool to confirm that discharges from the County's wastewater outfalls are not adversely affecting the marine environment. The Marine Ambient Monitoring Program is also part of an intergovernmental effort, the Puget Sound Assessment and Monitoring Program (PSAMP), that monitors the health of the Puget Sound marine environment on a larger-scale, region-wide basis.

3 MONITORING HISTORY

King County and its predecessor agency, Municipality of Metropolitan Seattle (Metro), have collected sediment quality data from intertidal monitoring stations for many years. Beginning in 1988, intertidal sediment samples were collected from two stations; at Carkeek Park near the mouth of Piper's Creek (Station KSHZ03) and at North Beach near Metro and City of Seattle combined sewer overflow (CSO) and storm water outfalls (Station KSHX02). These two intertidal monitoring stations were sampled multiple times per year between 1988 and 1994.

The intertidal sediment monitoring program was expanded in 1994 to include stations in the vicinity of the County's wastewater facilities at Alki Point (Stations LSKR01 and LSXS01), West Point (Stations KSSN04 and KSSN05), Richmond Beach (Stations JSVW04 and JSWX01), and the Magnolia CSO (Station KSUR01), as well as an ambient monitoring station in Golden Gardens Park (Station KSLU03). Other monitoring stations were added to the program, and some stations discontinued, between 1994 and 2005, the last year in which intertidal sediment samples were collected. Table 3-1 shows the stations at which intertidal sediment samples were collected in 2005, along with the monitoring history for each of these stations.

Table 3-1
Intertidal Sediment Monitoring Stations Sampled in 2005

Station	Location	Monitoring History
JSVW04	Richmond Beach/Point Wells	1994 – 1996, 1998 – 2005
KSHZ03	Carkeek Park/Piper's Creek	1988 – 2005
KSLU03	Golden Gardens Park	1994 – 1996, 1998 – 2005
KSSN05	West Point (South Side)	1994 – 1996, 1999, 2003 – 2005
LSKS01	Alki Point (South Side)	1994 – 1996, 2004, 2005
MSJL01	Vashon Island (Vashon Treatment Plant)	2002 – 2005
MTLD03	Normandy Park	1999 – 2003, 2005
NTAK01	Salt Water State Park	2005

Samples have been collected from the top five centimeters (cm) of sediment and analyzed for metals and trace organic chemicals, along with conventional sediment parameters such as total solids, total organic carbon, and particle size distribution. Sediment quality has been evaluated by comparing metals and organics concentrations to the published sediment quality chemical criteria of the Washington State Sediment Management Standards (SMS) as well as Puget Sound region-wide sediment data. Intertidal sediments have been collected in August of each monitoring year to coincide with the collection of shellfish tissue samples.

The former intertidal sediment monitoring program was temporarily discontinued after 2005 to provide an opportunity for King County staff scientists and a peer review panel to evaluate data generated from the program as well as other data collection efforts within the region. Following this review, the decision was made to sample intertidal sediments once every five years, rather than on an annual basis, as was the former practice. The intertidal sediment monitoring program will recommence in August 2010 with samples collected from 17 stations.

4 SAMPLING DESIGN

The primary goal of the intertidal sediment monitoring program is to collect data of known quality in order to effectively characterize sediments at King County public beaches.

4.1 Data Quality Objectives

The data quality objectives (DQOs) of the 2010 intertidal sediment sampling event are to collect data of sufficient *quantity* and *quality* to be able to meet the following project goals:

- evaluate the areal extent and spatial variations of sediment chemical concentrations in intertidal sediments within King County;
- compare sediment chemical concentrations to Puget Sound-wide regional values;
- evaluate sediment chemical concentrations relative to the current marine sediment quality standards of Chapter 173-204 WAC (Ecology 1995); and
- evaluate background sediment chemical concentrations at monitoring locations for which concurrent shellfish tissue chemistry data are being collected.

The *quantity* of sediment chemistry data to be collected is based on previous sampling events conducted under King County's intertidal sediment monitoring program, required compliance monitoring, the County's shellfish monitoring program, and a desire to encompass sediment monitoring at King County beaches that receive a high degree of public use. Six of the 17 monitoring stations to be sampled in 2010 are long-term monitoring stations with data going back to 1994 and, in one case, to 1988. Intertidal sediment monitoring is required at one station, located inshore of the Vashon Treatment Plant (TP) outfall, to comply with its outfall lease. Ten of the 17 stations will have concurrent shellfish tissue samples collected for chemical analysis. Seven of the 17 stations are new to the intertidal sediment monitoring program in 2010, and were selected for a variety of reasons: high public use; co-located shellfish sampling; history of water quality issues; and to provide background information for another station.

Validation of project data will assess whether the data collected are of sufficient *quality* to meet the study goals. The data quality issues of precision, accuracy, bias, representativeness, completeness, comparability, and sensitivity are described in the following sections.

4.1.1 Precision, Accuracy, and Bias

Precision is the agreement of a set of results among themselves and is a measure of the ability to reproduce a result. Accuracy is an estimate of the difference between the true value and the determined mean value. The accuracy of a result is affected by both systematic and random errors. Bias is a measure of the difference, due to a systematic factor, between an analytical result and the true value of an analyte. Precision, accuracy, and bias for sediment chemistry will be measured by the following quality control (QC) analyses: method blanks, spike blanks, matrix spikes, matrix spike duplicates, certified reference materials, laboratory control samples, and laboratory duplicates or triplicates.

4.1.2 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at the sampling point, or an environmental condition. Sediment chemistry samples will be collected from stations that represent specific site

locations. Sediment chemistry samples will be homogenized to minimize variations in the chemical and physical composition of the sediments. Following the guidelines described in Section 6 for sample collection, processing, and handling will also help ensure that samples are representative.

4.1.3 Completeness

Completeness is defined as the total number of samples for which acceptable analytical data are generated, compared to the total number of samples submitted for analysis. Adhering to standardized sampling and testing protocols will aid in providing a complete set of data for this study. The goal for completeness is 100%. If 100% completeness is not achieved, the study team will evaluate whether the DQOs can still be achieved or if additional samples may need to be collected and analyzed.

4.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. This goal is achieved through using standard techniques to collect and analyze representative samples, along with standardized data validation and reporting procedures. By following the guidance of this SAP, the goal of comparability will be achieved.

4.1.5 Sensitivity

Sensitivity is a measure of the capability of analytical methods to meet study goals. The sediment chemistry analytical method detection limits presented in Section 8 are sensitive enough to allow comparison of sediment chemistry data to current Ecology sediment quality criteria, both normalized to dry weight and to organic carbon, as appropriate.

4.2 Sampling Strategy

Sediment chemistry samples will be collected from 17 intertidal stations located throughout King County. Samples will be collected from the top 10 cm of sediment to evaluate chemical concentrations in the biologically-active zone. All field work will be conducted by personnel from the King County Environmental Laboratory and Marine and Sediment Assessment Group.

