

APPENDIX 9 – Stormwater Discharge Monitoring

This Appendix applies to Phase I and II Permittees with requirements pursuant to Special Condition S8.C – Stormwater *Discharge Monitoring*.

Stormwater discharge monitoring is intended to characterize stormwater runoff quantity and quality at a limited number of locations in a manner that allows analysis of loadings and changes in conditions over time and generalization across the Permittee's jurisdiction.

QAPP Preparation

Permittees shall prepare a Quality Assurance Project Plan (QAPP) in accordance with *Quality Assurance Project Plan Guidance*, Special Condition S8.D, *Phase I Municipal Stormwater Permit*, December 2010 (Ecology Publication no. 10-10-075, <https://fortress.wa.gov/ecy/publications/documents/1010075.pdf>). The QAPP shall be developed by qualified staff or contractors with experience in applying Ecology or U.S. Environmental Protection Agency (EPA) QAPP Guidelines. Ecology guidelines can be found at <https://ecology.wa.gov/>; search for 'QA project plan'.

A stormwater discharge monitoring QAPP shall be submitted to Ecology in accordance with the deadlines in S8.C. The QAPP shall describe field collection methods and sample preparation methods appropriate to each group of analytes, reporting limits, and field conditions.

Permittees are responsible for maintaining an up-to-date approved QAPP for stormwater discharge monitoring. Significant changes shall be reviewed by Ecology and reflected in a revised QAPP. Significant changes include, but are not limited to:

- Land disturbing activities over 10 acres in size within the sampled drainage area.
- Relocating a monitoring station.
- Introducing new sampling equipment.
- Unanticipated back water conditions, base flow, or tidal influences.
- Changes in laboratories, analytical methods, or reporting limits.

Permittees continuing their stormwater monitoring discharge programs from prior permits are required to update their QAPP to reflect the changes of this Appendix and extend the timeframe. Locations, methodology, and laboratory techniques previously approved by Ecology should be discussed in the QAPP.

Discharge Monitoring Location Selection

Stormwater monitoring discharge monitoring locations shall have mapped tributary conveyance systems and drainage areas, and be suitable for permanent installation and operation of flow-weighted composite sampling equipment. Additional monitoring location selection guidance and information about how to estimate a rainfall to runoff relationship is available in *Standard Operating Procedure for Automatic Sampling for Stormwater Monitoring*, WQP002, <https://fortress.wa.gov/ecy/publications/SummaryPages/1810024.html>.

Permittees may identify a discharge monitoring location upstream in the conveyance system (*i.e.*, up-gradient of the outfall) in order to achieve the desired land use, to accommodate the installation of sampling equipment, and/or to avoid or minimize back water or tidal interference.

The QAPP shall describe each stormwater discharge monitoring location and associated drainage basin in detail. The QAPP must describe how each discharge monitoring location was selected, the size of the drainage basin, and the percentage of area in the drainage basin representing the following land uses: high density residential, low density residential, commercial, industrial, agriculture, and transportation right-of-way. Table A9-1, below, provides characteristics to consider for some of these land uses. However, density definitions can vary from jurisdiction to jurisdiction and may be defined locally in codes and comprehensive plans. Report the residential density definitions used if they differ from these.

Table A9-1 Land Use Selection Characteristics

Land use category	Characteristics
High density residential	4 dwelling units per acre or greater
Medium to high density residential	2 to 4 dwelling units per acre
Low density residential	1 to 2 dwelling units per acre
Commercial	Includes multi-family residential
Industrial	Not predominated by one facility with a few operators

Flow Monitoring

Discharge monitoring locations must be evaluated for a rainfall to runoff relationship in order to ensure that the discharge monitoring location will receive enough runoff for sufficient sample volume. This rainfall to runoff relationship will also assist in programming the automatic sampling equipment. In order to establish the rainfall to runoff relationship, one year of continuous flow recording (including base flow and all storm events) is necessary.

Monitoring Frequency

Permittees shall sample each stormwater discharge monitoring location according to the frequency described below. Documented good faith efforts with good professional practice by the Permittee which do not result in collecting a successful sample for the full number of required storms may be considered as contributing toward compliance with this requirement.

