Washington State Toxics Monitoring Program

Trend Monitoring for Chlorinated Pesticides, PCBs, PAHs, and PBDEs in Washington Rivers and Lakes, 2008

April 2010

Publication No. 10-03-027

DEPARTMENT OF ECOLOGY
State of Washington

Publication and Contact Information

This report is available on the Department of Ecology's website at www.ecy.wa.gov/biblio/1003027.html

Data for this project are available at Ecology's Environmental Information Management (EIM) website www.ecy.wa.gov/eim/index.htm. Search User Study ID, SPMDTR08.

Project Tracker Code for this study is 07-501-02.

For more information contact:

Publications Coordinator
Environmental Assessment Program
P.O. Box 47600, Olympia, WA 98504-7600
Phone: (360) 407-6764

Washington State Department of Ecology - www.ecy.wa.gov/

- Headquarters, Olympia (360) 407-6000
- Northwest Regional Office, Bellevue (425) 649-7000
- Southwest Regional Office, Olympia (360) 407-6300
- Central Regional Office, Yakima (509) 575-2490
- Eastern Regional Office, Spokane (509) 329-3400

Cover photo: White pelicans fishing at Wanawish Dam (formally Horn Rapids Dam)

Washington State Toxics Monitoring Program

Trend Monitoring for Chlorinated Pesticides, PCBs, PAHs, and PBDEs in Washington Rivers and Lakes, 2008

by
Patti Sandvik

Toxics Studies Unit
Environmental Assessment Program
Washington State Department of Ecology
Olympia, Washington 98504-7710

Waterbody Numbers

Columbia River near Clatskanie	WA-CR-1010
Columbia River at McNary Dam	WA-CR-1026
Columbia River at Rock Island Dam	WA-CR-1040
Duwamish River	WA-09-1010
Lake Washington	WA-08-9340
Okanogan River	WA-49-1010
Queets River	WA-21-1030
Snohomish River	WA-07-1020
Spokane River	WA-54-1020
Walla Walla River	WA-32-1010
Wenatchee River	WA-45-1010
Yakima River	WA-37-1010

This page is purposely left blank

Table of Contents

List of Figures

List of Tables

Abstract

The Washington State Department of Ecology began monitoring 11 rivers and one lake in 2007 as part of a statewide trends program for persistent, bioaccumulative, toxic (PBT) chemicals. Waterbodies were selected for monitoring to represent present and historical contamination from a range of land use types. At each location, passive samplers (semi-permeable membrane devices) were deployed for a one month period during the spring (high flow) and fall (low flow). Target analytes included: chlorinated pesticides (CPs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ether flame retardants (PBDEs), and polycyclic aromatic hydrocarbons (PAHs).

This report presents results from 2008, the second year of the monitoring program. Chemicals frequently detected in 2008 samples included PAHs and PCBs (100%), as well as DDT and its metabolites, endosulfan, pentachloroanisole, and PBDEs (>50%). The widest variety of chemicals was detected in the Lower Columbia and Walla Walla Rivers. In general, more chemicals were detected in the spring than in the fall. PBDE concentrations in the Spokane River were an order of magnitude higher than in other sites monitored.

All sites, except the Queets River reference site, failed to meet one or more Washington State or EPA national recommended human health or aquatic life water quality criteria for PCBs. Other chemicals exceeding criteria included DDE (a DDT metabolite) in the Okanogan and Walla Walla Rivers, toxaphene in the Walla Walla River, and dieldrin in the Yakima River.

Recommendations are provided to modify monitoring sites, improve quality assurance, and standardize data analysis.

Acknowledgements

The author of this report would like to thank the following people for their contribution to this study:

- Site access
  - Walla Walla and Okanogan Rivers: Larry and Barbara Pierce and Duane and Mary Lou Denton.
  - Lower Columbia River: United Stated Geological Survey and Portland General Electric.
  - Duwamish River: Foster Golf Links management, Marty O'Brien, and Warren Orr.
  - Snohomish River: Snohomish Visitors Center.
  - Middle Columbia River at McNary Dam: Donna Martindale and other officials.
  - Spokane River at Nine Mile Dam: Jeff Turner, manager.
  - Upper Columbia River site at Rock Island Dam: Randy Browley, Mike Simpson, Kirby Reinhardt, Kelly Hampton, and other officials.
  - Yakima River site at Wanawish Dam: Larry Fox of the Columbia Irrigation District.
  - Lake Washington: Karin Walter, Sergeant Doug Harris, Joe Sepeda, Dick Devlin, John Post, Lynne Melder, U.S. Corps of Engineers, U.S. Coast Guard, Jim Seagrin.
  - Queets River: Jerry, Bill, and Kraig Snure.
- Terri Spencer of Environmental Sampling Technologies.
- David Alverez and Walter Cranor, United States Geological Survey Research Chemists.
- Jason Sharpley of Seattle Public Utilities and King County officials.
- PCB analysis: PACE Analytical Laboratories and Analytical Perspectives Laboratory.
- Washington State Department of Ecology staff:
  - Sample collection: Keith Seiders, Tighe Stuart, Casey Deligeannis, Randy Coots, Brandee Era-Miller, Brandi Lubliner, Paul Anderson, Brian Pickering, Jenna Durkee, Kristin Carmack, Chad Furl, Callie Meredith, Evan Newall, Michael Friese, Jennifer Norby, and Craig Homan.
  - Manchester Environmental Laboratory: Dean Momohara, Myrna Mandjikov, Dolores Montgomery, Dickey Huntamer, Karin Feddersen, Nancy Rosenbower, John Weakland, Jeff Westerlund, Leon Weiks, and other staff.
  - Project assistance and review: Dale Norton, Bill Kammin, Keith Seiders, Art Johnson, and Callie Meredith.
  - Formatting and editing the final report: Joan Le Tourneau, Cindy Cook, and Gayla Lord.

Introduction

Background

The Washington State Department of Ecology (Ecology) initiated a persistent bioaccumulative toxic (PBT) reduction strategy for toxic chemicals in 2000. The initiative targets slow degrading chemicals that can travel long distances, tend to build up in tissues, and can have adverse health effects on humans, fish, and wildlife. At this time, there are 27 substances on the PBT list (Table 1). Information about Ecology's PBT initiative can be found at www.ecy.wa.gov/programs/swfa/pbt/.

Table 1. Ecology's PBT List (Ecology 2007).

Metals	Flame Retardants	Banned Pesticides	Organic Chemicals
Methyl-Mercury	PBDEs Tetrabromobisphenol A Hexabromocyclododecane Pentachlorobenzene	Aldrin/Dieldrin Chlordane DDT/DDD/DDE Heptachlor Epoxide Toxaphene Chlordecone Endrin Mirex	1,2,4,5-TCB Perfluoro-octane Sulfonates Hexachlorobenzene Hexachlorobutadiene Short-chain chlor paraffins Polychlorinated Naphthalenes

Combustion By-Products	Banned Flame Retardants	Banned Organic Chemicals	Metals of Concern
PAHs PCDD PCD PBDD/PBDF	Hexabromobiphenyl	PCBs	Cadmium Lead

Ecology initiated the Washington State Toxics Monitoring Program (WSTMP) in 2000 to investigate the occurrences and concentrations of toxic chemicals in the state's waterbodies. One objective of WSTMP was to conduct trend monitoring for PBT chemicals. Johnson (2007a) developed a PBT Trends Study plan for monitoring organic chemicals, and sampling began in 2007. Target analytes included chlorinated pesticides (CPs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs). The 2007 results (Sandvik, 2009) were published as part of the WSTMP Trends Monitoring component. In 2008, polycyclic aromatic hydrocarbons (PAHs) were added to the program. Information about WSTMP can be found at www.ecy.wa.gov/programs/eap/toxics/wstmp.htm.

Monitoring for the PBT Trends component involves sampling two times a year at 12 sites: 11 major rivers and 1 lake. The sites were selected throughout the state to monitor waterbodies that have elevated concentrations of toxic chemicals in freshwater or fish. Standardized passive samplers called Semipermeable Membrane Devices (SPMDs) were used to concentrate and quantify these chemicals over time, approximately one month. SPMDs give low detection limits (sub parts per trillion) and reduce the variability often associated with conventional water and biological samples. Details of SPMD theory, construction, and applications can be found at wwwaux.cerc.cr.usgs.gov/SPMD/index.htm and in Huckins et al. (2006).

Monitoring Design

Monitoring Sites

Figure 1 shows locations of the 12 sampling sites for the PBT Trends component in 2008. These same sites were monitored in 2007.

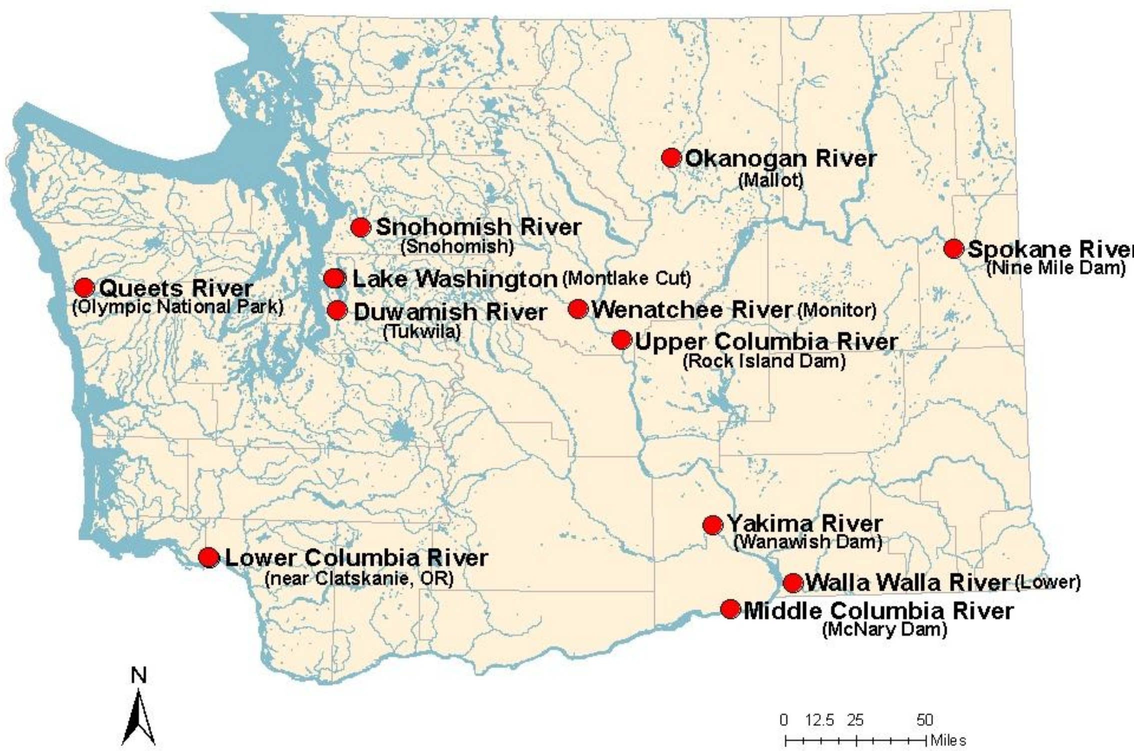

Figure 1. PBT Trends Monitoring Sites in 2008.

Criteria for selecting monitoring sites included:

- Levels and types of contaminants reported in fish.
- 303(d) listings and Total Maximum Daily Load (TMDL) status[1].
- Potential for water quality improvement.
- Fish consumption advisories.
- Statewide distribution of the monitoring effort.
- Availability of a secure sampling site.

Eight monitoring sites were in the Columbia River drainage, three sites were in the Puget Sound basin, and a reference site was in the Olympic National Park. Because of the size of the Columbia River mainstem and the many PBT sources discharging into it, three monitoring sites were chosen to integrate the effects of upstream pollutant sources. Descriptions of the monitoring sites are in Appendix A.

Passive Sampling

SPMDs provide time-weighted average concentrations for the chemicals of interest. SPMDs are polyethylene tubes filled with neutral lipid. They mimic the bioconcentration (uptake) of organic pollutants from water by aquatic organisms without the variability introduced by movements, growth, and spawning of fish (Huckins et al., 2006; USGS, 2008). Large chemical residues accumulated in SPMDs give a strong analyte signal, translating into parts-per-trillion detection limits or lower.

In water, SPMDs measure the dissolved portion of compounds concentrated over time. The amount of chemical absorbed by a SPMD is proportional to the local water column concentration. Trends in contaminant levels at a particular site can be assessed with SPMDs by directly comparing these absorbed amounts or by estimating water column concentrations.

To account for the effects of temperature, water velocity, and biofouling on SPMD sampling rates, permeability/performance reference compounds (PRCs) are used as an in-situ calibration method. PRCs are (analytically) non-interfering compounds with moderate to high tendency to escape and do not occur in significant concentrations in the environment. The rate of PRC loss while exposed during a sampling period is related to the uptake of the target compound. Based on studies by Huckins et al. (2002), the difference between measured concentrations of an analyte and the PRC-derived estimates should be within a factor of 2.

The uncertainty factors for multiple sampling rates reported in this study were about ± 1.3 fold, ranging from 1.0 to 1.5 among samples.

[1] The 303(d) listings are federal Clean Water Act required listings of impaired waterbodies. TMDLs are cleanup plans for impaired waters.

Timing and Placement of SPMDs

The SPMDs were deployed for approximately 28 days, from May 5 – June 6 (spring) and September 8 – October 10 (fall). Deployments during these periods captured typical seasonal high-flow (spring) and low-flow (fall) conditions for the rivers (Figure 2). For Lake Washington, these sampling events capture the higher water level (pre-stratification beginning in April) and the lower water level (strong stratification in the fall) (King County, 2003). Studies in Washington have shown that peak levels of the target chemicals tend to occur during these periods (Johnson et al., 2004; 2005).

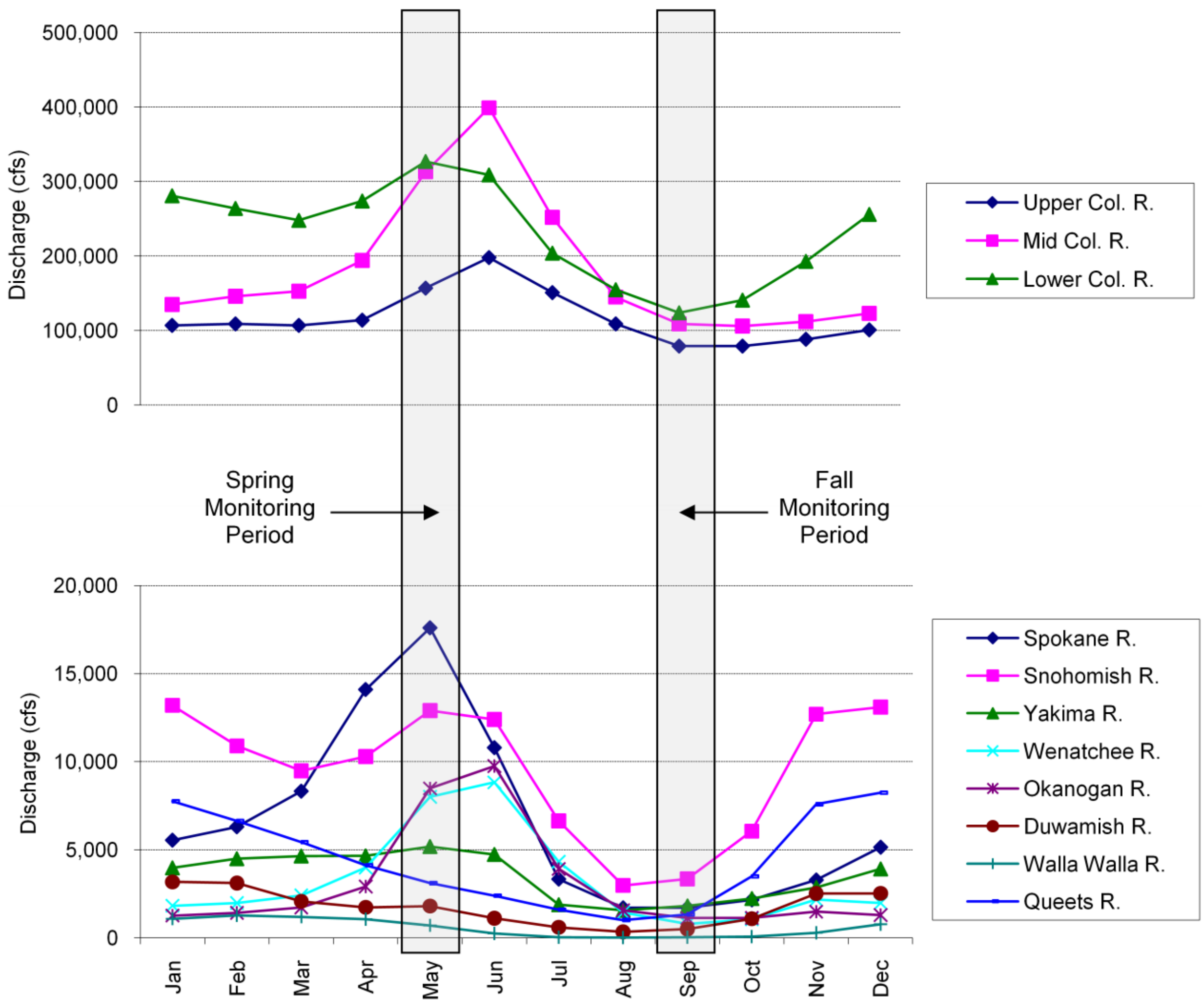

Figure 2. Annual Streamflow Pattern for the 11 River Monitoring Sites Showing Periods When SPMDs Were Deployed.

(http://waterdata.usgs.gov/wa/nwis/sw).

One SPMD sampler was placed at each monitoring site in a well-mixed location and away from known point sources of the chemicals of interest. For deepwater sites behind dams and in Lake Washington, the SPMDs were positioned in the top 20 feet of the water column, above the summer thermocline. For sites in the shallower rivers, SPMDs were placed approximately one foot above the bottom.

During each monitoring period, a replicate sampler was deployed in the Walla Walla River to provide an estimate of variability in the field samples. During the spring sampling event, a field trip blank was exposed to air during deployment and retrieval at the Duwamish River site to assess background air contamination. Three field trip blanks were exposed during the fall sampling event at the Duwamish, Queets, and Spokane River sites.

Chemical Analyses

Chemicals analyzed at each site included over 30 CPs or breakdown products, 209 individual PCBs or congeners, 22 PAHs, and 13 PBDE congeners. A complete list of target analytes is in Appendix B.

Total suspended solids (TSS) and total organic carbon (TOC) were determined at the beginning, middle, and end of each sampling period at each site. Salinity was measured in the Duwamish and Snohomish Rivers to determine if there was marine influence at those locations. Temperature was monitored continuously during deployment at all sites.

Brief descriptions of contaminants included in this monitoring program are presented below.

Chlorinated Pesticides

Chlorinated pesticides (CPs) include a number of legacy insecticides that do not degrade or metabolize easily, making them extremely persistent in the environment. They have low solubility in water but a strong affinity for lipids (fats), therefore accumulating to high concentrations in fatty tissue through the food chain (EPA, 2000).

Many CPs are neurotoxins and may cause cancer (EPA, 2000). Most were banned from use in the United States during the 1970s and 1980s as their hazards became evident (e.g., DDT). Other CPs currently used in agriculture are less persistent in the environment. However, the U.S. Environmental Protection Agency (EPA) recommends monitoring some of these because of their toxicity and potential to build up in tissue (e.g., chlorpyrifos and endosulfan).

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are chemically and physically stable synthetic organic compounds having excellent insulating properties. Hence, transformers and other electrical equipment, inks, paint, plastics, pesticide extenders, and a variety of other applications used PCBs. Manufacturing of PCBs in the United States ended in 1979 due to their toxicity and persistence in the environment.

PCBs have low solubility in water yet have a high affinity for sediments and animal fats, allowing them to readily build up in the aquatic food chain (EPA, 1999). Health effects from PCBs include toxicity to the nervous, endocrine, digestive, and immune reproductive systems. EPA currently classifies PCBs as a probable human carcinogen based on evidence in animal studies and inadequate, but suggestive, evidence in humans (IRIS, 2009; ATSDR, 2000).

Individual PCB compounds differ from one another in the number and relative positions of chlorine atoms that they contain (1 to 10). Up to 209 different compounds are possible. Commercial PCB congener mixtures were known in the United States by the trade name Aroclor. Historically, many studies analyzed for PCB Aroclor mixtures, but increasingly more studies, including the present effort, are analyzing all the individual congeners for a more thorough assessment of toxicity potential. The term “T-PCBs” refers to the sum of individual congeners or Aroclors.

Polybrominated Diphenyl Ethers

Polybrominated diphenyl ethers (PBDEs) are a group of brominated organic compounds added as a flame-retardant to a variety of plastic and foam products such as electronic enclosures, wire insulation, adhesives, textile coatings, foam cushions, and carpet padding. Individual PBDE congeners differ by the number and position of bromine atoms (1 to 10) creating as many as 209 individual congener possibilities. PBDEs are often categorized by the number of bromine atoms attached to the biphenyl rings: mono- through decabromo-congeners can exist.

Penta-BDE, Octa-BDE, and Deca-BDE are the three main types of PBDEs in consumer products worldwide, with North America having the highest volume of production (Ecology and WDOH, 2006; ATSDR, 2004). Commercial PBDE products are mixtures. The mixtures are named after the primary PBDE component. In this study, PBDE results refer to the individual compound and not the commercial mixtures.

PBDEs are ubiquitous in the environment, and concentrations in humans and wildlife are increasing throughout the world. The lower bromated congeners associated with the Penta formulation (e.g., PBDE-47, 99, 100, 153) are the most bioaccumulative and make up the brunt of the levels found in animals and humans. The highest levels of PBDEs in human tissue have been found in the U.S. and Canada (Ecology and WDOH, 2006). PBDE-209 (Deca-BDE) is the most prevalent congener found in sediment and indoor dust. Deca-BDE can debrominate to lower congeners, but its contribution to the levels found in animals and humans is unclear.

Animal studies show that PBDEs can affect the thyroid, liver, immune system, nervous system, and endocrine system (Ecology and WDOH, 2006; ATSDR, 2004). EPA found available information inadequate to assess the carcinogenic potential of PBDE-47, 99 and 153 but found “suggestive” evidence regarding the potential for Deca-BDE to cause cancer in humans.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a group of organic contaminants formed during the incomplete burning of coal, oil, gasoline, garbage, wood, or other organic substances. They are found in the environment as complex mixtures. PAHs occur naturally (i.e., forest fires and volcanoes) or can be anthropogenic. Manufactured PAH compounds are used in medicines and to make dyes, plastics, and pesticides. Other PAH compounds are found in asphalt, crude oil, coal, coal tar pitch, creosote, and roofing tar.

PAHs are generally associated with particulate matter; however, the compounds can be found in vapor form and in water (ATSDR, 1995). Principal sources of PAHs to the environment are believed to be from open burning, vehicles, heating and power plants, and industrial processes (ATSDR, 1995 and Van Metre et al., 2000). Factors such as the type and quantity of fuel, the temperature and duration of combustion, and the availability of oxygen determine the nature and extent of PAH formation.

PAHs are toxic to mammals, aquatic life, plants, and several are known to cause cancer (ATSDR, 1995).

This page is purposely left blank

Methods

Field Procedures

Standard SPMDs were prepared by Environmental Sampling Technologies (EST), St. Joseph, MO (www.est-lab.com/index.php). SPMDs are composed of a thin-walled, layflat polyethylene tube (91.4cm x 2.5cm x 70-95µm thickness) filled with 1 mL of neutral lipid triolein (purity 99.9%).

EST spiked each membrane with performance reference compounds (PRCs) consisting of 200 ng each of PCB-004, PCB-029, and PCB-050. Pacific Analytical Services Laboratories (PACE) prepared the PRCs for the spring samples, and EST prepared the PRCs for the fall. EST preloaded the SPMD membranes onto carriers then shipped them frozen in solvent-rinsed metal cans filled with argon gas.

The cans with SPMDs were transported to the field on bottled ice. Upon arriving at the sampling site, an anchoring and tethering system was constructed for securing the SPMD canisters. Standard operating procedures were used to deploy and retrieve the SPMDs (Johnson, 2007b). The cans were pried open; five carriers were slid into a 30 cm x 16 cm stainless-steel canister and the canister was inserted inside an 18-inch shade device cylinder (Figure 3). Shade devices are employed to protect against photo degradation of light-sensitive compounds such as PAHs. The device was secured in the water as quickly as possible to limit air contamination. Field personnel wore nitrile gloves and avoided touching the membranes.

Figure 3. SPMDs Inside a 5-membrane Canister and Inserted in a Shade Device Cylinder.

SPMDs were checked midway through the month-long deployment. At midcheck, the SPMD samplers were gently moved back and forth under water to remove loose sedimentation or biofouling. Retrieval procedure was essentially the reverse of deployment. All SPMDs were successfully retrieved during 2008. The cans holding the SPMDs were sealed and kept at or near freezing for shipping to EST for extraction. Samples were identified and recorded, and custody was maintained at all times. In other words, chain-of-custody procedures were followed.

To determine if SPMDs remained submerged throughout the sampling period, an Onset StowAway® TidbiTs™ temperature monitor was attached to each SPMD canister, and another TidbiT™ was secured out of the water near the site. Data from TidbiTs™ showed that all samples remained submerged during deployment.

Grab samples for TOC, TSS, and salinity were collected at the beginning, middle, and end of each deployment sampling period according to Ecology SOPs (Joy, 2006; Ward, 2007) (Table 2). These were held on ice and shipped within the holding time to Ecology's Manchester Environmental Laboratory with a chain-of-custody record.

Table 2. Field Procedures for Ancillary Water Quality Parameters.

Parameter	Minimum Sample Size	Container	Preservation	Holding Time
TSS	1000 mL	1 L poly bottle	Cool to 4ºC	7 days
TOC	50 mL	123 mL poly bottle	HCL to pH<2, 4ºC	28 days
Salinity	300 mL	500 mL poly bottle	Cool to 4ºC	28 days

HCL = hydrochloric acid.

Water temperature and conductivity were measured during each collection using a temperature/conductivity probe (Hanna DIST 5 pH/EC/TDS meter) or a water thermometer and Beckman conductivity meter. Flow data were obtained through Ecology's Environmental Assessment Program Freshwater Monitoring Unit, USGS, and other sources. Salinity was collected for the estuarine sites in the lower Duwamish and Snohomish Rivers.

Laboratory Procedures

Analysis

After retrieval from the field, the SPMD membranes required additional preparation and extraction (described below) by EST before further analysis by other laboratories. Manchester Laboratory analyzed pesticides, PAHs, and PBDEs from the cleaned-up extracts (described below). Conventional water quality samples were also analyzed by Manchester. PCB congeners were analyzed by Analytical Perspectives Laboratory, a contractor. The methods used are shown in Table 3.

Table 3. Laboratory Procedures.

Analysis	Sample Matrix	Sample Prep Method	Analytical Method
Chlorinated pesticides	SPMD extract	dialysis/GPC[a]	EPA 3620, 3665, 8081[b]
PBDE	SPMD extract	dialysis/GPC[a]	EPA 8270
PAH	SPMD extract	dialysis/GPC[a]	EPA 3630B/8270
PCB congeners	SPMD extract	dialysis/GPC[a]	EPA 1668A
TOC	whole water	N/A	SM5310B
TSS	whole water	N/A	SM2540D
Salinity	whole water	N/A	SM2520

a. EST SOPs E14, E15, E19, E21, E32, E33, E44, E48.
b. Modifications of EPA SW-846.

Extraction and Cleanup

Upon receiving the SPMDs, EST inspected and cleaned all membranes. Each sample was then spiked with surrogate compounds prior to extraction. Surrogates included 50 ng of each of PCB-014, PCB-078, and PCB-186 provided by PACE Laboratories for the spring sampling and by EST for the fall, as well as 50 ng of Manchester's PAH surrogates and 80 ng of combined pesticide and PBDE surrogates. Recovery of the surrogates provides estimates of recovery of target compounds in each sample.

Once dialyzed (extracted), the extracts were combined into single sample and solvent exchanged to methylene chloride for gel permeation chromatography (GPC) cleanup. After GPC, the samples were solvent exchanged into hexane, split 50:50, and each fraction sealed in a 5-mL ampoule for transport to the laboratories. One ampoule was sent to Manchester. The other ampoule was sent by Manchester to Analytical Perspectives. EST's extraction and cleanup methods are documented in SOPs on file at Ecology Headquarters.

The Manchester ampoule was further split 50:50 for pesticide and PBDE/PAH analysis, resulting in 25% fraction for each.

The PBDE/PAH extract was solvent exchanged into iso-octane prior to analysis. The pesticide fraction was concentrated and then eluted through a macro Florisil® column. Following a solvent exchange concentration, the extracts were split and one portion was treated with concentrated sulfuric acid to remove PBDE interferences. Both portions were analyzed by dual column GC-ECD. No additional cleanup was performed on the samples for PAH analysis.

Analytical Perspectives analyzed the PCB extracts. A multi-column cleanup step was performed, and each extract was brought to a fixed volume. Extraction, cleanup, and injection standards were spiked into each extract at various steps for measuring the analytical performance throughout the cleanup and analytical procedures.

Results were corrected for all dilutions and reported as 100% of extract (ng/sample).

Data Processing

Correction for Background Contamination (or Blank-Correction)

Prior to calculating dissolved water concentrations, sample results were evaluated for usability and corrected for background blank contamination following the concepts in Method 1668A (EPA, 1999) and Ecology's SOP for SPMD data processing (in development). The main steps in this blank-correction process included: selecting a blank to use in correction; determining which results could be corrected; applying the correction where possible, and qualifying results. This process is described below.

Field trip blanks were used to adjust the chemical concentrations reported in the SPMDs because the field trip blank represented contamination from both the field and laboratory environment. In most cases, the chemical residues in field trip blanks were similar to the Day0-Dialysis laboratory blanks[2]. 50% to 80% of the field trip and Day0-Dialysis blanks agreed fairly well (<25% RPD) for the spring and fall, respectively. The field trip blanks tended to have lower values than the Day0-Dialysis blanks, which indicate some loss of chemical residues in the field during a sampling period. Higher RPDs between the field trip blank and the Day0-Dialysis blank were more common where detections were near or below the reporting limit. Multiple field trip blanks in the fall were more representative among sites and better describes the variability seen between the field trip and Day0-Dialysis blanks.

The sample results were screened to determine if they could be blank-corrected. Results that were greater than the mean plus two standard deviations of the field trip blank were deemed correctable. Correctable results were adjusted by subtracting the mean of the field trip blank and then qualified as an estimate with an unknown bias (JK). For detected compounds that did not meet the blank-correction criteria, the original result was used as an estimated reporting limit and qualified as being below the method detection limit with an unknown bias (UJK). The detection limit was used where a compound was not detected.

Since there was only one field trip blank in the spring, those results were assumed to represent the mean SPMD background contamination for that period. The standard deviation of the spring field trip blank was estimated using the proportion of the standard deviation to the mean of the fall field trip blanks. The assumption was made that the proportion of standard deviation to mean for one sampling period is similar to another sampling period. Even though this approach limits representativeness, the assumption seems fair; based on the review of the spring and fall field trip blank results (see Data Quality section).

Once screened, the spring and fall sample results were blank-corrected and qualified as described above.

[2] The Day0-Dialysis blank is SPMD membranes from the same lot as the project batch, to represent background during dialysis and cleanup. This blank also serves as reference for PRC loss.

The impact of the correction process varied among the chemical groups. For the combined spring and fall PBDE results, 35% were detected, and of those detected, 20% were correctable. PAHs had 69% detected results with 56% of those correctable. For PCBs, 88% were detected with 69% of those correctable.

Some results fell below the original reporting limit after they were blank-corrected. These results were considered detected at the "new" corrected level in the remainder of this report.

Dissolved Water Concentrations

SPMDs only absorb the dissolved form of a chemical. The absorbed residue can be converted to a time-weighted average dissolved water concentration that can be compared with data from other sampling methods. Dissolved concentrations for the chemicals of interest were estimated using the most current version of the USGS Estimated Water Concentration Calculator Spreadsheet. This spreadsheet was downloaded from the U.S. Geological Survey (USGS) website for Columbia Environmental Research Center (CERC) Integrative Passive Samplers (USGS, 2008) and can be found at www.cerc.usgs.gov/Branches.aspx?BranchId=8. The data collected on chemical residues, exposure times, and PRC recoveries in the present study were entered into the spreadsheet for the available analytes. Input data are listed in Appendices C, D, and E.

Log K_{ow}s (octanol-water partition coefficient constant) are used to estimate water concentrations in the USGS spreadsheet. The spreadsheet provides log K_{ow} values for many bioaccumulative chemicals. For those analytes missing log K_{ow}s in the spreadsheet, literature values were used. If multiple log K_{ow} values were found, a mean was selected using the t test at 95% confidence for rejection of outliers (USGS, 2008; Alvarez, 2008).

Where log K_{ow}s could not be found in the literature, they were calculated using an atom/fragment calculation developed by Syracuse Research Corporation (Meylan et al., 1995). Log K_{ow}s for analytes PBDE-49, -71, -184, -191 were estimated using similar chemicals (PBDE-47, -69, -183, -190, respectively). This approach seemed reasonable based on other PBDE congeners that are consecutive to each other and have similar log K_{ow}s. USGS estimated the log K_{ow} for chlorpyrifos from endrin because of endrin's proximity in log K_{ow} values (USGS, 2008).

In view of the uncertainties previously stated, all calculated water concentrations in this report should be considered estimates. Log K_{ow}s used in calculating water concentrations can be found in Appendix F.

Several analytes are reported here as summed values of detected compounds. T-DDT is the sum of o,p'- and p,p'- isomers of DDD, DDE, and DDT. Total chlordane is the sum of *cis* and *trans* chlordane, *cis* and *trans* nonachlor, and oxychlordane. Endosulfan, unless specified, is the sum of alpha (endosulfan I) and beta endosulfan (endosulfan II). Total PCB is the sum of the individual congeners. Total PBDE is the sum of the 13 congeners analyzed in this study.

LPAH represents the sum of the following low molecular weight PAH (< 4 aromatic benzene rings):

- Naphthalene.
- Acenaphthylene.
- Acenaphthene.
- Fluorene.
- Phenanthrene.
- Anthracene.

HPAH represent the sum of the following high molecular weight PAH (5-6 aromatic benzene rings):

- Fluoranthene.
- Pyrene.
- Benz(a)anthracene.
- Chrysene.
- Total benzofluoranthene (“B,” “J,” and “K” isomers).
- Benzo(a)pyrene.
- Indeno(1,2,3,-c,d)pyrene.
- Dibenzo(a,h)anthracene.
- Benzo(g,h,i)perylene.

∑PAH is the sum of LPAH and HPAH.

Non-detect results were treated as zero when summing compounds for total DDT, total chlordane, ∑PAH, total PBDE, and total PCB. All summed compounds were calculated from water concentration values (as opposed to the residue concentration).

For the tables and figures in this report, the qualifiers have been omitted and a “less-than” value shown for the sake of clarity. All data qualifiers are retained for residue results in the data appendices.

Total Water Concentrations

Organic compounds in water partition between dissolved and particulate fractions. The “total” concentration is the sum of dissolved and particulate forms.

In this study, total water column concentrations were estimated from the dissolved data using an equation from Meadows et al. (1998):

$$C_{w\text{-}tot} = C_w\,(1 + TOC\,(K_{oc}/M_w))$$

where:

- $C_{w\text{-}tot}$ is the total water concentration.
- C_w is the dissolved concentration.
- TOC is total organic carbon (average of three samples per deployment period).
- K_{oc} is the organic carbon-water equilibrium partition coefficient.
- Mw is the mass of water (1g/mL).

TOC is critical in determining chemical uptake rates of high log K_{ow} compounds because of its effect on the dissolved fraction. The higher the K_{oc}, the greater the affinity of the compound has for suspended organic matter. There is therefore a lower tendency for these compounds to be transported in the dissolved phase. Limited water solubility coupled with increased binding to TOC limits the amount of the compound in contact with the SPMD membrane (Meadows et al., 1998). K_{oc} values were derived using Karickhoff's (1981) approximation $K_{oc} = 0.411K_{ow}$.

This page is purposely left blank

Data Quality

A Quality Assurance (QA) Project Plan (Johnson, 2007a) with measurement quality objectives (MQOs) establishes a data quality guideline for accuracy, bias, and reporting limits. To determine if MQOs were met, the project lead compared results on field and laboratory quality control samples to the MQOs. Based on these assessments, a review of the laboratory data packages, and Manchester Laboratory's data verification reports, the data were either accepted, accepted with appropriate qualifications, or rejected.

Laboratory Case Narratives

Manchester Laboratory prepared written case narratives assessing the quality of the data collected during the 2008 spring and fall sampling events. These reviews include a description of analytical methods, assessment of holding times, calibration and verification and degradation checks, on-going precision and recovery assessments, method blanks, matrix spike/matrix spike duplicates (MS/MSD) recoveries, qualitative identification, laboratory control samples, surrogate recoveries, laboratory replicates, and internal standards checks during analysis. Case narratives are available from the author on request.

Most (around 85%) of detected laboratory results for PCBs and PAHs and about 50% of the detected pesticide and PBDE results, met MQO requirements of this study. Exceptions were qualified as estimates and are briefly discussed below.

The PCB results that did not meet MQO requirements were qualified based on: failure to meet the isotopic abundance ratio and retention time criteria, results below lowest calibration standard, poor resolution, or laboratory method blank contamination.

Pesticides results outside the MQO requirements were qualified for a variety of reasons including: being outside the instrument calibration checks, low surrogate recoveries, qualitative identification not positive, and being outside of the acceptable range for a spiked blank. These results were acceptable with the appropriate qualifications.

Both spring and fall samples had excellent QA results for PBDEs and PAHs. Some PBDE and PAH results were qualified as being below the reporting limit (estimated quantitation limit). PBDE and PAH reporting limits were raised by a multiple of 4 to account for the total extract that was split to 25% for PBDE and PAH analysis. Only one PBDE sample in the spring samples required qualification due to high surrogate recovery.

Appendix G summarizes data quality as described in the case narratives.

Field Quality Control Samples

Field Trip and Day0-Dialysis Blanks

Two types of blank samples were used to assess contamination during each sampling period: a field trip blank and a Day0-Dialysis blank. Two processing laboratory blanks were added in the fall: a spiked Dialysis blank and a solvent blank run through the GPC process. The field trip blank was used to determine contamination from air during deployment and retrieval. The Day0-Dialysis, spiked Dialysis, and solvent blank helped assess contamination during the creation and processing of SPMD membranes at the EST Laboratory. More discussion of these blanks is included in Appendix G.

Individual PCB, PBDE, and PAH compounds were detected in laboratory blanks provided by EST. In contrast, there was no CP found in the blanks. Concentrations of individual target chemicals in the blanks were inconsistent. Some of these same compounds were found at similar levels in the field trip blanks, suggesting a combination of laboratory and field sources. Although the contamination source is unclear, a certain background level appears to exist. Blank correction for background contamination is described above in the Data Processing section.

Replicate Samples

Field Samples

A second SPMD (replicate) was deployed in the Walla Walla River for the spring and fall sampling events to provide an estimate of the total variability (field + laboratory) associated with the SPMD data. Results from the spring field replicate were unusable due to a laboratory accident. Results from the fall replicate are listed in Appendix H.

Good precision (95%) was found in the sample replicates for most cases, with RPDs of 20% or better for the residue data. RPDs for p,p' DDT and b-BHC were slightly higher (33% and 40% respectively).

Two LPAH had RPDs greater than 70%: naphthalene (73% RPD) and acenaphthene (86% RPD). Low recoveries of the LPAH surrogate acenaphthylene-d8 in the Walla Walla field sample suggest loss of some target compounds during dialysis and GPC cleanups. See Appendix G for further QA discussion.

Variability in the estimated water concentration between sample replicates reflects differences in PRC recoveries. RPDs for dissolved pesticides, PBDE, PCB, and PAH concentrations remained generally within 30% or better.

An effort to reduce within-site variability in the data began in 2008. Improved analytical techniques and data processing resulted in lower variability among 2008 PCB data: 10% RPD in 2008 versus 29% RPD in 2007 for total PCBs in field replicates.

The average of the replicate results is used in the remainder of this report.

Results and Discussion

Flow Conditions

Streamflows at many sites in the spring were in the upper 20% of historical flows. These higher flows were due to above average precipitation with normal temperatures for the month of May which followed cooler than normal temperatures and accumulated snow in the mountains.

Fall flows in September were generally less than the mean normal historical level due to dryer and warmer than normal weather. Exceptions included the Green and Queets Rivers, which were greater than 50% of the historical mean level. The Green River flow is regulated by Howard Hanson Dam. The higher Queets River flow likely reflects the snowmelt from the above average snow pack in the Olympic Mountains. Flow data are provided in Appendix I.

Ancillary Water Quality Data

The results for TSS, TOC, salinity, and conductivity at the SPMD monitoring sites are listed in Appendix J. Similar patterns were observed in 2008 as were seen in 2007. Average TSS was higher in the spring than in the fall, ranging from 2 – 106 mg/L and 1 – 11 mg/L, respectively. Spring TOC averages ranged from 1.3 – 7.1 mg/L, whereas fall TOC averages ranged from not detected (<1.0 mg/L) to 2.5 mg/L. Salinity was not detected at the Duwamish and Snohomish Rivers, indicating they were not influenced by marine water.

Dissolved Chemicals

Concentrations

Table 4 shows summary statistics for dissolved pesticides, PCBs, and PBDEs estimated from SPMDs deployed in the spring and fall of 2008. Reporting limits were used for nondetects in calculating the statistics. The concentrations are in picograms per liter (parts per quadrillion) and are considered estimates. The complete data are in Appendix C (residue data) and K and L (dissolved data). The dissolved data are also available through the Ecology Environmental Information Management System (EIM) in searchable databases at www.ecy.wa.gov.