4.2.1 Location of Sampling Stations

Sediment chemistry samples will be collected from the 17 stations shown in Figure 4-1. A summary of the station name, a brief location description, and the rationale for sampling at each station is provided in Table 4-1.

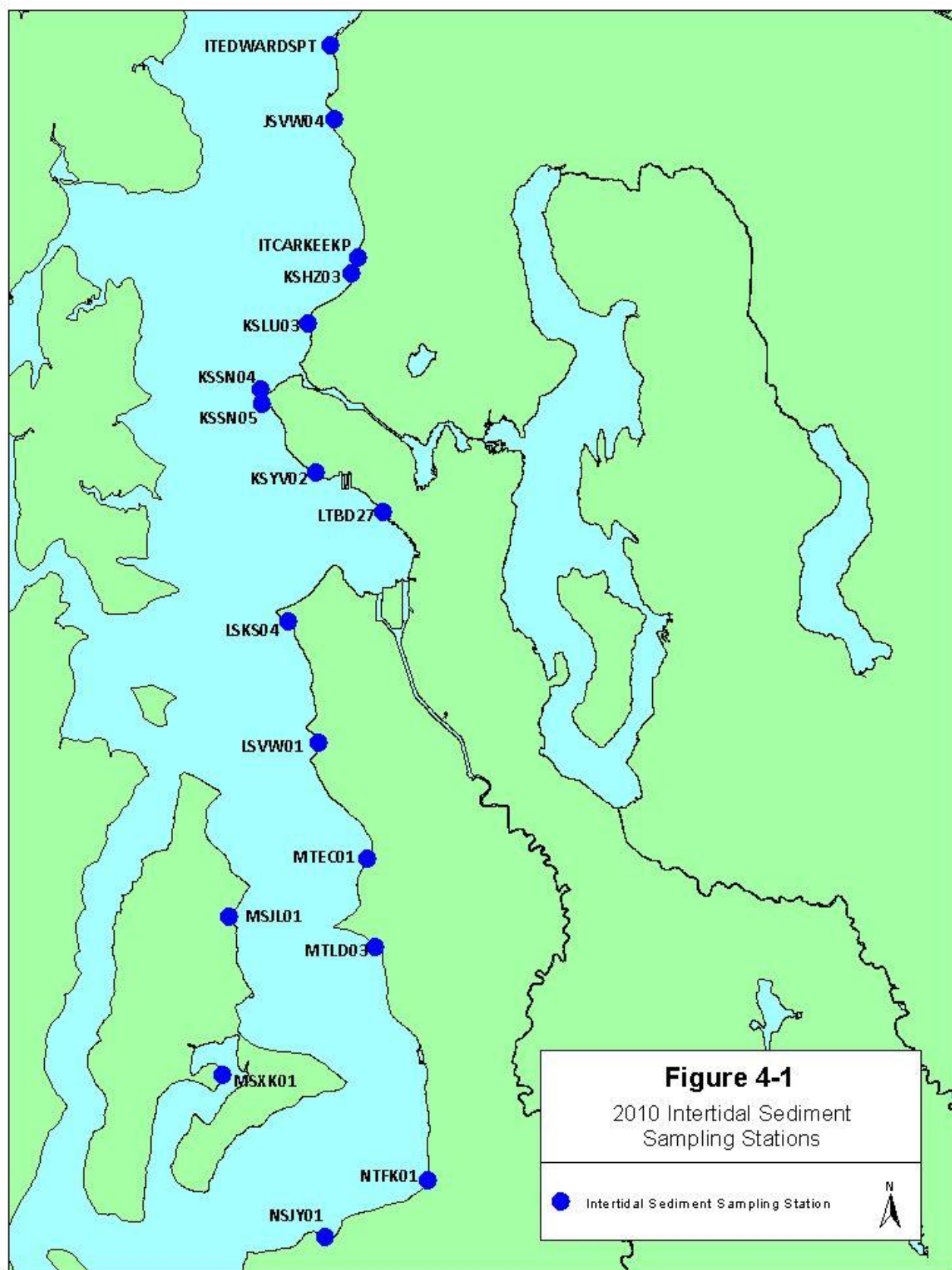


Table 4-1
2010 Intertidal Sediment Sampling Stations

Station	Location	Rationale
ITEDWARDSPT	Edwards Point – Marina Beach	High public use, co-located shellfish station
JSVW04	Richmond Beach/Point Wells	Long-term station, co-located shellfish station
ITCARKEEKP	Carkeek Park	Background station for KSHZ03
KSHZ03	Carkeek Park – Piper’s Creek	Long-term station, co-located shellfish station
KSLU03	Golden Gardens Park	Long-term station, co-located shellfish station
KSSN04	West Point – North Side	Long-term station, co-located shellfish station
KSSN05	West Point – South Side	Long-term station, co-located shellfish station
KSYV02	Magnolia CSO	Located proximal to CSO discharge
LTBD27	SAM Sculpture Park Beach	High public use
LSKS04	Alki Point – South Side	High public use, co-located shellfish station
LSVW01	Fauntleroy Cove	High public use
MTEC01	Seahurst Park	High public use
MTLD03	Normandy Park	High public use, co-located shellfish station
NTFK01	Redondo Beach	High public use, history of water quality issues
NSJY01	Dumas Bay	History of water quality issues
MSJL01	Vashon Island – Vashon TP	Required by outfall lease, co-located shellfish station
MSXK01	Vashon Island – Burton Acres Park	High public use, co-located shellfish station

4.2.2 Sample Acquisition and Analytical Parameters

Sediment chemistry samples will be collected from the 0- to 5-cm depth stratum. Samples will be comprised of sediment collected from a single sampling location at all 17 stations. Samples will be composited, homogenized, and split into laboratory containers in the field. Parameters of interest will include metals and trace organic compounds, as well as conventional sediment chemistry and physical properties.

Sediment chemistry analytical parameters were selected primarily based on guidance for conducting sediment characterizations (Ecology 2008) and will allow comparison of analytical results with published sediment quality criteria (Ecology 1995). Other analytical parameters were selected based on previous sediment studies in the vicinity, as well as a desire to begin monitoring emerging chemicals of concern such as polybrominated biphenyl ethers (PBDEs), which are also being monitored in shellfish tissue samples. Analytical parameters will include:

- conventionals – particle size distribution (PSD), total organic carbon (TOC), and total solids;
- metals – aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc; and
- organics - base/neutral/acid semivolatile organic compounds (BNAs), PBDEs, and polychlorinated biphenyls (PCBs).

4.3 Data Analysis

Chemistry data will be evaluated by comparison to sediment chemical criteria from Tables I and III in the Washington State Sediment Management Standards (SMS) of Chapter 173-204 WAC (Ecology 1995). Data for those analytes for which there are no published sediment quality criteria will be compared to results from previous King County monitoring events as well as other sediment studies in Puget Sound.