For each location, the Permittee shall sample and analyze a minimum of eleven (11) qualifying storm events per water year. Qualifying storm event sampling must be distributed throughout the year, approximately reflecting the distribution of rainfall between the wet and dry seasons (with a goal of 60-80% of the samples collected during the wet season and a goal of 20-40% of the samples collected in the dry season).

Ecology may approve a reduced sampling frequency if the Permittee provides a statistical analysis demonstrating that monitoring and reporting goals can be met with fewer samples.

Qualifying Storm Event Criteria

The wet season is from October 1 through April 30. A qualifying wet season storm event is defined as follows:

- Rainfall volume: 0.20" minimum, no fixed maximum
- Rainfall duration: No fixed minimum or maximum
- Antecedent dry period: Less than or equal to 0.05" rain in the previous 6 hours, unless more time is needed to return to baseflow at the sampling point
- Inter-event dry period: 6 hours

The dry season is from May 1 through September 30. A qualifying dry season storm event is defined as follows:

- Rainfall volume: 0.20" minimum, no fixed maximum
- Rainfall duration: No fixed minimum or maximum
- Antecedent dry period: less than or equal to 0.02" rain in the previous 24 hours
- Inter-event dry period: 6 hours

Types of Sampling

Storm events shall be sampled using flow-weighted composite sampling techniques. Automatic samplers shall be programmed to begin sampling as early in the runoff event as practical and to continue sampling past the longest estimated time of concentration for the tributary area. Refer to *Standard Operating Procedure for Automatic Sampling for Stormwater Monitoring*, WQP002, <https://fortress.wa.gov/ecy/publications/SummaryPages/1810024.html>.

For storm events lasting less than 24 hours, samples shall be collected for at least 75% of the storm event hydrograph. For storm events lasting longer than 24 hours, samples shall be collected for at least 75% of the hydrograph of the first 24 hours of the storm.

Each composite sample shall be targeted to contain at least 10 aliquots. Composite samples with 7 to 9 aliquots are acceptable if they meet the other sampling criteria and help achieve a representative balance of wet season/dry season events and storm sizes.

Continuous flow recording of all storm events (not just sampled storm events) is necessary for at least one complete water year to establish a baseline rainfall/runoff relationship. Ongoing continuous flow monitoring is required for each of the sampled storm events as necessary to properly conduct the flow-weighted composite sampling. Precipitation data shall be collected from the nearest rain gauge reporting at least hourly rainfall amounts.

Grab samples are necessary for some parameters (table A9-2) and shall be collected early in the storm event. Refer to *Standard Operating Procedure for Grab Sampling for Stormwater Monitoring*, WQP001, <https://fortress.wa.gov/ecy/publications/SummaryPages/1810023.html>.

Stormwater solids samples shall be collected twice per water year at each stormwater discharge monitoring location, or in the vicinity of each stormwater monitoring location. Ecology may approve reducing this requirement to a once per year frequency if the Permittee provides evidence demonstrating that insufficient material is present in the conveyance. In-line conveyance system

locations are the target for stormwater solids sampling (e.g. catch basin sumps), not receiving waters nor BMPs where soils could be inadvertently sampled.

Use of in-line traps or similar collection system is needed for stormwater solids sampling; refer to *Standard Operating Procedure for Collection of Stormwater Solids using In-Line Traps*, WQP003, <https://fortress.wa.gov/ecy/publications/SummaryPages/1810025.html>. The QAPP will need to specify the sampling approach for the selected sampling sites.

Parameters

Flow-weighted composite samples shall be analyzed for the following parameters utilizing an Ecology- or EPA-accredited laboratory and the methods and reporting limits as provided in table A9-2 or otherwise approved by Ecology.

- Conventional parameters
- Methylene blue activating substances (MBAS)
- Nutrients
- Metals
- Organics:
 - Polycyclic aromatic hydrocarbons (PAHs)
 - Pesticides
 - Phthalates

If the volume of the stormwater sample collected from a qualifying storm is insufficient to allow analysis for all of the parameters listed above, the sample shall be analyzed for as many parameters as possible in the following priority order: (1) metals and hardness; (2) conductivity; (3) TSS; (4) nutrients; (5) organics: PAHs, phthalates, insecticide, and herbicides; (6) BOD₅; and (7) remaining conventional parameters. If insufficient sample exists to run the next highest priority pollutant, that analysis may be bypassed and analyses run on lower priority pollutants in accordance with the remaining priority order to the extent possible. Parameters that are below reporting limits after two years of data may be dropped from the analysis.