A total of 25 samples were analyzed in 2008. Many of the results were similar to those in the 2007 sampling effort (Sandvik, 2009). Chemicals not detected were heptachlor, alpha-benzenehexachloride (a-BHC), beta-benzenehexachloride (b-BHC), delta-benzenehexachloride (d-BHC), aldrin, endrin, endrin ketone, endrin aldehyde, mirex, and methoxychlor. These same chemicals were also not detected in 2007.

DDT or its breakdown products (DDE and DDD) were detected in 72% of the samples. DDE and DDD were detected in 68% and 64% respectively, whereas the parent compound DDT was detected in 52%. DDT had the same detection frequency in 2007 (52%), but the breakdown products had slightly lower detections of 61%.

Table 4. Summary Statistics for 2008 CP, Total PCBs, and PBDEs. (dissolved, pg/L).

Parameter	No. of Detections	Detection Frequency	Min	Max	Median	Mean	Standard Deviation	90th %
Total PCBs	25	100	6.7	120	42	47	31	79
Total DDT[1]	18	72	<5.6	230	65	71	64	130
Total PBDEs	15	60	nd	220	5.3	22	55	25
Pentachloroanisole	16	64	<4.6	37	9	12	8.1	20
Endosulfan I	13	52	<220	10000	240	950	200	1600
Chlorpyrifos	12	48	<21	2500	22	180	500	220
Endosulfan II	10	40	<460	3000	460	760	600	1500
Dieldrin	10	40	<10	63	12	16	12	27
Hexachlorobenzene	9	36	<3.2	47	7.1	11	9.6	22
Endosulfan Sulfate	8	32	<320	980	320	410	170	620
Toxaphene	4	16	<75	1100	99	170	220	330
DDMU[2]	3	12	<3.5	14	5.9	6.7	2.2	8.8
Total Chlordane[3]	2	8	<3.7	39	6.6	8.1	6.7	9.7
Dacthal	2	8	<18	40	19	21	5.0	22
Heptachlor Epoxide	1	4	<11	19	12	13	1.7	15
Lindane	1	4	<68	460	68	84	78	<68

1. Total DDT is the sum of 2,4'- and 4,4' isomers of DDD, DDE, and DDT.
2. DDMU (1-chloro-2,2-bis(p-chlorophenyl)ethane) is a breakdown product of DDE.
3. Total chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane.

< = reporting limit for nondetects.
nd = not detected.

PCBs were detected in all samples. Total PCBs ranged from 6.7 to 120 pg/L with an average of 47 pg/L. These matched 2007 results closely where PCBs were found in all samples ranging from 6.2 to 99 pg/L and averaging 50 pg/L.

Dieldrin was detected in 40% of the samples, endosulfan was found in over half the samples, and chlorpyrifos in just under half of the samples. In 2007, dieldrin and endosulfan was found in over 50% of the samples whereas chlorpyrifos was found in only 30% of the samples. Although dieldrin was banned from the U.S. in 1987, endosulfan and chlorpyrifos are current use insecticides.

Pentachloroanisole (PCA), a microbial breakdown product of the wood preservative pentachlorophenol, was found less frequently in 2008 (64%) than in 2007 (74%). USGS found PCA to be the most frequently detected compound (71% detection frequency) in streams sampled in six U.S. metropolitan areas using SPMDs (Bryant et al., 2007).

PBDEs were detected in 60% of the samples. PBDE-47 was the most frequently detected (56%) which is consistent with other studies showing the distribution of commercial PBDEs and its breakdown products (Ecology and WDOH, 2006; Johnson et al., 2006; and Hale et al., 2003). In 2007, 96% of the samples had detected PBDEs. In 2007 as well as 2008, most PBDE congeners were detected at or below the reporting limit, except for PBDE-47 and -99. PBDE-191 and 209 were not detected. These highly brominated PBDEs are large molecules and strongly associated with particulate. They are not likely to be detected using SPMDs due to the small pore size of the membranes.

Table 5 shows summary statistics for dissolved PAHs. All PAH analyzed had detections in the 2008 residue results. ∑PAHs ranged from 11 to 6500 pg/L. PAHs were not analyzed in 2007.

Table 5. Summary Statistics for 2008 PAHs (dissolved, pg/L).

Parameter	No. of Detections	Detection Frequency	Min.	Max.	Median	Mean	Standard Deviation	90^{th} %
Phenanthrene	21	84	200	1200	410	510	270	950
Acenaphthene	19	76	4.3	1200	85	150	240	250
Anthracene	15	60	4.3	980	46	110	220	310
Acenaphthylene	10	40	0.56	<120	86	70	44	<110
Fluorene	10	40	47	<430	260	220	130	<360
Naphthalene	3	12	<820	4000	1600	2000	1000	3800
∑LPAH[1]	22	88	nd	5100	750	1200	1400	3500
Fluoranthene	24	96	22	1300	240	370	350	940
Pyrene	24	96	11	1100	99	230	280	620
Chrysene	12	48	<9.3	240	24	53	62	130
Benzo(a)anthracene	7	28	<4.1	91	21	29	25	68
Benzo(b)fluoranthene	6	24	<4.5	130	21	30	32	74
Benzo(k)fluoranthene	1	4	<1.6	<38	21	18	11	<31
Benzo(a)pyrene	0	0	<2.0	<43	22	19	12	<34
Indeno(1,2,3-cd)pyrene	0	0	<1.0	<53	28	25	15	<43
Benzo(ghi)perylene	0	0	<1.7	<58	31	28	16	<46
Dibenzo(a,h)anthracene	0	0	<0.8	<47	25	21	14	<38
∑HPAH[2]	25	100	11	2700	340	700	770	1900
∑PAH[3]	25	100	11	6500	1000	1800	1300	4600
Retene	25	100	15	5500	160	540	1100	1100
Dibenzofuran	21	84	16	<320	140	150	93	<290
1-Methylnaphthalene	7	28	230	1700	610	660	340	940
2-Methylnaphthalene	6	24	760	2800	1200	1300	470	1800
Carbazole	5	20	<1000	1700	1000	1100	170	1200
2-Chloronaphthalene	1	4	<210	250	210	210	8.2	<210

1. ∑LPAH is low molecular weight PAH: naphthalene, anthracene, acenaphthylene, acenaphthene, phenanthrene, and fluorene.
2. ∑HPAH is high molecular weight PAH: fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
3. ∑PAH is the sum of LPAH and HPAH.
< = reporting limit for nondetects.
nd = not detected. Nondetects for LPAH ranged from 12 pg/L (anthracene) to 1200 pg/L (naphthalene), depending on the chemical.

LPAH was detected in 88% of the samples, whereas HPAH was found in all the samples (100%).

Phenanthrene was a consistent contributor to LPAH totals with a detection frequency of 84% and averaging 510 pg/L. Acenaphthene ranked second among LPAH being detected in 76% of the samples with a mean contribution of 150 pg/L. Compared to the mean of 1,200 pg/L for total LPAH, phenanthrene and acenaphthene comprised over half the concentration for most samples. Naphthalene was occasionally a major contributor to LPAH concentrations, accounting for 51% to 78% of LPAH in the three samples in which it was detected. The naphthalene background in blank samples masked the naphthalene contribution in other lower level samples.

The major contributors to HPAH were fluoranthene and pyrene, each having detection frequencies of 96% and averaging 370 pg/L and 230 pg/L respectively. These two PAHs contributed over 86% of the total HPAH average of 700 pg/L and consistently accounted for over 75% of HPAH for all samples individually.

Retene was found in all the samples and ranged from 15 to 5,500 pg/L with a large standard deviation (1,100 pg/L) showing a lot of variability among samples. Retene can be found in the breakdown of wood products in sediment. Therefore, retene concentrations may be higher in sites with logging or pulp mill operations (historical or current) or when sediment from those sites or other forested areas is disturbed such as in high flows.

In contrast, carbazole was detected in only five samples with detections ranging from 1,200 to 1,700 pg/L. Sources of carbazole may be difficult to find because of the wide application of the chemical. Carbazole and its derivatives are common nitrogen compounds found in environments contaminated by coal tar, crude oil, and creosote. Carbazole is also commercially synthesized for use as (1) a dye intermediate, (2) manufacture of ultraviolet light sensitive photographic plates, and (3) a reagent for lignin, carbohydrates, and formaldehyde (Merck, 1983; Verschueren, 1983).

Spatial Patterns

A total of 70 chemicals were analyzed in each SPMD. The Lower Columbia and Walla Walla Rivers had the greatest number of detections (30 each). The Yakima River, Lake Washington, and Middle Columbia River followed with 24 detections each. The Queets River had the lowest detection frequency with nine detections overall. These results were similar to the 2007 results when the Walla Walla and Yakima Rivers had the most detections and the Snohomish and Queets Rivers had the least detections.

Figures 4-11 compare estimated dissolved concentrations for T-DDT, total PCBs, total PBDEs, dieldrin, endosulfan, toxaphene, chlorpyrifos, and pentachloroanisole by location. Concentrations for spring and fall were averaged. Reporting limits were plotted for chemicals not detected. Bars show the minimum and maximum concentration. An absence of bars indicates results were detected in only the spring or fall. In some cases, the bars were too close to the mean to show on the graph at the present scale. Some blank-corrected results may show below the typical reporting limit for that chemical (e.g., dieldrin and endosulfan). Sites were ordered from highest to lowest concentrations for each chemical.

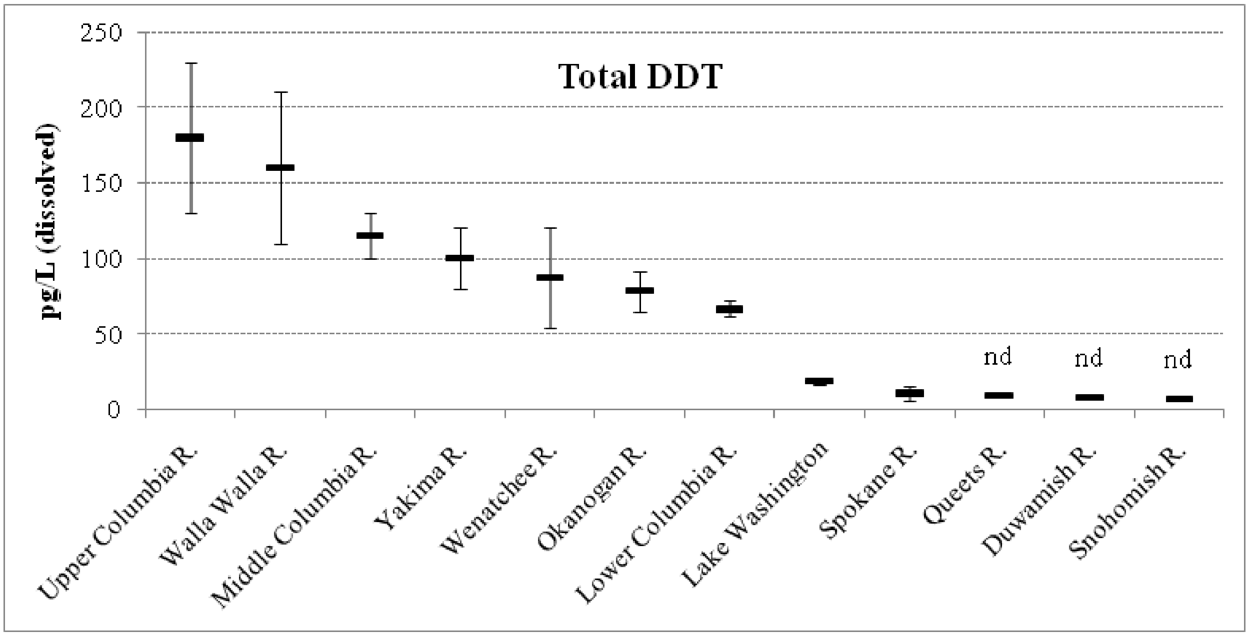

Figure 4. Average Estimated Dissolved Concentrations of Total DDT, 2008.

(nd = not detected; bars show maximum and minimum.)

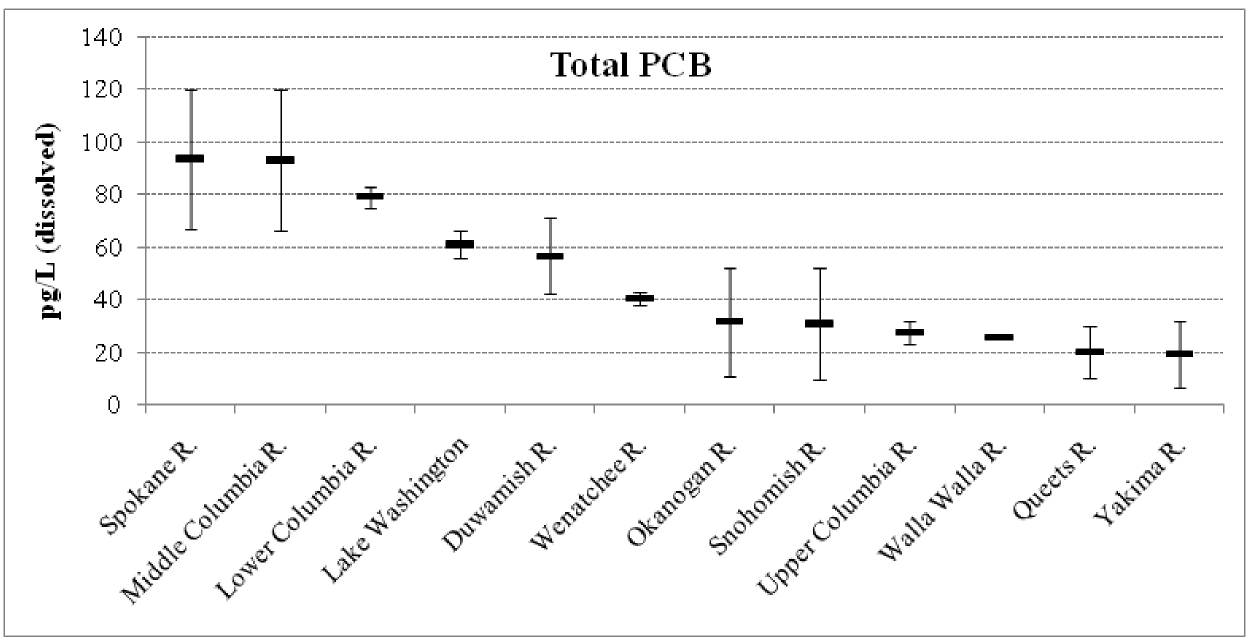

Figure 5. Average Estimated Dissolved Concentrations of Total PCB, 2008.

(nd = not detected; bars show maximum and minimum; minimum and maximum bars are too small to see differences for the Walla Walla River site.)

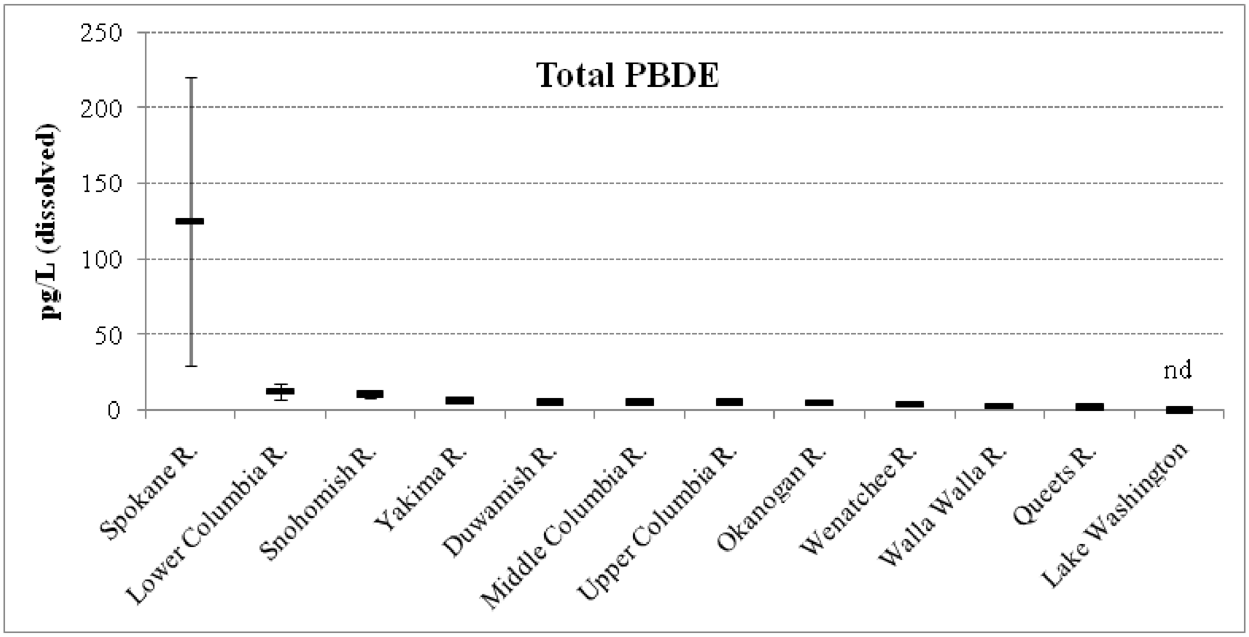

Figure 6. Average Estimated Dissolved Concentrations of Total PBDE, 2008.

(nd = not detected; bars show maximum and minimum; no bars indicate results were detected in only the spring or fall.)

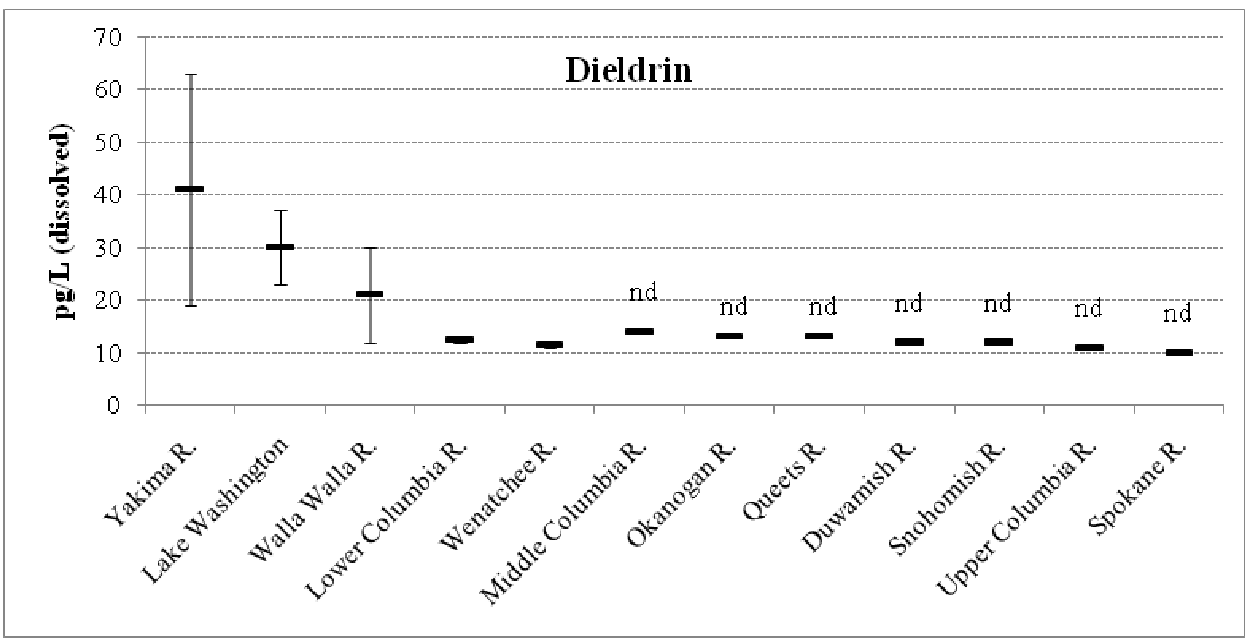

Figure 7. Average Estimated Dissolved Concentrations of Dieldrin, 2008.

(nd = not detected; bars show maximum and minimum; minimum and maximum bars are too small to see differences for the Lower Columbia and Wenatchee River sites.)

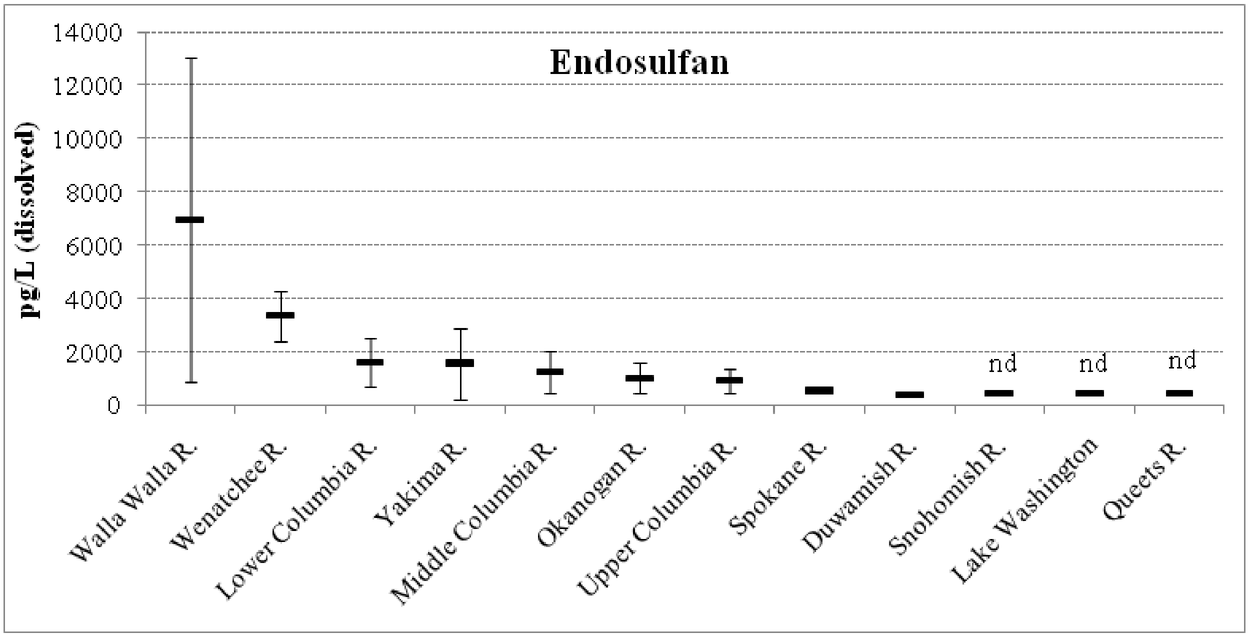

Figure 8. Average Estimated Dissolved Concentrations of Endosulfan, 2008.

(nd = not detected; bars show maximum and minimum; minimum and maximum are too small to see bars for the Spokane River site; no bars for the Duwamish River site indicate results were detected in only the spring or fall.)

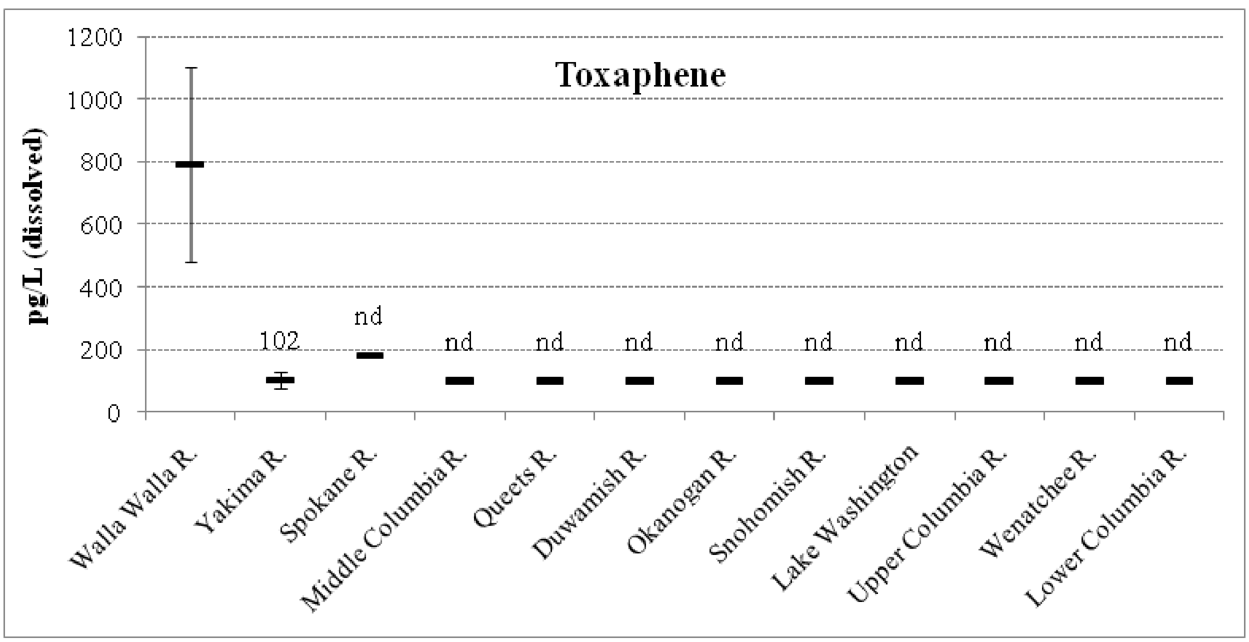

Figure 9. Average Estimated Dissolved Concentrations of Toxaphene, 2008.

(nd = not detected; bars show maximum and minimum.)

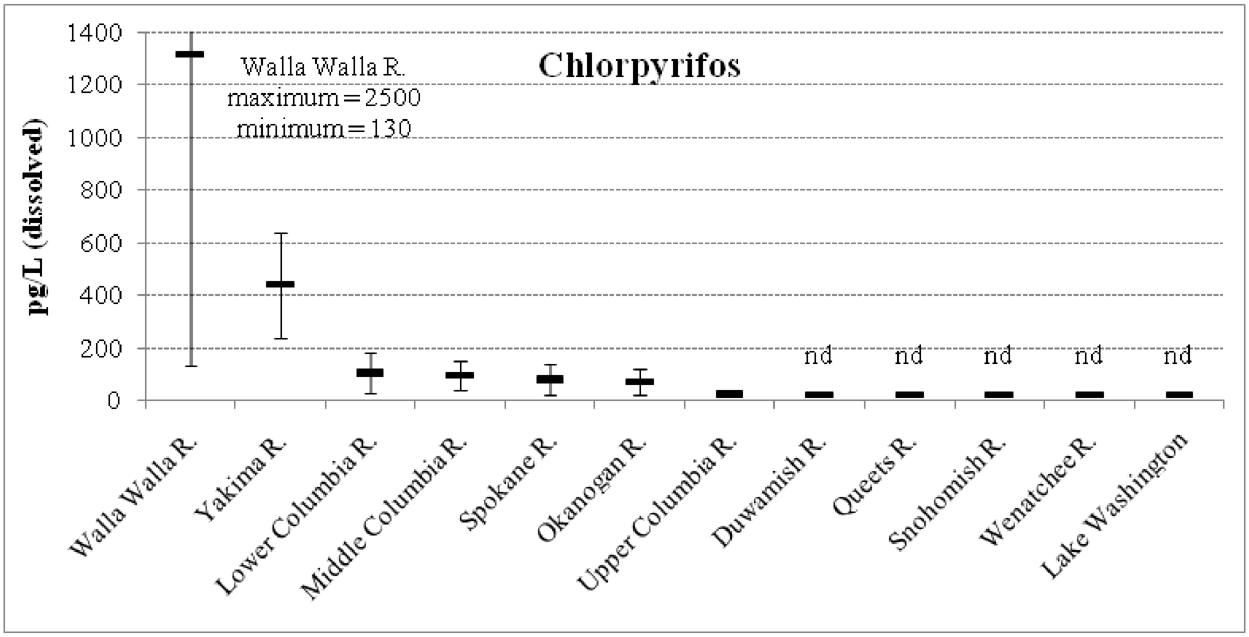

Figure 10. Average Estimated Dissolved Concentrations of Chlorpyrifos, 2008.

(nd = not detected; bars show maximum and minimum; minimum and maximum bars are too small to see for the Upper Columbia River site.)

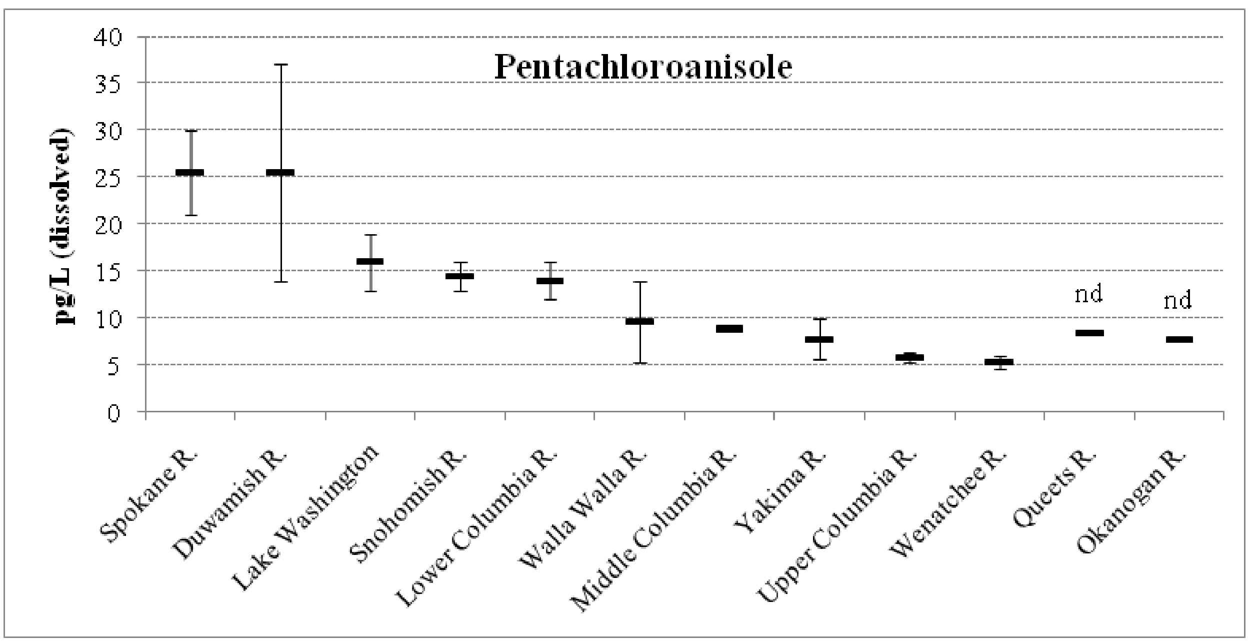

Figure 11. Average Estimated Dissolved Concentrations of Pentachloroanisole, 2008.

(nd = not detected; bars show maximum and minimum; minimum and maximum bars are too small to see for the Middle Columbia River site.)

Highest concentrations of T-DDT were found in the Upper Columbia and Walla Walla Rivers followed by the Middle Columbia, Yakima, and Wenatchee Rivers. DDT compounds were not detected or detected at very low levels in Lake Washington and the Spokane, Queets, Duwamish, and Snohomish Rivers. These findings match the 2007 results with the same top five rivers. Also, the same five waterbodies had low levels of DDT compounds. T-DDT ranged from 5.6 – 230 pg/L in 2008 compared to 4.4 – 340 pg/L in 2007.

PCBs were detected at all sites. In decreasing order, the Spokane, Middle, and Lower Columbia Rivers had the highest PCB concentrations in both 2007 and 2008. Lake Washington and the Duwamish and Wenatchee Rivers followed for both years, but not in the same order.

PBDEs were detected at 11 of the 12 sites. Concentrations in the Spokane River were greater than ten times higher than the other sites. Other Ecology studies as well as this monitoring effort in 2007 and 2008 have reported Spokane River as having the highest PBDE levels in the state (Sandvik, 2009; Johnson et al., 2006; Furl et al., 2010).

In 2008, the Yakima and Walla Walla Rivers ranked in the top two for toxaphene and chlorpyrifos and in the top four for endosulfan and dieldrin. The Wenatchee and Lower Columbia Rivers ranked second and third for endosulfan concentrations. Lake Washington and the Lower Columbia River were in second and fourth place for dieldrin. Again, these sites were also listed with the highest levels of these pesticides in 2007.

Most levels of toxaphene, dieldrin, chlorpyrifos, and endosulfan were also similar between 2007 and 2008 except for one site reporting 13,000 pg/L of endosulfan (Walla Walla River). Year-to-year comparisons are difficult for current use pesticides such as endosulfan and chlorpyrifos, although the chlorpyrifos levels were consistent between these sampling periods. Range comparisons are shown in Table 6.

Table 6. 2007 and 2008 Comparison for Toxaphene, Dieldrin, Chlorpyrifos, and Endosulfan (dissolved).

Chemical	Range (pg/L)	
	2007	2008
Toxaphene	91 - 1150	130 - 1100
Dieldrin	11 - 71	11 - 60
Chlorpyrifos	36 - 3800	29 - 2500
Endosulfan	310 - 3400	240 - 4300

The Spokane River, Duwamish River, Lake Washington, and Snohomish River had the highest levels of pentachloroanisole ranging from 6.0 to 37 pg/L. The 2007 monitoring period reported the same waterbodies with similar concentrations ranging from 6.0 to 31 pg/L.

PAHs were detected at all sites (Figures 12 and 13) although individual PAHs varied between sites. ∑PAH ranged from 39 to 5500 pg/L. The Snohomish River, Lake Washington, and the Duwamish and Lower Columbia Rivers had the highest ∑PAH. These sites are located on the west side of the Cascade Range where urban/industrial influence is high. The Queets River had the lowest concentrations of PAHs by orders of magnitude (one to two orders of magnitude lower in some cases). These low concentrations reflect the Queets River's remote location in the Olympic National Forest near the Pacific Coast.

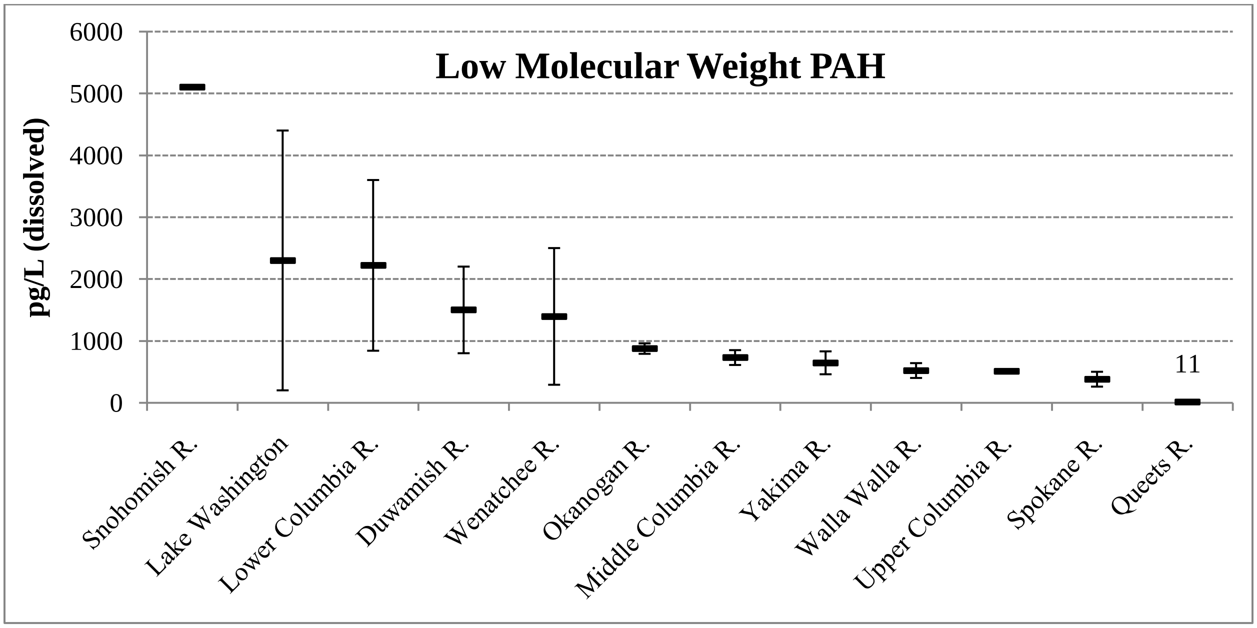

Figure 12. Average Estimated Dissolved Concentrations of Low Molecular Weight PAH, 2008.

(nd = not detected; bars show maximum and minimum; no bars indicate results were detected in only the spring or fall.)

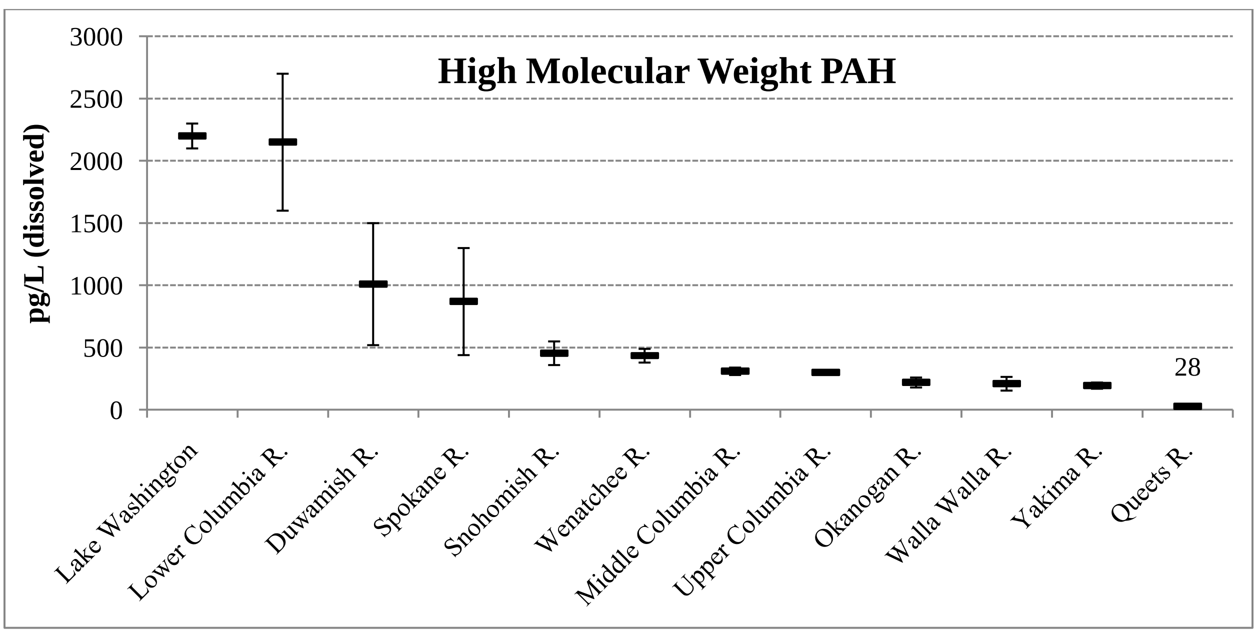

Figure 13. Average Estimated Dissolved Concentrations of High Molecular Weight PAH, 2008.

(nd = not detected; bars show maximum and minimum; minimum and maximum bars are too small to see for the Middle Columbia, Upper Columbia, Yakima, and Queets River sites.)

Generally, LPAH were the dominant hydrocarbons. They constituted 63% of the ∑PAH concentration based on an average of all sites. LPAH in the Snohomish, Okanogan, Yakima, and Wenatchee Rivers constituted over 70% of the total. In contrast, the Spokane and Queets Rivers had 30% or less LPAH and were dominated by HPAH.

HPAH are generated mainly by high temperature combustion (pyrogenic) and associated with grass, wood, and coal combustion whereas LPAH may be derived from slow, long-term, moderate temperatures (petrogenic) and associated with petroleum. The main source of PAHs at the trend monitoring sites appears to be processes related to petroleum and moderate temperature combustion. Generally speaking, LPAH are more easily degraded than HPAH. An abundance of LPAH verses HPAH may indicate ongoing sources verses historical contamination.

Concentration ratios of parent PAHs have been used to distinguish between natural and anthropogenic sources such as fluoranthene and pyrene (Fl/Fl + Py) and anthracene and phenanthrene (An/Pn). Using the Fl/Fl + Py ratio, Yunker et al. (2002) proposed a petroleum/ combustion boundary near 0.40, a combustion boundary between 0.40 and 0.50 for liquid fossil fuel (vehicle and crude oil), and a combustion boundary >0.50 for grass, wood, or coal. Values greater than 1 are generally related to pyrogenic origins (i.e., wildfires). The An/An + Pn ratio <0.10 usually indicates petroleum, and >0.10 indicates a dominance of combustion although some high temperature processes are indistinguishable such as in the formation of creosote compared with coal tar or coal combustion (Yunker et al., 2002).

Figure 14 shows the mean An/An + Pn and Fl/Fl + Py ratios for 2008.