Sediment data for some organic compounds are generally normalized to organic carbon content for comparison to SMS criteria. Normalization to organic carbon can produce biased results, however, when the organic carbon content of the sample is very low (Ecology 1992). When the organic carbon content of a sample is near 0.1 or 0.2% (1,000 to 2,000 milligrams/kilogram (mg/Kg) dry weight, even background concentrations of certain organic compounds can exceed sediment quality criteria. If the organic carbon content at any particular station is below 0.5% dry weight, then dry weight-normalized results for non-ionizable organic compounds will be compared to Lowest Apparent Effects Threshold (LAET) or Second Lowest Apparent Effects Threshold (2LAET) criteria (EPA 1988), rather than SMS criteria.

5 PROJECT ORGANIZATION AND SCHEDULE

The tasks involved in conducting the 2010 intertidal sediment sampling event and the King County personnel who will assume responsibility for those tasks are listed below.

- **Scott Mickelson** King County Marine and Sediment Assessment Group – (206) 296-8247 scott.mickelson@kingcounty.gov Project management, study design, preparation of SAP, data validation and analysis, and preparation of final study report.
- **Christopher Barnes** King County Environmental Laboratory – (206) 684-2392 christopher.barnes@kingcounty.gov Coordination of all field sampling activities.
- **Katherine Bourbonais** King County Environmental Laboratory – (206) 684-2382 katherine.bourbonais@kingcounty.gov Coordination of all laboratory analytical activities, data validation, and data reporting.
- **Colin Elliott** King County Environmental Laboratory – (206) 684-2343 colin.elliott@kingcounty.gov Review of SAP, coordination of laboratory QA/QC, data validation, and data reporting.

Sampling for the 2010 marine ambient subtidal sediment sampling event is anticipated to require up to three days of field time (weather dependent) and will be completed in August 2010. Analytical results for sediment chemistry will be available by November 2010. Validated chemistry data packages and electronic data files will be ready for release by December 31, 2010.

6 SAMPLING PROCEDURES

Chemistry samples will be comprised of intertidal sediments collected from a single discrete location at all 17 of the sampling stations.

6.1 Station Positioning

Single samples will be collected from the +6.5 foot tide height, referenced to mean lower low water (MLLW) at all 17 stations. The +6.5 foot tide height on the beach at each station will be measured using a “peashooter” hand-held level and stadia rod.

The field team will use the peashooter, which is set on a 5-foot staff, to set the target height to be read on the stadium rod. The target height on the stadia rod for +6.5 feet MLLW is 11.5 feet. The field team will then use a tide chart to estimate the tide height at the time of sampling. The current tide height will then be subtracted from the target height to provide the adjusted stadia rod height that should be read with the peashooter, resulting in location of the +6.5 foot tide height. For example, at a current tide height of +4 feet, the height that should be read on the stadium rod, with the stadia rod at the current water line is +7.5 feet. One member of the field team would hold the stadia rod at the current water line. The other team member would then adjust their position until a height of +7.5 feet is read through the peashooter.

Location coordinates for each of the stations will be obtained using Garmin™ hand-held global position system (GPS) units.

6.2 Sample Collection

Samples will be collected from the top five cm of intertidal sediment at each station, using dedicated stainless steel 5-cm diameter core tubes and bowls, which will preclude the need for decontamination of sampling gear in the field. If the use of the 5-cm diameter core tubes is not possible, because of rocks and/or other debris, then a dedicated stainless steel spoon will be used to collect the sample. When sampling with the spoon method, a ruler will be used to reference a depth of five cm. Visible debris, such as woody or plant material and large cobbles will be removed from the sample prior to placing the sediment in containers. Once enough sediment has been collected to fill all of the sample containers, the sediment will be thoroughly homogenized prior to placing it into the appropriate sample containers.

6.3 Sample Processing

Samples will be placed in pre-cleaned, pre-labeled sample containers supplied by the King County Environmental Laboratory. Head space will be left in all lab containers to allow further mixing at the laboratory and for expansion, should the containers be stored frozen. All sample containers will be stored in insulated, ice-filled coolers while in the field until delivery to the laboratory. Sample containers, storage conditions, and hold times are summarized in Table 6-1.

Table 6-1
Sample Containers, Storage Conditions, and Analytical Hold Times

Analyte	Container	Preferred Storage Conditions	Hold Time	Acceptable Storage Conditions	Hold Time
Particle Size Distribution	16-oz. glass or polypropylene	refrigerate at 4°C	6 months to analyze	N/A	N/A
Total Organic Carbon	4-oz. glass or polypropylene	freeze at -20°C	6 months to analyze	refrigerate at 4°C	14 days to analyze
Total Solids (collect w/ TOC)	4-oz. glass or polypropylene	freeze at -20°C	6 months to analyze	refrigerate at 4°C	14 days to analyze
Mercury	250-ml HDPE	freeze at -18°C	28 days to analyze	N/A	N/A
Other Metals	250-ml HDPE	freeze at -18°C	2 years to analyze	refrigerate at 4°C	6 months to analyze
BNAs	16-oz. glass	freeze at -18°C	1 year to extract 40 days to analyze	refrigerate at 4°C	14 days to extract 40 days to analyze
PCBs (collect w/ BNAs)	16-oz. glass	freeze at -18°C	1 year to extract 40 days to analyze	refrigerate at 4°C	14 days to extract 40 days to analyze
PBDEs (collect w/ BNAs)	16-oz. glass	freeze at -18°C	1 year to extract 40 days to analyze	refrigerate at 4°C	14 days to extract 40 days to analyze

6.4 Sample Storage and Delivery

All sample containers will be stored in an insulated cooler containing ice immediately after collection to maintain the samples at a temperature of approximately 4° Celsius until delivery to the laboratory. Sample containers from each station will be grouped and placed in plastic bags to facilitate sample receipt and login. At the end of the sampling day, all samples will be transported back to the King County Environmental Laboratory.

6.5 Chain-of-Custody

Chain-of-custody (COC) will commence at the time that each sample is collected. While in the field, all samples will be under direct possession and control of King County field staff. For chain-of-custody purposes, field vehicles will be considered a “controlled area.” All sample information will be recorded on a COC form (Figure 6-1). This form will be completed in the field and will accompany all samples during transport and delivery to the laboratory. Upon arrival at the King County Environmental Laboratory, the sample delivery person will relinquish all samples to the sample login person. The date and time of sample delivery will be recorded and both parties will then sign off in the appropriate sections on the COC form at this time. Once completed, original COC forms will be archived in the project file.

[illegible]

7 FIELD MEASUREMENTS AND OBSERVATIONS

Sampling information and sample metadata will be documented using the methods noted below.

- Field sheets generated by King County's Laboratory Information Management System (LIMS) that will include the following information for each sample:
 1. sample ID number;
 2. station name;
 3. date and time of sample collection;
 4. condition (ebb, slack, flow) and height of the tide;
 5. coordinates for the sampling location;
 6. beach height for the sampling location;
 7. gross physical characteristics of the sediment; and
 8. field personnel.
- LIMS-generated container labels will identify each container with a unique sample number, station and site names, collect date, analyses required, and preservation method.
- COC documentation will consist of the Lab's standard COC form, which is used to track release and receipt of each sample from collection to arrival at the lab.