Grab samples shall be analyzed for the following parameters utilizing an Ecology- or EPA-accredited laboratory and the methods and reporting limits listed in Table A9-2 at the end of this Appendix.

- Fecal coliform bacteria
- Total petroleum hydrocarbons – diesel fraction

Stormwater solids samples shall be analyzed for the following parameters utilizing an Ecology- or EPA-accredited laboratory and the methods and reporting limits listed in table A9-3 or otherwise approved by Ecology.

- Conventional parameters
- Metals
- Organics:
 - Pesticides
 - PAHs
 - Phthalates

- Phenolics
- Polychlorinated biphenyls (PCBs)
- Polybrominated diphenyl ethers (PBDEs)
- Total petroleum hydrocarbon – diesel fraction (TPH-Dx)

If the stormwater solids sample volume is insufficient to analyze for all of the parameters listed below, the sample shall be analyzed for as many parameters as possible in the following priority order: (1) conventional parameters; (2) metals; (3) TPH-Dx; (4) Phenolics; (5) PAHs and phthalates; (6) pesticides; (7) PBDEs; and (8) PCBs. If insufficient sample exists to run the next highest priority pollutant, that analysis may be bypassed and analyses run on lower priority pollutants in accordance with the remaining priority order to the extent possible. Additional samples shall be collected if insufficient sample exists from a single sample to run all of the organic pollutants listed above. A visual, qualitative determination of grain size shall be reported for all stormwater solids samples (in addition to the quantitative analysis for all samples with sufficient volume). Parameters that are below reporting limits after two years of data may be dropped from the analysis.

Recordkeeping and Reporting

An “Annual Stormwater Discharge Monitoring Report” shall be submitted with each Annual Report beginning in 2021. Each report shall summarize all monitoring data collected during the preceding water year (October 1 – September 30). The first annual monitoring report submitted will include data from a partial water year. Each report shall integrate data from earlier years into the analysis of results, as appropriate. Permittees continuing their stormwater monitoring discharge programs at the same locations will continue summarizing data from prior permit periods.

Annual Monitoring Reports

Annual Stormwater Discharge Monitoring Reports shall provide all monitoring data collected during the preceding water year (October 1 – September 30). Concentration data shall be provided in the same units that are specified for Reporting Limits in Tables A9-2 and A9-3. Flow data shall be provided in gallons per minute. Loading data for each water year shall be provided in total pounds and in pounds per acre. Annual Stormwater Discharge Monitoring Reports shall consist of a narrative report, an Excel spreadsheet with concentration data (summary statistics: minimum, maximum, mean, median and standard deviation), pollutant loading calculations, and a submittal to Ecology’s Environmental Information Management (EIM) database for applicable data. For the Annual Stormwater Discharge Monitoring Report to be considered on time, the EIM data submission process must be initiated before April 1 of each relevant year, and completed by June 15 of each relevant year.

The report shall include:

- A brief summary of each monitored drainage basin (full details of the monitoring drainage basin shall be in the QAPP), including any changes within the contributing drainage area or changes to the monitoring station that could affect hydrology and/or pollutant loading.
- A description of each flow-weighted composite and grab sampled storm event, including:
 - General summary about storm event criteria, including:
 - Precipitation data (in inches) including antecedent dry period and rainfall distribution throughout the event.