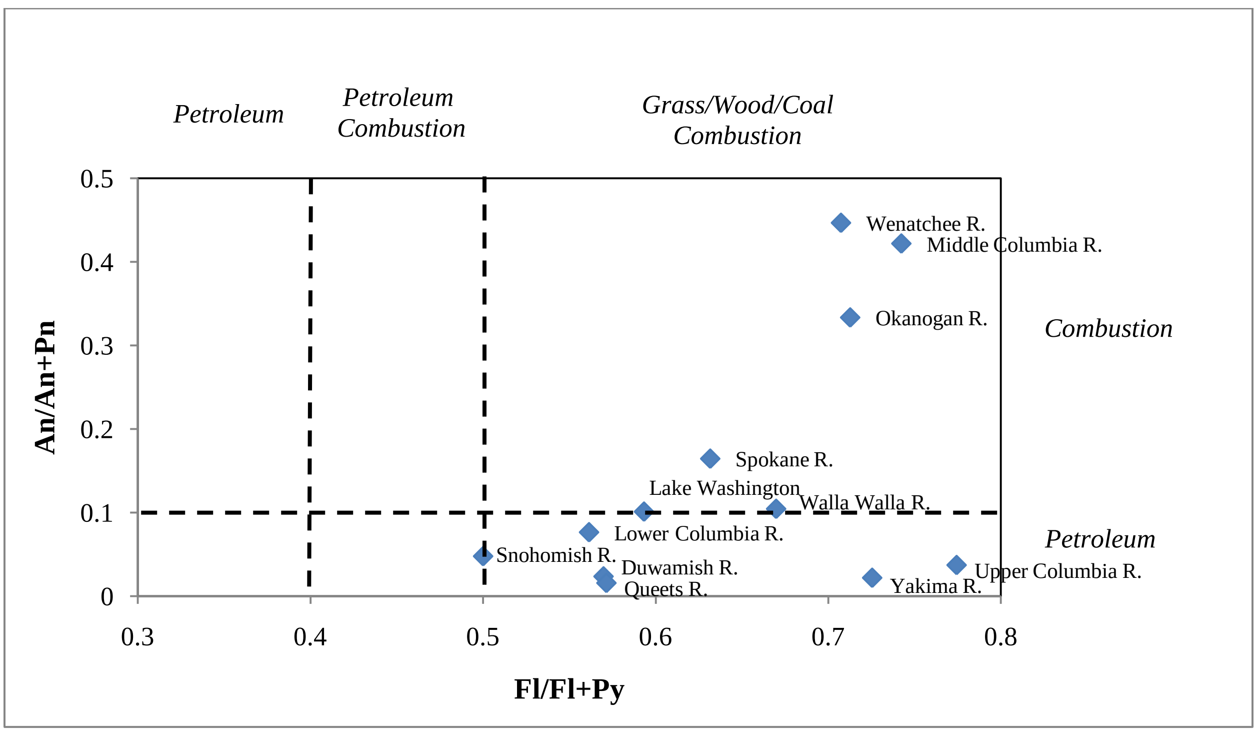

Figure 14. PAH Cross Plots for the Ratios of Anthracene and Phenanthrene (An/An + Pn) versus Fluoranthene and Pyrene (Fl/Fl + Py). (Nondetects = reporting limit.)

The ratios ranged from 0.02 – 0.44 for An/Pn and from 0.50 – 0.77 for Fl/Py. Most were below the An/Pn 0.10 transition suggesting petroleum sources. In contrast, all the samples were at or above the 0.5 boundary indicating high temperature combustion. Taken together, the ratios suggest mixed petroleum and combustion sources. The four sites clearly in the combustion range for both ratios were the Wenatchee, Middle Columbia, and Okanogan Rivers followed by the Spokane River. It is difficult to determine the source of PAH with small sample size and variations. Additional sampling is needed to evaluate forensic patterns.

Overall, there appears to be a pattern distinguishing urban sites from non-urban sites. The four sites that are predominantly urban (Lake Washington and the Snohomish, Lower Columbia, and Duwamish Rivers) tended to have the highest concentration of PAHs, leaning towards a petroleum-based fingerprint (Figure 13-15). Van Metre et al. (2000) found a trend toward increased PAH concentrations in sediment cores from 10 reservoirs and lakes in six U.S. metropolitan areas tracked over three decades. The study linked the increase to increasing amounts of urban sprawl and vehicle use, even in watersheds that had not undergone substantial changes in urban land use.

One anomaly in the present data set is the Spokane River site, located near the city of Spokane, with elevated HPAH but not LPAH. The Spokane River is east of the Cascades Mountain Range near the northeastern border of Washington State, whereas the other urban sites are located west of the Cascades in the northwestern area of the state. Although the Spokane site is downstream of the metropolis, the city itself is surrounded by open country and agricultural lands. Predominant winds favor this area as the downwind sector. This area may have fewer asphalt and other LPAH sources than the west side sites, and may be subject to upwind sources of pyrogenic PAHs from grass, wood, and coal burning.

Seasonal Patterns

Seasonal patterns were observed among the 12 sites. More chemicals were detected in the spring than in the fall, except for the Wenatchee River (Figure 15).

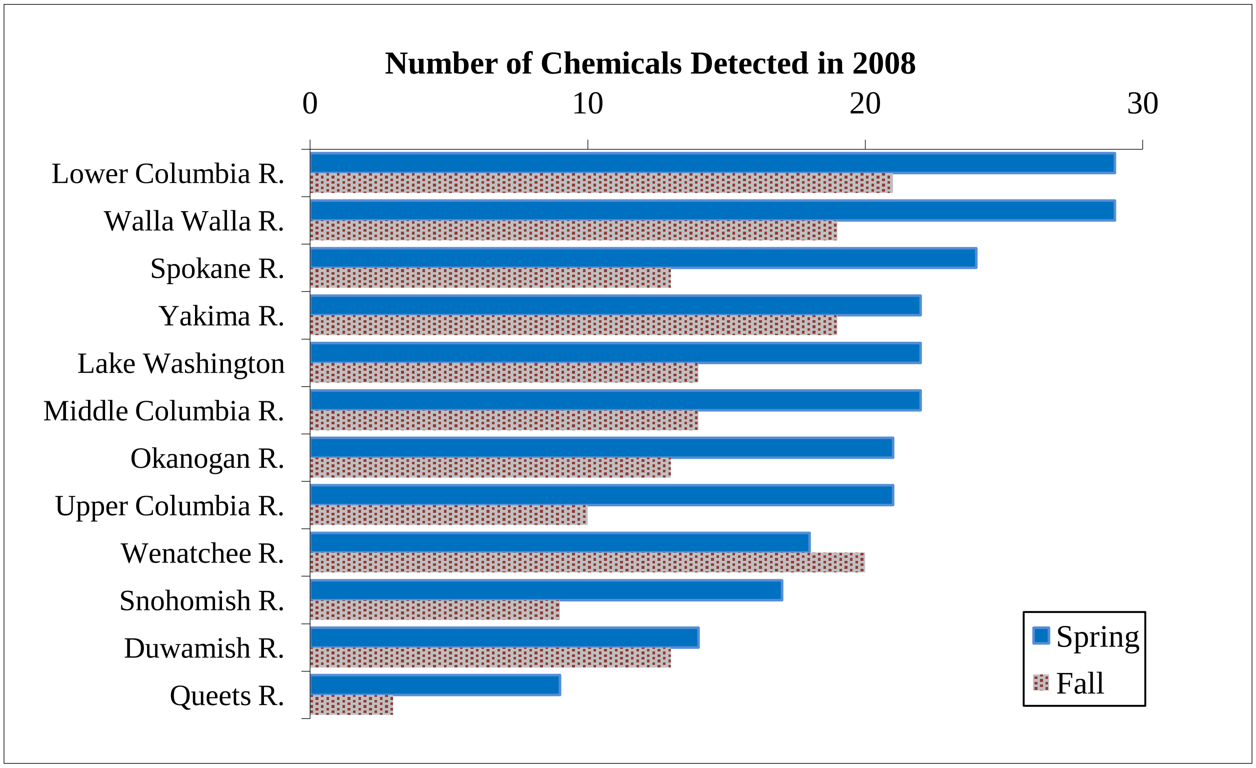

Figure 15. Number of Chemicals Detected in Spring versus Fall, 2008.

This same pattern was detected in the previous year except that Lake Washington and the Duwamish River had more chemicals detected in the fall versus the spring of 2007. Differences in detection limits (i.e., lower in fall) do not appear to explain the current data set. The apparent seasonal differences could be due to normal seasonal differences. Continued monitoring may allow for these variations to be accounted for.

Table 7 compares 2007 and 2008 waterbodies where the highest concentrations were recorded in the spring and fall.

The highest pesticide concentrations were generally found in the Walla Walla River in the spring, both in 2007 and 2008. The Spokane, Yakima, Middle Columbia, and Upper Columbia Rivers also had high concentrations of certain pesticides (dacthal, dieldrin, total PCB, and DDMU). Maximum concentrations of endosulfan sulfate and DDMU in the spring of 2008 were found in the same waterbodies as for the fall of 2007 (Walla Walla and Upper Columbia Rivers respectively).

Table 7. Location of Maximum Concentrations Observed in 2007 and 2008.

Parameter	2007		2008	
	pg/L[1]	Location	pg/L[1]	Location
Spring				
Chlorpyrifos	3800	Walla Walla R.	2500	Walla Walla R.
Toxaphene	1150	Walla Walla R.	1100	Walla Walla R.
Hexachlorobenzene (HCB)	34	Walla Walla R.	47	Walla Walla R.
Total Chlordane[2]	23	Walla Walla R.	39	Walla Walla R.
Heptachlor Epoxide	19	Walla Walla R.	19	Walla Walla R.
Lindane	755	Walla Walla R.	460	Walla Walla R.
Dacthal	30	Middle Columbia R.	40	Spokane R.
Endosulfan I	2660	Yakima R.	10000	Walla Walla R.
Endosulfan-II	1200	Walla Walla R.	3000	Walla Walla R.
Endosulfan Sulfate	-	-	980	Walla Walla R.
DDMU[3]	-	-	14	Upper Columbia R.
Total PCBs	-	-	120	Spokane R.
∑LPAH[5]	na	na	5100	Snohomish R.
∑PAH[7]	na	na	6500	Lake Washington
Fall				
Endosulfan Sulfate	2700	Walla Walla R.	-	-
Pentachloroanisole (PCA)	29	Spokane R.	37	Duwamish R.
Dieldrin	71	Yakima R.	63	Yakima R.
DDMU[3]	33	Upper Columbia R.	-	-
Total DDT[4]	340	Upper Columbia R.	230	Upper Columbia R.
Total PCBs	80	Spokane R.	120	Middle Columbia R.
Total PBDEs	182	Spokane R.	220	Spokane R.
∑HPAH[6]	na	na	2700	Lower Columbia R.

1. Estimated dissolved concentrations.
2. Total Chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane.
3. DDMU (1-chloro-2,2-bis(p-chlorophenyl)ethane) is a breakdown product of DDE.
4. Total DDT is the sum of 2,4'- and 4,4'- isomers of DDD, DDE, and DDT. DDD = p,p'-dichlorodiphenyldichloroethane. DDE = p,p'-dichlorodiphenyldichloroethylene. DDT = p,p'-dichlorodiphenyltrichloroethane.
5. ∑Total LPAH is low molecular weight PAH: naphthalene, anthracene, acenaphthylene, acenaphthene, phenanthrene, and fluorene.
6. ∑Total HPAH is high molecular weight PAH: fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
7. ∑PAH is the sum of LPAH and HPAH.

na = not analyzed.

- Maximum concentration found in the other sampling period; spring versus fall.

Total PCBs were higher in the Spokane River in the fall of 2007 and spring of 2008. Equally high concentrations of total PCBs were found in the Middle Columbia River in the fall of 2008. The Spokane River also dominated the highest concentrations of total PBDEs in the fall of both years by a factor of over 4 and 10 times, respectively.

Maximum concentrations of dacthal, endosulfan, toxaphene, and chlorpyrifos were seen in the spring, which could reflect the application period of these current-use pesticides.

Dieldrin, DDT, DDMU (a breakdown product of DDE), and PCBs are historical-use pesticides and had maximum concentrations in the fall. EPA (2009) identified sources of legacy pesticides from disturbed contaminated soils and runoff from farmlands, roads, construction sites, and stormwater as well as irrigation. Soil disturbance (tillage), spring runoff, and irrigation may help explain the elevated pesticide concentrations found in the Yakima and Walla Walla Rivers (Joy, 2002; Joy et al., 1997; and Johnson et al., 2004). The USGS reported the highest concentrations of pesticides in streams and groundwater across the nation were detected during the growing season and the lowest were detected during the winter (Gilliom et al., 2006).

The highest LPAHs were found in Snohomish River during the spring whereas the highest HPAHs were in the Lower Columbia River during the fall. Interestingly, the overall highest ∑PAHs were in Lake Washington, an urban lake environment.

Figures 16–18 compare 2007 with 2008 spring and fall levels of T-DDT, total PCBs, and total PBDEs. Sites are ordered from the highest to lowest concentrations observed in the spring of 2008. There were no data available for the Spokane and Okanogan Rivers in the spring of 2007.

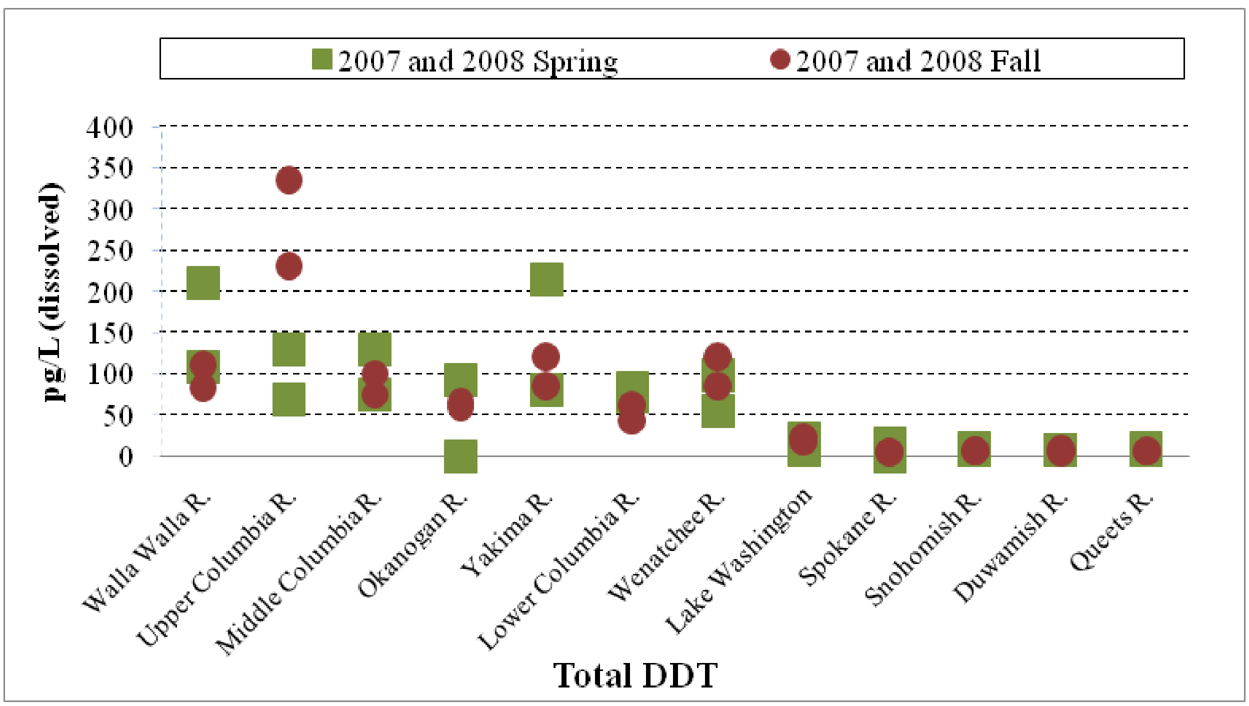

Figure 16. Estimated Dissolved Concentration of Total DDT in 2007 and 2008 Spring and Fall.

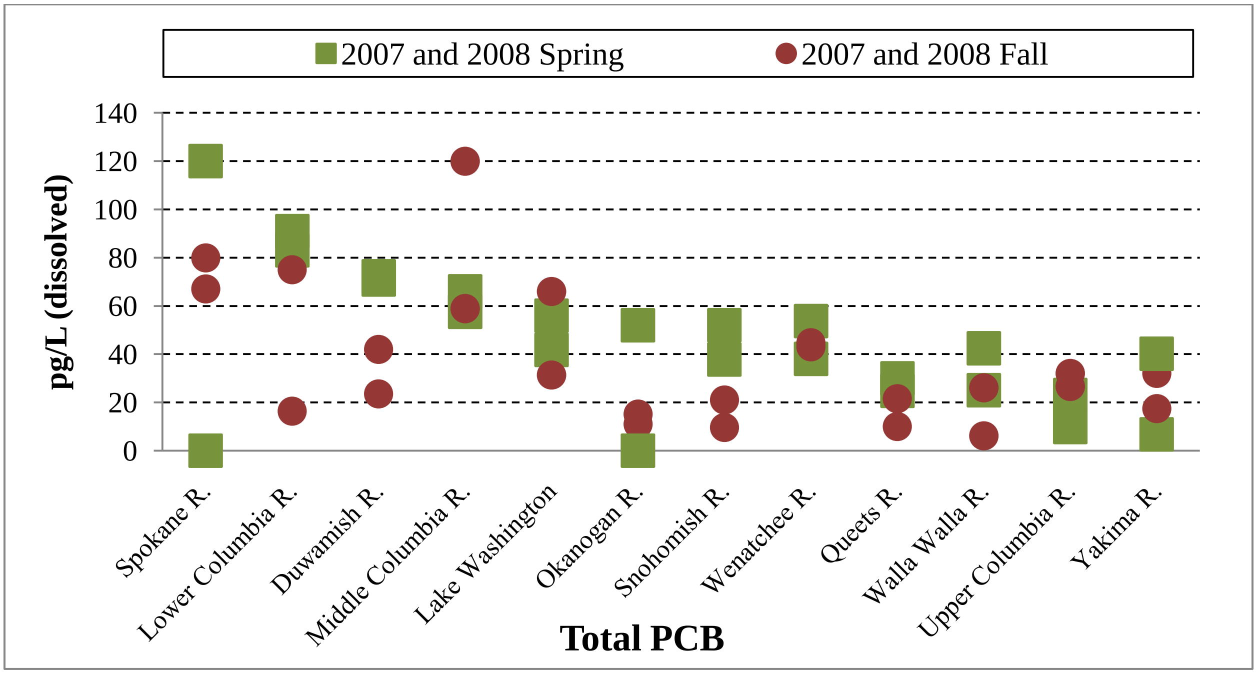

Figure 17. Estimated Dissolved Concentration of Total PCBs in 2007 and 2008 Spring and Fall.

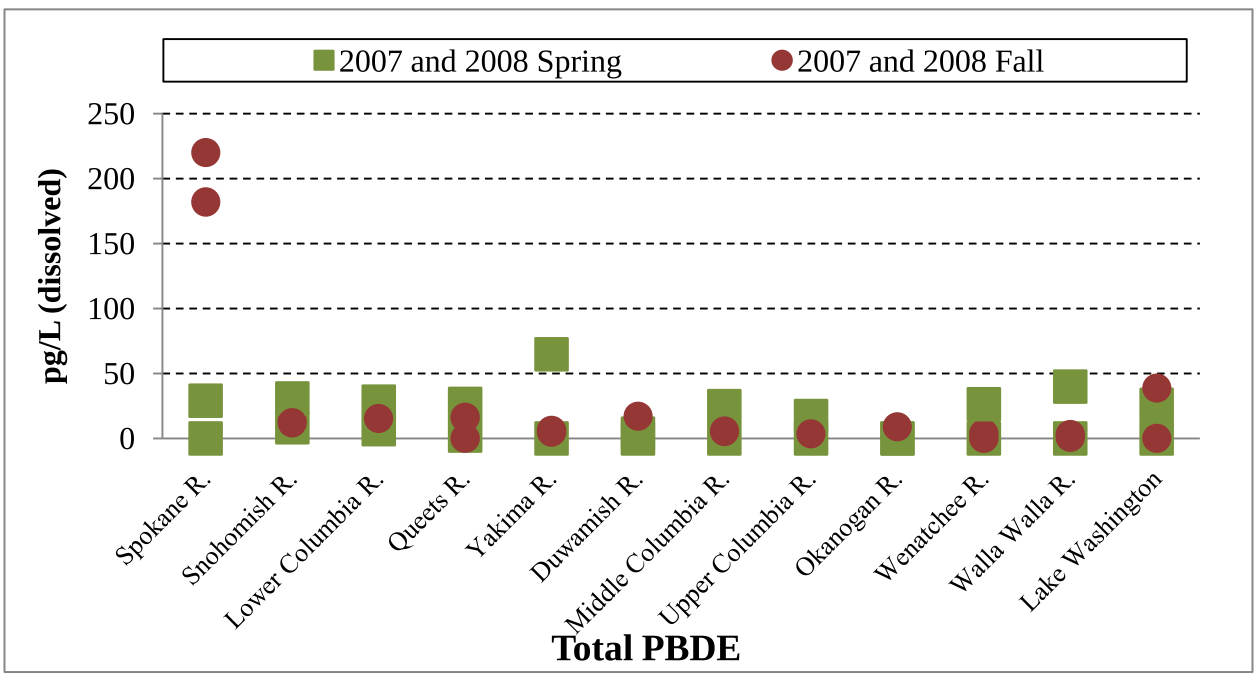

Figure 18. Estimated Dissolved Concentration of Total PBDEs in 2007 and 2008 Spring and Fall.

Concentrations of DDT compounds (T-DDT) were highest in the spring at most sites. Exceptions include the Upper Columbia River in 2007 and 2008 and the Yakima and Wenatchee Rivers in 2008. The Yakima and Wenatchee Rivers ranked second and thirds highest for T-DDT in the fall of both sampling years. The Upper Columbia River was two to four times higher for T-DDT in the fall than in the spring.

Other studies in the Yakima River basin have shown DDE and T-DDT vary directly with discharge (Joy and Patterson, 1997: Johnson et al., 2010), which can be seen at most of the trend monitoring sites during the spring. The pattern reflects the affinity these compounds have for soil particles and other suspended matter. It is not clear why there is a large fall spike of DDT in the Upper Columbia River site, but irrigation or other combined factors may be contributing to the spike.

Most total PCB concentrations were higher in the spring except for the Upper and Middle Columbia River for 2007 and 2008 and the Yakima River for 2008. The seasonal differences between PCB concentrations at these sites still remain unclear, but reservoir or water control effects could be playing a role. The Upper Columbia, Middle Columbia, and Yakima Rivers monitoring sites are at dams, whereas the Wenatchee, Okanogan, and Walla Walla Rivers are free flowing at the monitoring sties.

Results have been inconclusive for PBDEs. Seasonal patterns were not apparent at any of the monitoring sites. However, the 2007 and 2008 data for this study, as well as other studies, show elevated fall PBDE concentrations in the Spokane River (Sandvik, 2009; Johnson et al., 2006, and Furl et al., 2010). Fall PBDE concentrations in the Spokane River measured 5 to >10 times higher than other waterbodies tested in the state (Sandvik, 2009; Johnson et al., 2006). Seasonal variation has been attributed in part to the dilution of local sources generated by snowmelt in the upper watershed. Additional sampling up and downstream, in-between high and low flows, as well as WWTP and outfall particulates, may be necessary to define PBDE levels and sources in the river.

Figure 19 shows ∑PAH between sites in the spring and fall.

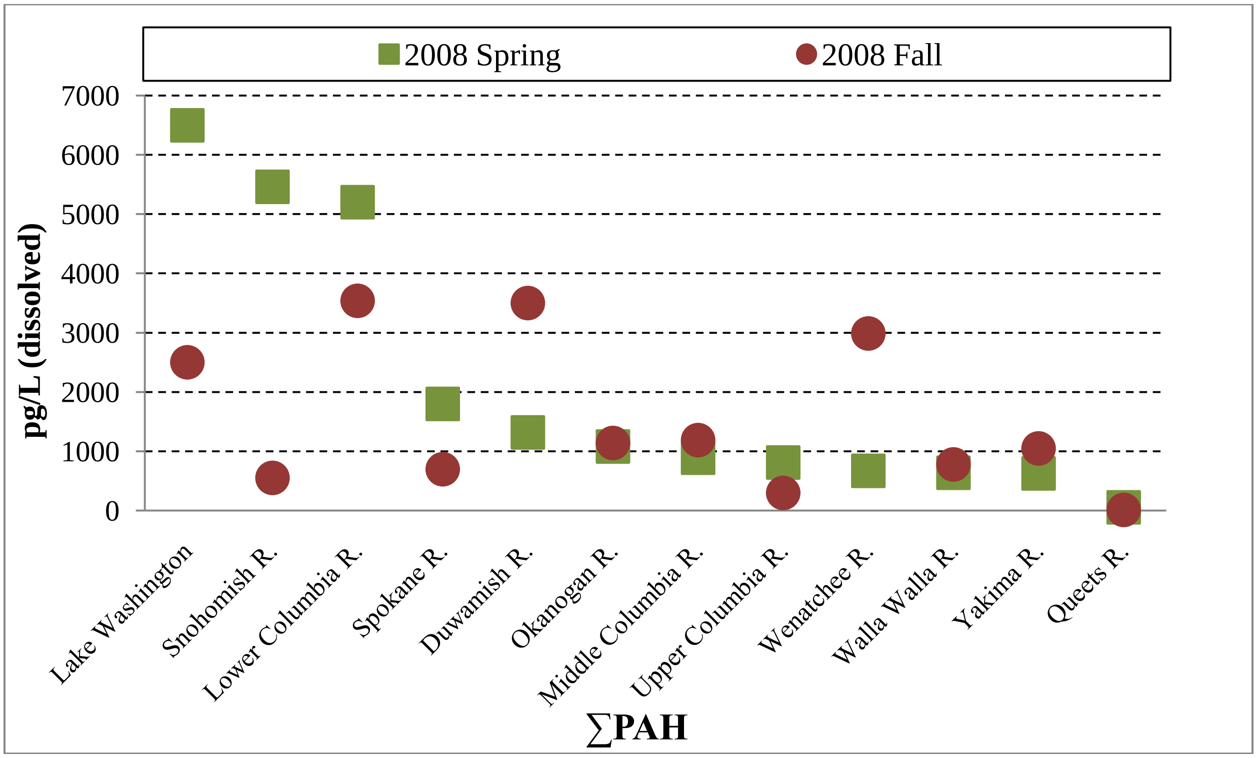

Figure 19. Estimated Dissolved Concentration of ∑PAH in 2008 Spring and Fall.

PAHs appear to be elevated in the urban sites (first five sites listed left to right in Figure 19) in the spring with the exception of the Duwamish River. The Wenatchee River appeared to have elevated levels of PAHs in the fall only. Again, a larger sample size would be required to confirm this pattern.

Comparison with Water Quality Standards

Federal and state agencies and tribes adopt water quality criteria to protect designated uses (e.g., public water supply, protection of fish and wildlife, and recreational or agricultural purposes). Although the focus of this study is to determine trends, comparing the results with criteria helps put the water quality of the study sites in perspective.

Total concentrations were compared to water quality criteria. The dissolved form is usually considered to be the chemical fraction available for bioconcentration by fish (EPA, 2000). Using the total concentration is a conservative approach for comparing to water quality standards. More importantly, the water quality criteria are framed in terms of the total amount of a chemical. Ecology is reviewing procedures for comparing SPMD results with water quality standards. Total chemical concentrations (Appendix L) were estimated from the dissolved data as described earlier.

The 2008 results were compared to the water quality standards and recommended criteria described below. The criteria for Washington State are regulatory whereas the EPA criteria are current national recommendations (Ecology, 2006a). These sources do not have water quality criteria for PAH.

Washington State Water Quality Criteria

Chapter 173-201A WAC establishes water quality standards for surface waters consistent with the maintenance and protection of uses such as public health, public enjoyment, and aquatic life and wildlife resources. Water quality criteria are designed to provide full protection for these uses.

The federal Clean Water Act requires that the waterbodies that fail to meet (exceed) water quality standards be put on a list (known as the 303(d) list) for development of a water cleanup plan specific for the pollutant causing the problem. The cleanup plan results from a Total Maximum Daily Load (TMDL) study and public involvement process. Ecology uses the TMDL program to control sources of the particular pollutant in order to bring the waterbody back into compliance with the water quality standards. To date, Washington State does not list waterbodies based on SPMD water concentrations.

Washington State's human health-based water quality standards for toxic substances are contained in 40 CFR 131.36, also known as the National Toxics Rule or NTR (EPA, 1992). Criteria for carcinogenic substances are based on a risk level of 10^{-6}. The risk level estimates the number of additional cancer cases that would be caused by long-term exposure to a specific contaminant. At a risk level of 10^{-6}, one person in a million could contract cancer due to long-term exposure to a specific contaminant. These risks are upper-bound estimates, while true risks may be as low as zero. Some chemicals in this study, such as endosulfan and chlorpyrifos, are not carcinogens. These compounds have criteria values below which adverse health effects are expected.

Washington State's aquatic life-based criteria are set at levels that provide full protection of the aquatic-life designated uses found in the standards.

EPA National Recommended Water Quality Criteria

EPA periodically updates their recommended numeric criteria for human health and aquatic life protection, as required by the Clean Water Act (CWA section 304(a)). These updates are used by states as they consider updates to their standards, but are not Clean Water Act-approved regulatory values unless adopted into state standards and approved by EPA.

Criteria Comparison

Human Health Criteria

Results from this 2008 study were compared to the Washington State water quality standards and EPA-recommended criteria for protection of human health and aquatic life. Human health criteria for water plus fish consumption verses fish only (Appendix M) were compared to total chemical concentration results.

The waterbodies monitored in 2008 met water quality criteria for most of the chemicals of concern. Exceptions included PCBs, dieldrin, and toxaphene. Figures 20-24 compare the estimated total concentrations of total PCBs, dieldrin, toxaphene, and DDE with the Washington and EPA human health criteria.

PCBs were detected at all sites in both the spring and fall of 2008. Seven sites did not meet (exceeded) the Washington State human health criterion (170 pg/L), and all sites except the Queets River reference site exceeded the EPA national recommended human health criterion (64 pg/L). Sites that exceeded the Washington State human health criterion were the Lower and Middle Columbia, Okanogan, Walla Walla, Spokane, and Duwamish Rivers, as well as Lake Washington.

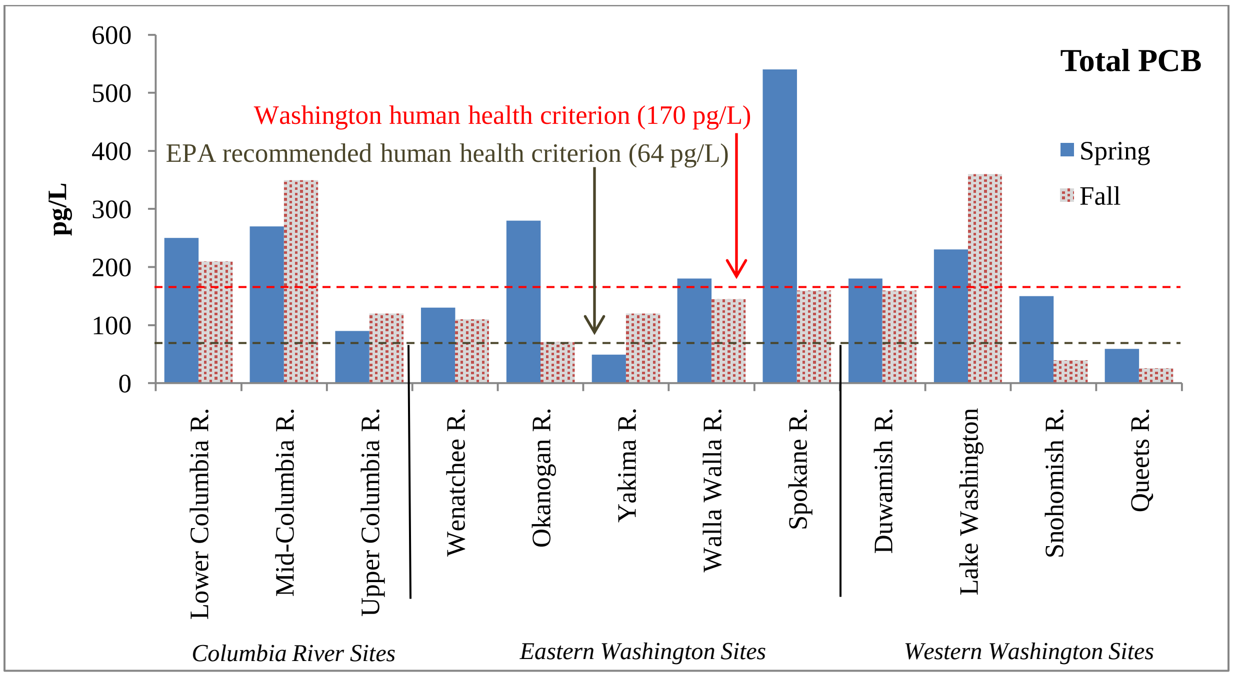

Figure 20. Estimated Total Concentrations of Total PCBs Compared with Washington State and EPA National Human Health Criteria.

(nd = not detected.)

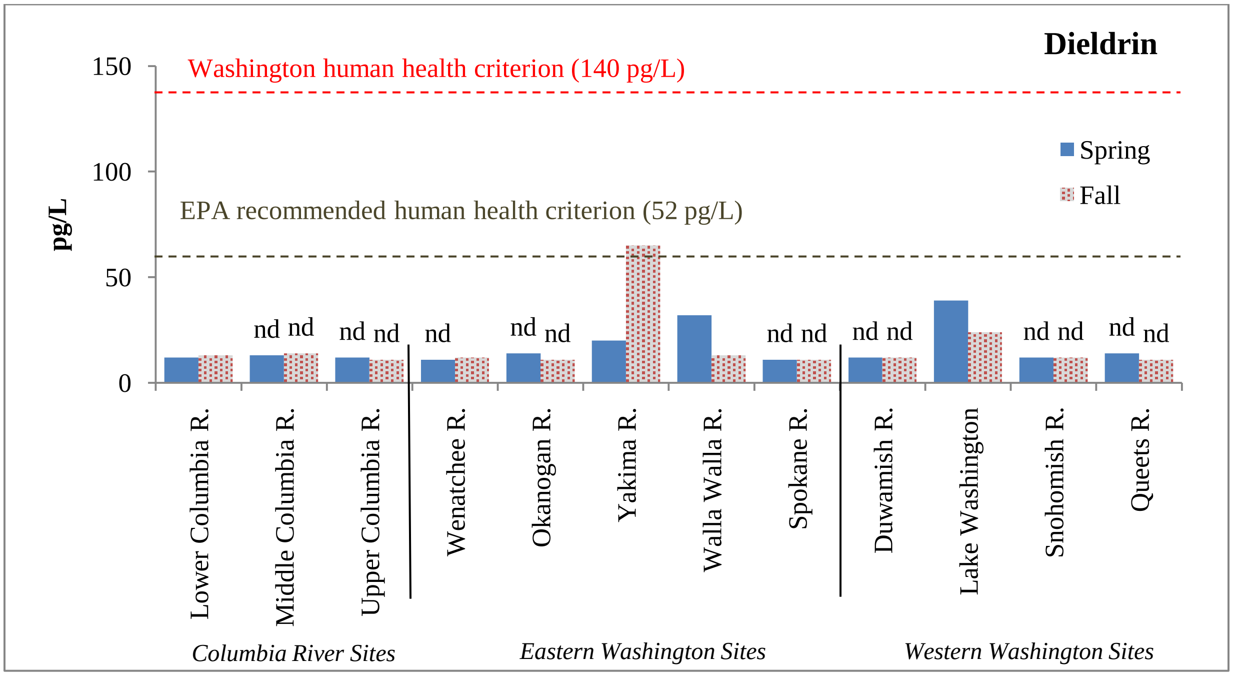

Figure 21. Estimated Total Concentrations of Dieldrin Compared with Washington State and EPA National Human Health Criteria.

(nd = not detected.)

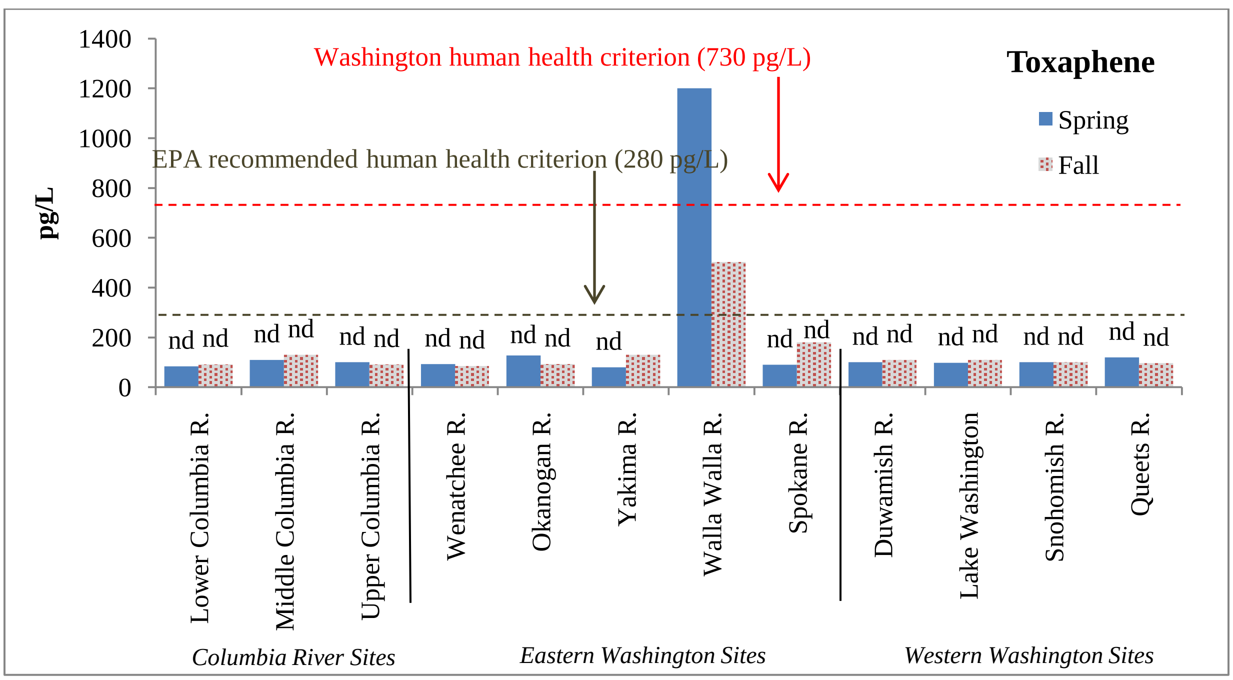

Figure 22. Estimated Total Concentrations of Toxaphene Compared with Washington State and EPA National Human Health Criteria.

(nd = not detected.)

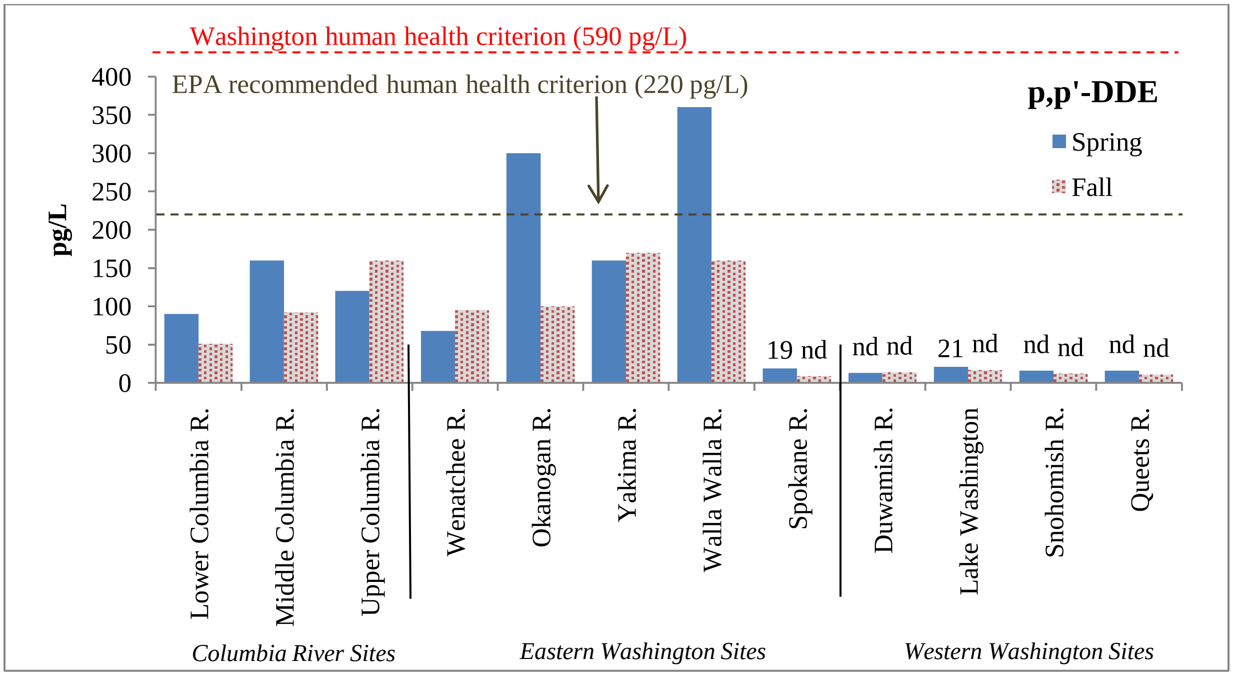

Figure 23. Estimated Total Concentrations of DDE Compared with Washington State and EPA National Human Health Criteria.

(nd = not detected.)

No sites exceeded the Washington State human health criterion for dieldrin (140 pg/L). The Yakima River exceeded the EPA national recommended human health criterion (52 pg/L) in the fall with a concentration of 65 pg/L.

Estimates obtained from the SPMD deployments indicate that more than 90% of the dieldrin is in dissolved form and not associated with particulates (Johnson and Norton, 2005; Sandvik, 2009). Johnson et al. (2009) suggested a potential groundwater contribution based on dieldrin having an inverse relationship with flow in the Yakima River. He found that dieldrin consistently exceeded criteria in the second half of the irrigation season in the Lower Yakima River during low flows (last half of June through August). This SPMD study collected samples in September – October and thus may have missed the period of maximum concentrations.

Toxaphene concentrations in the lower Walla Walla River during spring exceeded the Washington State human health criterion of 730 pg/L and the EPA national recommended human health criterion (280 pg/L) with a concentration of 1200 pg/L. Fall concentrations of 500 pg/L exceeded the EPA national recommended human health criterion. A toxaphene source is suspected in the nearby Pine Creek tributary with estimates of up to 40,000 pg/L of toxaphene from SPMDs (Johnson et al., 2004).