A typical field sheet used by the King County Environmental Laboratory is shown in Figure 7-1.

Figure 7-1

King County Environmental Laboratory

Standard Field Sheet

Fieldsheet ID: 421235_22JUN1999_101133

Page: 1

MAJOR LAKES (wtr col)

Project Number: 421235

Personnel: _____

Sample Number	P15790-1	P15790-2	P15790-3
Locator	0618	0623	0625
Short Loc. Desc.		Rosemnt SD	Sammalough
Locator Desc.		LAKE SAMM/WEST SHORE-ROSEMONT STOR	Lake Sammamish
Site	MAJOR LAKES	MAJOR LAKES	MAJOR LAKES
Sample Depth			
Collect Date			
Comments			
EH, FIELD			
SED DEPTH			
SED SAMP RANGE			
SED TYPE			
TIME			
Dept., Matrix, Prod			
	3 FRSHWTRSED AVS	3 FRSHWTRSED AVS	3 FRSHWTRSED AVS
	3 FRSHWTRSED NH3	3 FRSHWTRSED NH3	3 FRSHWTRSED NH3
	3 FRSHWTRSED PSD	3 FRSHWTRSED PSD	3 FRSHWTRSED PSD
	3 FRSHWTRSED TOC	3 FRSHWTRSED TOC	3 FRSHWTRSED TOC
	3 FRSHWTRSED TOTP	3 FRSHWTRSED TOTP	3 FRSHWTRSED TOTP
	3 FRSHWTRSED TOTS	3 FRSHWTRSED TOTS	3 FRSHWTRSED TOTS
	3 FRSHWTRSED TOTSULFIDE	3 FRSHWTRSED TOTSULFIDE	3 FRSHWTRSED TOTSULFIDE
	6 FRSHWTRSED HG-CVAA	6 FRSHWTRSED HG-CVAA	6 FRSHWTRSED HG-CVAA
	6 FRSHWTRSED PP ICPMS	6 FRSHWTRSED PP ICPMS	6 FRSHWTRSED PP ICPMS
	7 FRSHWTRSED BNA	7 FRSHWTRSED BNA	7 FRSHWTRSED BNA
	7 FRSHWTRSED CHLOROBENZENES	7 FRSHWTRSED CHLOROBENZENES	7 FRSHWTRSED CHLOROBENZENES
	7 FRSHWTRSED CLPESTPCB	7 FRSHWTRSED CLPESTPCB	7 FRSHWTRSED CLPESTPCB
	7 FRSHWTRSED HERB	7 FRSHWTRSED HERB	7 FRSHWTRSED HERB
	7 FRSHWTRSED OPPEST	7 FRSHWTRSED OPPEST	7 FRSHWTRSED OPPEST
	7 FRSHWTRSED TRIBUTYLTIN	7 FRSHWTRSED TRIBUTYLTIN	7 FRSHWTRSED TRIBUTYLTIN
	7 FRSHWTRSED WTPH-HCID	7 FRSHWTRSED WTPH-HCID	7 FRSHWTRSED WTPH-HCID

End of Fieldsheet.

8 ANALYTICAL PARAMETERS AND METHODS

Analytical parameters for sediment chemistry samples are presented in the following sections. All analyses will be performed at the King County Environmental Laboratory and will follow guidelines recommended in the Puget Sound Protocols (PSEP 1986, 1997a, and 1997b).

The terms MDL and RDL, used in the following sections, refer to *method detection limit* and *reporting detection limit*, respectively. The MDL is defined as *the minimum concentration of a chemical constituent that can be detected*, while the RDL is defined as *the minimum concentration of a chemical constituent that can be reliably quantified*.

8.1 Conventionals – Analytical Methods and Detection Limits

Conventional sediment parameters will include PSD, TOC, and total solids. The analytical methods and detection limits for conventional parameters are summarized in Table 8-1.

Table 8-1
Conventionals Methods and Detection Limits

Parameter	Method	MDL	RDL	Units
PSD (gravel and sand)	ASTM D422	0.1	1.0	percent dry wt.
PSD (silt and clay)	ASTM D422	0.5	1.0	percent dry wt.
Total Organic Carbon	EPA 9060, PSEP 1986	1,000	2,000	mg/Kg dry wt. ¹
Total Solids	SM 2540-G	0.005	0.01	percent wet wt.

¹Dry-weight MDL for TOC is based on an assumed 50% solids content.

Total solids will be analyzed on all samples to allow normalization of all other sediment chemistry data to dry weight. Total solids analysis will be performed according to Standard Method (SM)2540-G (APHA 1998), which is a gravimetric determination. Results for solids analyses are presented in units of percent on a wet-weight basis.

TOC analysis will be performed on all samples to allow normalization of some organic parameters to organic carbon. TOC analysis will be performed according to EPA Method 9060/SW-846 (EPA 1995), high-temperature combustion with infrared spectroscopy. Results for TOC analysis are presented in units of mg/Kg on a dry-weight basis.

PSD analysis will be performed according to ASTM Method D422 (ASTM 2002), which is a combination of sieve and hydrometer analyses. Results for PSD analysis are presented in units of percent on a dry weight basis, both for phi sizes and for the four broad classifications of clay, silt, sand, and gravel. Results for the clay and silt fractions are also summed to provide a result for “percent fines.” The MDL and RDL values shown in Table 8-1 may be adjusted for individual samples, based on the initial amount of sample analyzed.

8.2 Metals – Analytical Methods and Detection Limits

The analytical methods and detection limits for the target metals are summarized in Table 8-2. These MDLs and RDLs are presented on a wet-weight basis and are based on an initial sample weight of 1 ± 0.05 grams (g) and a final volume of 50 milliliters (ml) for ICP metals and 100 ml for mercury. Mercury will be analyzed by cold vapor atomic absorption spectroscopy (CVAA)

and other metals will be analyzed by inductively coupled plasma optical emission spectroscopy (ICP-OES) with a strong acid digestion.

Table 8-2
Metals Target Analytes, Methods,
and Detection Limits (mg/Kg wet weight)

Analyte	Method	MDL	RDL
Aluminum	EPA 3050B/6010C	5	25
Arsenic	EPA 3050B/6010C	1.25	6.25
Cadmium	EPA 3050B/6010C	0.1	0.5
Chromium	EPA 3050B/6010C	0.15	0.75
Copper	EPA 3050B/6010C	0.2	1
Iron	EPA 3050B/6010C	2.5	12.5
Lead	EPA 3050B/6010C	1	5
Manganese	EPA 3050B/6010C	0.1	0.5
Mercury	EPA 7471B	0.005	0.05
Nickel	EPA 3050B/6010C	0.25	1.25
Selenium	EPA 3050B/6010C	1.25	6.25
Silver	EPA 3050B/6010C	0.2	1
Zinc	EPA 3050B/6010C	0.25	1.25

MDLs for nine trace metals, normalized to dry weight over a range of percent solids concentrations, are shown in Appendix A (Table A-1). This information is provided to demonstrate whether dry-weight normalized MDLs for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc will meet Ecology's recommended Practical Quantitation Limits (PQLs) from Ecology's SAPA (Ecology 2008). The information in Table A-1 shows that dry-weight normalized MDLs for these 10 metals all meet the SAPA-recommended PQLs at the range of percent solids from 25 to 75%.