- Flow and hydrograph data including sampled and total runoff time periods and volumes.
 - Total number of qualifying storm events captured and analyzed at each monitoring location.
 - Distribution of storms collected between wet and dry seasons (permit goals include 60-80% of storms during the wet season and 20-40% of storms during the dry season).
 - Logistical problems associated with any storm event criterion.
- A hydrograph and a hydrograph for each sampled storm event. Include properly labeled graphs that display the following:
 - Date of the storm event.
 - Time of day versus precipitation information.
 - Time versus flow rate (in gallons per minute).
 - Time versus aliquot collection.
 - Display the total duration of the storm event, not just the duration when samples were collected (remember your pollutant load calculation must include flow for the entire storm event, not just the water quality sampled portion).
- A summary of (or in the graph) the total runoff volume in gallons.
- A rainfall/runoff relationship table used to estimate the un-sampled storm events (when water quality samples were not collected). This is used for future estimations of annual and seasonal loads.
- Whether or not any chemicals were removed from the list of analysis due to two years of non-detect data.
- A brief summary with storm event dates where insufficient volumes were collected. Include the parameters analyzed.
- A description of the stormwater solids sampling event, including:
 - Timeframe for the sampling event.
 - A summary of stormwater solids sampling (including dates) where insufficient volumes were collected. Include the parameters analyzed.
 - Whether or not any chemicals were removed from the list of analysis due to two years of non-detect data.
- Event Mean Concentrations (EMCs)
- The wet and dry season pollutant loads and annual pollutant load based on water year for each discharge monitoring location expressed in total pounds, and pounds per acre. The loadings must take into account potential pollutant load from base flow. Loadings shall be calculated following *Standard Operating Procedure for Calculating Pollutant Loads for Stormwater Discharges, WQP004* <https://fortress.wa.gov/ecy/publications/SummaryPages/1810026.html>. Pollutant loading calculations and reporting are required only for the nutrients, metals, and organics parameters in stormwater. Include the following:
 - For storm events where water quality samples were collected, the load in pounds per day for each parameter for each sampled storm event, include date of storm events.
 - An estimated seasonal pollutant load for each parameter at each discharge monitoring location. This is calculated using all storm events (when water quality samples were collected and when samples were not collected).

- A total annual pollutant load (wet season load + dry season load) for each parameter (include estimated events).
- The rainfall/runoff relationship including your pollutant load estimates for un-sampled events.
- Note that if any data is unavailable to effectively estimate your rainfall to runoff relationship due to an incomplete water year, submit this information in the next year's stormwater monitoring report.
- Quality Assurance/Quality Control information for each successfully sampled qualifying storm event at each discharge monitoring location and solids sample collection event at each discharge monitoring location, including:
 - A narrative summary of your field and laboratory verification, validation results and quality control checks performed.
 - A narrative analysis of your field and laboratory quality control sample results and how they compare with your data quality objectives/indicators in your QAPP.
 - Corrective actions reported/taken.
- An explanation and discussion of results from each successfully sampled qualifying storm event at each discharge monitoring location and solids sample collection event collected at each discharge monitoring location, including:
 - A statistical analysis of the event mean concentrations for each parameter and a narrative description of significant findings from this analysis.
 - Any conclusions based on data from this study including analyses of previously collected data from these discharge monitoring locations.
- A description of activities currently taking place or planned within the monitoring station's drainage area that may have affected or may potentially affect future monitoring results.

If the Permittee monitors any pollutant more frequently at the stormwater discharge monitoring locations, the results of this monitoring shall be included in the annual monitoring report reflecting the water year in which the monitoring occurred.

After three (3) water years of data, the Annual Monitoring Report shall include:

- Trend analyses,
- An evaluation of the data as it applies to the Stormwater Management Program (SWMP), and
- Any stormwater management activities the Permittee has identified that can be implemented or adjusted to respond to this data.

Laboratory Methods

The Permittee's stormwater discharge monitoring program shall use the following analytical methods or other methods approved by the U.S. Environmental Protection Agency or Ecology with similar reporting limits, unless alternative methods are approved by Ecology. Any alternative method proposed by a Permittee must have a similar reporting limit, or must be justified as adequate for the likely, expected range of concentrations. Permittees are not guaranteed approval of alternative methods or reporting limits.

In cases where smaller volumes of water are expected to be collected, or to save analytical costs, Permittees may propose that some of the analyses be optimized for specific parameters or groups. The Permittee must, in consultation with a qualified chemist, define the exact volumes and optimization steps and include them in the QAPP.

The QAPP shall identify Ecology- or EPA-approved methods with appropriate reporting limits. An individual sample that could not be run at a reporting limit because of matrix interference or other such reasons would not be called into question for compliance purposes. All results shall be reported. This includes positive detections between the method detection limit (MDL) and the reporting limit (RL), with the appropriate lab qualifier, and the non-detected concentrations at the value of the MDL or lower limit of quantitation (LLOQ) with the appropriate lab qualifier of "U" for undetected at that concentration. Non-detections must be reported and analyzed in the dataset. Results must be evaluated and censored for blank contamination (e.g. organic parameters should consider a censor threshold of less than 5x the laboratory blank contamination). All data gathering and data handling approaches should be explained in the QAPP.