No DDT or metabolites exceeded Washington State human health criterion. The Okanogan and Walla Walla Rivers exceeded EPA national recommended human health criterion (220 pg/L) for DDE in the spring with concentrations of 300 and 360 pg/L respectively. Higher concentrations in the fall were observed in the Upper Columbia, Wenatchee, and Yakima Rivers but were below the criterion. Decreasing trends of DDT and metabolites have been reported in the Yakima River based on fish and whole water data, but sporadic exceedances still occur in the mainstem (Johnson et al., 2009).

Aquatic Life Criteria

Concentrations of toxaphene and T-DDT were compared with Washington State and EPA acute and chronic aquatic life criteria. No results were above the acute criteria.

The Walla Walla River did not meet (exceeded) Washington State chronic aquatic life criterion for toxaphene (200 pg/L) in the spring (1200 pg/L) or fall (500 pg/L). The Yakima River showed elevated toxaphene concentrations in the fall (130 pg/L), but did not exceed the criterion. In 2007, concentrations were found at or above the aquatic life criterion in the Yakima River (Sandvik, 2008; Johnson et al., 2009). Johnson (2009) identified several Yakima River tributaries and irrigation returns as toxaphene sources and suggested a connection with historical use for parasite control in dairies and feedlots. Many of these operations were in existence prior to the ban on toxaphene in 1990.

No sites had T-DDT that exceeded aquatic life criteria (1,000 pg/L) in 2008. Both DDE and DDD appear to be the major contributors to T-DDT. DDT compounds break down very slowly and remain in agricultural soils a long time. The breakdown products (DDE and DDD) are often found in surface water.

Comparison between 2007 and 2008

Human health-based criteria

The 2007 results were similar to 2008 with respect to criteria comparison using total chemical concentrations. Table 8 compares 2007 and 2008 sites that did not meet the Washington State human health criteria or the EPA recommended human health criteria for one or more sampling periods.

Table 8. Comparison of Human Health-based Criteria Exceedances for 2007 and 2008.

Site		Total PCB		Dieldrin		Toxaphene		p,p'-DDE	
		2007	2008	2007	2008	2007	2008	2007	2008
Columbia River	Lower Columbia R.	WA EPA	WA EPA	-	-	-	-	-	-
	Middle Columbia R.	WA EPA	WA EPA	-	-	-	-	-	-
	Upper Columbia R.	EPA	EPA	-	-	-	-	EPA	-
Eastern Washington	Wenatchee R.	EPA	EAP	-	-	-	-	-	-
	Okanogan R.[1]	-	WA EPA	-	-	-	-	-	EPA
	Yakima R.	EPA	EPA	EPA	EPA	-	-	EPA	-
	Walla Walla R.	EPA	WA EPA	-	-	WA EPA	WA EPA	-	EPA
	Spokane R.[1]	WA EPA	WA EPA	-	-	-	-	-	-
Western Washington	Duwamish R.	EPA	WA EPA	-	-	-	-	-	-
	Lake Washington	EPA	WA EPA	-	-	-	-	-	-
	Snohomish R.	EPA	EPA	-	-	-	-	-	-
	Queets R.	-	-	-	-	-	-	-	-

[1.] No spring data for Okanogan and Spokane Rivers in 2007.

WA = Washington State human health criteria: Total PCB = 170, Dieldrin = 140 pg/L, Toxaphene = 730 pg/L, p,p'-DDE = 590 pg/L.

EPA = U.S. Environmental Protection Agency recommended human health criteria: Total PCB = 64 pg/L, Dieldrin = 52 pg/L, Toxaphene = 280 pg/L, p,p'-DDE = 220 pg/L.

Three sites in 2007 had total PCB concentrations above the Washington human health criterion: the Lower Columbia, Middle Columbia, and Spokane Rivers. All sites in 2007 exceeded the EPA recommended human health criterion for PCBs except the Queets and Okanogan Rivers. Only the fall results were available for the Okanogan River in 2007. PCB concentrations were much higher in the spring than in the fall of 2008 at the Okanogan River site. This could indicate possible exceedances at the Okanogan site for the spring of 2007, but data are not available.

The Yakima River was at the EPA recommended human health criterion for dieldrin in the spring of 2007 and exceeded the criterion in the fall of 2007. The 2008 results for the Yakima River were similar with higher concentrations in the fall as discussed above.

Aquatic life-based criteria

Toxaphene results agreed closely for the Walla Walla River and somewhat to a lesser extent for the Yakima River. The 2007 Walla Walla River results exceeded Washington's aquatic life criterion for toxaphene in the spring (1200 pg/L) and fall (550 pg/L), which matched the 2008 results of 1200 pg/L and 503 pg/L (spring and fall respectively). The Yakima River's 2007 concentrations were just at Washington's aquatic life criterion with 200 pg/L (spring) and 190 pg/L (fall), whereas in 2008, toxaphene was detected only in the fall (130 pg/L). An Ecology Yakima River TMDL study reported similar results in 2007 with concentrations exceeding the Washington aquatic life criterion in the spring (370 pg/L), but not in the fall (100 pg/L) (Johnson et al., 2010).

Concentration levels for DDT and its metabolites were elevated in both years in the Upper Columbia, Okanogan, Yakima, and Walla Walla Rivers, although criteria exceedances varied between the sites in 2007 compared to 2008.

Site Scoring Contaminant Rankings

A contaminant scoring index was used to help compare results and rank the monitoring sites. The scores index provides a single value that integrates the exceedances for multiple chemicals at each site. This scoring was applied only to sites sampled in 2008.

Contaminant scores were developed for each sample. The chemical concentrations in each sample were divided by the appropriate benchmark value to produce a ratio of the contaminant concentration to the benchmark. These ratios show whether individual contaminants are higher or lower than the benchmark values and by how much. The ratios for each contaminant were then summed to give a separate site contaminant score for spring and fall. The scores were then averaged to give an overall site contaminant index value.

Table 9 shows an example of contaminant scoring for the Yakima River monitoring site. The benchmark values used were the EPA national recommended criteria for human health or other value as described in the table's footnotes. Where results were qualified below the reporting limit, half the reporting limit was used rather than the reporting limit in order to reduce the weight carried by nondetects.

Table 9. Example Calculation of Sample and Site Contaminant Scores for the Yakima River Site, 2008.

Contaminant	Benchmark Value[1] (pg/L)	Sample Result Value (pg/L)		Benchmark Exceedance Factor	
		Spring	Fall	Spring	Fall
Total PCB congeners	64	49	120	0.8	1.9
Total DDT[2]	220	200 JK	230	0.9	1.0
Total PBDE[3]	50	2 UJK	14 JK	0.0	0.3
Dieldrin	54	20 J	65	0.4	1.2
Toxaphene	280	50 UJ	130 J	0.2	0.5
			Sample Contaminant Score:	2.3	4.9
			Site Contaminant Score: [4]	3.6	

1 - Benchmark values are EPA national recommended criterion value for human health unless noted otherwise.
2 - Benchmark value is the EPA national recommended criterion for human health for both 4,4'-DDT and 4,4'-DDE, the conservative value of the DDT metabolites (DDD benchmark value is 310 pg/L). DDE and DDD are the compounds which usually contribute the most to the total DDT value.
3 - There are no criteria for PBDEs. The benchmark value is half of the highest nondetect value (100/2 = 50 pg/L). PBDE nondetects are half the lowest reporting limit (4/2 = 2 pg/L).
4 - The site contaminant score is the mean of the sample contaminant scores from that site.
J - The analyte was positively identified. The associated numerical result is an estimate.
JK - The analyte is an estimate with an unknown bias.
U - The analyte was not detected at or above the reported result.
UJK - The reporting limit was raised to the result value and used as an estimated reporting limit then qualified as a nondetect with an unknown bias.

Figure 24 shows the 2008 sample contaminant scores by site.

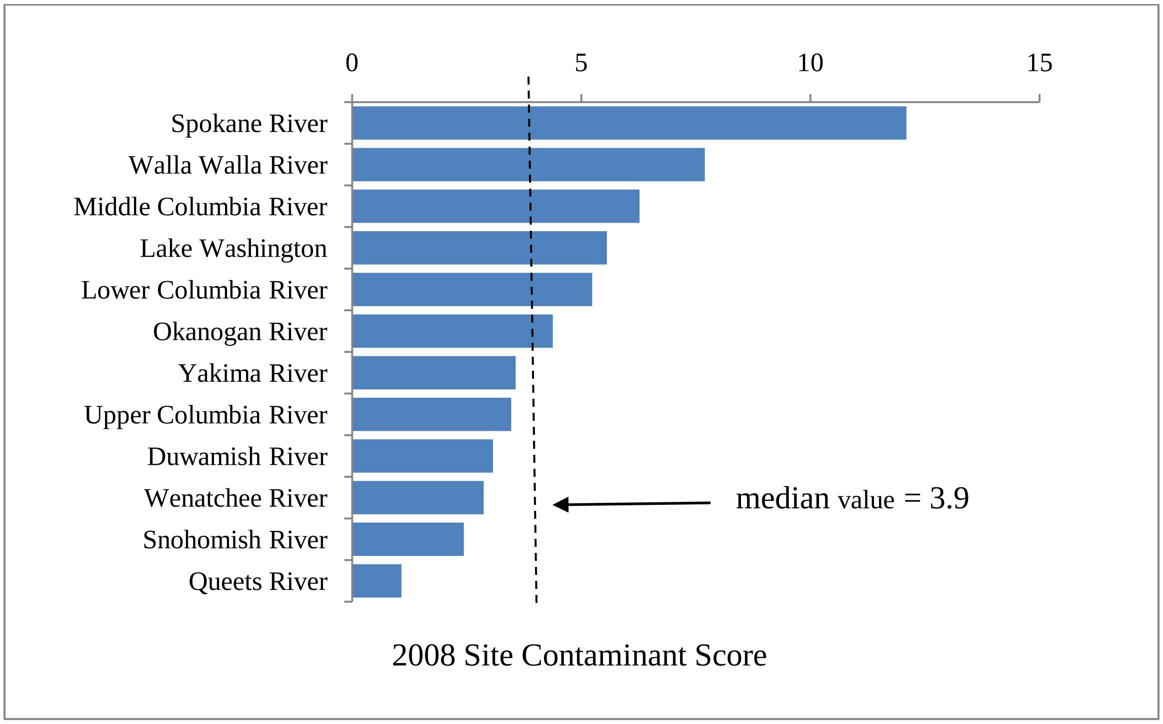

Figure 24. Sample Contaminant Score Sorted by Site, 2008.

The lowest contaminant score for 2008 was the Queets River reference site (1.1). This site did not exceed any benchmark values. The highest contaminant scores were for the Spokane (12.1), Walla Walla (7.7), and Middle Columbia (6.3) Rivers, and Lake Washington (5.6). These waterbodies exceeded one or more benchmark values.

The median score for all 2008 sites was 3.9. In most cases, PCB values contributed most to these scores. For example, the Middle Columbia River had a PCB level which exceeded the benchmark value of 64 by a factor of 4.8 (spring and fall average), accounting for about 77% of that site's contaminant score of 6.3. Exceptions to this included PBDEs and toxaphene in the Spokane River and Walla Walla River. PBDE levels contributed 52% followed by PCBs at 45% in the Spokane River. Toxaphene contributed 39% followed by PCBs at 33% in the Walla Walla River.

This page is purposely left blank

Conclusions

During 2008, the PBT Trends Study sampled 11 Washington rivers and one urban lake for CPs, PCBs, PBDE flame retardants, and PAHs. Results were reported for the second year of this long-term program. A similar range of types of chemicals were detected during the first year of monitoring, 2007. PAH analysis was added in 2008. A total of 25 field samples were analyzed in 2008; 23 were analyzed in 2007. The same 12 sites were monitored for both years.

Although it is too early to draw conclusions about temporal trends, comparisons were made among sites, seasons, and water quality criteria. Analysis for temporal trends will be conducted in 2011 after the fourth year of sample collection.

Major findings from this second year of monitoring are:

The number of chemicals detected among sites was similar to the 2007 results. The Lower Columbia, Walla Walla, Yakima, and Middle Columbia Rivers had more chemicals detected than other sites. Seasonal variations also showed the same pattern as 2007: more chemicals were detected in the spring than in the fall, except for PBDEs which do not follow this pattern.

Highest concentrations for individual chemicals were found in the following waterbodies:

- T-DDT in the Upper Columbia River.
- Total PCBs in the Spokane River.
- Dieldrin in the Yakima River.
- Toxaphene in the Walla Walla River.
- Chlorpyrifos in the Walla Walla River.
- Endosulfan in the Walla Walla River.
- PBDEs in the Spokane River.
- ∑PAH in Lake Washington (2008 only).

This order matched the 2007 results except for endosulfan which was highest in the Wenatchee River in 2007 and second highest in 2008. The timing of this pesticide application from year to year could be a factor here.

Several waterbodies failed to meet (exceeded) Washington State or EPA national recommended water quality criteria for the protection of human health and aquatic life:

- Seven waterbodies exceeded the Washington human health criterion for PCBs: Lower Columbia, Middle Columbia, Okanogan, Walla Walla, Spokane, and Duwamish Rivers, and Lake Washington. In comparison, three sites in 2007 did not meet this criterion for PCBs: Lower Columbia, Middle Columbia, and Spokane Rivers.

- All sites, except the Queets River reference site, exceeded EPA recommended human health criterion for total PCBs. This was true for 2007 sites except for the Okanogan River, which was missing data.

- Dieldrin exceeded the EPA recommended criterion for human health in the Yakima River fall sample. This is consistent with the 2007 results. Other water quality studies have shown dieldrin consistently exceeds criteria in the lower Yakima River in the second half of the irrigation season during low flows.

- In 2007 and 2008, toxaphene in the Walla Walla River did not meet the Washington human health, EPA recommended human health, or Washington aquatic life criteria.

- DDE did not meet the EPA national recommended human health criterion for the Okanogan and Walla Walla Rivers in the spring. In 2007, two rivers did not meet the criterion: the Upper Columbia and Yakima Rivers.

A contaminant scoring system was used to rank sites based on the levels of key contaminants found during 2008. The four sites having the highest levels of contamination were the Spokane, Walla Walla, and Middle Columbia Rivers, and Lake Washington.

Recommendations

As a result of this study, the following recommendations are made:

- After the third year of this project (2009), prioritize sites for continued monitoring by focusing on sites where detection of temporal trends for specific contaminants is most promising. Other waterbodies should also be considered if they seem appropriate for trend monitoring based on results from other semipermeable membrane device (SPMD) studies.

- Conduct a separate focused study to evaluate sources of PBDEs in the Spokane River. Such an effort could have multiple sites along the river and include other methods for assessing PBDEs, such as sampling permitted discharges (e.g., wastewater treatment plants), outfalls, and sediments.

- Consider additional monitoring for dieldrin in the Lower Yakima River or tributaries during the irrigation season to better identify spatial and temporal trends.

- Revise study protocols to address variability and improve data quality by:
    - Standardizing analytical and data processing techniques for SPMDs. A standard operating procedure (SOP) is under development for data processing.
    - Increasing the number of field trip blanks. Some field trip blanks should be at designated sampling sites and others rotated between sites each year.
    - Increasing the number of field replicates.

This page is purposely left blank

References

Alvarez, D., 2008. Personal communication. USGS Columbia Environmental Research Center. Leader, Passive Sampling Group. Columbia, MO.

ATSDR, 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Agency for Toxic Substances and Disease Registry. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. www.atsdr.cdc.gov/toxprofiles/tp17.html. Accessed March 2010.

ATSDR, 2004. Toxicological Profile for Polybrominated Biphenyls and Polybrominated Diphenyl Ethers (PBBs and PBDEs). Agency for Toxic Substances and Disease Registry. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. www.atsdr.cdc.gov/toxprofiles/tp68.html. Accessed March 2010.

ATSDR, 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Agency for Toxic Substances and Disease Registry. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. www.atsdr.cdc.gov/toxprofiles/tp69.html. Accessed March 2010.

Braekevelt, E., S.A. Tittlemier, and G.T. Tomy, 2003. Direct Measurement of Octanol-water Partition Coefficients of Some Environmentally Relevant Brominated Diphenyl Ether Congeners. Chemosphere 51:563-567.

Bryant, W.L., S.L. Goodbred, T.L. Leiker, L. Inouye, and B.T. Johnson, 2007. Use of Chemical Analysis and Assays of Semipermeable Membrane Devices Extracts to Assess the Response of Bioavailable Organic Pollutants in Streams to Urbanization in Six Metropolitan Areas of the United States. U.S. Geological Survey Scientific Investigations Report 2007-5113, 46 p., 2 app. http://pubs.usgs.gov/sir/2007/5113/. Accessed January 2010.

Ecology, 2006a. Water Quality Standards for Surface Waters of the State of Washington Chapter 173-201A WAC. Washington State Department of Ecology, Olympia, WA. Publication No. 06-10-091. www.ecy.wa.gov/programs/wq/swqs/index.html. Accessed January 2010.

Ecology, 2006b. Water Quality Program Policy 1-11: Assessment of Water Quality for the Clean Water Act Sections 303(d) and 305(b) Integrated Report. September 6, 2006. Water Quality Program, Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/programs/wq/303d/wqp01-11-ch1Final2006.pdf. Accessed January 2010.

Ecology, 2007. Multiyear PBT Chemical Action Plan Schedule. Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/biblio/0707016.html. Accessed September 2009.

Ecology and WDOH, 2006. Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: Final Plan. Washington State Department of Ecology and Washington State Department of Health, Olympia, WA. Ecology Publication No. 05-07-048. www.ecy.wa.gov/biblio/0507048.html.

EPA, 1992. National Toxics Rule. Office of Water and Office of Science and Technology, U.S. Environmental Protection Agency, Washington, D.C. 40 CFR 131.36. Federal Register, Vol. 57, Issue: 246. p. 60848 (57 FR 60848), December 22, 1992. www.epa.gov/waterscience/standards/rules/ntr.html#sectionA. Accessed January 2010.

EPA, 1999a. Method 1668A Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS. Office of Water and Office of Science and Technology, U.S. Environmental Protection Agency, Washington, D.C. EPA-821-R-00-002.

EPA, 1999b. Polychlorinated Biphenyls (PCBs) Update: Impact on Fish Advisories. U.S. Environmental Protection Agency. Office of Water, Washington D.C. EPA-823-F-99-019.

EPA, 2000. Guidance for assessing chemical contaminant data for use in fish advisories – Volume 1; Field sampling and analysis. Third Edition. U.S. Environmental Protection Agency. Office of Water, Washington D.C. EPA-823-B-00-007. www.epa.gov/waterscience/fishadvice/volume1/. Accessed September 2009.

EPA, 2006. National Recommended Water Quality Criteria. Office of Water and Office of Science and Technology, U.S. Environmental Protection Agency, Washington, D.C. EPA-822-R-02-047. www.epa.gov/waterscience/criteria/wqctable. Accessed January 2010.

EPA, 2009. Columbia River Basin: State of the River Report for Toxics. U.S. Environmental Protection Agency. Washington, D.C. Region 10. http://yosemite.epa.gov/r10/ecocomm.nsf/Columbia/SoRR/. Accessed January 2010.

Furl, C. and C. Meredith, 2010. PBT Monitoring: PBDE Flame Retardants in Spokane River Fish, 2009. Washington State Department of Ecology, Olympia, WA. Publication No. 10-03-015. www.ecy.wa.gov/biblio/1003015.html.

Gilliom, R.J., J.E. Barbash, C.G. Crawford, P.A. Hamilton, J.D. Martin, N. Nakagaki, L.H. Nowell, J.C. Scott, P.E. Stackelberg, G.P. Thelin, and D.M. Wolock, 2006. The Quality of Our Nation's Waters. Pesticides in the Nation's Streams and Ground Water, 1992-2001: U.S. Geological Survey Circular 1291, 172 p.

Hale, R.C., M. Alaee, J.B. Manchester-Neesvig, H.M. Stapleton, and M.G. Ikonomou, 2003. Polybrominated Diphenyl Ether Flame Retardants in the North American Environment. Environment International; 29. pp. 771-779.

Huckins, J.N., J.D. Petty, and K. Booij, 2006. Monitors of Organic Chemicals in the Environment; Semipermeable Membrane Devices: New York, Springer.

Huckins, J.N., J.D. Petty, J.A. Lebo, F.V. Almeida, K. Booij, D.A. Alvarez, W.L. Cranor, R.C. Clark, and B.B. Mogensen, 2002. Development of the Permeability/Performance Reference Compound Approach for In Situ Calibration of Semipermeable Membrane Devices. Environmental Science Technology 36(1):85-91.

IRIS, 2009. Integrated Risk Information System. U.S. Environmental Protection Agency. Washington, D.C. www.epa.gov/ncea/iris/index.html. Accessed September 2009.

Johnson, A., 2007a. A Trend Monitoring Component for Organic PBTs in the Washington State Toxics Monitoring Program – Quality Assurance Project Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-104. www.ecy.wa.gov/biblio/0703104.html.

Johnson, A., 2007b. Standard Operating Procedure (SOP) for using Semipermeable Membrane Devices to Monitor Hydrophobic Organic Compounds in Surface Water Washington State Department of Ecology, Olympia, WA. SOP Number EAP001. www.ecy.wa.gov/programs/eap/quality.html

Johnson, A., B. Era-Miller, R. Coots, and S. Golding, 2004. A Total Maximum Daily Load Evaluation for Chlorinated Pesticides and PCBs in the Walla Walla River. Washington State Department of Ecology, Olympia, WA. Publication No. 04-03-032. www.ecy.wa.gov/biblio/0403032.html.

Johnson, A. and D. Norton, 2005. Concentrations of 303(d) Listed Pesticides, PCBs, and PAHs Measured with Passive Samplers Deployed in the Lower Columbia River. Washington State Department of Ecology, Olympia, WA. Publication No. 05-03-006. www.ecy.wa.gov/biblio/0503006.html.

Johnson, A., K. Seiders, C. Deligeannis, K. Kinney, P. Sandvik, B. Era-Miller, and D. Alkire, 2006. PBDE Flame Retardants in Washington Rivers and Lakes: Concentrations in Fish and Water, 2005-06. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-027. www.ecy.wa.gov/biblio/0603027.html.

Johnson, A., K. Carmack, B. Era-Miller, B. Lubliner, S. Golding, and R. Coots, 2010. Yakima River Pesticides and PCBs Total Maximum Daily Load: Volume 1: Water Quality Study Findings. Washington Department of Ecology, Olympia, WA. Publication No. 1003018. www.ecy.wa.gov/biblio/1003018.html.

Joy, J., 2002. Upper Yakima River Basin Suspended Sediment and Organochlorine Pesticide Total Maximum Daily Load. Washington State Department of Ecology, Olympia, WA. Publication No. 02-03-012. www.ecy.wa.gov/biblio/0203012.html.

Joy, J., 2006. Standard Operating Procedure (SOP) for Manually Obtaining Surface Water Samples. Washington State Department of Ecology, Olympia, WA. SOP Number EAP015. www.ecy.wa.gov/programs/eap/quality.html.

Joy, J. and B. Patterson, 1997. A Suspended Sediment and DDT Total Maximum Daily Load Evaluation Report for the Yakima River. Washington State Department of Ecology, Olympia, WA. Publication No. 97-321. www.ecy.wa.gov/biblio/97321.html.

Karickhoff, S.W., 1981. Semi-empirical Estimation of Sorption of Hydrophobic Pollutants on Natural Sediments and Soils. Chemosphere 10(8):833-846.

King County. 2003. Sammamish/Washington Analysis and Modeling Program: Lake Washington Existing Conditions Report. Prepared by Tetra Tech ISG and Parametrix, Inc. King County Department of Natural Resources and Parks, Water and Land Resources Division, Seattle, WA.

Meadows, J.C., K.R. Echols, J.N. Huckins, F.A. Borsuk, R.F. Carline, and D.E. Tillitt, 1998. Estimation of Uptake Rates for PCB Congeners Accumulated by Semipermeable Membrane Devices and Brown Trout (*Salmo trutta*). Environmental Science Technology 32:1847-1852.

Merck, 1983. The Merck Index. 10th Ed. Merck and Co. New Jersey.

Meylan, W.M. and P.H. Howard, 1995. Atom/fragment contribution method for estimating octanol-water partition coefficients. J. Pharm. Sci. 84: 83-92.

Sandvik, P., 2009. Washington State Toxics Monitoring Program: Trends Monitoring for Chlorinated Pesticides, PCBs, and PBDEs in Washington Rivers and Lakes, 2007. Washington State Department of Ecology, Olympia, WA. Publication No. 09-03-013. www.ecy.wa.gov/pubs/0903013.pdf.

USGS, 2008. CERC Integrative Passive Samplers. U.S. Geological Survey. wwwaux.cerc.cr.usgs.gov/SPMD/index.htm. Accessed February 2010.

Van Metre, P., B. Mahler, and E. Furlong, 2000. Urban Sprawl Leaves Its PAH Signature. Environmental Science and Technology. Vol. 34: 4064-4070.

Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals. 2nd Ed. Van Nostrand Reinhold Co. New York.

Ward, W., 2007. Standard Operating Procedure (SOP) for the Collection, Processing, and Analysis of Stream Samples. Washington State Department of Ecology, Olympia, WA. SOP Number EAP034. www.ecy.wa.gov/programs/eap/quality.html.

Yunker, M.B., R.W. Macdonald, R. Vingarzan, R. Mitchell, D. Goyette, and S. Sylvestre, 2002. PAHs in the Fraser River Basin: a Critical Appraisal of PAH Ratios as Indicators of PAH Source and Composition. Organic Geochemistry. Vol. 33: 489-515.

Appendices

Appendix A. Monitoring Site Descriptions

Table A-1. Sample Site Descriptions, PBT Trends 2008.

Site Name	County	Sampling Dates		Site Description	Latitude[1]	Longitude[1]	WBID [2]	WRIA Number	EIM "User Location ID" [3]
		Deployed	Retrieved		Decimal Degrees				
Duwamish R.	King	5/7/08 9/11/08	6/4/08 10/9/08	Duwamish River, RM 10.	47.4825	-122.2614	WA 09-1010	9	SPMDTR-DUWAM
Lower Columbia R.	Wahkiakum	5/5/08 9/12/08	6/2/08 10/10/08	Columbia River, RM 54.	46.1849	-123.1876	WA CR-1010	25	SPMDTR-LCR2
Mid Columbia R.	Benton	5/8/08 9/9/08	6/5/08 10/7/08	Columbia River, McNary Dam, RM 292.0.	45.9394	-119.2972	WA CR-1026	31	SPMDTR-MCR
Okanogan R.	Okanogan	5/8/08 9/9/08	6/5/08 10/7/08	Okanogan River, RM 17.	48.2806	-119.7050	WA 49-1010	49	SPMDTR-OKAN
Queets R.	Jefferson	5/6/08 9/8/08	6/3/08 10/6/08	Queets River, RM 11.5.	47.5522	-124.1978	WA 21-1030	21	SPMDTR-QUEETS
Snohomish R.	Snohomish	5/7/08 9/11/08	6/9/08 10/9/08	Snohomish River, RM 12.5.	47.9108	-122.0992	WA 07-1020	7	SPMDTR-SNOHO
Spokane R.	Spokane	5/9/08 9/10/08	6/6/08 10/8/08	Spokane River, Nine Mile Dam, RM 58.1.	47.7747	-117.5444	WA 54-1020	54	SPMDTR-SPOK
Upper Columbia R.	Chelan-Douglas	5/8/08 9/9/08	6/5/08 10/7/08	Columbia River, Rock Island Dam, RM 453.5.	47.3439	-120.0939	WA CR-1040	44	SPMDTR-UCR
Walla Walla R.	Walla Walla	5/8/08 9/9/08	6/5/08 10/7/08	Walla Walla River, RM 9.	46.0709	-118.8268	WA 32-1010	32	SPMDTR-WALLA
Walla Walla R. Replicate.	Walla Walla	5/8/08 9/9/08	6/5/08 10/7/08	Walla Walla River, RM 9.	46.0709	-118.8268	WA 32-1010	32	SPMDTR-WALLA
Washington L.	King	5/7/08 9/11/08	6/4/08 10/9/08	Lake Washington, outlet.	47.6475	-122.3019	WA 08-9350	8	SPMDTR-LKWA2
Wenatchee R.	Chelan	5/8/08 9/8/08	6/5/08 10/6/08	Wenatchee River, RM 7.1.	47.5007	-120.4257	WA 45-1010	45	SPMDTR-WEN
Yakima R.	Benton	5/8/08 9/9/08	6/5/08 10/7/08	Yakima River, Wanawish Dam, RM 18.0.	46.3783	-119.4181	WA 37-1010	37	SPMDTR-YAK

1 - North American Datum 1983 is horizontal datum for coordinates.

2 - Ecology's Water Body Identification Number (WBID).

3 - Site identification as used in Ecology's Environmental Information Management system.

Appendix B. Chemicals Analyzed in SPMD Samples

Table B-1. Chemicals Analyzed in SPMD Samples Collected During 2008.

<u>Chlorinated Pesticides (MEL PEST2)</u>
alpha-BHC
beta-BHC
gamma-BHC (lindane)
delta-BHC
Heptachlor
Aldrin*
Chlorpyriphos
Heptachlor epoxide*
trans-chlordane (gamma)*
cis-chlordane (alpha)*
Endosulfan I (Alpha-endosulfan)
Dieldrin*
Endrin*
Endrin Ketone
Endosulfan II (Beta-endosulfan)
Endrin Aldehyde
Endosulfan Sulfate
4,4'-DDE*
4,4'-DDD*
4,4'-DDT*
2,4-DDE
2,4'-DDD
2,4'-DDT
Methoxychlor
Oxychlordane
DDMU
Cis-nonachlor
Toxaphene*
Trans-nonachlor
Mirex*
Chlordane (technical)*
Hexachlorobenzene*
Dacthal (DCPA)
Pentachloroanisole

Polychlorinated Biphenyls*[1]

<u>Polybrominated Diphenyl Ethers*</u>
PBDE-47
PBDE-49
PBDE-66
PBDE-71
PBDE-99
PBDE-100
PBDE-138
PBDE-153
PBDE-154
PBDE-183
PBDE-184
PBDE-191
PBDE-209

*PBTs as defined by Ecology

[1]. Approximately 170 PCB congeners and remainder as co-eluting groups.

Table B-1. (continued)

Polycyclic Aromatic Hydrocarbons*
Naphthalene
2-Methylnaphthalene
1-Methylnaphthalene
2-Chloronaphthalene
Acenaphthylene
Acenaphthene
Dibenzofuran
Fluorene
Phenanthrene
Anthracene
Carbazole
Fluoranthene
Pyrene
Retene
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(ghi)perylene

*PBTs as defined by Ecology

Appendix C. Pesticide, PCB, PBDE, and PAH Residues in SPMD Extracts

Table C-1. Pesticides Measured in SPMD Extracts, May – June 2008 (ng/5-SPMDs).

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
p,p'-DDT	10	U	10	U	10	U	10	U	38	J	19	J	14		17	J
p,p'-DDE	93		10	U	14		10	U	57	J	81		72		178	J
p,p'-DDD	61		10	U	22		10	U	10	UJ	79		26		40	J
o,p'-DDT	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
o,p'-DDE	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
o,p'-DDD	19		10	U	10	U	10	U	10	UJ	23		10	U	10	J
DDMU	18	J	10	U	10	U	10	U	10	UJ	23	J	10	U	10	UJ
Dieldrin	12		10	U	34		10	U	10	UJ	10	U	10	U	20	J
Chlorpyriphos	84	J	10	UJ	10	UJ	10	UJ	10	UJ	14	J	55	J	113	J
Endosulfan I	34		10	U	10	U	10	U	116	J	40		38		86	J
Endosulfan II	39		10	U	10	U	10	U	37	J	11	J	16	J	22	J
Endosulfan Sulfate	10	U	10	U	10	U	10	U	15	J	10	U	19		15	J
Hexachlorobenzene (HCB)	36		10	U	10	U	10	U	11	J	10	U	10	U	10	UJ
Pentachloroanisole (PCA)	29		21	J	33		24	J	11	J	10	J	10	U	16	J
Toxaphene	100	U	100	U	100	U	100	U	100	UJ	100	U	100	U	100	UJ
Chlordane (technical)	113		100	U	132		121		100	UJ	100	U	100	U	100	UJ
Trans-Chlordane	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Cis-Chlordane	10	U	10	U	11		10	U	10	UJ	10	U	10	U	10	UJ
Dacthal	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ
Trans-Nonachlor	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Cis-Nonachlor	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Heptachlor	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Heptachlor Epoxide	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ

Table C-1. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
b-BHC: beta-Benzenehexachloride	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
d-BHC: delta-Benzenehexachloride	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ
Lindane: gamma-Benzenehexachloride	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Aldrin	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Endrin	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Endrin Ketone	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Endrin Aldehyde	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ
Mirex	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ
Methoxychlor	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ
Oxychlordane	10	U	10	U	10	U	10	U	10	UJ	10	U	10	U	10	UJ

Table C-1. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
p,p'-DDT	11	J	62	J	14	J	10	U	no data	10	UJ	10	U
p,p'-DDE	78		247		17		10	U	"	10	UJ	10	U
p,p'-DDD	63		46		10	U	10	U	"	10	UJ	10	U
o,p'-DDT	10	U	16		10	U	10	U	"	10	UJ	10	U
o,p'-DDE	10	U	10	U	10	U	10	U	"	10	UJ	10	U
o,p'-DDD	19		18		10	U	10	U	"	10	UJ	10	U
DDMU	15	J	10	U	10	U	10	U	"	10	UJ	10	U
Dieldrin	10	U	29		10	U	10	U	"	10	UJ	10	U
Chlorpyriphos	68	J	1200	J	65	J	10	UJ	"	10	UJ	10	UJ
Endosulfan I	43		465		28		10	U	"	10	UJ	10	U
Endosulfan II	23	J	64		10	U	10	U	"	10	UJ	10	U
Endosulfan Sulfate	10	U	31		10	U	10	U	"	10	UJ	10	U
Hexachlorobenzene (HCB)	12	J	91		37		10	U	"	10	UJ	10	U
Pentachloroanisole (PCA)	12	J	27		41		10	U	"	10	UJ	10	U
Toxaphene	100	U	1300	J	100	U	100	U	"	100	UJ	100	U
Chlordane (technical)	100	U	204	J	119		100	U	"	100	UJ	100	U
Trans-Chlordane	10	U	20		10	U	10	U	"	10	UJ	10	U
Cis-Chlordane	10	U	24		10	U	10	U	"	10	UJ	10	U
Dacthal	10	UJ	18	J	21	J	10	UJ	"	10	UJ	10	UJ
Trans-Nonachlor	10	U	25	J	10	U	10	U	"	10	UJ	10	U
Cis-Nonachlor	10	U	10	U	10	U	10	U	"	10	UJ	10	U
Heptachlor	10	U	10	U	10	U	10	U	"	10	UJ	10	U
Heptachlor Epoxide	10	U	16	J	10	U	10	U	"	10	UJ	10	U

Table C-1. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	*RepWalla	Field Trip Blank Duwamish	Day 0 Dial
Sample No.	8244808	8244809	8244810	8244811	8244812	8244813	8244820
b-BHC: beta-Benzenehexachloride	10 U	13 UJ	12 UJ	24 UJ	no data	10 UJ	10 U
d-BHC: delta-Benzenehexachloride	10 UJ	10 UJ	10 UJ	10 UJ	"	10 UJ	10 UJ
Lindane: gamma-Benzenehexachloride	10 U	68	10 U	10 U	"	10 UJ	10 U
Aldrin	10 U	10 U	10 U	10 U	"	10 UJ	10 U
Endrin	10 U	10 U	10 U	10 U	"	10 UJ	10 U
Endrin Ketone	10 U	10 U	10 U	10 U	"	10 UJ	10 U
Endrin Aldehyde	10 UJ	24 UJ	10 UJ	10 UJ	"	10 UJ	10 UJ
Mirex	10 U	10 U	10 U	10 U	"	10 UJ	10 U
Methoxychlor	10 UJ	14 UJ	10 UJ	10 UJ	"	10 UJ	10 UJ
Oxychlordane	10 U	10 U	10 U	10 U	"	10 UJ	10 U

U = not detected at or above reported results.
UJ = not detected at or above reported estimated results.
J = estimated concentration.
*Data rejected. Extract lost in lab accident.
Rep = replicate.

Table C-2. Pesticides Measured in SPMD Extracts, September – October 2008 (ng/5-SPMDs).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807
p,p'-DDT	10 U	10 U	10 UJ	10 U	56 J	18 J	12 J	17 J
p,p'-DDE	49	10 U	10 UJ	10 U	126	155	70	187
p,p'-DDD	50	10 U	24 J	10 U	39	203	41	60
o,p'-DDT	10 U	10 U	10 UJ	10 U	13	10 U	10 U	10 U
o,p'-DDE	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
o,p'-DDD	14	10 U	10 UJ	10 U	12	59	10 U	15
DDMU	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	18 UJ
Dieldrin	12	10 U	19 J	10 U	12	10 U	10 U	64
Chlorpyriphos	14 J	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	307 J
Endosulfan I	10 U	14	10 UJ	10 U	56	10 U	10 U	11
Endosulfan II	10 U	10 U	10 UJ	10 U	27 J	10 U	10 U	10 U
Endosulfan Sulfate	10 U	10 U	10 UJ	10 U	17	10 U	10 U	15
Hexachlorobenzene (HCB)	16 J	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Pentachloroanisole (PCA)	30	51	19 J	20	10 U	10 U	10 U	23
Toxaphene	100 U	100 U	100 UJ	100 U	100 U	100 U	100 U	160 J
Chlordane (technical)	100 U	100 U	100 UJ	100 U	100 U	100 U	100 U	100 U
Trans-Chlordane	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Cis-Chlordane	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Dacthal	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Trans-Nonachlor	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Cis-Nonachlor	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Heptachlor	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Heptachlor Epoxide	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U

Table C-2. (continued)

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807
b-BHC: beta-Benzenehexachloride	10 U	10 U	10 UJ	10 U	11 UJ	10 U	10 U	10 U
d-BHC: delta-Benzenehexachloride	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Lindane: gamma-Benzenehexachloride	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Aldrin	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Endrin	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Endrin Ketone	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Endrin Aldehyde	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Mirex	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Methoxychlor	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Oxychlordane	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U

Table C-2. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
p,p'-DDT	10	U	21	J	10	U	10	U	15	J	10	U	10	U	10	UJ	10	U
p,p'-DDE	47		138		10	U	10	U	126		10	U	10	U	10	UJ	10	U
p,p'-DDD	45		44		10	U	10	U	39		10	U	10	U	10	UJ	10	U
o,p'-DDT	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
o,p'-DDE	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
o,p'-DDD	14		15		10	U	10	U	14		10	U	10	U	10	UJ	10	U
DDMU	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
Dieldrin	10	U	12	J	10	U	10	U	11	J	10	U	10	U	10	UJ	10	U
Chlorpyriphos	18	J	57	J	10	UJ	10	UJ	64	J	10	UJ	10	UJ	10	UJ	10	UJ
Endosulfan I	10	U	17		10	U	10	U	16		10	U	10	U	10	UJ	10	U
Endosulfan II	10	U	12	J	10	U	10	U	11	J	10	U	10	U	10	UJ	10	U
Endosulfan Sulfate	10	U	22		10	U	10	U	20		10	U	10	U	10	UJ	10	U
Hexachlorobenzene (HCB)	10	U	52		27		10	U	51		10	U	10	U	10	UJ	10	U
Pentachloroanisole (PCA)	10	U	10	U	56		10	U	10	U	10	U	10	U	10	UJ	10	U
Toxaphene	100	U	590	J	200	UJ	100	U	510	J	100	U	100	U	100	UJ	100	U
Chlordane (technical)	100	U	100	U	100		100	U	100	U	100	U	100	U	100	UJ	100	U
Trans-Chlordane	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
Cis-Chlordane	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
Dacthal	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ	10	UJ
Trans-Nonachlor	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
Cis-Nonachlor	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
Heptachlor	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U
Heptachlor Epoxide	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	UJ	10	U

Table C-2. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	RepWalla	Field Trip Blank Duwamish	Field Trip Blank Queets	Field Trip Blank Spokane	Day 0 Dial
Sample No.	8424808	8424809	8424810	8424811	8424812	8424813	8424814	8424815	8424820
b-BHC: beta-Benzenehexachloride	10 U	10 U	10 U	10 U	15 UJ	10 U	10 U	10 UJ	10 U
d-BHC: delta-Benzenehexachloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Lindane: gamma-Benzenehexachloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Aldrin	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Endrin	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Endrin Ketone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Endrin Aldehyde	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Mirex	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Methoxychlor	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Oxychlordane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U

U = not detected at or above reported results.

UJ = not detected at or above reported estimated results.

J = estimated concentration.

Table C-3. PBDEs Measured in SPMD Extracts, May – June 2008 (ng/5-SPMDs).