8.3 Trace Organics – Analytical Methods and Detection Limits

Trace organic parameters will include BNAs, PCBs, and PBDEs. The analytical methods and detection limits for the target BNA and PCB compounds are summarized in Tables 8-3 and 8-4 on a wet-weight basis. Wet-weight MDLs are normalized to dry weight over a range of percent solids contents in Appendix A (Tables A-2 and A-3) for comparison with practical quantitation limits (PQLs) recommended in the SAPA. The SAPA does not provide specific PQLs for PBDEs, therefore, detection limits for these compounds are presented on a dry-weight basis, with an assumed 50% solids content, in Table 8-5.

Results for certain non-ionizing organic compounds are generally normalized to organic carbon for comparison to SMS chemical criteria. The King County Environmental Laboratory has attempted to optimize its procedures to produce the lowest cost-effective MDLs that are routinely achievable in a standard sediment sample. These MDLs should meet the required SMS chemical criteria for each parameter in most cases. The ability of the laboratory to attain detection limits which meet organic-carbon normalized chemical criteria, however, will depend upon the TOC content of each sample. Organic-carbon normalized detection limits are shown in Table 8-6. These values are based on the wet-weight MDLs shown in Tables 8-3 and 8-4 and converted using a conservatively-low percent solids content of 35% and the minimum TOC content that would be applicable for organic-carbon normalization (0.5% by dry weight).

8.3.1 BNA Target Analytes and Detection Limits

The detection limits for the target BNA compounds are summarized in Table 8-3. These MDLs and RDLs are presented on a wet-weight basis and are based on a 40-g extraction with gel permeation cleanup and concentration to a final volume of 0.5 ml for analysis. Note that the detection limits can vary if limited sample is available for extraction (less than 30 g) or if dilution is required due to elevated analyte concentration(s). BNA analysis will be performed according to EPA methods 3550B/8270D (SW 846), which employ solvent extraction with sonication and analysis by gas chromatography/mass spectroscopy (GC/MS).

Table 8-3
BNA Target Analytes and Detection Limits (µg/Kg wet weight)

Analyte	MDL	RDL	Analyte	MDL	RDL
1,2,4-Trichlorobenzene	0.20	0.40	Chrysene	2.0	4.0
1,2-Dichlorobenzene	0.20	0.40	Coprostanol	40	80
1,4-Dichlorobenzene	0.20	0.40	Dibenzo(a,h)anthracene	2.0	4.0
2,4-Dimethylphenol	2.0	4.0	Dibenzofuran	2.0	4.0
2-Methylnaphthalene	2.0	4.0	Diethyl Phthalate	4.0	8.0
2-Methylphenol	4.0	8.0	Dimethyl Phthalate	4.0	8.0
4-Methylphenol	4.0	8.0	Di-N-Butyl Phthalate	4.0	8.0
Acenaphthene	2.0	4.0	Di-N-Octyl Phthalate	4.0	8.0
Acenaphthylene	2.0	4.0	Fluoranthene	2.0	4.0
Anthracene	2.0	4.0	Fluorene	2.0	4.0
Benzo(a)anthracene	2.0	4.0	Hexachlorobenzene	0.4	.8
Benzo(a)pyrene	2.0	4.0	Hexachlorobutadiene	1.0	2.0
Benzo(b)fluoranthene	2.0	4.0	Indeno(1,2,3-cd)pyrene	2.0	4.0
Benzo(g,h,i)perylene	2.0	4.0	Naphthalene	2.0	4.0
Benzo(k)fluoranthene	2.0	4.0	N-Nitrosodiphenylamine	4.0	8.0
Benzoic Acid	10	20	Pentachlorophenol	10	20
Benzyl Alcohol	4.0	8.0	Phenanthrene	2.0	4.0
Benzyl Butyl Phthalate	4.0	8.0	Phenol	4.0	8.0
Bis(2-Ethylhexyl) Phthalate	4.0	8.0	Pyrene	4.0	8.0
Caffeine	4	8	Total 4-Nonylphenol	5	10

MDLs for BNA compounds, normalized to dry weight over a range of percent solids concentrations, are shown in Appendix A (Table A-2). This information is provided to demonstrate whether dry-weight normalized MDLs for BNAs will meet Ecology's recommended PQLs. The information in Table A-2 shows that all dry-weight normalized MDLs for BNA compounds meet the SAPA-recommended PQLs at the range of percent solids from 25 to 75%.

8.3.2 PCB Target Analytes and Detection Limits

The detection limits for the target PCB Aroclors® are summarized in Table 8-4. These MDLs and RDLs are presented on a wet-weight basis and are based on a 20-g extraction with gel permeation cleanup and concentration to a final volume of 0.5 ml. Note that the detection limits can vary if limited sample is available for extraction (less than 20 g) or if dilution is required due to elevated analyte concentration(s). PCB analysis will be performed according to EPA methods 3550B/8082 (SW 846), which employ solvent extraction with sonication and analysis by gas chromatography with electron capture detector (GC/ECD) and dual column confirmation.

Table 8-4
PCB Target Analytes and Detection Limits (µg/Kg wet weight)

Analyte	MDL	RDL	Analyte	MDL	RDL
Aroclor 1016	1.0	2.0	Aroclor 1248	1.0	2.0
Aroclor 1221	2.0	4.0	Aroclor 1254	1.0	2.0
Aroclor 1232	2.0	4.0	Aroclor 1260	1.0	2.0
Aroclor 1242	1.0	2.0			

MDLs for PCBs, normalized to dry weight over a range of percent solids concentrations, are shown in Appendix A (Table A-3). This information is provided to demonstrate whether dry-weight normalized MDLs for PCBs will meet Ecology's recommended PQLs. The information in Table A-3 that dry-weight normalized MDLs for PCB Aroclors meet the SAPA-recommended PQLs at the range of percent solids from 25 to 75% with two exceptions. The dry-weight normalized MDLs for Aroclors 1221 and 1232 at 25% solids exceed the SAPA-recommended PQL of 6 µg/Kg DW. This should not prove problematic, however, since the highest dry-weight normalized MDL of 8 µg/Kg DW is still greater than a factor of 10 lower than the LAET of 130 µg/Kg DW.

8.3.3 *PBDE Target Analytes and Detection Limits*

The detection limits for target PBDE congeners are summarized in Table 8-5. These MDLs and RDLs are presented on a dry-weight basis (assumed 50% solids content) and are based on a 15-g extraction with GPC cleanup and concentration to a final volume of 1 ml for analysis. Note that the detection limits can vary if limited sample is available for extraction (less than 15 g) or if dilution is required due to elevated analyze concentration(s). PBDE analysis will be performed according to EPA method 3550B (SW-846) and King County standard operating procedure (SOP) #7-03-025-000 (King County 2006), which employ solvent extraction with sonication and analysis by GC-ICPMS.