Table A9-2 Analytical Procedures in Stormwater

Analyte	Method in Water	Method Detection Limit Target ^a	Reporting Limit or Lower Limit of Quantitation (LLOQ) ^b
Conventional Parameters			
Total suspended solids ^c	SM2540B or SM2540D		1.0 mg/L
Turbidity	EPA Method 180.1 or SM2130B		± 0.2 NTU
Conductivity	EPA Method 120.1 or SM2510B		± 1 µmhos/cm
Chloride	EPA Method 300.0, EPA Method 325.2, or SM4110B or SM4500 Cl-B, SM4500 Cl-C, SM4500 Cl-D, SM4500 Cl-EPAHS		0.2 mg/L
BOD ₅	SM5210B		2.0 mg/L
pH	EPA Method 150.2 or SM4500H+ B		0.2 units
Hardness as CaCO ₃	EPA Method 200.7, SM2340B(ICP), SM2340C (titration), or SM3120B		1.0 mg/L
Methylene blue activated substances (MBAS)	CHEMetrics Colorimetric or SM5540C		0.025 mg/L

Analyte	Method in Water	Method Detection Limit Target ^a	Reporting Limit or Lower Limit of Quantitation (LLOQ) ^b
Bacteria			
Fecal Coliform	SM9221E		2-2x10 ⁶ CFU
Nutrients			
Orthophosphate as P	EPA Method 365.3, EPA Method 365.4, SM4500-P E, SM4500-P F, or SM4500-P G	0.003 mg/L	0.01 mg/L
Total phosphorus as P	EPA Method 365.3, EPA Method 365.4, or SM4500-P-B followed by SM4500-P E or P F	0.003 mg/L	0.01 mg/L
Total Kjeldahl nitrogen as N	EPA Method 351.2, EPA Method 351.1, SM4500 Norg-B, SM4500 Norg-C, SM4500 NH3-D, SM4500 NH3-G, SM4500 NH3-E, SM4500 NH3-F, SM4500 NH3-G, or SM4500 NH3-H		0.3 mg/L
Nitrate-Nitrite as N	EPA Method 353.2, SM4500 -NO ₃ ⁻ E, SM4500 -NO ₃ ⁻ F, or SM4500 -NO ₃ ⁻ H		0.1 mg/L
Metals			
Total zinc	EPA Method 200.8 or SM 3125B		5.0 µg/L
Dissolved zinc	EPA Method 200.8 or SM 3125B		1.0 µg/L
Total lead, copper and cadmium	EPA Method 200.8 or SM 3125B		0.1 µg/L, 0.5 µg/L, and 0.2 µg/L
Dissolved lead, copper, and cadmium	EPA Method 200.8 or SM 3125B	0.05, 0.02, and 0.03 µg/L	0.1 µg/L
Organics			
PAHs ^d	EPA Method 8270D SIM or EPA 8270E SIM		0.1 µg/L
Pesticides: Bifenthrin (pyrethroid insecticide) and dichlobenil (herbicide)	EPA Method 8270D SIM, EPA 8270E SIM, or EPA Method 625.1	0.02 µg/L	0.05 µg/L
Phthalates ^e	EPA Method 8270D SIM or EPA 8270E SIM	0.5 µg/L	1 µg/L

Petroleum Hydrocarbons			
NWTPH-Dx (diesel, heavy oil, and summed total)	Ecology, 1997	0.1 mg/L	0.25-0.5 mg/L

NA – Not applicable

SM – Standard Methods

SIM – Selective Ion Monitoring mode

- a. If a value is not present in this column then the target MDL is not published or not different from reporting limit target.
- b. The QAPP shall identify Ecology- or EPA-approved methods with appropriate reporting limits. An individual sample that could not be run at a reporting limit because of matrix interference or other such reasons would not be called into question for compliance purposes.
- c. Research results indicate that errors may be introduced by decanting a subsample, care and use of tools like a funnel splitter may help.
- d. Polycyclic aromatic hydrocarbons (PAH), total and these individual compounds: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, and retene. Report the individual compound concentrations, and their summed total.
- e. Phthalates, total and these individual compounds: bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-octyl phthalate, dibutyl phthalate, and diethyl phthalate. Report the individual compound concentrations, and their summed total.