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
PBDE- 47	40		15		30		35		20		23		25	J	24	
PBDE- 49	2.8	J	4	U	4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 66	4	U	4	U	4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 71	4	U	4	U	4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 99	17		10		14		16		9.5		9.5		11	J	11	
PBDE-100	5.2		2.5	J	3.8	J	4.6		2.5	J	2.3	J	2.5	J	3.2	J
PBDE-138	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
PBDE-153	8	U	8	U	8	U	2.2	J	8	U	8	U	8	U	8	U
PBDE-154	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
PBDE-183	8	U	8	U	8	U	4.1	J	8	U	1.5	J	8	U	8	U
PBDE-184	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
PBDE-191	8	U	8	U	8	U	8	U	8	U	8	U	8	U	8	U
PBDE-209	20	U	20	U	20	U	20	U	20	U	20	U	20	U	20	U

Table C-3. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	*RepWalla	Field Trip Blank Duwamish	Day 0 Dial
Sample No.	8244808	8244809	8244810	8244811	8244812	8244813	8244820
PBDE- 47	21	27	62	32	no data	26	11
PBDE- 49	4 U	2.5 J	3.2 J	4 U	"	4 U	4 U
PBDE- 66	4 U	4 U	4 U	4 U	"	4 U	4 U
PBDE- 71	4 U	4 U	4 U	4 U	"	4 U	4 U
PBDE- 99	11	11	28	21	"	17	9.1
PBDE-100	3 J	3.5 J	7	4.9	"	3.4 J	1.6 J
PBDE-138	8 U	8 U	8 U	8 U	"	8 U	8 U
PBDE-153	8 U	8 U	1.8 J	2 J	"	1.7 J	8 U
PBDE-154	8 U	8 U	1.5 NJ	1.1 NJ	"	8 U	8 U
PBDE-183	8 U	8 U	1.9 J	1.2 J	"	8 U	8 U
PBDE-184	8 U	8 U	8 U	8 U	"	8 U	8 U
PBDE-191	8 U	8 U	8 U	8 U	"	8 U	8 U
PBDE-209	20 U	20 U	20 U	20 U	"	20 U	20 U

U = not detected at or above reported results.
UJ = not detected at or above reported estimated results.
J = estimated concentration.
NJ = tentatively identified. Result reported as estimate.
*Data rejected. Extract lost in lab accident.

Table C-4. PBDEs Measured in SPMD Extracts, September – October 2008 (ng/5-SPMDs).

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PBDE- 47	39.6		23.6		17.2		27.7		24.6		26.2		25.2		30.6	
PBDE- 49	2.4	J	4	U	4	U	4	U	4	U	4	U	1.8	J	2.1	J
PBDE- 66	4	U	4	U	4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 71	4	U	4	U	4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 99	22.9		18.3		12.6		21.9		18		19		16.9		20.2	
PBDE-100	6.4		5		3.2	J	5.3		4.6		4.6		4.4		5.8	
PBDE-138	16	U	16	U	16	U	16	U	16	U	16	U	16	U	16	U
PBDE-153	11.2	J	11.5	J	10.5	J	11.2	J	10.9	J	10.8	J	11	J	11.1	J
PBDE-154	9.5	J	9.3	J	8.8	J	8.9	J	9.2	J	9.2	J	8.6	J	9.4	J
PBDE-183	16	U	12.4	J	16	U	16	U	16	U	16	U	16	U	16	U
PBDE-184	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ
PBDE-191	16	U	16	U	16	U	16	U	16	U	16	U	16	U	16	U
PBDE-209	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U

Table C-4. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
PBDE- 47	22.3		22.9		239		17.4		22		19.5		17		14.9		29.6	
PBDE- 49	4	U	1.7	J	7.7		4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 66	4	U	4	U	5.4		4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 71	4	U	4	U	4	U	4	U	4	U	4	U	4	U	4	U	4	U
PBDE- 99	17.5		16.8		122		13.2		14.5		18.1		16.1		13.6		26.5	
PBDE-100	4.6		4.8		28		3.7	J	3.9	J	3.4	J	3.5	J	3	J	6.2	
PBDE-138	16	U	16	U	16	U	16	U	16	U	16	U	16	U	16	U	16	U
PBDE-153	11	J	11.6	J	15.8	J	10.8	J	11	J	11.4	J	10.9	J	10.7	J	11.9	J
PBDE-154	9.1	J	9.1	J	12.2	J	9	J	9	J	9	J	8.8	J	8.8	J	9.4	J
PBDE-183	16	U	16	U	16	U	16	U	16	U	12.2	J	16	U	16	U	12.1	J
PBDE-184	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ	16	UJ
PBDE-191	16	U	16	U	16	U	16	U	16	U	16	U	16	U	16	U	16	U
PBDE-209	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U	100	U

U = not detected at or above reported results.
UJ = not detected at or above reported estimated results.
J = estimated concentration.

Table C-5. PAHs Measured in SPMD Extracts, May – June 2008 (ng/5-SPMDs).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807
Naphthalene	340	280	410	490	80	150	230	200
2-Methylnaphthalene	640	530	830	920	230	370	490	400
1-Methylnaphthalene	300	230	420	460	56	140	210	150
2-Chloronaphthalene	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U
Acenaphthylene	26 J	15 J	42	28 J	8.5 J	14 J	18 J	11 J
Acenaphthene	79	66	78	56	16 J	19 J	27 J	34 J
Dibenzofuran	130	100	130	140	53	76	100	76
Fluorene	170	83	190	120	38 J	66	76	66
Phenanthrene	1200	600	910	750	410	490	620	480
Anthracene	76	16 J	55	32 J	5.3 J	14 J	8.9 J	11 J
Carbazole	40 U	40 U	40 U	40 U	40 U	47	58	40 U
Fluoranthene	1800	470	1700	370	460	420	280	330
Pyrene	1300	330	1100	240	240	140	150	190
Retene	4000	740	190	320	2000	820	620	320
Benzo(a)anthracene	110	25 J	140	18 J	23 J	9.5 J	12 J	13 J
Chrysene	160	65	420	35 J	44	26 J	26 J	28 J
Benzo(b)fluoranthene	63	29 J	220	16 J	14 J	10 J	13 J	14 J
Benzo(k)fluoranthene	25 J	11 J	6.4 J	5.4 J	5.5 J	3.9 J	4.3 J	4.8 J
Benzo(a)pyrene	20 J	6.7 J	25 J	6.1 J	3.7 J	3.4 J	3.2 J	6 J
Indeno(1,2,3-cd)pyrene	23 J	8.4 J	35 J	4.6 J	3.1 J	3.1 J	3.5 J	2.6 J
Dibenzo(a,h)anthracene	22 J	6.4 J	9.9 J	3.8 J	3.1 J	2.5 J	2.1 J	2.2 J
Benzo(ghi)perylene	24 J	9.8 J	37 J	5.5 J	3.8 J	3.8 J	4.4 J	3.9 J

Table C-5. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
Naphthalene	290		150		100		110		no data	200		300	
2-Methylnaphthalene	510		300		250		250		"	330		430	
1-Methylnaphthalene	220		100		71		65		"	100		160	
2-Chloronaphthalene	40	U	40	U	40	U	40	U	"	40	U	40	U
Acenaphthylene	20	J	9.3	J	8.2	J	8.2	J	"	8.3	J	8.6	J
Acenaphthene	27	J	21	J	26	J	11	J	"	9.1	J	11	J
Dibenzofuran	90		69		56		51		"	45		5.2	J
Fluorene	77		53		66		31	J	"	22	J	2.2	J
Phenanthrene	490		430		470		260		"	210		19	J
Anthracene	29	J	40	U	54		6.2	J	"	1.6	J	40	U
Carbazole	40	U	48		65		40	U	"	40	U	40	U
Fluoranthene	420		340		1300		93		"	68		4.8	J
Pyrene	40	U	220		800		70		"	44		3.2	J
Retene	460		340		9800		120		"	70		6.4	J
Benzo(a)anthracene	28	J	18	J	96		40	U	"	40	U	40	U
Chrysene	31	J	44		160		40	U	"	40	U	40	U
Benzo(b)fluoranthene	11	J	17	J	52		40	U	"	40	U	40	U
Benzo(k)fluoranthene	40	U	40	U	14	J	40	U	"	40	U	40	U
Benzo(a)pyrene	40	U	40	U	14	J	6.6	J	"	40	U	40	U
Indeno(1,2,3-cd)pyrene	40	U	40	U	40	U	40	U	"	40	U	40	U
Dibenzo(a,h)anthracene	40	U	40	U	40	U	40	U	"	40	U	40	U
Benzo(ghi)perylene	40	U	40	U	40	U	40	U	"	40	U	40	U

U = not detected at or above reported results.
UJ = not detected at or above reported estimated results.
J = estimated concentration.

Table C-6. PAHs Measured in SPMD Extracts, September – October 2008 (ng/5-SPMDs).

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
Naphthalene	81		120		67		77		60		68		87		130	
2-Methylnaphthalene	220		260		220		250		190		180		210		310	
1-Methylnaphthalene	140		200		120		140		120		100		130		180	
2-Chloronaphthalene	40	U	40	U	48		40	U	40	U	40	U	40	U	40	U
Acenaphthylene	40	U	30	J	40	U	40	U	30	J	40	U	40	U	40	U
Acenaphthene	64		570		40	U	40	U	270		40	U	57		140	
Dibenzofuran	150		170		120		120		210		120		150		180	
Fluorene	240		260		190		190		260		180		210		220	
Phenanthrene	650		810		300		250		920		250		440		600	
Anthracene	62		40	U	40	U	40	U	880		40	U	420		40	U
Carbazole	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Fluoranthene	2300		950		1500		340		680		440		280		380	
Pyrene	1900		740		1100		450		280		160		100		130	
Retene	1800		320		240		550		360		320		240		110	
Benzo(a)anthracene	170		57		120		42		29		35	J	40	U	40	U
Chrysene	230		200		310		64		59		37	J	40	U	40	U
Benzo(b)fluoranthene	100		120		160		37	J	27	J	40	U	40	U	40	U
Benzo(k)fluoranthene	40	U	28	J	44		40	U	40	U	40	U	40	U	40	U
Benzo(a)pyrene	38	J	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Indeno(1,2,3-cd)pyrene	40	U	40	U	26	J	40	U	40	U	40	U	40	U	40	U
Dibenzo(a,h)anthracene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Benzo(ghi)perylene	40	U	40	U	36	J	40	U	40	U	40	U	40	U	40	U

Table C-6. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
Naphthalene	82		130		110		87		280		250		150		100		250	
2-Methylnaphthalene	260		280		260		220		300		410		300		200		40	U
1-Methylnaphthalene	140		160		140		100		160		220		150		89		170	
2-Chloronaphthalene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Acenaphthylene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Acenaphthene	52		40	U	40	UJ	40	UJ	100	J	40	UJ	40	UJ	40	UJ	40	UJ
Dibenzofuran	140		150		140		110		170		120		110		100		120	
Fluorene	200		200		210		170		220		40	U	170		160		170	
Phenanthrene	330		540		360		210		560		210		160		120		200	
Anthracene	310		40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Carbazole	40	U	40	U	49		40	U	40	U	40	U	40	U	40	U	40	U
Fluoranthene	310		270		480		68		270		60		45		35	J	54	
Pyrene	130		110		290		47		110		38	J	28	J	21	J	32	J
Retene	160		110		440		170		110		83		78		76		85	
Benzo(a)anthracene	40	U	40	U	28	J	40	U	40	U	40	U	40	U	40	U	40	U
Chrysene	40	U	40	U	65		40	U	40	U	40	U	40	U	40	U	40	U
Benzo(b)fluoranthene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Benzo(k)fluoranthene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Benzo(a)pyrene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Indeno(1,2,3-cd)pyrene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Dibenzo(a,h)anthracene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U
Benzo(ghi)perylene	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U

U = not detected at or above reported results.

UJ = not detected at or above reported estimated results.

J = estimated concentration.

Table C-7. PCB Congeners Measured in SPMD Extracts, May – June 2008 (ng/5-SPMDs).

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
PCB-001	0.494		1.13		1.09		1.34		0.55		1.01		1.66		0.345	
PCB-002	0.159	N	0.209	N	0.2	N	0.208	N	0.108	N	0.177	N	0.201	N	0.114	N
PCB-003	0.308		0.424		0.436		0.487		0.24		0.299		0.416		0.252	
PCB-004	140		326		303		392		243		370		462		99.7	
PCB-005	0.157		0.21		0.193		0.194		0.131		0.144		0.165		0.0921	
PCB-006	1.48		1.58		1.94		1.65		0.929		1.09		1.17		0.736	
PCB-007	0.286		0.353		0.371		0.375		0.21		0.261		0.281		0.175	
PCB-008	5.7		6.28		6.93		6.77		4.12		4.24		5.62		3.59	
PCB-009	0.374		0.463		0.48		0.495		0.278		0.33		0.398		0.271	
PCB-010	0.154	J	0.185	J	0.191	J	0.17	J	0.104	J	0.141	J	0.135	J	0.0648	J
PCB-011	44.9		4.55		5.12		4.87		3.39		4.49		4.56		8.28	
PCB-012/013	0.569		0.652		0.729		0.679		0.491		0.563		0.703		0.339	
PCB-014	32.3		41.4		31		35.2		31.7		32		36.3		17.4	
PCB-015	2.49		2.36		2.5		2.34		1.7		1.63		2.02		1.31	
PCB-016	3.45		4.25		4.18		4.18		2.8		2.82		3.77		2.68	
PCB-017	4.73		4.61		4.34		4.52		3.06		2.95		4.01		2.69	
PCB-018/030	9.45		9.5		9.57		9.31		6.35		6.28		8.17		5.86	
PCB-019	1.22		0.825		0.967		0.718		0.495		0.542		0.629		0.445	
PCB-020/028	12.7		11.3		11		11.7		9.05		8.35		10.1		7.12	
PCB-021/033	5.96		6.11		6.04		6.78		4.97		4.7		5.91		3.76	
PCB-022	4.16		4.16		3.61		4.22		3.28		2.92		3.59		2.37	
PCB-023	0.0705		0.0901		0.0904		0.0918		0.0765		0.0802		0.114		0.0544	
PCB-024	0.245		0.3		0.325		0.33		0.256		0.281		0.34		0.149	

Table C-7. (continued)

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807
PCB-025	0.965 J	0.909 J	1.32 J	1.25 J	0.935 J	0.983 J	0.04 U	0.878 J
PCB-026/029	487	694	643	696	603	641	702	335
PCB-027	1.03	0.65	0.973	0.644	0.448	0.44	0.558	0.396
PCB-031	10.9	10.5	9.99	11.2	8.04	7.67	9.54	6.57
PCB-032	4.07	2.93	2.95	2.99	2.15	2.07	2.69	1.76
PCB-034	0.19	0.196	0.204	0.212	0.175	0.177	0.222	0.123
PCB-035	0.273	0.158	0.167	0.155	0.147	0.131	0.04 U	0.113
PCB-036	0.0697	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.0255
PCB-037	2.37	1.86	1.93	1.88	1.66	1.55	1.63	1.09
PCB-038	0.0445	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.02 U
PCB-039	0.0701	0.0407	0.0402	0.02 U	0.02 U	0.02 U	0.04 U	0.02 U
PCB-040/071	4.71	2.65	2.96	2.69	2.47	2.35	2.86	1.88
PCB-041	0.937	0.82	0.866	0.876	0.721	0.723	0.525	0.514
PCB-042	2.63	1.61	1.77	1.61	1.46	1.4	1.81	1.18
PCB-043	0.433	0.32	0.336	0.332	0.274	0.249	0.351	0.201
PCB-044/047/065	10.5	6.16	7.13	6.12	5.99	5.29	6.26	4.41
PCB-045	1.9	1.46	1.48	1.37	1.13	1.13	1.13	0.873
PCB-046	0.828	0.524	0.581	0.519	0.433	0.434	0.549	0.34
PCB-048	1.95	1.65	1.69	1.66	1.39	1.35	1.64	1.17
PCB-049/069	6.55	3.64	4.22	3.55	3.43	3.07	3.82	2.78
PCB-050/053	480	642	585	610	604	616	695	339
PCB-051	0.667	0.32	0.426	0.34	0.286	0.283	0.516	0.249
PCB-052	13.5	7.35	8.54	6.99	8.3	6.45	7	5.8

Table C-7. (continued)

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807
PCB-054	0.0578	0.0217	0.0466	0.0262	0.0175 J	0.0183 J	0.0211 J	0.013 J
PCB-055	0.136	0.0954	0.104	0.0897	0.0968	0.0791	0.278	0.0519
PCB-056	4.49	2.36	2.65	2.34	2.32	1.92	2.18	1.4
PCB-057	0.0722	0.0442	0.0431	0.0393	0.0426	0.0344	0.04 U	0.0219
PCB-058	0.0389	0.0165 J	0.0268	0.0164 J	0.02 U	0.0109 NJ	0.04 U	0.0138 J
PCB-059/062/075	1.12	0.779	0.81	0.776	0.692	0.66	0.732	0.508
PCB-060	2.64	1.44	1.6	1.46	1.43	1.23	1.54	0.856
PCB-061/070/074/076	15.8	9.48	11.1	9.24	10.1	7.77	8.55	6.17
PCB-063	0.452	0.216	0.256	0.221	0.213	0.176	0.193	0.141
PCB-064	4.66	2.54	2.85	2.55	2.48	2.26	2.65	1.82
PCB-066	10	4.89	5.78	4.9	4.97	4.13	4.44	3.06
PCB-067	0.609	0.537	0.521	0.526	0.512	0.449	0.52	0.304
PCB-068	0.214	0.161	0.155	0.144	0.142	0.131	0.0875	0.0798
PCB-072	0.123	0.0459	0.0683	0.0345	0.0289	0.0333 N	0.04 U	0.0348
PCB-073	0.0667	0.0447	0.0403	0.0351	0.0351	0.0322	0.04 U	0.02
PCB-077	0.519	0.303	0.383	0.282	0.28	0.286	0.286	0.186
PCB-078	44.4	56.3	41.2	48.9	51.4	47.2	50.6	26.3
PCB-079	0.0761	0.037	0.0476	0.0371	0.0357 N	0.0256 N	0.04 U	0.0216
PCB-080	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.02 U
PCB-081	0.0365 J	0.0243 N	0.0236 J	0.0248 J	0.0238 N	0.0193 NJ	0.04 U	0.0152 J
PCB-082	0.866	0.446	0.582	0.435	0.701	0.463	0.486	0.389
PCB-083	0.445	0.199	0.267	0.161	0.26	0.2	0.118	0.138
PCB-084	2.27	1.07	1.42	0.969	1.56	1.01	0.917	0.88

Table C-7. (continued)

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807
PCB-085/116	1.34	0.629	0.751	0.584	0.842	0.661	0.401	0.464
PCB-086/087/097/108/119/125	4.77	2.26	3.02	2.08	3.37	2.26	1.92	1.9
PCB-088	0.122	0.0885	0.106	0.0707	0.0808 N	0.0863	0.0407	0.0407
PCB-089	0.155	0.0908	0.0953	0.0914	0.0899	0.0842	0.0854	0.0592
PCB-090/101/113	7.42	3.65	4.67	3.43	5.1	3.41	2.63	3.25
PCB-091	1.14	0.541	0.667	0.539	0.713	0.523	0.609	0.489
PCB-092	1.45	0.603	0.815	0.415	0.84	0.556	0.446	0.544
PCB-093/100	0.378	0.31	0.317	0.306	0.319	0.287	0.341	0.197
PCB-094	0.0736	0.0317	0.0428	0.0294	0.0355	0.0304	0.04 U	0.0225
PCB-095	7.09	3.33	4.27	3.03	4.73	3.09	2.69	2.81
PCB-096	0.135	0.0597	0.0688	0.0575	0.0658	0.0571	0.0469 N	0.0326 N
PCB-098	0.132	0.161	0.14	0.179	0.169	0.159	0.209	0.103
PCB-099	3.43	1.65	2.03	1.48	2.24	1.55	1.33	1.47
PCB-102	0.299	0.122	0.152	0.0987	0.134	0.106	0.131	0.0946
PCB-103	0.1	0.0338	0.05	0.0242 N	0.0333	0.0261 N	0.04 U	0.0268
PCB-104	0.0185 J	0.0198 NJ	0.0172 NJ	0.0143 J	0.0121 NJ	0.0143 J	0.0155 NJ	0.006 NJ
PCB-105	1.99	1.04	1.37	0.851	1.38	0.984	0.878	0.751
PCB-106	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.0097 NJ
PCB-107/124	0.19	0.0943	0.131	0.0794	0.142	0.0958	0.0704	0.0828
PCB-109	0.425	0.209	0.286	0.176	0.262	0.201	0.159	0.168
PCB-110	7.57	3.23	4.47	2.69	5.01	3.23	3.09	3.29
PCB-111	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.02 U
PCB-112	0.02	0.014 NJ	0.0155 NJ	0.02 U	0.02 U	0.0118 J	0.152	0.00671 NJ

Table C-7. (continued)

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807
PCB-114	0.14	0.0779	0.0882	0.0701	0.0922 N	0.0658	0.072	0.0504 N
PCB-115	0.0875	0.0595	0.0712	0.0403	0.0463	0.0552	0.04 U	0.0507
PCB-117	0.182	0.0912	0.116	0.0463	0.119	0.0668	0.0499	0.0697
PCB-118	4.6	2.13	3.02	1.7	3.14	2.11	1.71	1.7
PCB-120	0.0197 NJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.00594 J
PCB-121	0.0122 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.02 U
PCB-122	0.0673	0.033 N	0.0419 N	0.0303	0.0456	0.0307	0.04 U	0.0247
PCB-123	0.118	0.0539	0.0703	0.049	0.0648	0.0488	0.0588 N	0.0414
PCB-126	0.0229 J	0.0182 J	0.0218 J	0.0127 J	0.00977 J	0.0119 J	0.04 U	0.00961 J
PCB-127	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.02 U
PCB-128/166	0.419	0.259	0.396	0.209	0.362	0.261	0.182	0.267
PCB-129/138/163	4.45	2.34	3.47	2.07	2.82	2.22	1.62	2.35
PCB-130	0.227	0.126	0.183	0.0939 N	0.149	0.104 N	0.0643	0.127
PCB-131	0.0704	0.0363	0.0421 N	0.0324	0.0513	0.0383	0.04 U	0.0256
PCB-132	1.43	0.826	1.15	0.799	1.12	0.778	0.645	0.726
PCB-133	0.087	0.0387	0.0574	0.0348	0.0382	0.0351	0.0237 J	0.0386
PCB-134	0.251	0.147	0.201	0.146	0.19	0.148	0.123	0.118
PCB-135/151	2.33	1.36	1.64	1.48	1.4	1.3	1.1	1.27
PCB-136	0.805	0.587	0.645	0.593	0.68	0.497	0.49	0.425
PCB-137	0.14	0.0973	0.108	0.0581	0.115	0.0789	0.0847	0.069
PCB-139/140	0.0887	0.0524	0.0641	0.0448	0.0689	0.0522	0.0348 J	0.0387 J
PCB-141	0.69	0.503	0.623	0.528	0.557	0.44	0.362	0.433
PCB-142	0.0317	0.0278	0.0207	0.0216	0.0208 N	0.0231	0.04 U	0.0123 J

Table C-7. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
PCB-143	0.0299	N	0.0272		0.021		0.0136	J	0.0234		0.0221	N	0.0327	NJ	0.0222	
PCB-144	0.264		0.186		0.209		0.205		0.197		0.181		0.134	N	0.147	
PCB-145	0.00894	J	0.00909	J	0.00816	J	0.00529	J	0.02	U	0.00765	J	0.04	U	0.00347	J
PCB-146	1.08		0.709		0.857		0.691		0.731		0.674		0.548		0.551	
PCB-147/149	4.47		2.54		3.31		2.68		2.86		2.43		2.09		2.46	
PCB-148	0.024	N	0.011	J	0.00721	J	0.02	U	0.0462	N	0.02	N	0.04	U	0.0289	N
PCB-150	0.00993	J	0.02	U	0.00465	NJ	0.02	U	0.02	U	0.02	U	0.04	U	0.00283	NJ
PCB-152	0.037		0.0386		0.035		0.0325	N	0.0293	N	0.0297		0.04	U	0.0159	J
PCB-153/168	3.67		1.93		2.67		1.86		2.06		1.73		1.3		1.95	
PCB-154	0.069		0.0295		0.0415		0.0178	J	0.025		0.0272		0.04	U	0.0248	
PCB-155	0.0782		0.0814		0.06	N	0.0812		0.0857		0.0754		0.0811		0.045	
PCB-156/157	0.28		0.204		0.302		0.161		0.255		0.189		0.153		0.171	
PCB-158	0.365		0.221		0.301		0.184		0.274		0.187		0.132		0.185	
PCB-159	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.02	U
PCB-160	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.0103	J
PCB-161	0.00917	J	0.02	U	0.00857	J	0.00722	NJ	0.0085	NJ	0.00609	NJ	0.0546		0.00307	J
PCB-162	0.00895	NJ	0.00584	J	0.00895	NJ	0.02	U	0.02	U	0.02	U	0.04	U	0.00672	J
PCB-164	0.252		0.143		0.227		0.147		0.189		0.128		0.0705		0.153	
PCB-165	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.02	U
PCB-167	0.119		0.0696		0.0998		0.0496		0.0783		0.0629		0.0478		0.0676	
PCB-169	0.0123	J	0.00874	J	0.02	U	0.02	U	0.02	U	0.02	U	0.00882	NJ	0.02	U
PCB-170	0.518		0.443		0.494		0.41		0.408		0.362		0.354		0.334	
PCB-171/173	0.186		0.129		0.167		0.131		0.114		0.113		0.102		0.113	

Table C-7. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
PCB-172	0.0972		0.0638		0.0799		0.0642		0.0553		0.0543		0.0419		0.062	
PCB-174	0.729		0.521		0.62		0.64		0.475		0.478		0.318		0.445	
PCB-175	0.0395	N	0.0296	N	0.0324		0.0371		0.0304		0.0289		0.0249	J	0.0246	N
PCB-176	0.124		0.0927		0.101		0.105	N	0.0849	N	0.0778		0.0931		0.0728	
PCB-177	0.467		0.338		0.395		0.333		0.287		0.293		0.234		0.28	
PCB-178	0.181		0.12		0.147		0.135		0.102		0.0998		0.11		0.134	
PCB-179	0.479		0.374		0.402		0.434		0.319		0.304		0.338		0.314	
PCB-180/193	0.901		0.658		0.808		0.604		0.504		0.52		0.478		0.622	
PCB-181	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.02	U
PCB-182	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.02	U
PCB-183	0.406		0.301		0.373		0.354		0.27		0.269		0.225		0.239	
PCB-184	0.796		0.845		0.764		0.891		0.922		0.787		0.896		0.451	
PCB-185	0.0841	N	0.0604		0.0752		0.0647		0.0589		0.0539		0.0693		0.0567	
PCB-186	43.1		51		43.4		48.8		50.3		45.6		48.7		23.9	
PCB-187	1.2		0.781		0.914		0.891		0.681		0.65		0.518		0.691	
PCB-188	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.02	U
PCB-189	0.0519	N	0.0551		0.0507		0.0583		0.0537	N	0.0532		0.0539		0.0332	
PCB-190	0.0998		0.0715		0.0824		0.0639		0.0623		0.0566		0.0531		0.0643	
PCB-191	0.0219		0.014	J	0.0152	NJ	0.02	U	0.0105	J	0.02	U	0.00869	J	0.0107	J
PCB-192	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.02	U
PCB-194	0.0882	N	0.0915		0.0818	N	0.0686	N	0.0567		0.0598		0.0624		0.0716	
PCB-195	0.0462	N	0.0453		0.0464		0.0426		0.0265		0.0303		0.0285	J	0.035	
PCB-196	0.0672		0.0609		0.0721	N	0.0599		0.0425		0.0418		0.0347	NJ	0.0416	N

Table C-7. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8244800		8244801		8244802		8244803		8244804		8244805		8244806		8244807	
PCB-197	0.0107	NJ	0.008	J	0.00863	NJ	0.0072	NJ	0.00495	NJ	0.02	U	0.04	U	0.00635	J
PCB-198/199	0.198		0.158		0.175	N	0.146		0.106		0.105		0.113		0.131	
PCB-200	0.0293		0.0282		0.0305		0.0271		0.0221	N	0.0206		0.0232	NJ	0.0194	NJ
PCB-201	0.0515		0.0497		0.0524		0.0425	N	0.0406		0.0379		0.0448		0.0269	N
PCB-202	0.0656		0.0659		0.0692		0.0624		0.0467		0.0455		0.0488		0.049	
PCB-203	0.123		0.1		0.111		0.0884		0.0692		0.0731		0.0725		0.074	
PCB-204	0.0122	J	0.0114	NJ	0.01	J	0.00946	J	0.00769	NJ	0.00686	J	0.0102	J	0.00503	J
PCB-205	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.00604	NJ
PCB-206	0.0517		0.0492		0.0649		0.0447		0.0358		0.0365		0.0292	J	0.038	
PCB-207	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.04	U	0.00507	NJ
PCB-208	0.0195	NJ	0.0234		0.0317		0.0228	N	0.0156	J	0.015	J	0.0163	J	0.0194	J
PCB-209	0.187		0.213		0.177		0.194		0.18		0.175		0.18		0.11	

Table C-7. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	*RepWalla	Field Trip Blank Duwamish	Day 0 Dial
Sample No.	8244808	8244809	8244810	8244811	8244812	8244813	8244820
PCB-001	0.991	0.537	0.383	0.984	no data	2.13	7.19
PCB-002	0.17 N	0.12 N	0.108 N	0.147	"	0.163	0.361
PCB-003	0.331	0.255	0.206	0.263	"	0.298	0.476
PCB-004	354	233	180	412	"	511	1660
PCB-005	0.131	0.101	0.0981	0.115	"	0.117	0.149
PCB-006	0.969	0.735	0.733	0.823	"	0.794	0.786
PCB-007	0.238	0.18	0.164	0.226	"	0.193	0.254
PCB-008	4.39	3.28	3.44	3.56	"	3.47	3.01
PCB-009	0.331	0.248	0.248	0.302	"	0.28	0.326
PCB-010	0.128 J	0.0774 J	0.0779 J	0.107 J	"	0.104 J	0.231 J
PCB-011	8.02	3.35	4.62	3.42	"	3.74	7.13
PCB-012/013	0.596	0.427	0.427	0.527	"	0.586	0.629
PCB-014	36.2	30.8	35.1	35.4	"	29.2	29.5
PCB-015	1.7	1.32	1.75	1.26	"	1.21	1
PCB-016	3.38	2.67	3.16	2.61	"	2.4	2.17
PCB-017	3.62	2.77	3.27	2.76	"	2.57	2.25
PCB-018/030	7.47	5.79	7.15	5.74	"	5.15	4.36
PCB-019	0.59	0.444	0.623	0.426	"	0.381	0.363
PCB-020/028	8.96	7.52	11.8	7.49	"	6.12	5.66
PCB-021/033	4.98	4.16	5.18	4.31	"	3.5	3.38
PCB-022	3.09	2.57	3.78	2.53	"	2.01	1.98
PCB-023	0.109	0.0902	0.0909	0.117	"	0.0849	0.24
PCB-024	0.303	0.248	0.253	0.284	"	0.261	0.667

Table C-7. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
PCB-025	1.06	J	0.771	J	1.3	J	0.813	J	no data	0.843	J	1.59	J
PCB-026/029	708		609		575		762		"	701		2240	
PCB-027	0.512		0.417		0.556		0.379		"	0.362		0.289	
PCB-031	8.66		6.94		10.1		7.08		"	5.87		6.18	
PCB-032	2.32		1.81		2.62		1.78		"	1.68		1.39	
PCB-034	0.243		0.201		0.218		0.257		"	0.185		0.524	
PCB-035	0.151		0.119		0.218		0.109		"	0.093		0.102	
PCB-036	0.0256		0.0276		0.0339		0.02	U	"	0.012	J	0.02	U
PCB-037	1.55		1.32		2.38		1.27		"	1.17		1.3	
PCB-038	0.0329		0.0424	N	0.0319		0.02	U	"	0.02	U	0.02	U
PCB-039	0.02	U	0.0719		0.0834		0.02	U	"	0.017	J	0.02	U
PCB-040/071	2.63		2.03		4.07		2.14		"	1.85		2.35	
PCB-041	0.775		0.595		1.04		0.611		"	0.548		0.627	
PCB-042	1.69		1.27		2.62		1.28		"	1.12		1.31	
PCB-043	0.28		0.201		0.389		0.217		"	0.209		0.222	
PCB-044/047/065	6.36		5		10.3		4.74		"	4.04		4.83	
PCB-045	1.24		0.924		1.83		0.96		"	0.811		0.925	
PCB-046	0.479		0.352		0.691		0.383		"	0.313		0.331	
PCB-048	1.61		1.2		2.16		1.27		"	1.1		1.23	
PCB-049/069	3.78		3.08		6.47		2.81		"	2.5		2.9	
PCB-050/053	717		567		600		732		"	700		2200	
PCB-051	0.294		0.232		0.391		0.268		"	0.21		0.229	
PCB-052	7.59		6.33		13.4		5.26		"	4.53		5.42	

Table C-7. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
PCB-054	0.0192	J	0.0159	J	0.0284		0.0177	J	no data	0.0109	J	0.0129	J
PCB-055	0.0817		0.0773		0.13		0.0892		"	0.0565		0.0754	
PCB-056	2.29		2.06		4.53		2.14		"	1.5		2.89	
PCB-057	0.0315		0.0329	N	0.0501		0.0341	N	"	0.0193	J	0.0278	
PCB-058	0.0182	J	0.0132	J	0.0216		0.02	U	"	0.02	U	0.0185	J
PCB-059/062/075	0.771		0.608		1.06		0.613		"	0.557		0.858	
PCB-060	1.43		1.28		2.44		1.33		"	0.956		1.81	
PCB-061/070/074/076	9.38		9.09		18.5		8.5		"	6.12		11.3	
PCB-063	0.212		0.198		0.412		0.195		"	0.149		0.253	
PCB-064	2.62		2.18		4.65		2		"	1.74		2.23	
PCB-066	4.9		4.64		10.3		4.53		"	3.16		5.63	
PCB-067	0.517		0.473		0.616		0.565		"	0.423		1.19	
PCB-068	0.142		0.145		0.197		0.157		"	0.0973		0.161	
PCB-072	0.0433		0.0461		0.0988		0.0309		"	0.0185	J	0.0225	
PCB-073	0.0413	N	0.0394		0.0513		0.0482		"	0.0351		0.0344	
PCB-077	0.302		0.272		0.678		0.232		"	0.219		0.451	
PCB-078	52.6		45.9		53.3		51.8		"	42.4		41	
PCB-079	0.034		0.0403		0.0862		0.0232		"	0.0161	J	0.035	
PCB-080	0.02	U	0.02	U	0.02	U	0.02	U	"	0.02	U	0.02	U
PCB-081	0.0225	J	0.0233	N	0.0329	N	0.0195	J	"	0.0172	J	0.0257	J
PCB-082	0.548		0.666		1.45		0.41		"	0.296		0.632	
PCB-083	0.231		0.249		0.595		0.127		"	0.106		0.164	
PCB-084	1.32		1.48		3.38		1		"	0.617		1.2	

Table C-7. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
PCB-085/116	0.738		0.886		2.35		0.531		no data	0.368		0.808	
PCB-086/087/097/108/119/125	2.96		3.3		7.74		1.85		"	1.4		2.68	
PCB-088	0.0782		0.0486		0.147		0.0817		"	0.0485		0.194	
PCB-089	0.0976		0.0993		0.19		0.0913		"	0.064		0.123	
PCB-090/101/113	4.52		5.14		12.4		2.92		"	2.1		3.16	
PCB-091	0.757		0.867		1.93		0.629		"	0.426		0.888	
PCB-092	0.721		0.877		2.3		0.42		"	0.317		0.464	
PCB-093/100	0.363		0.388		0.465		0.43		"	0.294		0.968	
PCB-094	0.0327		0.0323		0.0812		0.0287		"	0.016	NJ	0.0312	
PCB-095	3.81		4.41		10.5		2.59		"	1.98		2.57	
PCB-096	0.0549		0.0527		0.118		0.0438		"	0.0361		0.0536	
PCB-098	0.186		0.195		0.229		0.196		"	0.161		0.443	
PCB-099	2.26		2.75		5.8		1.55		"	1.13		2.51	
PCB-102	0.158		0.146		0.357		0.163		"	0.0828		0.206	
PCB-103	0.0357		0.0369		0.124		0.0234	N	"	0.0169	J	0.0293	
PCB-104	0.0225		0.0166	J	0.0159	NJ	0.0182	J	"	0.0111	J	0.027	
PCB-105	1.3		1.35		3.36		0.713		"	0.682		1.57	
PCB-106	0.00962	NJ	0.00624	NJ	0.0205		0.02	U	"	0.00441	J	0.00715	J
PCB-107/124	0.122		0.145		0.342		0.0711		"	0.0554		0.118	
PCB-109	0.268		0.288		0.654		0.155		"	0.126		0.306	
PCB-110	4.81		5.97		13.9		2.85		"	1.96		3.82	
PCB-111	0.02	U	0.02	U	0.02	U	0.02	U	"	0.02	U	0.02	U
PCB-112	0.0146	J	0.00999	J	0.0318		0.02	U	"	0.00728	NJ	0.0115	J

Table C-7. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
PCB-114	0.0904		0.0927	N	0.196		0.0593	N	no data	0.0507		0.115	
PCB-115	0.0959		0.0526		0.0964		0.0466		"	0.0341		0.0675	
PCB-117	0.12		0.142		0.263		0.0592		"	0.0362		0.0819	
PCB-118	3.01		2.98		7.11		1.51		"	1.36		2.8	
PCB-120	0.00917	J	0.00835	J	0.0263		0.02	U	"	0.02	U	0.02	U
PCB-121	0.00649	J	0.011	J	0.0133	J	0.02	U	"	0.00574	J	0.0153	J
PCB-122	0.0391		0.0426		0.108		0.0339		"	0.0242		0.0553	
PCB-123	0.0623		0.0737		0.179		0.0445		"	0.0393		0.0823	
PCB-126	0.0176	J	0.015	J	0.023	J	0.02	U	"	0.00777	J	0.0213	J
PCB-127	0.02	U	0.02	U	0.02	U	0.02	U	"	0.02	U	0.02	U
PCB-128/166	0.347		0.416		1.05		0.179		"	0.135		0.26	
PCB-129/138/163	2.61		2.82		8.43		1.09		"	1		1.19	
PCB-130	0.14		0.15		0.448		0.0486	N	"	0.0491		0.0682	
PCB-131	0.041		0.0396		0.106		0.0215		"	0.0207		0.0259	
PCB-132	0.883		0.948		2.93		0.517		"	0.382		0.406	
PCB-133	0.0404		0.0418	N	0.13		0.0242	N	"	0.0148	J	0.0176	NJ
PCB-134	0.144		0.167		0.456		0.0899		"	0.0728		0.0754	
PCB-135/151	1.42		1.38		4.68		0.976		"	0.766		0.593	
PCB-136	0.518		0.471		1.45		0.373		"	0.311		0.245	
PCB-137	0.0976		0.118		0.244		0.0453		"	0.0397		0.0649	
PCB-139/140	0.0581		0.0638		0.145		0.0394	J	"	0.0298	J	0.0635	N
PCB-141	0.444		0.462		1.55		0.279		"	0.288		0.24	
PCB-142	0.0243	N	0.0228		0.0233	N	0.0274		"	0.0199	J	0.0222	

Table C-7. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	*RepWalla	Field Trip Blank Duwamish	Day 0 Dial
Sample No.	8244808	8244809	8244810	8244811	8244812	8244813	8244820
PCB-143	0.0402	0.0246	0.0282	0.0214	no data	0.0228	0.0248
PCB-144	0.184	0.172	0.536	0.147	"	0.105	0.0858
PCB-145	0.00728 J	0.00662 NJ	0.00762 J	0.02 U	"	0.0143 J	0.0142 J
PCB-146	0.815	0.737	1.74	0.559	"	0.499	1.17
PCB-147/149	2.85	2.76	8.9	1.8	"	1.36	1.13
PCB-148	0.0187 NJ	0.0531 N	0.0207	0.02 U	"	0.02 U	0.02 U
PCB-150	0.02 U	0.00442 J	0.00841 J	0.02 U	"	0.00154 NJ	0.00309 J
PCB-152	0.0435	0.0295	0.039	0.0323	"	0.0294	0.0303
PCB-153/168	2.19	2.25	6.48	1.12	"	1.1	1.06
PCB-154	0.0243 N	0.0323	0.095	0.0151 NJ	"	0.0139 J	0.0264
PCB-155	0.083	0.0808	0.081	0.0818	"	0.0695	0.193
PCB-156/157	0.243	0.25	0.561	0.136	"	0.127	0.271
PCB-158	0.217	0.225	0.649	0.0951	"	0.098	0.122
PCB-159	0.02 U	0.02 U	0.02 U	0.02 U	"	0.02 U	0.02 U
PCB-160	0.02 U	0.00274 NJ	0.02 U	0.02 U	"	0.00332 NJ	0.00364 J
PCB-161	0.00846 NJ	0.00784 J	0.02 U	0.00754 J	"	0.00846 J	0.022
PCB-162	0.00667 J	0.00602 NJ	0.0172 J	0.02 U	"	0.02 U	0.02 U
PCB-164	0.151	0.177	0.592	0.074	"	0.0599	0.0701
PCB-165	0.02 U	0.02 U	0.02 U	0.02 U	"	0.02 U	0.02 U
PCB-167	0.0805 N	0.081	0.212	0.0411 N	"	0.0398	0.0629
PCB-169	0.00978 J	0.00613 NJ	0.00918 NJ	0.02 U	"	0.00468 J	0.00914 J
PCB-170	0.419	0.412	1.01	0.332	"	0.314	0.74
PCB-171/173	0.135	0.117	0.372	0.0849	"	0.0694	0.0654

Table C-7. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
PCB-172	0.0563		0.0652		0.199		0.0408		no data	0.0339		0.0301	
PCB-174	0.473		0.507		1.6		0.395		"	0.275		0.239	
PCB-175	0.0264	N	0.0316		0.0724		0.0279	N	"	0.0157	NJ	0.0124	NJ
PCB-176	0.0845		0.0811		0.214		0.0659		"	0.0606		0.0402	
PCB-177	0.329		0.35		0.904		0.236	N	"	0.195		0.268	
PCB-178	0.124		0.12		0.384		0.0718		"	0.0796		0.0504	
PCB-179	0.324		0.334		0.934		0.257	N	"	0.244		0.162	
PCB-180/193	0.596		0.638		2.17		0.412		"	0.376		0.385	
PCB-181	0.02	U	0.02	U	0.02	U	0.02	U	"	0.02	U	0.02	U
PCB-182	0.02	U	0.02	U	0.02	U	0.02	U	"	0.02	U	0.02	U
PCB-183	0.284		0.29		0.813		0.25		"	0.196		0.155	
PCB-184	0.874		0.832		0.928		0.853		"	0.846		2.39	
PCB-185	0.058		0.0756		0.191		0.068		"	0.0445		0.0337	N
PCB-186	48.1		38.9		50.8		42.1		"	45.9		42.6	
PCB-187	0.732		0.873		2.26		0.621		"	0.428		0.355	
PCB-188	0.00501	J	0.00427	J	0.02	U	0.02	U	"	0.00366	J	0.00708	NJ
PCB-189	0.0587		0.0542		0.0726		0.0541		"	0.0525		0.147	
PCB-190	0.0666		0.0686		0.186		0.0496		"	0.0441		0.0834	
PCB-191	0.00858	NJ	0.013	J	0.0383		0.02	U	"	0.0048	NJ	0.00732	J
PCB-192	0.02	U	0.02	U	0.02	U	0.02	U	"	0.02	U	0.02	U
PCB-194	0.0711		0.0752		0.23		0.0571		"	0.0573		0.0566	
PCB-195	0.0471		0.0396		0.119		0.0273		"	0.0256	N	0.025	
PCB-196	0.0427	N	0.042		0.139		0.0264		"	0.0318	N	0.0323	

Table C-7. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		*RepWalla	Field Trip Blank Duwamish		Day 0 Dial	
Sample No.	8244808		8244809		8244810		8244811		8244812	8244813		8244820	
PCB-197	0.00588	NJ	0.00714	J	0.0125	J	0.00659	J	no data	0.00571	J	0.00437	J
PCB-198/199	0.118		0.144		0.374		0.0715		"	0.0804		0.0716	
PCB-200	0.0204	N	0.0225		0.0602		0.0137	NJ	"	0.0154	J	0.0122	NJ
PCB-201	0.0403		0.036	N	0.0794		0.0418		"	0.0345		0.0551	
PCB-202	0.0582		0.0673		0.127		0.046		"	0.0365		0.0308	
PCB-203	0.0794		0.0823		0.206		0.0485		"	0.0531		0.0602	
PCB-204	0.013	J	0.0077	NJ	0.00698	NJ	0.00782	NJ	"	0.0072	J	0.00665	NJ
PCB-205	0.00906	J	0.00782	J	0.0149	J	0.02	U	"	0.0048	J	0.00525	J
PCB-206	0.0378		0.0655		0.0904		0.02	U	"	0.0257		0.0409	
PCB-207	0.02	U	0.00747	NJ	0.0102	NJ	0.02	U	"	0.00549	NJ	0.00808	J
PCB-208	0.0207		0.0323		0.0403		0.02	U	"	0.0131	NJ	0.0182	J
PCB-209	0.22		0.215		0.211		0.206		"	0.188		0.501	

U = not detected at or above reported results.
UJ = not detected at or above reported estimated results.
J = estimated concentration.
N = tentative identification.
NJ = tentative identification. Result reported as estimate.
*Data rejected. Extract lost in lab accident.