Table 8-5
PBDE Target Analytes and Detection Limits (µg/Kg dry weight)

Analyte	MDL	RDL	Analyte	MDL	RDL
PBDE-17	0.04	0.086	PBDE-100	0.040	0.086
PBDE-28	0.04	0.086	PBDE-138	0.040	0.086
PBDE-47	0.04	0.086	PBDE-153	0.040	0.086
PBDE-66	0.04	0.086	PBDE-154	0.040	0.086
PBDE-71	0.04	0.086	PBDE-183	0.040	0.086
PBDE-85	0.04	0.086	PBDE-190	0.040	0.086
PBDE-99	0.04	0.086	PBDE-209	0.20	0.41

8.3.4 *Organic Carbon Normalized Detection Limits*

Table 8-6 presents the organic-carbon normalized detection limits for the non-ionizable organic compounds regulated under the SMS, based on a percent solids concentration of 35% and a TOC content of 0.5%.

Table 8-6
Non-Ionizable Organic Compound Detection Limits (mg/Kg OC)

Analyte	MDL	RDL	Analyte	MDL	RDL
2-Methylnaphthalene	1.1	2.3	Pyrene	2.3	4.6
Acenaphthene	1.1	2.3	1,2,4-Trichlorobenzene	0.11	0.23
Acenaphthylene	1.1	2.3	1,2-Dichlorobenzene	0.11	0.23
Anthracene	1.1	2.3	1,4-Dichlorobenzene	0.11	0.23
Benzo(a)anthracene	1.1	2.3	Hexachlorobenzene	0.23	0.46
Benzo(a)pyrene	1.1	2.3	Benzyl Butyl Phthalate	2.3	4.6
Benzo(b)fluoranthene	1.1	2.3	Diethyl Phthalate	2.3	4.6
Benzo(g,h,i)perylene	1.1	2.3	Dimethyl Phthalate	2.3	4.6
Benzo(k)fluoranthene	1.1	2.3	Di-N-Butyl Phthalate	2.3	4.6
Chrysene	1.1	2.3	Bis(2-Ethylhexyl) Phthalate	2.3	4.6
Dibenzo(a,h)anthracene	1.1	2.3	Di-N-Octyl Phthalate	2.3	4.6
Fluoranthene	1.1	2.3	Dibenzofuran	1.1	2.3
Fluorene	1.1	2.3	Hexachlorobutadiene	0.57	1.1
Indeno(1,2,3-cd)pyrene	1.1	2.3	N-Nitrosodiphenylamine	2.3	4.6
Naphthalene	1.1	2.3	PCBs (1016, 1242, 1248, 1254, 1260)	0.57	1.1
Phenanthrene	1.1	2.3	PCBs (1221, 1232)	1.1	2.2

All of the organic carbon normalized MDLs shown in Table 8-6 are below their respective SQS chemical criteria from Table I of Chapter 173-204 WAC (Ecology 1995).

9 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

The quality control (QC) samples that will be analyzed in association with sediment chemistry analyses are summarized in Table 9-1. The frequency of method blanks, spike blanks, duplicates, triplicates, and matrix spikes is one per QC batch (20 samples maximum). The frequency of SRM (standard reference material) or LCS (laboratory control sample) analysis is one per project (40 samples maximum) and one per QC batch (20 samples maximum) for metals analyses. Surrogates are analyzed with every organic sample.

Table 9-1
Marine Sediment Chemistry Quality Control Samples

Analyte	Method Blank	Spiked Blank	Duplicate/Triplicate	Matrix Spike (MS)	MS Duplicate	SRM/LCS	Surrogates
PSD	No	No	Triplicate	No	No	No	No
TOC	Yes	Yes	Triplicate	Yes	No	Yes	No
Total Solids	Yes	No	Triplicate	No	No	No	No
Mercury	Yes	Yes	Duplicate	Yes	Yes	Yes	No
Other Metals	Yes	Yes	Duplicate	Yes	No	Yes	No
BNAs	Yes	Yes	Duplicate	Yes	Yes	Yes	Yes
PCBs	Yes	Yes	Duplicate	Yes	Yes	Yes	Yes
PBDEs	Yes	Yes	Duplicate	Yes	Yes	Yes	Yes

Quality assurance (QA1) marine sediment chemistry acceptance criteria (Ecology 1989) are shown in Table 9-2.

Table 9-2
QA1 Acceptance Criteria for Marine Sediment Chemistry Samples

Analyte	Method Blank	Spiked Blank	Duplicate/Triplicate	Matrix Spike	SRM/LCS	Surrogates
PSD	N/A	N/A	RSD < 20%	N/A	N/A	N/A
TOC	< MDL	80 - 120%	RSD < 20%	75 - 125%	80 - 120%	N/A
Total Solids	< MDL	N/A	RSD < 20%	N/A	N/A	N/A
Metals (incl. Hg)	< MDL	85 – 115%	RPD < 20%	75 - 125%	Appendix B	N/A
BNAs	< MDL	Appendix B	RPD < 35%	Appendix B	Appendix B	Appendix B
PCBs	< MDL	Appendix B	RPD < 35%	Appendix B	Appendix B	Appendix B
PBDEs	< MDL	50 – 150%	RPD < 35%	50 – 150%	80 – 120%	50 – 150%

< MDL - Method Blank result should be less than the *method detection limit*.

RPD – Relative Percent Difference, RSD – Relative Standard Deviation

QC results for matrix spike, SRM/LCS, and surrogates are in *percent recovery of analyte*.

Some trace metal and organic analyses have empirically-derived laboratory limits for various QC samples. Specific laboratory-derived acceptance limits for trace metal and organic analyses are included as Appendix B (Tables B1 – B8). QC results that exceed the acceptance limits will be evaluated to determine appropriate corrective actions. Samples will typically be reanalyzed if the unacceptable QC results indicate a systematic problem with the overall analysis.

Unacceptable QC results caused by a particular sample or matrix will not require reanalysis unless an allowed method modification would improve the results. Analytical results that do not meet QA1 acceptance criteria will be qualified and flagged according to Ecology guidance (Ecology 2008).

10 DATA REPORTING AND RECORD KEEPING

This section provides information on how monitoring data will be reported and interpreted and how project records will be maintained.

10.1 Analytical Data

All sediment chemistry data will be reported in QA1 format (Ecology 1989). The final QA1 report will contain the following information and deliverables:

- a QA1 narrative discussing data quality in relation to study objectives and data criteria;
- all associated QC data (LIMS QC reports and worklists);
- copies of field sheets and COC forms; and
- a comprehensive report containing all analytical and field data (including data qualifier flags).