Table A9-3 Analytical Procedures in Stormwater Solids

Analyte	Method for Solid/Sediment	Reporting Limit or LLOQ ^a
Conventional Parameters		
Percent solids	SM 2540G	0.1 %
Total organic carbon	Puget Sound Estuary Protocols (PSEP 1997), SM5310B, SM5310C, SM5310D, or EPA Method 9060	0.1%
Grain size	Sieve and Pipette (ASTM 1997), ASTM F312-97, ASTM D422, or PSEP 1986/2003	Not Applicable
Total phosphorus	EPA Method 365.3, EPA Method 365.4, SM4500 P E, or SM4500 P F	0.01 mg/kg
Total volatile solids	EPA Method 160.4 or SM2540G	0.1%

Analyte	Method for Solid/Sediment	Reporting Limit or LLOQ ^a
Metals, dry weight		
Total zinc	EPA Method 200.8, EPA Method 6010D, EPA Method 6020B, or SM3125B	5.0 mg/kg
Total lead	EPA Method 200.8, EPA Method 6010D, EPA Method 6020B, or SM 3125B	0.1 mg/kg
Total copper	EPA Method 200.8, EPA Method 6010D, EPA Method 6020B, or SM 3125B	0.1 mg/kg
Total cadmium	EPA Method 200.8, EPA Method 6010D, EPA Method 6020B, or SM 3125B	0.1 mg/kg
Organics, dry weight		
Pesticides: Bifenthrin and dichlobenil	EPA Method 8270D, EPA 8270E, or EPA Method 1660	1.0 µg/kg
PAHs ^b	EPA Method 8270D or EPA 8270E SIM	70 µg/kg
Phthalates ^c	EPA Method 8270D or EPA 8270E SIM	70 µg/kg Except di-n-octylphthalate (250 µg/kg)
Phenolics ^d	EPA Method 8270D or EPA 8270E SIM	660 µg/kg
PCBs ^e	EPA Method 608.3 or EPA Method 8082A	0.195 µg/kg or 5-20 ng/kg
PBDEs ^f	EPA Method 1614	5-10 ng/kg Except PBDE 209: (200 ng/kg)
Petroleum Hydrocarbons		
TPH-Dx (diesel, heavy oil, and summed total)	Ecology, 1997 or EPA Method 8015B	25-100 mg/kg

NA – Not applicable

SM – Standard Methods

SIM – Selective Ion Monitoring mode

a. The QAPP shall identify Ecology- or EPA-approved methods with appropriate reporting limits. An individual sample that could not be run at a reporting limit because of matrix interference or other such reasons would not be called into question for compliance purposes.

- b. Polycyclic aromatic hydrocarbon (PAH) compounds, total and these individual compounds: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, and retene. Report the individual compound concentrations, and their summed total.
- c. Phthalates: bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-octyl phthalate, dibutyl phthalate, and diethyl phthalate. Report the individual compound concentrations, and their summed total.
- d. Phenolics: pentachlorophenol, p-cresol, and o-cresol. Report the individual compound concentrations.
- e. PCBs. EPA Methods 608.3 or EPA Method 8082A for Aroclors: 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268) are suitable starting points for stormwater solids characterization. If a more sensitive congener analysis is conducted (EPA Method 8082A or EPA Method 1668C) then those individual compound concentrations should also be reported in the annual report.
- f. Polybrominated diphenyl ethers (PBDEs): congener numbers 47, 49, 66, 71, 99, 100, 138, 153, 154, 183, 184, 191, and 209. Report the individual compound concentrations, and their summed total.

References

ASTM. 1997. *Standard test methods for determining sediment concentration in water samples. Method D 3977*. American Society for Testing and Materials, Philadelphia, PA.

PSEP. 1986. *Recommended Protocols for measuring conventional sediment variables in Puget Sound*. Prepared by Tetra Tech, Inc. for U.S. Environmental Protection Agency and Puget Sound Water Quality Authority. Tetra Tech Inc., Bellevue, WA.

Ecology, 1997. *Analytical Methods for Petroleum Hydrocarbons*. Washington State Department of Ecology, Toxics Cleanup Program. Olympia, WA. Publication No. 97-602.