Table C-8. PCB Congeners Measured in SPMD Extracts, September - October 2008 (ng/5-SPMDs).

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-001	0.277		0.407		0.197		0.176		0.225		0.192		0.311		0.266	
PCB-002	0.0654		0.0584		0.0486		0.0361		0.0642		0.0373		0.0547		0.101	
PCB-003	0.129		0.121		0.115		0.0759		0.0952		0.0966		0.124		0.205	
PCB-004	33.6		67.7		48		64.6		42.4		37.4		51.3		23.9	
PCB-005	0.058		0.0588		0.0563		0.0438		0.0459		0.0529		0.0603		0.132	
PCB-006	0.563		0.494		0.423		0.28		0.303		0.344		0.39		0.645	
PCB-007	0.11		0.106		0.104		0.0695		0.0678		0.0798		0.0864		0.148	
PCB-008	2.44		2.17		1.92		1.31		1.44		1.67		1.91		3.17	
PCB-009	0.173		0.183		0.148		0.112		0.119		0.129		0.145		0.269	
PCB-010	0.157		0.0846		0.0742		0.02	U	0.0683		0.0472		0.0466		0.0649	
PCB-011	27.6		1.37		1.5		0.847		0.926		0.986		1.02		13.4	
PCB-012/013	0.372		0.254		0.262		0.182		0.24		0.229		0.236		0.347	
PCB-014	34.5		34.4		37		31		26.9		32.6		30.3		29.6	
PCB-015	1.65		0.999		1.22		0.709		0.958		0.909		0.885		1.4	
PCB-016	1.66		1.49		1.59		1.05		1.03		1.22		1.35		1.99	
PCB-017	2.23		1.42		1.63		1.03		1.05		1.22		1.25		1.98	
PCB-018/030	4.3		3.35		3.62		2.31		2.37		2.77		2.76		4.46	
PCB-019	1.51		0.431		0.485		0.275		0.33		0.306		0.307		0.445	
PCB-020/028	7.5		5.08		5.89		3.52		4.18		4.77		4.29		6.23	
PCB-021/033	2.75		2.38		2.53		1.81		1.95		2.34		2.34		3.08	
PCB-022	2.1		1.6		1.63		1.08		1.34		1.53		1.39		1.9	
PCB-023	0.019	J	0.019	J	0.0191	J	0.0152	J	0.0176	J	0.0165	J	0.015	J	0.0191	J
PCB-024	0.0583		0.0461		0.0513		0.0415		0.0381		0.0388		0.02	U	0.0695	

Table C-8. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-025	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.496	
PCB-026/029	126		147		152		137		108		125		120		107	
PCB-027	0.661		0.292		0.392		0.191		0.213		0.232		0.224		0.349	
PCB-031	5.85		4.15		4.82		3.08		3.13		3.92		3.73		5.33	
PCB-032	1.37		0.9		1.03		0.702		0.748		0.791		0.84		1.19	
PCB-034	0.0544		0.0263		0.0386		0.0169	J	0.0206		0.0236		0.0266		0.0287	
PCB-035	0.172		0.108		0.138		0.0845		0.0803		0.102		0.0882		0.133	
PCB-036	0.0545		0.0253		0.0323		0.0201		0.017	J	0.0204		0.0206		0.0425	
PCB-037	1.31		0.853		1.11		0.632		0.713		0.899		0.762		0.958	
PCB-038	0.0229		0.0263		0.0228		0.0122	NJ	0.012	NJ	0.0226	N	0.0204		0.0215	
PCB-039	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-040/071	2.67		1.35		1.69		0.938		1.14		1.4		1.07		1.4	
PCB-041	0.493		0.367		0.427		0.278		0.296		0.352		0.332		0.443	
PCB-042	1.78		0.936		1.24		0.656		0.805		1.02		0.761		1.05	
PCB-043	0.297		0.182		0.185		0.124		0.12		0.174		0.14		0.204	
PCB-044/047/065	7.37		3.53		4.88		2.25		3.98		3.81		2.53		3.69	
PCB-045	1.15		0.603		0.688		0.427		0.466		0.594		0.515		0.733	
PCB-046	0.492		0.249		0.309		0.17		0.18		0.25		0.199		0.295	
PCB-048	1.14		0.752		0.828		0.536		0.59		0.783		0.633		0.896	
PCB-049/069	4.83		2.11		2.99		1.38		2.2		2.33		1.55		2.31	
PCB-050/053	124		138		141		125		101		120		107		107	
PCB-051	0.529		0.209		0.292		0.123		0.135		0.192		0.137		0.226	
PCB-052	8.7		4.24		5.83		2.56		7.01		4.89		2.68		4.53	

Table C-8. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-054	0.149		0.0131	J	0.0306		0.00805	J	0.00859	J	0.0112	J	0.00856	J	0.0138	J
PCB-055	0.0792		0.0635		0.0811		0.0497		0.0496		0.0707		0.0577		0.0705	
PCB-056	1.74		0.9		1.2		0.566		0.873		0.967		0.659		0.777	
PCB-057	0.0341		0.0181	J	0.0198	NJ	0.011	J	0.0106	J	0.0197	J	0.014	J	0.0185	J
PCB-058	0.0155	J	0.02	U	0.02	U	0.02	U	0.00434	J	0.00772	J	0.00425	NJ	0.0068	J
PCB-059/062/075	0.615		0.323		0.403		0.224		0.248		0.346		0.261		0.365	
PCB-060	1.09		0.508		0.672		0.348		0.556		0.619		0.395		0.502	
PCB-061/070/074/076	6.97		3.93		5.53		2.42		5.63		4.58		2.66		3.64	
PCB-063	0.217		0.0993		0.131		0.0584		0.0948		0.114		0.0696		0.1	
PCB-064	2.85		1.26		1.68		0.836		1.37		1.44		0.952		1.37	
PCB-066	4.29		1.95		2.91		1.22		2.24		2.35		1.41		1.85	
PCB-067	0.147		0.0935		0.108		0.0628		0.0708		0.0977		0.0746		0.0986	
PCB-068	0.113		0.0826		0.11		0.0667		0.0609		0.0817		0.0644		0.0763	
PCB-072	0.0782		0.0263		0.0527		0.0125	J	0.0147	J	0.0377		0.0125	J	0.0239	
PCB-073	0.0923		0.0394		0.064		0.0372		0.045		0.0449		0.0405		0.0501	
PCB-077	0.296		0.153		0.317		0.0922		0.153		0.174		0.1		0.141	
PCB-078	43.5		43.7		50.4		41.8		36.8		45.4		42		43.2	
PCB-079	0.0403		0.0223		0.0488		0.02	U	0.07		0.0298	N	0.0138	J	0.0184	J
PCB-080	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-081	0.02	U	0.02	U	0.0307	N	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-082	0.451		0.3		0.442		0.136		0.81		0.332		0.129		0.177	
PCB-083	0.208		0.142		0.28		0.0739		0.321		0.179		0.0631		0.0945	
PCB-084	1.32		0.8		1.22		0.375		2.04		1.02		0.368		0.568	

Table C-8. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-085/116	0.673		0.365		0.541		0.205		0.98		0.528		0.175		0.304	
PCB-086/087/097/108/119/125	2.76		1.78		2.8		0.833		5.15		2.26		0.798		1.3	
PCB-088	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-089	0.101		0.07		0.0936		0.0535		0.086		0.0755		0.054		0.0625	
PCB-090/101/113	4.78		2.99		4.51		1.43		7.61		3.79		1.36		2.58	
PCB-091	0.861		0.412		0.644		0.208		0.896		0.508		0.202		0.322	
PCB-092	1.01		0.562		0.904		0.261		1.37		0.763		0.238		0.503	
PCB-093/100	0.213		0.118		0.159		0.0967		0.11		0.122		0.0907		0.112	
PCB-094	0.0535		0.0177	J	0.0345		0.0111	NJ	0.0297		0.0219		0.0115	J	0.0177	J
PCB-095	4.39		2.55		3.81		1.26		6.11		3.23		1.28		2.14	
PCB-096	0.0968		0.035		0.053		0.0235		0.0573		0.0415		0.0258		0.036	
PCB-098	0.02	U	0.0412		0.0406		0.0459		0.0412		0.0619		0.0428		0.0487	
PCB-099	1.93		1.03		1.71		0.483		2.68		1.48		0.44		0.859	
PCB-102	0.264		0.103		0.143		0.0496		0.163		0.0985		0.0563		0.079	
PCB-103	0.0883		0.0275		0.0487		0.0172	J	0.0378		0.0367		0.0151	J	0.0305	
PCB-104	0.0131	NJ	0.00549	J	0.0111	J	0.00416	J	0.0044	NJ	0.00465	J	0.00717	J	0.00403	NJ
PCB-105	1.11		0.689		1.08		0.26		2.15		0.944		0.22		0.458	
PCB-106	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-107/124	0.115		0.09		0.122		0.0359		0.237		0.104		0.028		0.0519	
PCB-109	0.215		0.12		0.21		0.0511		0.328		0.185		0.0386		0.097	
PCB-110	4.31		2.65		4.43		1.13		7.41		3.34		0.987		1.87	
PCB-111	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-112	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.00795	J	0.02	U

Table C-8. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-114	0.074		0.0471		0.0689		0.0205		0.13		0.0636		0.0177	J	0.0324	
PCB-115	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-117	0.149		0.0731		0.146		0.0253		0.238		0.115		0.0232	N	0.0464	
PCB-118	2.49		1.66		2.77		0.656		5.22		2.36		0.539		1.08	
PCB-120	0.0153	J	0.02	U	0.0146	NJ	0.02	U	0.02	U	0.0093	NJ	0.02	U	0.00734	J
PCB-121	0.00694	NJ	0.02	U	0.00648	NJ	0.00464	J	0.02	U	0.02	U	0.00375	J	0.00553	J
PCB-122	0.0456		0.0286		0.0412		0.0105	J	0.069		0.0306		0.0093	J	0.0157	J
PCB-123	0.0557		0.0457		0.0659		0.0171	J	0.0849		0.0518		0.0134	J	0.0274	
PCB-126	0.0188	J	0.0225		0.0331		0.0131	J	0.0162	J	0.0198	J	0.0123	J	0.0203	
PCB-127	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-128/166	0.407		0.339		0.52		0.129		0.853		0.391		0.114		0.239	
PCB-129/138/163	2.76		2.01		2.86		0.839		4.08		2.31		0.705		1.89	
PCB-130	0.181		0.132		0.2		0.0524		0.295		0.15		0.0404		0.118	
PCB-131	0.0365		0.0277		0.0401		0.0142	J	0.0838		0.0329		0.0124	J	0.0221	
PCB-132	0.957		0.679		0.893		0.311		1.48		0.737		0.293		0.543	
PCB-133	0.0628		0.033		0.0542		0.0174	J	0.0508		0.0377		0.0133	J	0.0412	
PCB-134	0.247		0.165		0.222		0.0643		0.297		0.17		0.0589		0.123	
PCB-135/151	1.69		1.03		1.36		0.573		1.33		1.14		0.607		1.24	
PCB-136	0.688		0.441		0.516		0.238		0.64		0.469		0.266		0.435	
PCB-137	0.0863		0.0837		0.0965		0.0323		0.246		0.0886		0.0212		0.0306	
PCB-139/140	0.0555		0.0353	N	0.0547		0.0199	J	0.0997		0.0501		0.0169	J	0.031	
PCB-141	0.482		0.4		0.432		0.181		0.635		0.355		0.181		0.293	
PCB-142	0.00595	NJ	0.00634	NJ	0.00941	J	0.00814	J	0.00689	NJ	0.00792	J	0.00542	NJ	0.00676	J

Table C-8. (continued)

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807
PCB-143	0.0136 NJ	0.0147 J	0.0159 J	0.0135 J	0.0292	0.0148 J	0.0126 J	0.0127 J
PCB-144	0.209	0.15	0.182	0.0816	0.227	0.15	0.0871	0.148
PCB-145	0.0108 J	0.0101 J	0.0105 NJ	0.0085 J	0.00692 NJ	0.00934 NJ	0.00522 J	0.00696 NJ
PCB-146	0.52	0.304	0.467	0.145	0.47	0.354	0.129	0.321
PCB-147/149	3.24	2.01	2.57	0.982	2.99	2.05	0.993	2.06
PCB-148	0.0131 J	0.02 U	0.00817 J	0.02 U	0.02 U	0.00367 NJ	0.02 U	0.02 U
PCB-150	0.0103 NJ	0.00411 J	0.00569 J	0.02 U	0.00458 J	0.00408 J	0.02 U	0.00405 J
PCB-152	0.0569	0.0544	0.0858	0.0419	0.0432	0.0492	0.0538	0.045
PCB-153/168	2.45	1.75	2.52	0.815	2.53	1.85	0.759	1.7
PCB-154	0.0675	0.0216	0.0415	0.00998 J	0.0328	0.0263	0.00659 NJ	0.0286
PCB-155	0.0128 J	0.0112 J	0.013 J	0.00995 J	0.00883 J	0.011 J	0.0103 J	0.013 J
PCB-156/157	0.181	0.16	0.234	0.0589	0.447	0.197	0.0474	0.109
PCB-158	0.251	0.204	0.263	0.084	0.495	0.217	0.0683	0.154
PCB-159	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.00786 NJ	0.02 U
PCB-160	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-161	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-162	0.00911 J	0.0068 J	0.0105 J	0.02 U	0.0129 J	0.00592 J	0.02 U	0.02 U
PCB-164	0.168	0.128	0.164	0.053	0.236	0.129	0.0461	0.113
PCB-165	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-167	0.0708	0.0699	0.0957	0.0274	0.145	0.074	0.0205	0.0481
PCB-169	0.0107 J	0.0108 J	0.017 J	0.0116 J	0.00975 J	0.0108 J	0.00789 J	0.0131 J
PCB-170	0.283	0.23	0.268	0.0921	0.214	0.198	0.0849	0.214
PCB-171/173	0.129	0.107	0.124	0.0471	0.101	0.091	0.0492	0.121

Table C-8. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-172	0.0625		0.0581		0.0621		0.0258		0.0391		0.0445		0.0221		0.0524	
PCB-174	0.488		0.431		0.415		0.208		0.306		0.325		0.206		0.415	
PCB-175	0.0272		0.0245	N	0.0246	N	0.0132	J	0.0183	J	0.0219		0.0117	NJ	0.0247	
PCB-176	0.0825		0.0744		0.0823		0.0451		0.0617		0.0654		0.0505		0.0847	
PCB-177	0.319		0.234		0.279		0.114		0.18		0.199		0.109		0.314	
PCB-178	0.143		0.116		0.139		0.0639		0.0744		0.0896		0.0584		0.158	
PCB-179	0.347		0.305		0.312		0.184		0.216		0.262		0.201		0.37	
PCB-180/193	0.75		0.65		0.712		0.283		0.429		0.49		0.269		0.57	
PCB-181	0.00745	J	0.00818	J	0.00882	J	0.00487	J	0.00845	J	0.00627	NJ	0.00577	J	0.00541	J
PCB-182	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-183	0.277		0.247		0.265		0.127		0.185		0.192		0.127		0.251	
PCB-184	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-185	0.0587		0.0542		0.0723		0.0339		0.0347		0.0389		0.0325		0.0557	
PCB-186	32.9		36.4		41.3		36.7		32.4		38.6		34.7		35.4	
PCB-187	0.779		0.661		0.771		0.352		0.406		0.519		0.336		0.806	
PCB-188	0.02	U	0.02	U	0.00389	NJ	0.02	U	0.0014	NJ	0.02	U	0.02	U	0.00364	J
PCB-189	0.0105	J	0.0103	J	0.0162	J	0.00526	J	0.0097	J	0.00781	J	0.0043	J	0.00991	J
PCB-190	0.073		0.0628		0.0733		0.0228		0.0414		0.0503		0.0211		0.0714	
PCB-191	0.0157	J	0.0137	J	0.0161	J	0.00606	NJ	0.0111	J	0.00952	NJ	0.00564	J	0.0115	J
PCB-192	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.00279	J	0.02	U
PCB-194	0.1		0.087		0.106		0.0387		0.0371		0.061		0.0332		0.0909	
PCB-195	0.0494		0.038		0.0497		0.018	J	0.0173	J	0.0318		0.0171	J	0.0528	
PCB-196	0.0641		0.0568		0.069		0.0293		0.027		0.0418		0.0265		0.0592	

Table C-8. (continued)

Site	Lower Columbia River		Duwamish River		Lake Washington		Snohomish River		Wenatchee River		Upper Columbia River		Okanogan River		Yakima River	
Sample No.	8424800		8424801		8424802		8424803		8424804		8424805		8424806		8424807	
PCB-197	0.0071	J	0.00632	NJ	0.00966	J	0.00629	J	0.00431	NJ	0.00587	J	0.00366	J	0.00862	J
PCB-198/199	0.18		0.166		0.201		0.087		0.0741		0.118		0.0719		0.179	
PCB-200	0.03		0.0295		0.0347		0.0161	J	0.015	J	0.0226		0.0181	J	0.0338	
PCB-201	0.0318		0.0332		0.0427		0.0193	J	0.0184	J	0.0247		0.0211		0.0425	
PCB-202	0.0557		0.0627		0.073		0.0348		0.0306		0.0431		0.0348		0.0758	
PCB-203	0.097		0.101		0.12		0.0475		0.0405		0.0662		0.0401		0.106	
PCB-204	0.0363		0.0395		0.0457		0.0365		0.033		0.04		0.036		0.0377	
PCB-205	0.00675	NJ	0.00694	NJ	0.0119	J	0.00425	J	0.00354	J	0.00432	NJ	0.00323	NJ	0.00912	J
PCB-206	0.0395		0.0402		0.0593		0.0224		0.0149	J	0.0257		0.0164	J	0.0411	
PCB-207	0.0082	J	0.0074	NJ	0.0108	J	0.00474	J	0.00409	J	0.0057	J	0.00373	NJ	0.00915	J
PCB-208	0.016	J	0.0195	J	0.0303		0.0115	J	0.00729	NJ	0.014	J	0.00991	J	0.0202	
PCB-209	0.0286		0.0343		0.0526		0.0255		0.0205		0.0261		0.0305		0.0386	

Table C-8. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
PCB-001	0.459		0.268		0.337		0.394		77		0.91		1.1		0.94		0.759	
PCB-002	0.106		0.0652		0.117		0.0567		0.079		0.0493		0.0541		0.0494		0.0393	
PCB-003	0.244		0.178		0.159		0.145		0.197		0.124		0.137		0.0998		0.109	
PCB-004	62.5		28		50.7		60.1		27.4		102	E	127	E	116	E	84.8	E
PCB-005	0.14		0.11		0.0914		0.0754		0.103		0.0543		0.0599		0.052		0.0457	
PCB-006	0.811		0.572		0.52		0.451		0.582		0.383		0.388		0.327		0.326	
PCB-007	0.18		0.122		0.105		0.103		0.128		0.0905		0.0916		0.0775		0.0745	
PCB-008	3.97		2.79		2.54		2.17		2.81		1.8		1.81		1.48		1.52	
PCB-009	0.298		0.221		0.191		0.176		0.225		0.148		0.157		0.134		0.123	
PCB-010	0.0877		0.0625		0.089		0.0713		0.0622		0.0806		0.0801		0.119		0.0674	
PCB-011	21.7		1.78		23.7		1.14		1.77		0.844		0.835		0.685		0.76	
PCB-012/013	0.464		0.28		0.405		0.298		0.299		0.25		0.256		0.302		0.203	
PCB-014	38.8		33.9		28.9		30.1		35.2		28.3		33.5		33		23.4	
PCB-015	1.65		1.24		1.63		0.89		1.26		0.709		0.699		0.589		0.613	
PCB-016	2.3		1.84		1.87		1.47		1.7		0.977		1.08		0.745		0.812	
PCB-017	2.32		1.81		1.92		1.37		1.7		1.05		1.05		0.808		0.858	
PCB-018/030	5.19		4.06		4.48		3.09		3.9		2.31		2.35		1.82		1.88	
PCB-019	0.556		0.413		0.539		0.334		0.406		0.317		0.323		0.256		0.235	
PCB-020/028	7.64		6.2		7.19		4.29		5.6		3.17		3.11		2.64		2.68	
PCB-021/033	4		3.22		2.93		2.33		2.83		1.61		1.62		1.37		1.42	
PCB-022	2.37		1.95		2.2		1.34		1.68		0.967		0.946		0.807		0.797	
PCB-023	0.0253		0.0188	J	0.017	J	0.0191	J	0.016	J	0.0136	J	0.0153	J	0.0147	J	0.0125	J
PCB-024	0.0906		0.0629		0.0782		0.02	U	0.0616		0.0321		0.02	U	0.0374		0.0312	N

Table C-8. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	RepWalla	Field Trip Blank Duwamish	Field Trip Blank Queets	Field Trip Blank Spokane	Day 0 Dial
Sample No.	8424808	8424809	8424810	8424811	8424812	8424813	8424814	8424815	8424820
PCB-025	4.9	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-026/029	166 E	127	118	129	118	133	158	151	109
PCB-027	0.411	0.328	0.389	0.245	0.31	0.222	0.206	0.156	0.154
PCB-031	6.55	5.3	5.94	3.68	4.77	2.73	2.76	2.31	2.38
PCB-032	1.43	1.18	1.3	0.929	1.11	0.725	0.715	0.528	0.563
PCB-034	0.0387	0.0302	0.0316	0.0233	0.0274	0.0173 J	0.0182 J	0.0135 J	0.0155 J
PCB-035	0.175	0.123	0.224	0.0906	0.11	0.0724	0.0768	0.074	0.0611
PCB-036	0.0406	0.02 U	0.0707	0.0229	0.0263	0.0234	0.02 U	0.0209	0.0135 J
PCB-037	1.23	1.01	1.38	0.646	0.855	0.463	0.458	0.396	0.399
PCB-038	0.0259	0.0268	0.0184 J	0.018 J	0.0195 J	0.0161 J	0.0138 J	0.0127 NJ	0.0116 J
PCB-039	0.02 U	0.0287	0.0356	0.0176 J	0.0261	0.0186 J	0.0164 J	0.02 U	0.012 J
PCB-040/071	1.79	1.48	2.17	0.964	1.28	0.679	0.68	0.618	0.593
PCB-041	0.489	0.474	0.508	0.279	0.352	0.229	0.152	0.148	0.14
PCB-042	1.28	1.08	1.59	0.674	0.931	0.498	0.466	0.425	0.408
PCB-043	0.248	0.199	0.261	0.13	0.188	0.0919	0.095	0.0831	0.0789
PCB-044/047/065	4.64	3.76	5.7	2.32	3.29	1.8	1.68	1.54	1.45
PCB-045	0.878	0.736	1	0.486	0.665	0.374	0.362	0.303	0.301
PCB-046	0.351	0.28	0.376	0.198	0.256	0.134	0.138	0.118	0.11
PCB-048	1.1	0.899	1.13	0.582	0.786	0.388	0.395	0.362	0.36
PCB-049/069	2.93	2.4	3.55	1.49	2.13	1.15	1.06	0.966	0.925
PCB-050/053	152	125	117	119	119	113	136	142	102
PCB-051	0.301	0.222	0.289	0.182	0.214	0.107	0.132	0.103 N	0.0987
PCB-052	5.71	4.23	6.84	2.59	3.8	2.07	1.92	1.76	1.65

Table C-8. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
PCB-054	0.0157	J	0.0121	J	0.0175	J	0.00925	J	0.0105	NJ	0.00897	J	0.00865	J	0.00615	NJ	0.00595	J
PCB-055	0.0911		0.0721		0.02	U	0.0441		0.02	U	0.036		0.0346		0.0413		0.0358	
PCB-056	0.997		0.872		1.64		0.536		0.752		0.391		0.353		0.333		0.317	
PCB-057	0.0233		0.0211		0.0256		0.0134	J	0.0169	J	0.00908	NJ	0.02	U	0.00809	J	0.00765	NJ
PCB-058	0.00994	J	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-059/062/075	0.451		0.37		0.51		0.24		0.326		0.171		0.169		0.153		0.14	
PCB-060	0.658		0.542		0.888		0.322		0.473		0.236		0.217		0.191		0.194	
PCB-061/070/074/076	4.91		3.76		6.81		2.17		3.25		1.62		1.5		1.38		1.41	
PCB-063	0.128		0.105		0.169		0.0571		0.0891		0.0467		0.0424		0.0381		0.0365	
PCB-064	1.76		1.45		2.31		0.85		1.25		0.682		0.605		0.549		0.52	
PCB-066	2.47		1.96		3.7		1.14		1.72		0.893		0.801		0.743		0.725	
PCB-067	0.12		0.101		0.137		0.0631		0.0894		0.044		0.0421		0.038		0.0374	
PCB-068	0.0979		0.0874		0.0851		0.068		0.081		0.061		0.0674		0.068		0.0519	
PCB-072	0.0332		0.0236		0.0388		0.0119	J	0.0229		0.0108	NJ	0.00792	J	0.00977	J	0.00638	NJ
PCB-073	0.0481		0.059		0.0486		0.0443		0.0452		0.033		0.0378	N	0.0468		0.0282	
PCB-077	0.202		0.147		0.296		0.0637		0.131		0.0558		0.0635		0.0652		0.0416	
PCB-078	53.5		50.9		41.4		41.8		47.5		40.1		45.2		48.3		34.5	
PCB-079	0.0237		0.02	U	0.0492		0.02	U	0.0144	NJ	0.02	U	0.02	U	0.02	U	0.02	U
PCB-080	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-081	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-082	0.234		0.196		0.499		0.0963		0.178		0.0714		0.0631		0.0584		0.057	
PCB-083	0.161		0.0935		0.269		0.0573		0.0864		0.0429		0.0272	N	0.0301		0.0288	
PCB-084	0.83		0.551		1.17		0.282		0.477		0.22		0.199		0.179		0.179	

Table C-8. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	RepWalla	Field Trip Blank Duwamish	Field Trip Blank Queets	Field Trip Blank Spokane	Day 0 Dial
Sample No.	8424808	8424809	8424810	8424811	8424812	8424813	8424814	8424815	8424820
PCB-085/116	0.401	0.371	0.667	0.123	0.268	0.0972	0.093	0.0789	0.0836
PCB-086/087/097/108/119/125	1.66	1.34	2.9	0.619	1.17	0.481	0.449	0.394	0.412
PCB-088	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-089	0.0754	0.0714	0.0983	0.0517	0.0617	0.041	0.0441	0.0423	0.0378
PCB-090/101/113	3.15	2.46	4.58	1.14	2.12	0.832	0.781	0.683	0.736
PCB-091	0.439	0.318	0.634	0.159	0.272	0.122	0.111	0.0971	0.097
PCB-092	0.63	0.476	0.892	0.202	0.435	0.149	0.139	0.12	0.127
PCB-093/100	0.14	0.114	0.12	0.098	0.104	0.0906	0.0988	0.0989	0.0761
PCB-094	0.0233	0.0172 J	0.0312	0.0105 J	0.0144 J	0.02 U	0.00673 J	0.02 U	0.02 U
PCB-095	2.83	2.01	3.74	1.09	1.76	0.79	0.735	0.637	0.694
PCB-096	0.0476	0.0372	0.061	0.0219	0.0312	0.0174 J	0.0149 J	0.0138 J	0.0134 J
PCB-098	0.0587	0.0535	0.02 U	0.0417 N	0.02 U	0.0513	0.0487	0.0512	0.0373
PCB-099	1.08	0.933	1.75	0.341	0.827	0.271	0.254	0.226	0.231
PCB-102	0.0978	0.0833	0.186	0.0467	0.104	0.0305	0.02 U	0.0291	0.0284
PCB-103	0.0331	0.024	0.034	0.0149 J	0.0212	0.0115 NJ	0.0123 J	0.0128 NJ	0.00987 J
PCB-104	0.00522 NJ	0.00466 NJ	0.00477 J	0.00425 J	0.00523 NJ	0.0053 J	0.00635 J	0.00516 J	0.00483 J
PCB-105	0.631	0.489	1.2	0.147	0.45	0.128	0.109	0.0971	0.101
PCB-106	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-107/124	0.0725	0.0572	0.136	0.0197 J	0.0526	0.0166 J	0.014 J	0.0125 J	0.0131 J
PCB-109	0.127	0.0931	0.193	0.0231	0.0821	0.0207	0.0176 J	0.0136 NJ	0.0165 J
PCB-110	2.47	1.98	4.33	0.743	1.75	0.585	0.535	0.459	0.49
PCB-111	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-112	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

Table C-8. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	RepWalla	Field Trip Blank Duwamish	Field Trip Blank Queets	Field Trip Blank Spokane	Day 0 Dial
Sample No.	8424808	8424809	8424810	8424811	8424812	8424813	8424814	8424815	8424820
PCB-114	0.042	0.0337	0.0806	0.0119 J	0.0321	0.0123 J	0.0119 J	0.00767 NJ	0.00956 NJ
PCB-115	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-117	0.0807	0.02 U	0.138	0.026	0.0674	0.0211 N	0.0105 NJ	0.0171 NJ	0.0141 NJ
PCB-118	1.51	1.14	2.83	0.369	1.05	0.304	0.277	0.242	0.262
PCB-120	0.02 U	0.02 U	0.00849 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-121	0.02 U	0.02 U	0.00578 J	0.00305 J	0.0044 NJ	0.00317 J	0.02 U	0.02 U	0.02 U
PCB-122	0.0216	0.02 U	0.0495	0.02 U	0.02 U	0.00694 J	0.02 U	0.02 U	0.02 U
PCB-123	0.0309	0.0359	0.104	0.0111 J	0.0302	0.011 J	0.00982 J	0.02 U	0.02 U
PCB-126	0.0187 J	0.0158 NJ	0.0217	0.00915 J	0.02 U	0.0108 NJ	0.0121 J	0.0122 J	0.00875 J
PCB-127	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-128/166	0.328	0.248	0.429	0.0663	0.236	0.0587	0.0448	0.0388	0.0465
PCB-129/138/163	1.76	1.7	2.83	0.551	1.55	0.35	0.32	0.293	0.35
PCB-130	0.124	0.113	0.175	0.0353	0.102	0.0229	0.0201	0.0211	0.0177 NJ
PCB-131	0.0266	0.0215	0.039	0.0105 J	0.0184 J	0.00541 J	0.00546 J	0.02 U	0.00433 NJ
PCB-132	0.593	0.493	0.958	0.231	0.425	0.132	0.124	0.113	0.128
PCB-133	0.0324	0.0336	0.0445	0.0103 J	0.0283	0.00649 J	0.00694 J	0.02 U	0.00615 J
PCB-134	0.135	0.134	0.221	0.0594	0.113	0.0335	0.029	0.0273	0.0309
PCB-135/151	1.19	1.01	1.61	0.532	0.882	0.324	0.31	0.287	0.315
PCB-136	0.487	0.408	0.614	0.235	0.326	0.144	0.139	0.121	0.145
PCB-137	0.0524	0.0491	0.112	0.0162 J	0.0367	0.0115 NJ	0.00921 NJ	0.02 U	0.00992 NJ
PCB-139/140	0.0389	0.0308	0.0533	0.0148 J	0.0284	0.00915 NJ	0.011 J	0.0123 J	0.00983 J
PCB-141	0.289	0.278	0.561	0.159	0.253	0.0911	0.0888	0.0739	0.0934
PCB-142	0.00837 NJ	0.02 U	0.02 U	0.00736 NJ	0.02 U	0.00677 J	0.00683 J	0.00665 NJ	0.00593 J

Table C-8. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
PCB-143	0.0137	NJ	0.016	J	0.02	U	0.0123	J	0.0133	J	0.013	J	0.0129	J	0.0177	J	0.0107	J
PCB-144	0.155		0.139		0.218		0.0792		0.115		0.049		0.0454		0.0426		0.0481	
PCB-145	0.0115	J	0.011	J	0.00927	J	0.00906	J	0.00887	J	0.00981	J	0.00896	J	0.0131	J	0.00868	J
PCB-146	0.3		0.274		0.438		0.1		0.249		0.0657		0.0637		0.0562		0.0603	
PCB-147/149	2.01		1.8		3.01		0.869		1.54		0.523		0.472		0.437		0.497	
PCB-148	0.02	U	0.02	U	0.00502	NJ	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-150	0.02	U	0.02	U	0.00438	J	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-152	0.0599		0.0559		0.0455		0.0454		0.052		0.047		0.0494		0.0523		0.0428	
PCB-153/168	1.54		1.53		2.44		0.633		1.38		0.383		0.35		0.312		0.381	
PCB-154	0.0234		0.0168	J	0.0264	N	0.02	U	0.0176	J	0.02	U	0.02	U	0.02	U	0.02	U
PCB-155	0.0144	J	0.0133	J	0.0166	J	0.00979	J	0.0117	J	0.00917	J	0.00966	J	0.0103	J	0.00831	J
PCB-156/157	0.122		0.112		0.221		0.0348		0.103		0.0299		0.027		0.0219		0.0257	
PCB-158	0.171		0.153		0.269		0.056		0.138		0.0383		0.035		0.0305		0.0377	
PCB-159	0.0153	J	0.0166	NJ	0.021		0.02	U	0.014	NJ	0.02	U	0.00386	J	0.02	U	0.02	U
PCB-160	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-161	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-162	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-164	0.0982		0.0996		0.176		0.0384		0.0925		0.0218		0.0207		0.018	J	0.0223	
PCB-165	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-167	0.0481		0.0464		0.086		0.0148	J	0.0428		0.0114	J	0.0107	J	0.0114	J	0.0115	J
PCB-169	0.0108	J	0.00871	NJ	0.00935	J	0.00737	J	0.00794	NJ	0.00785	J	0.00789	J	0.00684	NJ	0.00661	J
PCB-170	0.163		0.146		0.266		0.0664		0.143		0.0436		0.0413		0.0378		0.0448	
PCB-171/173	0.0964		0.0826		0.114		0.042		0.073		0.0233		0.0231		0.0207		0.0244	

Table C-8. (continued)

Site	Middle Columbia River	Walla Walla River	Spokane River	Queets River	RepWalla	Field Trip Blank Duwamish	Field Trip Blank Queets	Field Trip Blank Spokane	Day 0 Dial
Sample No.	8424808	8424809	8424810	8424811	8424812	8424813	8424814	8424815	8424820
PCB-172	0.0387	0.0381	0.0626	0.0196 J	0.0353	0.0113 J	0.00846 J	0.00888 NJ	0.0106 J
PCB-174	0.359	0.324	0.535	0.187	0.281	0.0937	0.0886	0.0819	0.0938
PCB-175	0.0199 J	0.0219	0.0272	0.02 U	0.0176 J	0.00632 J	0.02 U	0.02 U	0.02 U
PCB-176	0.0824	0.07	0.0875	0.0438	0.062	0.0254	0.023	0.0186 J	0.0263
PCB-177	0.239	0.198	0.262	0.092	0.178	0.0488	0.0488	0.0425	0.0518
PCB-178	0.112	0.102	0.135	0.0492	0.0901	0.0275 N	0.0304	0.0245	0.0306
PCB-179	0.338	0.295	0.398	0.176	0.254	0.103	0.104	0.0835	0.104
PCB-180/193	0.476	0.417	0.759	0.215	0.397	0.143	0.133	0.115	0.14
PCB-181	0.0076 J	0.00689 J	0.02 U	0.02 U	0.02 U	0.02 U	0.00483 J	0.02 U	0.02 U
PCB-182	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-183	0.236	0.201	0.283	0.115	0.188	0.0614	0.0648	0.051	0.0683
PCB-184	0.02 U	0.02 U	0.0122 J	0.02 U	0.02 U	0.00177 J	0.02 U	0.02 U	0.02 U
PCB-185	0.0401	0.0559	0.0673	0.0318	0.0375	0.0175 J	0.0147 J	0.0173 J	0.0121 J
PCB-186	44.7	40.3	34.7	33.1	36.5	34.8	38.5	38.1	30.5
PCB-187	0.657	0.611	0.797	0.295	0.56	0.174	0.16	0.142	0.179
PCB-188	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PCB-189	0.00714 NJ	0.0065 J	0.00972 J	0.00366 J	0.00716 J	0.02 U	0.00366 J	0.02 U	0.02 U
PCB-190	0.0475	0.0434	0.0615	0.0175 J	0.042	0.0104 J	0.0116 J	0.00809 J	0.0109 J
PCB-191	0.0106 J	0.00881 J	0.0129 J	0.02 U	0.00833 J	0.02 U	0.02 U	0.02 U	0.02 U
PCB-192	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.00177 NJ	0.02 U	0.02 U
PCB-194	0.0653	0.0637	0.0951	0.0248 N	0.0568	0.0237	0.0227	0.0185 J	0.0242
PCB-195	0.0348	0.0316	0.0437	0.0154 J	0.029	0.01 J	0.00985 J	0.0105 J	0.012 J
PCB-196	0.0448	0.0497	0.0723	0.0234	0.0416	0.0128 NJ	0.0137 J	0.0115 J	0.016 J

Table C-8. (continued)

Site	Middle Columbia River		Walla Walla River		Spokane River		Queets River		RepWalla		Field Trip Blank Duwamish		Field Trip Blank Queets		Field Trip Blank Spokane		Day 0 Dial	
Sample No.	8424808		8424809		8424810		8424811		8424812		8424813		8424814		8424815		8424820	
PCB-197	0.00842	J	0.02	U	0.00845	J	0.00434	J	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
PCB-198/199	0.132		0.146		0.215		0.0658		0.132		0.04		0.0368		0.0293		0.0379	
PCB-200	0.0258		0.0258		0.0359		0.017	J	0.0224		0.00894	NJ	0.00761	J	0.0073	J	0.00908	J
PCB-201	0.0354		0.0344		0.042		0.0201		0.0326		0.0122	J	0.0117	J	0.00944	NJ	0.0129	J
PCB-202	0.0627		0.0638		0.0693		0.0288		0.0609		0.0218		0.0199	J	0.0147	J	0.0222	
PCB-203	0.0754		0.0937		0.116		0.037		0.0788		0.0246		0.0212		0.0184	J	0.0245	
PCB-204	0.047		0.0429		0.0376		0.0355		0.0411		0.035		0.0382		0.0422		0.033	
PCB-205	0.00727	J	0.02	U	0.02	U	0.02	U	0.00635	NJ	0.00354	J	0.00341	J	0.02	U	0.00255	NJ
PCB-206	0.0325		0.0504		0.0441		0.012	J	0.0461		0.0091	NJ	0.011	J	0.00867	J	0.0104	J
PCB-207	0.00998	J	0.0124	J	0.00806	J	0.02	U	0.0112	J	0.02	U	0.00324	J	0.02	U	0.02	U
PCB-208	0.0187	J	0.0301		0.0195	J	0.00678	NJ	0.026		0.0065	NJ	0.00595	J	0.00661	J	0.0066	J
PCB-209	0.036		0.068		0.0299	UJ	0.0221	UJ	0.069		0.021	UJ	0.0241	UJ	0.0225	UJ	0.0205	UJ

U = not detected at or above reported results.
UJ = not detected at or above reported estimated results.
J = estimated concentration.
N = tentative identification.
NJ = tentative identification. Result reported as estimate.
E = exceeds calibration range, estimated concentration.