10.2 Final Report and EIMS Files

A final monitoring report will be prepared that will include a presentation and interpretation of the sediment chemistry results. The report will compare sediment chemistry results to published sediment quality chemical criteria (Ecology 1995, EPA1988) as well as regional Puget Sound values in order to provide an evaluation of sediment quality in intertidal areas within King County. The chemistry data will be also reported in the regional Environmental Information Management System (EIMS) format for delivery to Ecology.

10.3 Record Keeping

All field and sampling records, custody documents, raw lab data, and summaries and narratives will be archived according to King County Environmental Laboratory policy, for a minimum of 10 years from the date samples were collected. Interpretive reports and memoranda, along with all chemistry data, data analysis project narratives, and reports will be stored in project files for a minimum of 10 years from the date samples were collected. Appendix C includes LIMS “product names” and “list types” under which analytical data will be stored.

11 REFERENCES

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- PSEP 1997a. *Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment and Tissue Samples*. Prepared for the Puget Sound Estuary Program (U.S. Environmental Protection Agency Region 10) by the King County Environmental Laboratory. Seattle, Washington.
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APPENDIX A

**Metals and Trace Organics Dry-Weight Normalized Method Detection Limits (MDLs)
Compared to Recommended Practical Quantitation Limits (PQLs)
Tables A-1 through A-3**

Table A-1
Dry-Weight Normalized MDLs for Trace Metals
Compared to SAPA PQLs (all values in mg/Kg)

Trace Metal	WW MDL	DW MDL 25%	DW MDL 50%	DW MDL 75%	DW SAPA PQL
Arsenic	1.25	5	2.5	1.7	19
Cadmium	0.1	0.4	0.2	0.13	1.7
Chromium	0.15	0.6	0.3	0.2	87
Copper	0.2	0.8	0.4	0.27	130
Lead	1	4	2	1.3	150
Mercury	0.005	0.02	0.01	0.0067	0.14
Nickel	0.25	1	0.5	0.33	47
Silver	0.2	0.8	0.4	0.27	2
Zinc	0.25	1	0.5	0.33	137

WW MDL – Nominal wet-weight method detection limit from Table 9-2.

DW MDL – Dry-weight normalized method detection limit based on percent solids content of 25, 50, and 75%.

DW SAPA PQL – Recommended practical quantitation limit from Sampling and Analysis Plan Appendix (Ecology 2008).

All dry-weight normalized MDLs for Trace Metals meet the SAPA-recommended PQLs at the range of percent solids from 25 to 75%.

Table A-2
Dry-Weight Normalized MDLs for BNAs
Compared to SAPA PQLs (all values in µg/Kg)

BNA	WW MDL	DW MDL 25%	DW MDL 50%	DW MDL 75%	DW SAPA PQL
1,2,4-Trichlorobenzene	0.2	0.8	0.4	0.3	31
1,2-Dichlorobenzene	0.2	0.8	0.4	0.3	35
1,4-Dichlorobenzene	0.2	0.8	0.4	0.3	37
2,4-Dimethylphenol	2.0	8.0	4.0	2.7	29
2-Methylnaphthalene	2.0	8.0	4.0	2.7	223
2-Methylphenol	4.0	16.0	8.0	5.3	63
4-Methylphenol	4.0	16.0	8.0	5.3	223
Acenaphthene	2.0	8.0	4.0	2.7	167
Acenaphthylene	2.0	8.0	4.0	2.7	433
Anthracene	2.0	8.0	4.0	2.7	320
Benzo(a)anthracene	2.0	8.0	4.0	2.7	433
Benzo(a)pyrene	2.0	8.0	4.0	2.7	533
Benzo(b)fluoranthene	2.0	8.0	4.0	2.7	1,067
Benzo(g,h,i)perylene	2.0	8.0	4.0	2.7	223
Benzo(k)fluoranthene	2.0	8.0	4.0	2.7	1,067
Benzoic Acid	10.0	40.0	20.0	13.3	217
Benzyl Alcohol	4.0	16.0	8.0	5.3	57
Benzyl Butyl Phthalate	4.0	16.0	8.0	5.3	21
Bis(2-Ethylhexyl) Phthalate	4.0	16.0	8.0	5.3	433
Caffeine	4.0	16.0	8.0	5.3	--
Chrysene	2.0	8.0	4.0	2.7	467
Coprostanol	40.0	160.0	80.0	53.3	--
Dibenzo(a,h)anthracene	2.0	8.0	4.0	2.7	77
Dibenzofuran	2.0	8.0	4.0	2.7	180
Diethyl Phthalate	4.0	16.0	8.0	5.3	67
Dimethyl Phthalate	4.0	16.0	8.0	5.3	24
Di-N-Butyl Phthalate	4.0	16.0	8.0	5.3	467
Di-N-Octyl Phthalate	4.0	16.0	8.0	5.3	2,067
Fluoranthene	2.0	8.0	4.0	2.7	567
Fluorene	2.0	8.0	4.0	2.7	180
Hexachlorobenzene	0.4	1.6	0.8	0.5	22
Hexachlorobutadiene	1.0	3.9	2.0	1.3	11
Indeno(1,2,3-cd)pyrene	2.0	8.0	4.0	2.7	200
Naphthalene	2.0	8.0	4.0	2.7	700
N-Nitrosodiphenylamine	4.0	16.0	8.0	5.3	28
Pentachlorophenol	10.0	40.0	20.0	13.3	120
Phenanthrene	2.0	8.0	4.0	2.7	500
Phenol	4.0	16.0	8.0	5.3	140
Pyrene	4.0	16.0	8.0	5.3	867
Total 4-Nonylphenol	5.0	20.0	10.0	6.7	--

WW MDL – Nominal wet weight method detection limit from Table 9-3.

DW MDL – Dry-weight normalized method detection limit based on percent solids content of 25, 50, and 75%.

DW SAPA PQL – Recommended practical quantitation limit from Sampling and Analysis Plan Appendix (Ecology 2008).

All dry-weight normalized MDLs for BNA compounds meet the SAPA-recommended PQLs at the range of percent solids from 25 to 75%.

Table A-3
Dry-Weight Normalized MDLs for PCBs
Compared to SAPA PQLs (all values in µg/Kg)

PCB	WW MDL	DW MDL 25%	DW MDL 50%	DW MDL 75%	DW SAPA PQL
Aroclor 1016	1	4	2	1.3	6
Aroclor 1221	2	8	4	2.7	6
Aroclor 1232	2	8	4	2.7	6
Aroclor 1242	1	4	2	1.3	6
Aroclor 1248	1	4	2	1.3	6
Aroclor 1254	1	4	2	1.3	6
Aroclor 1260	1	4	2	1.3	6

DW MDL – Dry-weight normalized method detection limit based on percent solids content of 25, 50, and 75%.

DW SAPA PQL – Recommended practical quantitation limit from Sampling and Analysis Plan Appendix (Ecology 2008).