Appendix D. Mean Water Temperatures and Exposure Times

Table D-1. Mean Temperatures and Exposure Times for SPMD Samples, 2008.

Site	April-May		Aug.-Sept.	
	Temp (ºC)	Time (days)	Temp (ºC)	Time (days)
Lower Columbia River	12.6	27.9	18.0	27.9
Duwamish River	9.3	27.9	14.6	27.9
Lake Washington	13.5	28.0	18.3	27.9
Snohomish River	7.7	33.1	13.9	27.9
Wenatchee River	8.3	28.2	14.3	28.0
Upper Columbia River at Rock Island Dam	10.4	28.0	18.6	28.0
Okanogan River	11.6	27.7	16.7	27.9
Yakima River at Wanawish Dam	15.0	27.9	17.5	28.0
Middle Columbia River at McNary Dam	12.4	27.9	19.0	28.0
Walla Walla River	13.4	27.8	17.2	28.0
Spokane River at Nine Mile Dam	10.5	27.9	14.3	28.0
Queets River	8.4	28.0	13.2	27.9
Walla Walla Replicate	13.4	27.8	17.2	28.0

Appendix E. Performance Reference Compounds (PRC) Recovery in SPMDs

Table E-1. 2008 PRC Sample Recovery (Spring). PRCs spiked in each membrane. Samples = 5 membranes.

Sample Field ID	Sample Lab ID	Parameter Name	Final Concentration[1] (ng/sample)	Recovered (%)
Lower Columbia River	08244800	PCB-004	140	14%
		PCB-029	487	49%
		PCB-050	480	48%
Duwamish River	08244801	PCB-004	326	33%
		PCB-029	694	69%
		PCB-050	642	64%
Lake Washington	08244802	PCB-004	303	30%
		PCB-029	643	64%
		PCB-050	585	59%
Snohomish River	08244803	PCB-004	392	39%
		PCB-029	696	70%
		PCB-050	610	61%
Wenatchee River	08244804	PCB-004	243	24%
		PCB-029	603	60%
		PCB-050	604	60%
Upper Columbia River	08244805	PCB-004	370	37%
		PCB-029	641	64%
		PCB-050	616	62%
Okanogan River	08244806	PCB-004	462	46%
		PCB-029	702	70%
		PCB-050	695	70%
Yakima River	08244807	PCB-004	99.7	10%
		PCB-029	335	34%
		PCB-050	339	34%
Middle Columbia River	08244808	PCB-004	354	35%
		PCB-029	708	71%
		PCB-050	717	72%
Walla Walla River	08244809	PCB-004	233	23%
		PCB-029	609	61%
		PCB-050	567	57%

Sample Field ID	Sample Lab ID	Parameter Name	Final Concentration[1] (ng/sample)	Recovered (%)
Spokane River	08244810	PCB-004	180	18%
		PCB-029	575	58%
		PCB-050	600	60%
Queets River	08244811	PCB-004	412	41%
		PCB-029	762	76%
		PCB-050	732	73%
Replicate - Walla Walla River	08244812	PCB-004	*	-
		PCB-029	*	-
		PCB-050	*	-
Field Trip Blank - Duwamish River	08244813	PCB-004	511	51%
		PCB-029	701	70%
		PCB-050	700	70%
DAY0-DIAL[2]	08244820	PCB-004	1660	166%
		PCB-029	2240	224%
		PCB-050	2200	220%

1. Spring initial concentration = 1000 ng/sample.
2. This sample may have been spiked twice with PCB-004, -029, -050 reducing recovery to 83%, 112%, and 110% respectively.
* Lab accident lost >80% extract.

Table E-2. 2008 PRC Sample Recovery (Fall). PRCs spiked in each membrane. Samples = 5 membranes.

Sample Field ID	Sample Lab ID	Parameter Name	Final Concentration[1] (ng/sample)	Recovered (%)
Lower Columbia River	08424800	PCB-004	33.6	17%
		PCB-029	126	63%
		PCB-050	124	62%
Duwamish River	08424801	PCB-004	67.7	34%
		PCB-029	147	74%
		PCB-050	138	69%
Lake Washington	08424802	PCB-004	48	24%
		PCB-029	152	76%
		PCB-050	141	71%
Snohomish River	08424803	PCB-004	64.6	32%
		PCB-029	137	69%
		PCB-050	125	63%
Wenatchee River	08424804	PCB-004	42.4	21%
		PCB-029	108	54%
		PCB-050	101	51%
Upper Columbia River	08424805	PCB-004	37.4	19%
		PCB-029	125	63%
		PCB-050	120	60%
Okanogan River	08424806	PCB-004	51.3	26%
		PCB-029	120	60%
		PCB-050	107	54%
Yakima River	08424807	PCB-004	23.9	12%
		PCB-029	107	54%
		PCB-050	107	54%
Middle Columbia River	08424808	PCB-004	62.5	31%
		PCB-029	166	83%
		PCB-050	152	76%
Walla Walla River	08424809	PCB-004	28	14%
		PCB-029	127	64%
		PCB-050	125	63%
Spokane River	08424810	PCB-004	50.7	25%
		PCB-029	118	59%
		PCB-050	117	59%

Sample Field ID	Sample Lab ID	Parameter Name	Final Concentration[1] (ng/sample)	Recovered (%)
Queets River	08424811	PCB-004	60.1	30%
		PCB-029	129	65%
		PCB-050	119	60%
WallaRep	08424812	PCB-004	27.4	14%
		PCB-029	118	59%
		PCB-050	119	60%
Field Trip Blank - Duwamish River	08424813	PCB-004	102	51%
		PCB-029	133	67%
		PCB-050	113	57%
Field Trip Blank - Queets River	08424814	PCB-004	127	64%
		PCB-029	158	79%
		PCB-050	136	68%
Field Trip Blank - Spokane River	08424815	PCB-004	116	58%
		PCB-029	151	76%
		PCB-050	142	71%
DAY0-DIAL	08424820	PCB-004	84.8	42%
		PCB-029	109	55%
		PCB-050	102	51%

1. Fall initial concentration = 200 ng/sample.

Appendix F. Log K_{ow}s Used in the USGS Estimated Water Concentration Calculator Spreadsheet for the 2008 PBT Trends Study

Table F-1. Log K_{ow}s Used to Estimate Water Concentration.

Organochlorine Pesticides	Log K_{ow}	Ref.
p,p'-DDT	5.47	a
p,p'-DDE	6.14	a
p,p'-DDD	5.75	a
o,p'-DDT	5.59	a
o,p'-DDE	5.56	a
o,p'-DDD	6.08	a
DDMU	5.50	e
Dieldrin	4.60	a
Chlorpyrifos	4.90	f
Endosulfan I	3.78	a
Endosulfan-II	3.50	e
Endosulfan Sulfate	3.64	e
Hexachlorobenzene (HCB)	5.71	a
Pentachloroanisole (PCA)	5.48	b, e
Toxaphene	4.73	a
Chlordane (technical)	6.29	e
trans-Chlordane	5.38	a, c, d, e
cis-Chlordane	5.38	a, c, d, e
Dacthal	4.26	e
trans-Nonachlor	6.35	c, e
cis-Nonachlor	6.20	c, e
Heptachlor	5.19	a
Heptachlor Epoxide	4.51	a
alpha-Benzenehexachloride (a-BHC)	3.86	a
beta-Benzenehexachloride (b-BHC)	3.86	a
delta-Benzenehexachloride (d-BHC)	4.12	a
Lindane	3.71	a
Aldrin	5.97	e, i
Endrin	4.63	a
Endrin ketone	4.99	e
Endrin aldehyde	4.80	e
Mirex	6.89	a
p,p'-Methoxychlor	4.61	a
Oxychlordane	5.48	e

PAHs	Log K_{ow}	Ref.
Naphthalene	3.45	k
2-Methylnaphthalene	3.86	l
1-Methylnaphthalene	3.86	l
2-Chloronaphthalene	3.81	e
Acenaphthylene	4.08	k
Acenaphthene	4.22	k
Dibenzofuran	4.12	l
Fluorene	4.38	k
Phenanthrene	4.46	k
Anthracene	4.54	k
Carbazole	3.23	e
Fluoranthene	5.20	k
Pyrene	5.30	k
Retene	6.35	e
Benzo(a)anthracene	5.91	k
Chrysene	5.61	k
Benzo(b)fluoranthene	5.78	k
Benzo(k)fluoranthene	6.20	k
Benzo(a)pyrene	6.35	k
Indeno(1,2,3-cd)pyrene	6.75	k
Dibenzo(a,h)anthracene	6.51	k
Benzo(ghi)perylene	6.90	k

Table F-1. (continued)

Individual PCB Congeners Log K_{ow} Ref. g

PCB Congeners IUPAC No.	Log K_{ow}
1	4.46
2	4.69
3	4.69
4	4.65
5	4.97
6	5.06
7	5.07
8	5.07
9	5.06
10	4.84
11	5.28
12,13	5.26
12	5.22
13	5.29
14	5.28
15	5.30
16	5.16
17	5.25
18,20	5.34
18	5.24
19	5.02
20,28	5.62
20	5.57
21,33	5.56
21	5.51
22	5.58
23	5.57
24	5.35
25	5.67
26,29	5.63
26	5.66
27	5.44

PCB Congeners IUPAC No.	Log K_{ow}
28	5.67
29	5.60
30	5.44
31	5.67
32	5.44
33	5.60
34	5.66
35	5.82
36	5.88
37	5.83
38	5.76
39	5.89
40,71	5.82
40	5.66
41	5.69
42	5.76
43	5.75
44,47,65	5.82
44	5.75
45	5.53
46	5.53
47	5.85
48	5.78
49,69	5.95
49	5.85
50,53	5.63
50	5.63
51	5.63
52	5.84
53	5.62
54	5.21
55	6.11

PCB Congeners IUPAC No.	Log K_{ow}
56	6.11
57	6.17
58	6.17
59,62,75	5.96
59	5.95
60	6.11
61,70,74,76	6.14
61	6.04
62	5.89
63	6.17
64	5.95
65	5.86
66	6.20
67	6.20
68	6.26
69	6.04
70	6.20
71	5.98
72	6.26
73	6.04
74	6.20
75	6.05
76	6.13
77	6.36
78	6.35
79	6.42
80	6.48
81	6.36
82	6.20
83	6.26
84	6.04
85,116	6.32

PCB Congeners IUPAC No.	Log K_{ow}
85	6.30
86,87,97,108,119,125	6.44
86	6.23
87	6.29
88	6.07
89	6.07
90,101,113	6.43
90	6.36
91	6.13
92	6.35
93,100	6.14
93	6.04
94	6.13
95	6.13
96	5.71
97	6.29
98	6.13
99	6.39
100	6.23
101	6.38
102	6.16
103	6.22
104	5.81
105	6.65
106	6.64
107,124	6.72
107	6.71
108	6.71
109	6.48
110	6.48
111	6.76
112	6.45

PCB Congeners IUPAC No.	Log K_{ow}
113	6.54
114	6.65
115	6.49
116	6.33
117	6.46
118	6.74
119	6.58
120	6.79
121	6.64
122	6.64
123	6.74
124	6.73
125	6.51
126	6.89
127	6.95
128,166	6.84
128	6.74
129,138,163	6.85
129	6.73
130	6.80
131	6.58
132	6.58
133	6.86
134	6.55
135,151	6.64
135	6.64
136	6.22
137	6.83
138	6.83
139,140	6.67
139	6.67
140	6.67

PCB Congeners IUPAC No.	Log K_{ow}
141	6.82
142	6.51
143	6.60
144	6.67
145	6.25
146	6.89
147,149	6.66
147	6.64
148	6.73
149	6.67
150	6.32
151	6.64
152	6.22
153,168	7.02
153	6.92
154	6.76
155	6.41
156,157	7.18
156	7.18
157	7.18
158	7.02
159	7.24
160	6.93
161	7.08
162	7.24
163	6.99
164	7.02
165	7.05
166	6.93
167	7.27
168	7.11
169	7.42

PCB Congeners IUPAC No.	Log K_{ow}
170	7.27
171,173	7.07
171	7.11
172	7.33
173	7.02
174	7.11
175	7.17
176	6.76
177	7.08
178	7.14
179	6.73
180,193	7.44
180	7.36
181	7.11
182	7.20
183	7.20
184	6.85
185	7.11
186	6.69
187	7.17
188	6.82
189	7.71
190	7.46
191	7.55
192	7.52
193	7.52
194	7.80
195	7.56
196	7.65
197	7.30
198,199	7.41
198	7.62

PCB Congeners IUPAC No.	Log K_{ow}
199	7.20
200	7.27
201	7.62
202	7.24
203	7.65
204	7.30
205	8.00
206	8.09
207	7.74
208	7.71
209	8.18

Table F-1. (continued)

Individual PBDE Congeners IUPAC No.	Log K_{ow}	Ref.
47	6.22	h, j
49	6.22	f
66	6.25	j
71	6.02	f, j
99	6.75	h, j
100	6.64	h, j
138	7.57	j
153	7.17	h, j
154	7.39	h, j
183	7.71	h, j
184	8.27	f
191	8.36	f, j
209	10.0	j

If multiple log K_{ow} values were found in the literature, a mean value was selected using the t test at 95% Confidence for rejection of outliers (USGS 2008 and Alvarez 2008).

Ref. = Reference.

[a] Mackay, D.; Shiu, W-Y; Ma, K-C Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals. Volume V, Lewis Publishers, Boca Raton, 1997.

[b] Oliver, B.G.; Niimi, A.J. Environ. Sci. Technol., 1985, 19:9, 842-849.

[c] Simpson, C.D.; Wilcock, R.J.; Smith, T.J.; Wilkins, A.L.; Langdon, A.G. Bull. Environ. Contam. Toxicol., 1995, 55:1, 149-153.

[d] Veith, G.D.; DeFoe, D.L.; Bergstedt, B.V. J. Fish Res. Board Can., 1979, 36, 1040-1048.

[e] Syracuse Research Corporation, On-Line Log K_{ow} Estimator (KowWin), www.srcinc.com/what-we-do/environment.aspx.

[f] Chlorpyrifos, PBDE-49, -71, -184, and -191 values estimated from Endrin (USGS 2008), PBDE-47, -69, -183, and -190 respectively, due to their proximity in Log K_{ow} values.

[g] Hawker, D.W. and Connell, D.W. Environ. Sci. Technol, 1988, 22, 382-387.

[h] Braekevelt, E., S.A. Tittlemier, and G.T. Tomy, 2003. Direct Measurement of Octanol-water Partition Coefficients of Some Environmentally Relevant Brominated Diphenyl Ether Congeners. Chemosphere 51 (7):563-567. Rantalainen, A.L., W. Cretney, M.G. Ikonomou, 2000. Uptake Rates of Semipermeable Membrane Devices (SPMDs) for PCDDs, PCDFs and PCBs in Water and Sediment. Chemosphere 40 (2): 147-158.

[i] Mackay, D.; Shiu, W-Y; Ma, K-C Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals. Volume IV, Lewis Publishers, Boca Raton, 2006.

[j] Mackay, D.; Shiu, W-Y; Ma, K-C Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals. Volume III, Lewis Publishers, Boca Raton, 2006.

[k] Huckins, J.N.; Petty, J.D.; Orazio, C.E.; Lebo, J.A.; Clark, R.C.; Gibson, V.L.; Gala, W.R.; Echols, K.R. Environ. Sci. Technol., 1999, 33, 3918-3923.

[l] Luellen, D.R.; Shea, D. Environ. Sci. Technol., 2002, 36, 1791-1797.

Appendix G. Data Quality Summary

Laboratory Case Narrative Summary

Manchester Laboratory prepared written case narratives assessing the quality of the data collected during the 2008 spring and fall sampling events. Case narratives are available upon request. An overview of the data quality for the 2008 PBT Trends Study is summarized below.

All samples were prepared and analyzed within the methods holding times for the various parameters. Analytical laboratory methods blanks showed no significant contamination for any of the chemicals analyzed. Most Quality Control (QC) procedures and corresponding samples fell within acceptable limits. Exceptions were qualified as estimates and are briefly discussed below.

Pesticides

All calibration checks were within QC limits with a few exceptions of chlorpyrifos, DDMU, and toxaphene. Detected native samples were qualified as estimates (J).

Most recoveries of pesticide surrogates spiked into the spring and fall samples were within the acceptable range of 50% - 150%. Exceptions were for low recoveries in four spring samples and two fall samples. Spring samples included the Wenatchee River (08244804), Yakima River (08244807), Walla Walla River Replicate (08244812), and a Field-Trip Blank taken at the Duwamish River (08244813). The Walla Walla River sample results from the spring deployment were rejected due to a lab accident. Fall samples included Lake Washington (08424802) and one Field Trip Blank taken from the Spokane River. Detected results were qualified as estimates (J).

Positive qualitative identification was made for all pesticide analytes in the 2008 spring and fall sampling periods with a few exceptions. The exceptions were qualified as estimates (for relative percent differences > 40%) or nondetects (for chromatographic interference).

Where relative percent difference (RPD) between the results for an analyte on both columns was greater than 40%, the lower value was reported and flagged as an estimate (J). If chromatograph interference prevented proper identification of the analyte, the reporting limit was raised to the level of the interference.

A spiked blank was prepared for evaluation of the dialysis process. Most analytes recovered within the acceptable range of 50% - 150% except for chlorpyrifos, endrin aldehyde, methoxychlor, dacthal, and d-BHC (d-BHC spring only). These results may be biased low and have been reported at the estimated reporting limits, “UJ”, if undetected, or qualified estimates “J”, if detected.

Concentrations of technical chlordane and toxaphene were determined using 3 - 10 of the most prominent homologs for averaging and comparing to a commercial standard. Because these analytes are subject to weathering (processes in the environment that degrade) the homologues, the pattern ratios are rarely the same as the commercial standards. Therefore, if the homologs exceeded 40% RPD, the results were reported as estimated concentrations (J). A detected technical chlordane result for spring sample 08244809 has been qualified as estimate (J). Detected toxaphene results for spring samples 08244809 and 08244812 and fall samples 08424807, 08424809, 08424812 have been qualified as estimates (J).

PBDEs

Both spring and fall samples had excellent Quality Assurance (QA) results for PBDEs. Only one spring sample (#08244806) required qualification (J) because the surrogate recovery was above the acceptable range of 50% - 150% (167% recovered).

Other qualified PBDE results were qualified because they were below an elevated reporting limit (EQL). PBDE and PAH's reporting limits were raised by a multiple of 4 to account for the total extract that was split to 25% for PBDE and PAH analysis.

PAHs

Two isotopically labeled compounds (acenaphthylene-d8 and pyrene-d10) were added after recovery from the field but prior to dialysis as surrogates. All recoveries of pyrene-d10 were within 30% to 150% criteria range, whereas acenaphthylene-d8 recoveries were consistently lower and often less than 50%. Recovery of the acenaphthylene-d8 in the in-house blanks and laboratory control samples (LCS) were above 50%. Low recoveries of the surrogate compound could indicate losses during dialysis and GPC cleanups. Since recoveries of surrogate pyrene-d10 and the acenaphthylene-d8 in the in-house blanks were acceptable, no qualifiers were applied.

PCBs

Each congener reported as detected met the isotopic abundance ratio and retention time criteria for positive identification with several exceptions. These exceptions have been qualified to reflect tentative identification, and the associated numerical value represents its approximate concentration; qualified N or NJ. The values reported for these congeners were not included in the totals for the corresponding homolog.

Some spring results were considered estimates (J qualified) based on poor resolution of the congener. Poor resolution can occur for a number of reasons, one of which was directly related to high levels of the PRC spikes causing fragmented ions from the PRCs to coelute with other congeners.

A number of congeners in the fall samples were qualified as estimates (J) because the concentration was below the lowest calibration standard. Also, low levels of certain target compounds were detected in the laboratory blanks. All corresponding concentrations were qualified as nondetects with an estimated reporting limit (UJ) because the values were below the reporting limit (0.02 ng/sample) and less than 10 times that of the corresponding method blank.

Field Quality Control Samples

SPMDs

All SPMDs were retrieved for the 2008 spring and fall sampling events. SPMDs were checked for presence midway (two weeks) during the deployment period. During midcheck, the SPMD samplers were gently swished under water to remove loose sedimentation or biofouling.

Field Replicate Samples

A SPMD field replicate was deployed in the Walla Walla River for each sampling period in 2008 (spring and fall) to estimate total variability in the field and laboratory. Each replicate contained five SPMD membranes like the field sample and was deployed beside the sample within a few feet. Unfortunately, the spring field replicate (#08244812) results were rejected due to a lab accident. Results from the fall replicate sample are listed in Appendix H.

The replicates showed good precision in most cases with 95% of the residue results having RPDs of 20% or less. RPDs for p,p' DDT and b-BHC were slightly higher (33% and 40% respectively).

PCB congeners showed excellent precision for individual congeners with 88% having RPDs of 20% or less. The congeners with RPDs greater than 20% were detected near or below the detection limit (0.02 ng/sample). Only three results with RPDs >20% were more than 10 times the detection limit, and these had RPDs of less than 32%. As a result, precision was good for total PCB congeners (10% RPD).

PAH residues had good precision (<14% RPD) except for naphthalene and acenaphthene (73% and 86% respectively). Low molecular weight PAHs (LPAH) are more volatile than the high molecular weight PAHs (HPAH). The LPAH were found at lower concentrations in the field sample than in the replicate. This pattern is foretold by the low recoveries of the surrogate compound acenaphthylene-d8 for several samples in both sampling events, which included the fall Walla Walla field sample but not the fall Walla Walla replicate. Low recoveries of the surrogate compound could indicate losses during dialysis and GPC cleanups. Precision of PRC recovery in the replicates was excellent (<7% RPD).

Variability in the estimated water concentration between replicates reflects the differences in PRC recoveries. Overall, RPDs for the estimated pesticides, PBDE, PCB, and PAH concentrations remained generally within 30% or better.

Field Trip, Day0-Dialysis, and Other Blanks

Two types of blank samples were used to assess contamination during each sampling period: a field trip blank and a Day0-Dialysis blank. The field trip blank was used to determine contamination from air during deployment and retrieval. The Day0-Dialysis, along with a spiked Dialysis and solvent blank, helped assess contamination during the creation and processing of SPMD membranes at Environmental Sampling Technologies (EST) Laboratory. The field trip and Dialysis blanks consisted of five membranes each and were manufactured identical to field samples. The spiked Dialysis blank contained one membrane, and the solvent blank contained the solvent used in processing the SPMDs. All of these blanks were processed at the same time as the samples.

One field trip blank was used for the spring sampling period, and three field trip blanks were used for the fall sampling period. The Duwamish River was chosen for the field trip blank exposure for the 2008 spring sampling event. The three sites chosen for the 2008 fall field trip blank exposures were the Duwamish, Queets, and Spokane Rivers. These three blanks were added to the fall sampling event to address concerns about the representativeness and the uncertainty associated with applying the results from a single field trip blank sample to samples collected across the state. The Duwamish and Spokane River sites were considered to be high-risk areas for air contamination, whereas the Queets River reference site was assumed to have low risk for air contamination.

Field-trip blanks were transported in a sealed argon-filled stainless steel can. During or shortly after deployment of the field sample, the lid of the can was removed for a two minute exposure to ambient air. Two minutes was determined from the approximate average time the 2007 field samples were exposed during deployment and again during retrieval. Actual average total exposure time was 148 seconds (spring) and 122 seconds (fall). To increase air exposure and limit handling of the membranes, the opened can was gently moved back and forth. The blank was resealed and stored frozen until retrieval. During retrieval of the samples, the field trip blank was taken back into the field, opened, and exposed to the air for another two minutes. These blanks consisted of 5 membranes placed loosely in the bottom of the can (membranes were not mounted on spider arrays as the samples membranes were). The blanks was prepared, processed, and analyzed the same as the field samples.

The Day0-Dialysis blank was held frozen at EST during the sampling period. After the sampling period, EST processes the Day0-Dialysis blank along with the field samples in the laboratory.

The results of the field trip blank and the Day0-Dialysis blank analysis are included in Appendix C. PBDE-47, -99, -100, -153, and certain PCB congeners were detected in both the spring and fall field trip blanks. PBDE-154 was also detected in the fall field blank. LPAH (2-3 ring compounds) were detected in the field blanks for both deployments. HPAH compounds, particularly fluoranthene, pyrene, and retene, were also found in the field blanks for both deployments.

Individual PBDE, PCB, and PAH compounds were detected in the other laboratory blanks provided by EST, suggesting contamination from a combination of sources from the processing laboratory and field. Although the sources of contamination are unclear, a background level appears to be from EST and field operations. Analytical laboratory method blanks showed no significant contamination for any of the chemicals analyzed.

The contamination of blanks was substantial on a relative scale. Since this study is looking at low level concentrations, contaminants found in blanks can have a greater impact when sample results are near the reporting limit, whereas samples with higher concentrations will be impacted less. Because most samples had low concentrations of PCBs, PBDEs, and PAHs, contaminant concentrations in the field trip and Day0-Dialysis blanks were much greater than 10% of the concentrations found in samples, with many blanks having concentrations that were over 50% of the concentrations found in the samples. (In contrast, there was no CP contamination found in blanks.) Sample results were evaluated and a blank-correction procedure used, where possible, before residue results were used for estimating water column concentrations (described in the Concentration Estimation Methods section).

Field Trip and Processing Blank Comparisons

Levels of contamination in the field trip blanks and the processing laboratory blanks were similar; around 50% to 80% of the results had RPDs less than 25% for spring and fall, respectively. Field trip blanks tended to have lower values overall indicating environmental loss within a sampling period. Higher RPDs seen between the field trip blank and the Day0-Dial lab blank were greater when detections were near or below the reporting limit. The use of multiple field trip blanks in the fall better describes the variability seen among field trip blanks and between the field trip and lab blanks.

Precision was generally good among the three fall field trip blanks and the single spring field trip blank. The blanks had identical pesticide results, all below the method detection limits. Five identical PBDE congeners were detected in all the blanks. One blank had an additional PBDE congener detected; the Duwamish River site. Relative standard deviation (RSD) for the PBDEs was less than 15% among the fall blanks and under 30% for all blanks (spring and fall), except for one congener at 54%, which had low detections.

Similar results for PAHs revealed eight identical analytes detected in both spring and fall field trip blanks. Four additional analytes were detected in the spring and one additional analyte in two of the three fall blanks (Queets and Spokane River sites). Variability for PAHs ranged from 0% to 95% RSD, although 72% of the results were less than 30% RSD overall.

Most (88%) PCB congeners among the fall blanks were 30% RSD or less. Those PCB congeners with RSDs greater than 30% were near or below the detection limit (0.02 ng). Variability was high among the spring and fall field trip blanks: 82% of the congeners were > 30% RSD. This large variation is likely due to differences in the total PCB spiking solutions and sources of that solution in spring versus fall. Initial examination of individual PCB congeners showed mixed results for identifying common congeners but revealed a pattern in concentrations: spring levels were generally higher than fall.

The similarities among the spring and fall field trip blanks suggest a background contamination as mentioned above.

TidbiTs

Onset StowAway TidbiTs™ were used to measure water and air temperature during deployment. These data were used to determine if the SPMDs remained submerged during deployment. One TidbiT™ was attached to the top of each SPMD canister holding the membranes in the water and another TidbiT™ was secured out of the water nearby. Each TidbiT™ was programmed to record temperature every two minutes. The date and time of deployment and retrieval was recorded to capture the exact monitoring period.

Upon retrieval, the data were downloaded and charted for comparing the water and air temperature. If the SPMDs were out of the water during the sample periods, a spike in water temperature appeared on the graph and followed the same temperature values as the air during the time period the SPMDs were exposed to the air. Three TidbiTs™ displayed error messages upon downloading the data. These pertained to the Yakima, Upper Columbia, and Okanogan River sites. Only the Upper Columbia and Okanogan River air sampling TidbiTs™ resulted in data lost. The data from the TidbiTs™ mounted on the SPMDs did not show any spikes relating to air exposure and showed similar patterns to other sites, thus indicating the SPMDs were not compromised.

All results used in this study were from SPMDs that remained submerged during the monitoring period. Mean water temperatures can be found in Appendix D.

PRC and Surrogate Recoveries

The PRC and surrogate recoveries were within acceptable ranges: 20 - 80% recovery for PRCs and 25 – 150% for the surrogates. There were some exceptions for PRCs. PRCs with low K_{ow} values such as PCB-004, typically dissipate faster than the more hydrophobic PRCs. Recoveries for PCB-004 ranged from 10% to 64% which were considered acceptable since the other PRCs were within range. High PRC recoveries were reported for sample number 08244820 (the spring Day0-Dial blank) by a factor of 2. These recoveries were verified by applying a 10 times dilution and reanalysis. An inadvertent double spiking of the PRCs at the time of manufacturing may explain the high recoveries since the surrogates and other PCB results for this sample as well as the PRC results for all other samples were reasonable. PRC recoveries can be found in Appendix E.

Appendix H. Field Replicate Results

H-1. Field Replicate Results: September - October Fall Deployment, 2008.

Residue Accumulated in SPMD (ng/5-SPMDs)						Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %	Walla Walla		RepWalla		RPD %
p,p'-DDT	21	J	15	J	33	11	J	7.5	J	38
p,p'-DDE	140		130		9	76		64		17
p,p'-DDD	44		39		12	23		19		20
o,p'-DDT	10	U	10	U		5.2	U	4.9	U	7
o,p'-DDE	10	U	10	U		5.2	U	4.9	U	6
o,p'-DDD	15		14		7	8.1		7.0		14
DDMU	10	U	10	U		5.3	U	4.9	U	7
Dieldrin	12	J	11	J	9	13	J	11	J	14
Chlorpyrifos	57	J	64	J	12	120	J	130	J	11
Endosulfan I	17		16		6	380		350		7
Endosulfan-II	12	J	11	J	9	560	J	510	J	10
Endosulfan Sulfate	22		20		10	700		640		10
Hexachlorobenzene (HCB)	52		51		2	27		24		9
Pentachloroanisole (PCA)	10	U	10	U		5.3	U	5.0	U	7
Toxaphene	590	J	510	J	15	520	J	430	J	18
Chlordane (technical)	100	U	100	U		58	U	53	U	8
trans-Chlordane	10	U	10	U		5.4	U	5.1	U	5
cis-Chlordane	10	U	10	U		5.4	U	5.1	U	5
Dacthal	10	UJ	10	UJ		19	UJ	19	UJ	1
trans-Nonachlor	10	U	10	U		5.9	U	5.5	U	8
cis-Nonachlor	10	U	10	U		5.6	U	5.2	U	8
Heptachlor	10	U	10	U		5.9	U	5.6	U	6
Heptachlor Epoxide	10	U	10	U		12	U	12	U	2
a-BHC: alpha-Benzenehexachloride	10	U	10	U		47	U	47	U	1
b-BHC: beta-Benzenehexachloride	10	U	15	UJ		47	U	70	UJ	39

Residue Accumulated in SPMD (ng/5-SPMDs)						Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %	Walla Walla		RepWalla		RPD %
d-BHC: delta-Benzenehexachloride	10	U	10	U		25	U	25	U	1
Lindane	10	U	10	U		68	U	68	U	
aldrin	10	U	10	U		5.3	U	4.9	U	8
Endrin	10	U	10	U		10	U	9.8	U	2
endrin ketone	10	U	10	U		6.7	U	6.5	U	4
endrin aldehyde	10	UJ	10	UJ		8	UJ	7.8	UJ	2
Mirex	10	U	10	U		7.7	U	7.1	U	8
p,p'-Methoxychlor	10	UJ	10	UJ		10	UJ	10	UJ	1
Oxychlordane	10	U	10	U		5.3	U	5.0	U	7

J = estimated concentration.
U = not detected at or above reported result.
UJ = not detected at or above reported estimated result.

Performance/Permeability Reference Compound (percent recovered)			
PRC	Walla Walla	RepWalla	RPD %
PCB-004	28	27	2
PCB-029	127	118	7
PCB-050	125	119	5

Table H-1. (continued)

Parameter	Residue Accumulated in SPMD (ng/5-SPMDs) Walla Walla		RepWalla		RPD %	Estimated Water Concentration RPD% Walla Walla		RepWalla		RPD %
Naphthalene	130		280		73	1800	UJK	3800	UJK	73
2-Methylnaphthalene	280		300		7	1300	UJK	1400	UJK	7
1-Methylnaphthalene	160		160		0	740	UJK	740	UJK	
2-Chloronaphthalene	40	U	40	U		210	U	210	U	
Acenaphthylene	40	U	40	U		110	U	110	U	
Acenaphthene	40	U	100	J	86	82	U	200	J	85
Dibenzofuran	150		170		13	100	JK	150	JK	40
Fluorene	200		220		10	300	UJK	330	UJK	8
Phenanthrene	540		560		4	490	JK	510	JK	4
Anthracene	40	U	40	U		46	U	45	U	2
Carbazole	40	U	40	U		1000	U	1000	U	
Fluoranthene	270		270			130	JK	120	JK	5
Pyrene	110		110			45	JK	43	JK	6
Retene	110		110			18	JK	17	JK	8
Benzo(a)anthracene	40	U	40	U		21	U	19	U	7
Chrysene	40	U	40	U		21	U	19	U	7
Benzo(b)fluoranthene	40	U	40	U		21	U	19	U	7
Benzo(k)fluoranthene	40	U	40	U		22	U	21	U	8
Benzo(a)pyrene	40	U	40	U		24	U	22	U	8
Indeno(1,2,3-cd)pyrene	40	U	40	U		29	U	26	U	8
Dibenzo(a,h)anthracene	40	U	40	U		25	U	23	U	8
Benzo(ghi)perylene	40	U	40	U		31	U	29	U	8

J = estimated concentration.
JK = estimated concentration with unknown bias.
U = not detected at or above reported result.
UJ = not detected at or above reported estimated result.
UJK = not detected at or above reported estimated result with unknown bias.

Table H-1. (continued)

	Residue Accumulated in SPMD (ng/5-SPMDs)							Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %			Walla Walla		RepWalla		RPD %
PBDE-47	22.9		22		4			3.2	JK	2.5	JK	25
PBDE-49	1.7	J	4	U				1.0	UJK	2.1	U	74
PBDE-66	4	U	4	U				2.3	U	2.1	U	8
PBDE-71	4	U	4	U				2.1	U	2.0	U	7
PBDE-99	16.8		14.5		15			12	UJK	9.5	UJK	23
PBDE-100	4.8		3.9	J	21			3.2	UJK	2.4	UJK	29
PBDE-138	16	U	16	U				20	U	18	U	8
PBDE-153	11.6	J	11	J	5			11	UJK	9.3	UJK	14
PBDE-154	9.1	J	9	J	1			9.8	UJK	8.9	UJK	9
PBDE-183	16	U	16	U				22	U	20	U	8
PBDE-184	16	UJ	16	UJ				33	U	31	U	8
PBDE-191	16	U	16	U				36	U	33	U	8
PBDE-209	100	U	100	U				700	U	650	U	8

J = estimated concentration.
JK = estimated concentration with unknown bias.
U = not detected at or above reported result.
UJ = not detected at or above reported estimated result.
UJK = not detected at or above reported estimated result with unknown bias.

Table H-1. (continued)

Residue Accumulated in SPMD (ng/5-SPMDs)						Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %	Walla Walla		RepWalla		RPD %
PCB-001	0.27		0.28		3	0.35	UJK	0.35	UJK	1
PCB-002	0.065		0.079		19	0.013	JK	0.025	JK	63
PCB-003	0.18		0.2		10	0.053	JK	0.069	JK	25
PCB-004	28		27		2	27	UJK	26	UJK	5
PCB-005	0.11		0.1		7	0.037	JK	0.031	JK	18
PCB-006	0.57		0.58		2	0.13	JK	0.13	JK	
PCB-007	0.12		0.13		5	0.022	JK	0.025	JK	11
PCB-008	2.8		2.8		1	0.69	JK	0.67	JK	3
PCB-009	0.22		0.22		2	0.048	JK	0.048	JK	
PCB-010	0.062		0.062		0	0.048	UJK	0.046	UJK	4
PCB-011	1.8		1.8		1	0.56	JK	0.52	JK	7
PCB-012/013	0.28		0.3		7	0.16	UJK	0.16	UJK	1
PCB-014	34		35		4	19	UJK	19	UJK	2
PCB-015	1.2		1.3		2	0.32	JK	0.31	JK	2
PCB-016	1.8		1.7		8	0.54	JK	0.44	JK	22
PCB-017	1.8		1.7		6	0.48	JK	0.39	JK	20
PCB-018/030	4.1		3.9		4	1.0	JK	0.9	JK	15
PCB-019	0.41		0.41		2	0.075	JK	0.068	JK	11
PCB-020/028	6.2		5.6		10	1.7	JK	1.3	JK	27
PCB-021/033	3.2		2.8		13	0.88	JK	0.63	JK	33
PCB-022	2.0		1.7		15	0.54	JK	0.38	JK	36
PCB-023	0.019	J	0.016	J	16	0.0022	JK	0.0078	UJK	110
PCB-024	0.063		0.062		2	0.018	JK	0.016	JK	10
PCB-025	0.02	U	0.02	U		0.01	U	0.0096	U	7
PCB-026/029	130		120		7	66	UJK	57	UJK	14
PCB-027	0.33		0.31		6	0.071	JK	0.058	JK	21

	Residue Accumulated in SPMD (ng/5-SPMDs)			Estimated Water Concentration RPD%		
Parameter	Walla Walla	RepWalla	RPD %	Walla Walla	RepWalla	RPD %
PCB-031	5.3	4.8	11	1.4 JK	1.0 JK	29
PCB-032	1.2	1.1	6	0.28 JK	0.23 JK	21
PCB-034	0.03	0.027	10	0.0072 JK	0.0053 JK	29
PCB-035	0.12	0.11	11	0.025 JK	0.017 JK	38
PCB-036	0.02 U	0.026	27	0.01 U	0.0024 JK	130
PCB-037	1.01	0.86	17	0.3 JK	0.2 JK	38
PCB-038	0.027	0.02 J	32	0.0065 JK	0.0026 JK	87
PCB-039	0.029	0.026	9	0.0054 JK	0.0038 JK	36
PCB-040/071	1.5	1.3	14	0.42 JK	0.3 JK	35
PCB-041	0.47	0.35	30	0.15 JK	0.085 JK	58
PCB-042	1.1	0.93	15	0.32 JK	0.22 JK	34
PCB-043	0.2	0.19	6	0.056 JK	0.047 JK	18
PCB-044/047/065	3.8	3.3	13	1.1 JK	0.78 JK	32
PCB-045	0.74	0.66	10	0.2 JK	0.16 JK	26
PCB-046	0.28	0.26	9	0.079 JK	0.062 JK	24
PCB-048	0.9	0.79	13	0.27 JK	0.19 JK	31
PCB-049/069	2.4	2.1	12	0.71 JK	0.52 JK	30
PCB-050/053	12	120	5	65 UJK	58 UJK	12
PCB-051	0.22	0.21	4	0.056 JK	0.048 JK	14
PCB-052	4.2	3.8	11	1.2 JK	0.91 JK	28
PCB-054	0.012 J	0.01 NJ	14	0.0024 JK	0.0058 UJK	82
PCB-055	0.072	0.02 U	113	0.019 JK	0.01 U	61
PCB-056	0.87	0.75	15	0.28 JK	0.2 JK	34
PCB-057	0.021	0.017 J	22	0.012 UJK	0.0087 UJK	30
PCB-058	0.02 U	0.02 U		0.011 U	0.01 U	8
PCB-059/062/075	0.37	0.33	13	0.11 JK	0.079 JK	31
PCB-060	0.54	0.47	14	0.18 JK	0.13 JK	31

Residue Accumulated in SPMD (ng/5-SPMDs)							Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %		Walla Walla		RepWalla		RPD %
PCB-061/070/074/076	3.8		3.2		15		1.2	JK	0.89	JK	33
PCB-063	0.1		0.089		16		0.035	JK	0.024	JK	37
PCB-064	1.4		1.2		15		0.44	JK	0.31	JK	34
PCB-066	2.0		1.7		13		0.64	JK	0.47	JK	31
PCB-067	0.1		0.089		12		0.033	JK	0.025	JK	29
PCB-068	0.087		0.081		8		0.012	JK	0.0082	JK	42
PCB-072	0.024		0.023		3		0.0081	JK	0.007	JK	13
PCB-073	0.059		0.045		26		0.011	JK	0.022	UJK	72
PCB-077	0.15		0.13		12		0.051	JK	0.038	JK	28
PCB-078	51		48		7		30	UJK	26	UJK	15
PCB-079	0.02	U	0.014	NJ			0.012	U	0.0081	UJK	40
PCB-080	0.02	U	0.02	U			0.012	U	0.012	U	8
PCB-081	0.02	U	0.02	U			0.012	U	0.011	U	8
PCB-082	0.2		0.18		10		0.074	JK	0.059	JK	22
PCB-083	0.094		0.086		8		0.034	JK	0.028	JK	20
PCB-084	0.55		0.48		14		0.19	JK	0.14	JK	31
PCB-085/116	0.37		0.27		32		0.16	JK	0.096	JK	52
PCB-086/087/097/108/119/125	1.3		1.2		14		0.55	JK	0.41	JK	29
PCB-088	0.02	U	0.02	U			0.011	U	0.01	U	8
PCB-089	0.071		0.062		15		0.016	JK	0.0096	JK	47
PCB-090/101/113	2.5		2.1		15		1.0	JK	0.76	JK	30
PCB-091	0.32		0.27		16		0.11	JK	0.082	JK	32
PCB-092	0.48		0.44		9		0.2	JK	0.16	JK	21
PCB-093/100	0.11		0.1		9		0.0098	JK	0.053	UJK	140
PCB-094	0.017	J	0.014	J	18		0.0094	UJK	0.0073	UJK	25
PCB-095	2.01		1.8		13		0.71	JK	0.53	JK	29
PCB-096	0.037		0.031		18		0.011	JK	0.0076	JK	39