Dry-weight normalized MDLs for PCB Aroclors meet the SAPA-recommended PQLs at the range of percent solids from 25 to 75% with two exceptions. The dry-weight normalized MDLs for Aroclors 1221 and 1232 at 25% solids exceed the SAPA-recommended PQL of 6 µg/Kg DW.

APPENDIX B

Metals and Trace Organics Performance-Based QC Limits Tables B-1 through B-8

Table B-1a
Laboratory QC Limits for Sediment Metals – SRM Recoveries (PACS-2)

Parameter	Lower Limit (%)	Upper Limit (%)
Chromium	30	70
Copper	78	118
Lead	74	114
Mercury	80	120
Nickel	51	91
Zinc	73	113

Table B-1b
Laboratory QC Limits for Sediment Metals – LCS Recoveries (ERA Soil)

Parameter	Lower Limit (%)	Upper Limit (%)
Arsenic	80	120
Cadmium	80	120
Chromium	80	120
Copper	80	120
Lead	80	120
Nickel	80	120
Silver	66	134
Zinc	80	121

No QA1 flagging occurs as a result of LCS recoveries being outside of control limits.

Table B-2
Laboratory QC Limits for Sediment BNAs, Matrix Spike Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)	Parameter	Lower Limit (%)	Upper Limit (%)
1,2,4-Trichlorobenzene	10	115	Chrysene	14	184
1,2-Dichlorobenzene	10	105	Coprostanol	10	183
1,3-Dichlorobenzene	10	103	Di-N-Butyl Phthalate	10	194
1,4-Dichlorobenzene	10	104	Di-N-Octyl Phthalate	52	151
2,4-Dimethylphenol	10	150	Dibenzo(a,h)anthracene	10	166
2-Methylnaphthalene	22	112	Dibenzofuran	21	134
2-Methylphenol	10	142	Diethyl Phthalate	31	150
4-Methylphenol	10	163	Dimethyl Phthalate	13	162
Acenaphthene	25	130	Fluoranthene	12	188
Acenaphthylene	27	132	Fluorene	22	147
Anthracene	10	181	Hexachlorobenzene	18	151
Benzo(a)anthracene	32	168	Hexachlorobutadiene	10	97
Benzo(a)pyrene	10	200	Hexachloroethane	10	89
Benzo(b)fluoranthene	10	199	Indeno(1,2,3-Cd)Pyrene	10	177
Benzo(g,h,i)perylene	10	173	N-Nitrosodiphenylamine	10	169
Benzo(k)fluoranthene	10	192	Naphthalene	12	97
Benzoic Acid	10	158	Pentachlorophenol	17	170
Benzyl Alcohol	10	138	Phenanthrene	10	200
Benzyl Butyl Phthalate	41	145	Phenol	10	127
Bis(2-Ethylhexyl)Phthalate	10	189	Pyrene	20	174

Table B-3
Laboratory QC Limits for Sediment BNAs, Blank Spike Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)	Parameter	Lower Limit (%)	Upper Limit (%)
1,2,4-Trichlorobenzene	13	110	Chrysene	69	111
1,2-Dichlorobenzene	10	116	Coprostanol	10	159
1,3-Dichlorobenzene	18	95	Di-N-Butyl Phthalate	17	180
1,4-Dichlorobenzene	21	99	Di-N-Octyl Phthalate	10	200
2,4-Dimethylphenol	10	81	Dibenzo(a,h)anthracene	53	129
2-Methylnaphthalene	22	99	Dibenzofuran	37	97
2-Methylphenol	16	91	Diethyl Phthalate	51	118
4-Methylphenol	10	125	Dimethyl Phthalate	38	114
Acenaphthene	29	102	Fluoranthene	55	132
Acenaphthylene	31	101	Fluorene	39	106
Anthracene	45	114	Hexachlorobenzene	40	111
Benzo(a)anthracene	69	117	Hexachlorobutadiene	10	97
Benzo(a)pyrene	15	137	Hexachloroethane	17	92
Benzo(b)fluoranthene	50	121	Indeno(1,2,3-Cd)Pyrene	51	132
Benzo(g,h,i)perylene	46	126	N-Nitrosodiphenylamine	11	148
Benzo(k)fluoranthene	58	128	Naphthalene	17	94
Benzoic Acid	10	170	Pentachlorophenol	38	124
Benzyl Alcohol	10	119	Phenanthrene	57	104
Benzyl Butyl Phthalate	15	183	Phenol	10	107
Bis(2-Ethylhexyl)Phthalate	10	182	Pyrene	48	132

Table B-4
Laboratory QC Limits for Sediment BNAs, Surrogate Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)
2,4,6-Tribromophenol	29	112
2-Fluorophenol	10	112
d5-Phenol	10	106
d5-Nitrobenzene	28	94
d4-2-Chlorophenol	11	105
d4-1,2-Dichlorobenzene	24	91
2-Fluorobiphenyl	31	101
d14-Terphenyl	51	130

Table B-5
Laboratory QC Limits for Sediment BNAs, SRM Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)
Anthracene	28	98
Benzo(a)anthracene	66	124
Benzo(a)pyrene	60	116
Benzo(b)fluoranthene	52	190
Benzo(g,h,i)perylene	15	121
Benzo(k)fluoranthene	60	146
Chrysene	77	136
Dibenzo(a,h)anthracene	10	200
Fluoranthene	45	126
Indeno(1,2,3-Cd)Pyrene	33	121
Naphthalene	10	29
Phenanthrene	51	106
Pyrene	36	135

Table B-6
Laboratory QC Limits for Sediment PCBs
Matrix Spike Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)
Aroclor 1016	32	164
Aroclor 1260	28	144

Table B-7
Laboratory QC Limits for Sediment PCBs
Blank Spike Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)
Aroclor 1016	39	121
Aroclor 1260	53	140

Table B-8
Laboratory QC Limits for Sediment PCBs
SRM and Surrogate Recoveries

Parameter	Lower Limit (%)	Upper Limit (%)
Aroclor 1254	57	139
Decachlorobiphenyl	15	155
2,4,5,6-Tetrachloro-m-xylene	30	134

APPENDIX C

Laboratory Information Management System (LIMS) Products and List Types Table C-1

Table C-1
King County Environmental Laboratory
Laboratory Information Management System (LIMS)
Products and List Types

Parameter	LIMS Product	LIMS List Type
PSD	PSD	CVPSD
TOC	TOC	CVTOC
Total Solids	TOTS	CVTOTS
Mercury by CVAA	HG-CVAAM	MTHG-MIDS, 6-MIDS
Other Metals by ICP	AL-ICP, AS-ICP, CD-ICP, CR-ICP, CU-ICP, FE-ICP, MN-ICP, PB-ICP, NI-ICP, SE-ICP, AG-ICP, ZN-ICP	MTICP-SED, 6-SED
BNAs (low-level)	BNASMS	ORSMS
PBDEs	PBDE	ORPBDE
PCBs (low-level)	PCBLL	ORPCBLL

CVAA – Cold vapor atomic absorption spectroscopy.

ICP – Inductively coupled plasma optic emission spectroscopy.