Residue Accumulated in SPMD (ng/5-SPMDs)							Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %		Walla Walla		RepWalla		RPD %
PCB-098	0.054		0.02	U	91		0.0017	JK	0.01	U	140
PCB-099	0.93		0.83		12		0.41	JK	0.32	JK	25
PCB-102	0.083		0.1		22		0.031	JK	0.04	JK	23
PCB-103	0.024		0.021		12		0.0066	JK	0.0047	JK	34
PCB-104	0.0047	NJ	0.0052	NJ	12		0.0024	UJK	0.0025	UJK	4
PCB-105	0.49		0.45		8		0.26	JK	0.21	JK	19
PCB-106	0.02	U	0.02	U			0.013	U	0.012	U	8
PCB-107/124	0.057		0.053		8		0.03	JK	0.025	JK	19
PCB-109	0.093		0.082		13		0.047	JK	0.037	JK	24
PCB-110	2.0		1.8		12		0.91	JK	0.7	JK	25
PCB-111	0.02	U	0.02	U			0.014	U	0.013	U	8
PCB-112	0.02	U	0.02	U			0.012	U	0.011	U	8
PCB-114	0.034		0.032		5		0.016	JK	0.013	JK	15
PCB-115	0.02	U	0.02	U			0.012	U	0.012	U	8
PCB-117	0.02	U	0.067				0.012	U	0.029	JK	81
PCB-118	1.1		1.0		8		0.62	JK	0.51	JK	19
PCB-120	0.02	U	0.02	U			0.015	U	0.013	U	8
PCB-121	0.02	U	0.0044	NJ			0.013	U	0.0027	UJK	130
PCB-122	0.02	U	0.02	U			0.013	U	0.012	U	8
PCB-123	0.036		0.03		17		0.016	JK	0.011	JK	37
PCB-126	0.016	NJ	0.02	U	23		0.0032	JK	0.014	U	130
PCB-127	0.02	U	0.02	U			0.016	U	0.015	U	8
PCB-128/166	0.25		0.24		5		0.15	JK	0.13	JK	14
PCB-129/138/163	1.7		1.6		9		1.0	JK	0.86	JK	20
PCB-130	0.11		0.1		10		0.067	JK	0.054	JK	21
PCB-131	0.022		0.018	J	16		0.014	UJK	0.011	UJK	23
PCB-132	0.49		0.42		15		0.24	JK	0.18	JK	28

Residue Accumulated in SPMD (ng/5-SPMDs)						Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %	Walla Walla		RepWalla		RPD %
PCB-133	0.034		0.028		17	0.017	JK	0.012	JK	35
PCB-134	0.13		0.11		17	0.067	JK	0.049	JK	30
PCB-135/151	1.0		0.88		14	0.47	JK	0.36	JK	28
PCB-136	0.41		0.33		22	0.15	JK	0.1	JK	43
PCB-137	0.049		0.037		29	0.026	JK	0.016	JK	50
PCB-139/140	0.031		0.028		8	0.014	JK	0.011	JK	21
PCB-141	0.28		0.25		9	0.14	JK	0.12	JK	22
PCB-142	0.02	U	0.02	U		0.013	U	0.012	U	8
PCB-143	0.016	J	0.013	J	18	0.01	UJK	0.0081	UJK	26
PCB-144	0.14		0.12		19	0.064	JK	0.044	JK	37
PCB-145	0.011	J	0.0088	J	21	0.0063	UJK	0.0047	UJK	29
PCB-146	0.27		0.25		10	0.16	JK	0.13	JK	21
PCB-147/149	1.8		1.5		16	0.9	JK	0.67	JK	30
PCB-148	0.02	U	0.02	U		0.014	U	0.013	U	8
PCB-150	0.02	U	0.02	U		0.012	U	0.011	U	8
PCB-152	0.056		0.05		7	0.0036	JK	0.027	UJK	150
PCB-153/168	1.5		1.4		10	0.99	JK	0.8	JK	22
PCB-154	0.017	J	0.018	J	5	0.012	UJK	0.012	UJK	3
PCB-155	0.013	J	0.012	J	13	0.0022	JK	0.0011	JK	65
PCB-156/157	0.11		0.1		8	0.08	JK	0.066	JK	19
PCB-158	0.15		0.14		10	0.099	JK	0.08	JK	22
PCB-159	0.017	NJ	0.014	NJ	17	0.016	UJK	0.012	UJK	25
PCB-160	0.02	U	0.02	U		0.016	U	0.015	U	8
PCB-161	0.02	U	0.02	U		0.017	U	0.016	U	8
PCB-162	0.02	U	0.02	U		0.019	U	0.018	U	8
PCB-164	0.1		0.092		7	0.066	JK	0.056	JK	18
PCB-165	0.02	U	0.02	U		0.017	U	0.016	U	8

	Residue Accumulated in SPMD (ng/5-SPMDs)						Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %	Walla Walla		RepWalla		RPD %
PCB-167	0.046		0.043		8	0.035	JK	0.029	JK	19
PCB-169	0.0087	NJ	0.0079	NJ	9	0.0095	UJK	0.008	UJK	18
PCB-170	0.15		0.14		2	0.1	JK	0.093	JK	11
PCB-171/173	0.083		0.073		12	0.052	JK	0.04	JK	25
PCB-172	0.038		0.035		8	0.029	JK	0.024	JK	19
PCB-174	0.32		0.28		14	0.21	JK	0.16	JK	28
PCB-175	0.022		0.018	J	22	0.02	UJK	0.015	UJK	30
PCB-176	0.07		0.062		12	0.034	JK	0.026	JK	26
PCB-177	0.2		0.18		11	0.13	JK	0.1	JK	22
PCB-178	0.1		0.09		12	0.067	JK	0.052	JK	26
PCB-179	0.3		0.25		15	0.14	JK	0.1	JK	31
PCB-180/193	0.42		0.4		5	0.32	JK	0.27	JK	16
PCB-181	0.0069	J	0.02	U	98	0.0061	UJK	0.016	U	91
PCB-182	0.02	U	0.02	U		0.019	U	0.017	U	8
PCB-183	0.2		0.19		7	0.13	JK	0.11	JK	18
PCB-184	0.02	U	0.02	U		0.015	U	0.014	U	8
PCB-185	0.056		0.038		39	0.035	JK	0.017	JK	68
PCB-186	40		36		10	28	UJK	23	UJK	18
PCB-187	0.61		0.56		9	0.42	JK	0.34	JK	20
PCB-188	0.02	U	0.02	U		0.015	U	0.014	U	8
PCB-189	0.0065	J	0.0072	J	10	0.0088	UJK	0.0089	UJK	1
PCB-190	0.043		0.042		3	0.038	JK	0.033	JK	13
PCB-191	0.0088	J	0.0083	J	6	0.011	UJK	0.0092	UJK	14
PCB-192	0.02	U	0.02	U		0.024	U	0.022	U	8
PCB-194	0.064		0.057		11	0.061	JK	0.047	JK	26
PCB-195	0.032		0.029		9	0.026	JK	0.021	JK	21
PCB-196	0.05		0.042		18	0.048	JK	0.034	JK	33

Residue Accumulated in SPMD (ng/5-SPMDs)						Estimated Water Concentration RPD%				
Parameter	Walla Walla		RepWalla		RPD %	Walla Walla		RepWalla		RPD %
PCB-197	0.02	U	0.02	U		0.02	U	0.018	U	8
PCB-198/199	0.15		0.13		10	0.12	JK	0.097	JK	22
PCB-200	0.026		0.022		14	0.018	JK	0.013	JK	29
PCB-201	0.034		0.033		5	0.03	JK	0.025	JK	16
PCB-202	0.064		0.061		5	0.044	JK	0.037	JK	15
PCB-203	0.094		0.079		17	0.094	JK	0.068	JK	31
PCB-204	0.043		0.041		4	0.043	UJK	0.038	UJK	13
PCB-205	0.02	U	0.0064	NJ	104	0.034	U	0.0099	UJK	110
PCB-206	0.05		0.046		9	0.074	JK	0.061	JK	19
PCB-207	0.012	J	0.011	J	10	0.017	UJK	0.014	UJK	19
PCB-208	0.03		0.026		15	0.032	JK	0.024	JK	27
PCB-209	0.068		0.069		1	0.088	JK	0.083	JK	6

J = estimated concentration.
JK = estimated concentration with unknown bias.
U = not detected at or above reported result.
UJ = not detected at or above reported estimated result.
UJK = not detected at or above reported estimated result with unknown bias.

Appendix I. Streamflow Data

Table I-1. Flow Data for the 2008 PBT Trends Study, Spring.

Site Location	River Mile	Source of Flow Data	Station Identifier	Station Identifier Name	Date	Flow Range (cfs)	Geometric Mean (cfs)
Lower Columbia River	54	USGS	14246900	Columbia River @ Beaver Army Terminal near Quincy, OR	5/5/2008 - 6/2/2008	247,000-515,000	404,296.6
Duwamish River	10[a]	USGS	12113000	Green River near Auburn, WA	5/7/2008 - 6/4/2008	1,850-6,250	3,406.2
Lake Washington	na	King Co.	King County, 2005	controlled water level: fluctuation ~ 2 ft	5/7/2008 - 6/4/2008	Flushing Rate 0.43 / year	-
Snohomish River	12.5[b]	USGS	12150800 12155300	Snohomish River near Monroe, WA Pilchuck River near Snohomish, WA	5/7/2008 - 6/9/2008	10,337-42,620	21,366.5
Wenatchee River	7.1	USGS	12462500	Wenatchee River at Monitor, WA	5/8/2008 - 6/5/2008	4,880-22,000	10,758.5
Upper Columbia River	453.5	USGS	12462600	Columbia River below Rock Island Dam, WA	5/8/2008 - 6/5/2008	133,000-245,000	184,119.7
Okanogan River	17	USGS	12447200	Okanogan River at Malott, WA	5/8/2008 - 6/5/2008	3,620-19,500	9,995.5
Yakima River	18	USGS	12510500	Yakima River at Kiona, WA	5/8/2008 - 6/5/2008	3,920-14,300	6,670.8
Middle Columbia River	292[c]	USACE & USGS	McNary & 14019200	Columbia River at McNary Dam near Umatilla, OR	5/8/2008 - 6/5/2008	224,100-424,000	337,230.3
Walla Walla River	9	USGS	14018500	Walla Walla River near Touchet, WA	5/8/2008 - 6/5/2008	1,120-2,930	1,665.5
Spokane River	58.1[d]	USGS & Spokane	12422500 12424000 City of Spokane 2008	Spokane River at Spokane, WA Hangman Creek at Spokane, WA RPWRF Spokane WWTP	5/9/2008 - 6/6/2008	20,132-40,935	30,163.8
Queets River	11.5[e]	USGS	12040500	Queets River near Clearwater, WA	5/6/2008 - 6/3/2008	1,563-4,366	1,786.6

a. Mill and Spring Creeks discharge below the USGS station upstream of the sampling station. Mill and Spring Creeks' historical averaged monthly high discharge is not significant at 34 and 19 cfs respectively.

b. Flow for the Snohomish station was the sum discharge from Snohomish and Pilchuck Rivers.

c. Flow for the McNary site was the Outflow Discharge.

d. Flow for the Spokane site was the sum discharge from Spokane River, Hangman Creek, and the Spokane Wastewater Treatment Plant. Historical (1995-2008) WWTP contribution ranged from .28-5.27%.

e. Flow for the Queets site was calculated by subtracting the Clearwater River percent contribution (23%) from the Queets River flow data based on available historical data for the Queets River above Clearwater.

Table I-2. Flow Data for the 2008 PBT Trends Study, Fall.

Site Location	River Mile	Source of Flow Data	Station Identifier	Station Identifier Name	Date	Flow Range (cfs)	Geometric Mean (cfs)
Lower Columbia River	54	USGS	14246900	Columbia River @ Beaver Army Terminal near Quincy, OR	9/12/2008 - 10/10/2008	95,000-129,000	109,985.0
Duwamish River	10[a]	USGS	12113000	Green River nr Auburn, WA	9/11/2008 - 10/9/2008	274-712	456.9
Lake Washington	na	King Co.	King County, 2005	Controlled water level: fluctuation ~ 2 ft	9/11/2008 - 10/9/2008	Flushing Rate 0.43 / year	-
Snohomish River	12.5[b]	USGS	12150800 12155300	Snohomish River near Monroe, WA Pilchuck River near Snohomish, WA	9/11/2008 - 10/9/2008	2,201-7,876	3,041.1
Wenatchee River	7.1	USGS	12462500	Wenatchee River at Monitor, WA	9/8/2008 - 10/6/2008	440-712	529.0
Upper Columbia River	453.5	USGS	12462600	Columbia River below Rock Island Dam, WA	9/9/2008 - 10/7/2008	39,300-81,100	56,838.8
Okanogan River	17	USGS	12447200	Okanogan River at Malott, WA	9/9/2008 - 10/7/2008	801-1,380	1,047.3
Yakima River	18	USGS	12510500	Yakima River at Kiona, WA	9/9/2008 - 10/7/2008	1,280-2,470	1,820.6
Middle Columbia River	292[c]	USACE & USGS	McNary & 14019200	Columbia River at McNary Dam near Umatilla, OR	9/9/2008 - 10/7/2008	60,800-107,100	78,106.7
Walla Walla River	9	USGS	14018500	Walla Walla River nr Touchet, WA	9/9/2008 - 10/7/2008	23-67	38.3
Spokane River	58.1[d]	USGS & Spokane	12422500 12424000 City of Spokane 2008	Spokane River at Spokane, WA Hangman Creek at Spokane, WA RPWRF Spokane WWTP	9/10/2008 - 10/8/2008	1,695-2,338	2,016.7
Queets River	11.5[e]	USGS	12040500	Queets River near Clearwater, WA	9/8/2008 - 10/6/2008	454-7,508	864.0

a. Mill and Spring Creeks discharge below the USGS station upstream of the sampling station. Mill and Spring Creeks' historical averaged monthly high discharge is not significant at 34 and 19 cfs respectively.
b. Flow for the Snohomish station was the sum discharge from Snohomish and Pilchuck Rivers.
c. Flow for the McNary site was the Outflow Discharge.

d. Flow for the Spokane site was the sum discharge from Spokane River, Hangman Creek, and the Spokane Wastewater Treatment Plant. Historical (1995-2008) WWTP contribution ranged from .28-5.27%.

e. Flow for the Queets site was calculated by subtracting the Clearwater River percent contribution (23%) from the Queets River flow data based on available historical data for the Queets River above Clearwater.

Appendix J. Ancillary Water Quality Data

Table J-1. Ancillary Water Quality Data, Spring.

Site	Field ID	Sample Number	Collection Date	Conduct. (us/cm)	TSS (mg/L)	TOC (mg/L)	Salinity (g/kg)	
Lower Columbia River	LCR	8194800	5/5/2008	153	17	2.2	NA	
	LCR	8214800	5/19/2008	148	100	2.0	NA	
	LCR	8234800	6/2/2008	106	53	2.6	NA	
Duwamish River	DUWAM	8194801	5/7/2008	47	22	1.1	2.0	U
	DUWAM	8214801	5/21/2008	40	53	1.9	2.0	U
	DUWAM	8234801	6/4/2008	69	18	1.6	2.0	U
Lake Washington	WASH	8194802	5/7/2008	113	1	2.4	NA	
	WASH	8214802	5/21/2008	113	2	2.5	NA	
	WASH	8234802	6/4/2008	119	2	2.4	NA	
Snohomish River	SNOHO	8194803	5/7/2008	35	23	1.5	2.0	U
	SNOHO	8214803	5/21/2008	17	63	2.3	2.0	U
	SNOHO	8234803	6/4/2008	20	33	2.5	2.0	U
Wenatchee River	WEN	8194804	5/8/2008	46	17	2.0	NA	
	WEN	8214804	5/21/2008	28	39	2.1	NA	
	WEN	8234804	6/5/2008	38	11	1.5	NA	
Upper Columbia River at Rock Island Dam	ROCK	8194805	5/8/2008	148	3	1.5	NA	
	ROCK	8214805	5/21/2008	112	12	2.4	NA	
	ROCK	8234805	6/5/2008	124	6	2.5	NA	
Okanogan River	OKAN	8194806	5/8/2008	168	54	5.4	NA	
	OKAN	8214806	5/21/2008	75	61	10.7	NA	
	OKAN	8234806	6/5/2008	119	59	5.1	NA	

Site	Field ID	Sample Number	Collection Date	Conduct. (us/cm)	TSS (mg/L)	TOC (mg/L)	Salinity (g/kg)
Yakima River at Wanawish Dam	YAK	8194807	5/8/2009	163	63	3.1	NA
	YAK	8214807	5/22/2008	102	98	4	NA
	YAK	8234807	6/5/2008	139	48	2.3	NA
Middle Columbia River at McNary Dam	MCNARY	8194808	5/8/2008	174	5	2.0	NA
	MCNARY	8214808	5/22/2008	122	7	3.8	NA
	MCNARY	8234808	6/5/2008	59	5	2.3	NA
Walla Walla River	WALLA	8194809	5/8/2008	86	105	3.1	NA
	WALLA	8214809	5/22/2008	65	141	3.0	NA
	WALLA	8234809	6/5/2008	40	73	2.6	NA
Spokane River at Nine Mile Dam	SPOK	8194810	5/9/2008	76	10	2.2	NA
	SPOK	8214810	5/23/2008	51.8	14	2.0	NA
	SPOK	8234810	6/6/2008	23	7	1.7	NA
Queets River	QUEETS	8194811	5/6/2009	77	11	1.3	NA
	QUEETS	8214811	5/20/2008	63	68	1.5	NA
	QUEETS	8234811	6/3/2008	74	19	1.0 U	NA

U = Not detected at or above reported quantitation limit.

Table J-2. Ancillary Water Quality Data, Fall.

Site	Field ID	Sample Number	Collection Date	Conduct. (us/cm)	TSS (mg/L)	TOC (mg/L)	Salinity (g/kg)
Lower Columbia River	LCR	8374800	9/12/2008	139	5	1.5	NA
	LCR	8394800	9/26/2008	135	8	1.6	NA
	LCR	8414800	10/10/2008	68	5	1.4	NA
Duwamish River	DUWAM	8374801	9/11/2008	185	5	1.4	1.0 U
	DUWAM	8394801	9/25/2008	86	8	1.3	1.0 U
	DUWAM	8414801	10/9/2008	95	10	1.3	1.0 U
Lake Washington	WASH	8374802	9/11/2008	105	1 U	2.2	NA
	WASH	8394802	9/25/2008	97	1 U	2.2	NA
	WASH	8414802	10/9/2008	98	1 U	2.1	NA
Snohomish River	SNOHO	8374803	9/11/2008	50	7	1.0 U	1.0 U
	SNOHO	8394803	9/25/2008	46	9	1.0	1.0 U
	SNOHO	8414803	10/9/2008	33	12	1.9	1.0 U
Wenatchee River	WEN	8374804	9/8/2008	54	1	1.0 U	NA
	WEN	8394804	9/23/2008	71	1 U	1.0 U	NA
	WEN	8414804	10/6/2008	32	2	1.0	NA
Upper Columbia River at Rock Island Dam	ROCK	8374805	9/9/2008	130	2	1.5	NA
	ROCK	839/4805	9/23/2008	130	1	1.4	NA
	ROCK	8414805	10/7/2008	64	2	1.7	NA
Okanogan River	OKAN	8374806	9/9/2008	273	7	3.1	NA
	OKAN	8394806	9/22/2008	297	3	3.0	NA
	OKAN	8414806	10/7/2008	150	3	2.9	NA
Yakima River at Wanawish Dam	YAK	8374807	9/9/2008	138	2	1.8	NA
	YAK	8394807	9/24/2008	251	4	1.9	NA
	YAK	8414807	10/7/2008	*	7	1.7	NA

Site	Field ID	Sample Number	Collection Date	Conduct. (us/cm)	TSS (mg/L)		TOC (mg/L)		Salinity (g/kg)
Middle Columbia River at McNary Dam	MCNARY	8374808	9/9/2008	73	3		1.6		NA
	MCNARY	8394808	9/24/2008	143	3		2.0		NA
	MCNARY	8414808	10/7/2008	*	2		1.5		NA
Walla Walla River	WALLA	8374809	9/9/2008	300	2		2.2		NA
	WALLA	8394809	9/24/2008	277	2		2.7		NA
	WALLA	8414809	10/7/2008	*	2		2.5		NA
Spokane River at Nine Mile Dam	SPOK	8374810	9/10/2008	289	1	U	1.0	U	NA
	SPOK	8394810	9/24/2008	190	1	U	1.0		NA
	SPOK	8414810	10/8/2008	171	2		1.1		NA
Queets River	QUEETS	8374811	9/8/2008	80	4		1.0	U	NA
	QUEETS	8394811	9/22/2008	77	3		1.0	U	NA
	QUEETS	8414811	10/6/2008	55	25		2.0		NA

U = Not detected at or above reported quantitation limit.
*Data not usable due to poor calibration.

Appendix K. Estimated Dissolved Concentrations in SPMDs, 2008

Table K-1. Estimated Concentration of Pesticides and Total PCBs Detected in SPMDs, May - June 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807	8244808	8244809	8244810	8244811	8244812
p,p'-DDT	<4.3	<6.6	<5.8	<6.7	**21**	**12**	**11**	**6.0**	**8.1**	**33**	**7.2**	<8.4	no data
p,p'-DDE	**39**	<7.1	**8.7**	<7.2	**33**	**54**	**61**	**58**	**63**	**140**	**9.0**	<9.3	"
p,p'-DDD	**25**	<6.5	**13**	<6.7	<5.4	**49**	**20**	**13**	**46**	**24**	<5.0	<8.4	"
o,p'-DDT	<4.2	<6.5	<5.8	<6.6	<5.4	<6.2	<7.7	<3.4	<7.3	**8.4**	<5.0	<8.4	"
o,p'-DDE	<4.2	<6.5	<5.8	<6.7	<5.4	<6.2	<7.7	<3.4	<7.3	<5.2	<5.0	<8.4	"
o,p'-DDD	**7.9**	<7.0	<6.1	<7.1	<5.7	**15**	<8.4	**3.2**	**15**	**9.8**	<5.2	<9.1	"
Total DDT[1]	**72**	<7.1	**21**	<7.2	**54**	**130**	**92**	**80**	**130**	**210**	**16**	<9.3	"
DDMU[2]	**7.6**	<6.6	<5.8	<6.7	<5.5	**14**	<7.7	<3.5	**11**	<5.3	<5.1	<8.4	"
Dieldrin	**12**	<12	**37**	<12	<11	<11	<13	**19**	<12	**30**	<10	<13	"
Chlorpyrifos	**180**	<21	<21	<21	<21	**30**	**120**	**240**	**150**	**2500**	**140**	<22	"
Endosulfan I	**750**	<220	<220	<220	**2600**	**880**	**840**	**1900**	**950**	**10,000**	**620**	<220	"
Endosulfan II	**1800**	<460	<460	<460	**1700**	**510**	**740**	**1000**	**1100**	**3000**	<460	<460	"
Endosulfan Sulfate	<320	<320	<320	<320	**480**	<320	**600**	**480**	<320	**980**	<320	<320	"
Hexachlorobenzene	**15**	<6.5	<5.8	<6.7	**5.9**	<6.2	<7.8	<3.2	**8.8**	**47**	**18**	<8.4	"
Pentachloroanisole	**12**	**14**	**19**	**16**	**6.0**	**6.3**	<7.7	**5.6**	**8.8**	**14**	**21**	<8.4	"
Toxaphene	<80	<99	<93	<100	<90	<97	<110	<75	<110	**1100**	<86	<120	"
Total Chlordane[3]	<4.5	<7.6	**6.6**	<7.8	<6.2	<7.2	<9.2	<3.7	<8.7	**39**	<5.6	<10	"
Dacthal	<18	<20	<19	<20	<19	<20	<21	<18	<20	**34**	**40**	<21	"
Heptachlor Epoxide	<11	<13	<12	<13	<12	<13	<14	<11	<14	**19**	<12	<15	"
Lindane	<68	<68	<68	<68	<68	<68	<68	<68	<68	**460**	<68	<68	"
Total PCBs	**83**	**71**	**56**	**52**	**38**	**23**	**52**	**6.7**	**66**	**25**	**120**	**30**	"

1. Total DDT is the sum of 2,4'- and 4,4' isomers of DDD, DDE, and DDT.
DDD = p,p'-dichlorodiphenyldichloroethane. DDE = p,p'-dichlorodiphenyldichloroethylene. DDT = p,p'-dichlorodiphenyltrichloroethane.
2. DDMU (1-chloro-2,2-bis(p-chlorophenyl)ethane) is a breakdown product of DDE.
3. The NTR criterion for chlordane is interpreted as the sum of five chlordane components: Total chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane.

Table K-2. Estimated Concentration of Pesticides and Total PCBs Detected in SPMDs, September - October 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807	8424808	8424809	8424810	8424811	8424812
p,p'-DDT	<5.4	<7.3	<7.1	<6.4	**27**	**9.6**	**6.3**	**7.7**	<9.0	**11**	<5.4	<5.9	**7.5**
p,p'-DDE	**27**	<8.0	<7.7	<6.9	**61**	**86**	**38**	**84**	**47**	**76**	<5.6	<6.2	**64**
p,p'-DDD	**26**	<7.3	**17**	<6.3	**18**	**110**	**21**	**26**	**41**	**23**	<5.3	<5.8	**19**
o,p'-DDT	<5.3	<7.2	<7.0	<6.3	**6.0**	<5.2	<5.2	<4.4	<8.9	<5.2	<5.3	<5.8	<4.9
o,p'-DDE	<5.3	<7.3	<7.0	<6.3	<4.7	<5.3	<5.2	<4.4	<8.9	<5.2	<5.3	<5.8	<4.9
o,p'-DDD	**7.7**	<7.8	<7.6	<6.7	**5.7**	**32**	<5.4	**6.7**	**14**	**8.1**	<5.5	<6.1	**7.0**
Total DDT[1]	**61**	<8.0	**17**	<6.9	**120**	**230**	**65**	**120**	**100**	**120**	<5.6	<6.2	**97**
DDMU[2]	<5.4	<7.3	<7.1	<6.4	<4.7	<5.3	<5.2	<8.0	<9.0	<5.3	<5.4	<5.9	<4.9
Dieldrin	**13**	<12	**23**	<11	**12**	<10	<10	**63**	<14	**13**	<10	<11	**11**
Chlorpyrifos	**29**	<22	<21	<21	<21	<21	<21	**640**	**40**	**120**	<21	<21	**130**
Endosulfan I	<220	**310**	<220	<220	**1200**	<220	<220	**240**	<220	**380**	<220	<220	**350**
Endosulfan II	<460	<460	<460	<460	**1200**	<460	<460	<460	<460	**550**	<460	<460	**510**
Endosulfan Sulfate	<320	<320	<320	<320	**540**	<320	<320	**480**	<320	**700**	<320	<320	**640**
Hexachlorobenzene	**8.4**	<7.3	<7.1	<6.3	<4.6	<5.2	<5.1	<4.3	<9.0	**27**	**14**	<5.8	**24**
Pentachloroanisole	**16**	**37**	**13**	**13**	<4.6	<5.3	<5.2	**10**	<9.0	<5.3	**30**	<5.9	<5.0
Toxaphene	<89	<110	<100	<98	<84	<88	<88	**130**	<120	**520**	<180	<93	**430**
Total Chlordane[3]	<6.0	<8.6	<8.3	<7.4	<5.2	<6.0	<5.8	<4.8	<11	<5.9	<6.0	<6.7	<5.5
Dacthal	<19	<20	<20	<20	<19	<19	<19	<19	<22	<19	<19	<19	<19
Heptachlor Epoxide	<12	<14	<14	<13	<12	<12	<12	<12	<15	<12	<12	<12	<12
Lindane	<68	<68	<68	<68	<68	<68	<68	<68	<68	<68	<68	<68	<68
Total PCBs`	**74**	**42**	**66**	**9.6**	**43**	**31**	**11**	**32**	**120**	**29**	**67**	**10**	**23**

1. Total DDT is the sum of 2,4'- and 4,4' isomers of DDD, DDE, and DDT.
DDD = p,p'-dichlorodiphenyldichloroethane. DDE = p,p’-dichlorodiphenyldichloroethylene. DDT = p,p'-dichlorodiphenyltrichloroethane.
2. DDMU (1-chloro-2,2-bis(p-chlorophenyl)ethane) is a breakdown product of DDE.
3. The NTR criterion for chlordane is interpreted as the sum of five chlordane components: Total chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane.

Table K-3. Estimated Concentration of PBDEs Detected in SPMDs, May - June and September - October, 2008 (pg/L).

May – June 2008

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807	8244808	8244809	8244810	8244811	8244812
PBDE- 47	**6.0**	<11	<19	**6.7**	<12	<16	<22	<7.9	<17	<15	**19**	<30	no data
PBDE- 49	<1.2	<2.9	<2.5	<3.0	<2.4	<2.8	<3.5	<1.3	<3.3	<1.4	<1.7	<3.8	"
PBDE- 66	<1.7	<2.9	<2.6	<3.0	<2.4	<2.8	<3.5	<1.3	<3.3	<2.3	<2.2	<3.9	"
PBDE- 71	<1.6	<2.7	<2.4	<2.8	<2.2	<2.6	<3.3	<1.3	<3.1	<2.2	<2.0	<3.6	"
PBDE- 99	<9.2	<9.3	<11	<15	<7.1	<8.4	<12	<4.4	<12	<7.9	**7.5**	<26	"
PBDE-100	**0.92**	<2.2	<2.9	**1.1**	<1.8	<1.9	<2.6	<1.2	<3.0	<2.4	**2.3**	**1.7**	"
PBDE-138	<7.3	<13	<11	<13	<10	<12	<16	<5.4	<15	<9.8	<9.3	<17	"
PBDE-153	<5.5	<9.7	<8.4	**0.62**	<7.7	<9.2	<12	<4.1	<11	<7.4	<1.6	**0.48**	"
PBDE-154	<6.4	<11	<9.7	<12	<9.0	<11	<14	<4.8	<13	<8.6	<1.5	<2.0	"
PBDE-183	<8.1	<14	<12	<7.5	<11	<2.5	<17	<6.0	<16	<11	<2.4	<2.8	"
PBDE-184	<12	<22	<19	<22	<17	<21	<27	<9.2	<25	<17	<16	<29	"
Total PBDEs	**7.0**	nd	nd	**8.4**	nd	nd	nd	nd	nd	nd	**29**	**2.2**	"

nd = not detected.

Table K-3. (continued)

September – October 2008

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807	8424808	8424809	8424810	8424811	8424812
PBDE- 47	**13**	**5.3**	<14	**7.4**	**3.7**	**5.2**	**4.5**	**6.2**	**5.3**	**3.2**	**130**	<11	**2.5**
PBDE- 49	<1.4	<3.3	<3.2	<2.8	<2.0	<2.3	<1.0	<0.97	<4.1	<0.96	<4.4	<2.6	<2.1
PBDE- 66	<2.3	<3.3	<3.2	<2.8	<2.0	<2.3	<2.2	<1.9	<4.2	<2.3	<3.1	<2.6	<2.1
PBDE- 71	<2.2	<3.1	<3.0	<2.6	<2.0	<2.2	<2.1	<1.8	<3.8	<2.1	<2.2	<2.4	<2.0
PBDE- 99	**5.1**	<19	<13	**5.4**	<11	<14	<12	<12	<23	<12	**78**	<11	<9.5
PBDE-100	<4.4	<4.9	<3.1	<4.5	<2.7	<3.1	<2.9	<3.2	<5.8	<3.2	**17**	<2.8	<2.4
PBDE-138	<20	<29	<28	<25	<17	<20	<19	<16	<37	<20	<20	<22	<18
PBDE-153	<10	<16	<14	<13	<8.7	<10	<10	<8.2	<19	<11	<15	<11	<9.3
PBDE-154	<10	<15	<14	<12	<8.6	<10	<9.1	<8.1	<18	<9.8	<13	<11	<8.9
PBDE-183	<22	<25	<31	<28	<19	<22	<21	<17	<41	<22	<22	<25	<20
PBDE-184	<34	<49	<48	<42	<29	<34	<33	<27	<63	<33	<34	<38	<31
Total PBDEs	**18**	**5.3**	nd	**13**	**3.7**	**5.2**	**4.5**	**6.2**	**5.3**	**3.2**	**220**	nd	**2.5**

nd = not detected.

Table K-4. Estimated Concentration of PAHs Detected in SPMDs, May - June 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807	8244808	8244809	8244810	8244811	8244812
Naphthalene	**1900**	<3800	**2900**	**4000**	<1100	<2000	<3100	<2700	<4000	<2000	<1400	<1500	no data
2-Methylnaphthalene	**1400**	**940**	**2300**	**2800**	<1100	<1700	**760**	<1900	**850**	<1400	<1200	<1200	"
1-Methylnaphthalene	**930**	**610**	**1500**	**1700**	<260	<650	**520**	**230**	**570**	<470	<330	<310	"
2-Chloronaphthalene	<210	<210	<210	<210	<210	<210	<210	<210	<210	<210	<210	<210	"
Acenaphthylene	**49**	**19**	**94**	**56**	**0.56**	**16**	**28**	**7.4**	**34**	**2.8**	<23	<24	"
Acenaphthene	**140**	**120**	**140**	**100**	**14**	**21**	**40**	**50**	**39**	**24**	**34**	**4.3**	"
Dibenzofuran	**210**	**140**	**220**	**250**	**20**	**80**	**150**	**78**	**120**	**61**	**28**	**16**	"
Fluorene	**220**	**97**	**260**	**160**	<58	**69**	**92**	**63**	**91**	**47**	**66**	<54	"
Phenanthrene	**1200**	**550**	**940**	**760**	**260**	**390**	**620**	**330**	**410**	**290**	**340**	<410	"
Anthracene	**80**	**18**	**64**	**38**	**4.3**	**15**	**9.9**	**9.8**	**36**	<46	**59**	**6.5**	"
Carbazole	<1000	<1000	<1000	<1000	<1000	**1200**	**1500**	<1000	<1000	**1200**	**1700**	<1000	"
Fluoranthene	**850**	**280**	**1000**	**220**	**240**	**240**	**170**	**110**	**280**	**160**	**700**	**22**	"
Pyrene	**580**	**200**	**650**	**140**	**110**	**63**	**85**	**57**	<30	**99**	**410**	**22**	"
Retene	**1800**	**510**	**80**	**200**	**1200**	**540**	**510**	**86**	**340**	**160**	**5500**	**50**	"
Benzo(a)anthracene	**45**	<17	**82**	<12	<13	<6.0	<9.6	<4.1	<21	<7.9	**48**	<35	"
Chrysene	**66**	**42**	**240**	<23	**24**	<16	<20	<9.3	<23	**23**	**80**	<33	"
Benzo(b)fluoranthene	**26**	<19	**130**	<11	<7.5	<6.2	<10	<4.5	<8.1	<8.8	**26**	<34	"
Benzo(k)fluoranthene	<11	<7.9	<4.0	<4.0	<3.2	<2.7	<3.7	<1.6	<33	<23	<7.5	<38	"
Benzo(a)pyrene	<9.0	<5.1	<17	<4.8	<2.3	<2.5	<3.0	<2.0	<35	<24	<7.9	<6.6	"
Indeno(1,2,3-cd)pyrene	<12	<7.8	<28	<4.4	<2.3	<2.7	<3.9	<1.0	<43	<29	<27	<49	"
Dibenzo(a,h)anthracene	<10	<5.2	<7.1	<3.2	<2.0	<1.9	<2.1	<0.8	<38	<26	<24	<43	"
Benzo(ghi)perylene	<14	<10	<33	<5.7	<3.1	<3.7	<5.4	<1.7	<46	<31	<30	<54	"
∑LPAH[1]	**3600**	**800**	**4400**	**5100**	**290**	**510**	**790**	**460**	**610**	**360**	**500**	**11**	**"**
∑HPAH[2]	**1600**	**520**	**2100**	**360**	**380**	**300**	**260**	**170**	**280**	**280**	**1300**	**44**	**"**
∑PAH[3]	**5200**	**1320**	**6500**	**5460**	**670**	**810**	**1050**	**630**	**890**	**640**	**1800**	**55**	**"**

1. ∑LPAH is low molecular weight PAH: naphthalene, anthracene, acenaphthylene, acenaphthene, phenanthrene, and fluorene.
2. ∑HPAH is high molecular weight PAH: fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
3. ∑PAH is the sum of LPAH and HPAH.

Table K-5. Estimated Concentration of PAHs Detected in SPMDs, September - October 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807	8424808	8424809	8424810	8424811	8424812
Naphthalene	<1100	<1600	<910	<1000	<820	<930	<1200	<1800	<1100	<1800	<1500	<1200	<3800
2-Methylnaphthalene	<1000	<1200	<1000	<1200	<880	<840	<980	<1400	<1200	<1300	<1200	<1000	<1400
1-Methylnaphthalene	<650	<940	<560	<660	<560	<470	<600	<840	<670	<740	<650	<470	<740
2-Chloronaphthalene	<210	<210	**250**	<210	<210	<210	<210	<210	<220	<210	<210	<210	<210
Acenaphthylene	<110	<86	<110	<110	<83	<110	<110	<110	<120	<110	<110	<110	<110
Acenaphthene	**130**	**1200**	<87	<85	**550**	<82	**120**	**280**	**120**	<82	<82	<83	**200**
Dibenzofuran	**100**	**160**	<320	<310	**250**	<300	**100**	**180**	**83**	**100**	**76**	<280	**150**
Fluorene	<360	<430	<310	<300	<380	<270	<320	<320	<360	<300	<320	<260	<330
Phenanthrene	**640**	**950**	**200**	<350	**960**	<330	**360**	**550**	**270**	**490**	**260**	<280	**510**
Anthracene	**72**	<53	<52	<50	**980**	<46	**480**	<44	**460**	<46	<46	<48	<45
Carbazole	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	**1200**	<1000	<1000
Fluoranthene	**1300**	**700**	**1100**	**200**	**340**	**230**	**140**	**170**	**250**	**130**	**260**	<44	**120**
Pyrene	**1100**	**540**	**790**	**280**	**130**	**74**	**40**	**49**	**92**	**45**	**150**	**11**	**43**
Retene	**1000**	**200**	**130**	**350**	**140**	**140**	**94**	**15**	**88**	**18**	**220**	**61**	**17**
Benzo(a)anthracene	**91**	**43**	**87**	**27**	<13	<18	<21	<17	<35	<21	<15	<24	<19
Chrysene	**120**	**140**	**220**	**40**	**27**	<19	<21	<18	<36	<21	**34**	<23	<19
Benzo(b)fluoranthene	**53**	**88**	**110**	<24	<12	<21	<21	<17	<36	<21	<21	<23	<19
Benzo(k)fluoranthene	<23	<23	**35**	<28	<20	<23	<22	<18	<41	<22	<23	<26	<21
Benzo(a)pyrene	<23	<34	<33	<30	<21	<24	<23	<19	<43	<24	<24	<27	<22
Indeno(1,2,3-cd)pyrene	<29	<42	<26	<36	<25	<29	<28	<23	<53	<29	<29	<33	<26
Dibenzo(a,h)anthracene	<26	<37	<36	<32	<22	<26	<25	<20	<47	<25	<26	<29	<23
Benzo(ghi)perylene	<32	<46	<40	<40	<27	<32	<31	<25	<58	<31	<32	<36	<29
∑LPAH[1]	**840**	**2200**	**200**	nd	**2500**	nd	**960**	**830**	**850**	**490**	**260**	nd	**710**
∑HPAH[2]	**2700**	**1500**	**2300**	**550**	**490**	**300**	**180**	**220**	**340**	**180**	**440**	**11**	**170**
∑PAH[3]	**3540**	**3700**	**2500**	**550**	**2990**	**300**	**1140**	**1050**	**1190**	**670**	**700**	**11**	**880**

1. ∑LPAH is low molecular weight PAH: naphthalene, anthracene, acenaphthylene, acenaphthene, phenanthrene, and fluorene.
2. ∑HPAH is high molecular weight PAH: fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
3. ∑PAH is the sum of LPAH and HPAH.

Appendix L. Estimated Total Concentrations in SPMDs, 2008

Table L-1. Estimated Total Concentration of Pesticides and Total PCBs, May - June 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807	8244808	8244809	8244810	8244811	8244812
p,p'-DDT	<5.5	<7.8	<7.6	<8.4	**26**	**15**	**20**	**8.2**	**11**	**45**	**8.9**	<9.7	no data
p,p'-DDE	**90**	<13	**21**	<16	**68**	**120**	**300**	**160**	**160**	**360**	**19**	<16	"
p,p'-DDD	**38**	<8.8	**20**	<9.9	<7.7	**73**	**53**	**22**	**75**	**40**	<7.2	<11	"
o,p'-DDT	<5.6	<8.1	<8.0	<8.9	<7.0	<8.3	<16	<5.0	<10	**12**	<6.6	<10	"
o,p'-DDE	<5.6	<8.0	<7.8	<8.8	<6.9	<8.2	<16	<5.0	<10	<7.5	<6.5	<9.9	"
o,p'-DDD	**17**	<12	<13	<14	<11	**31**	<38	**8.2**	**35**	**24**	<10	<15	"
Total DDT[1]	**140**	<13	**40**	<16	**93**	**240**	**380**	**200**	**280**	**480**	**28**	<16	"
DDMU[2]	**9.9**	<7.9	<7.7	<8.5	<6.8	**18**	<15	<4.9	**15**	<7.3	<6.4	<9.7	"
Dieldrin	**12**	<12	**39**	<12	<11	<12	<14	**20**	<13	**32**	<11	<14	"
Chlorpyrifos	**190**	<22	<23	<23	<22	**32**	**150**	**260**	**160**	**2800**	**140**	<23	"
Endosulfan I	**760**	<220	<220	<220	**2600**	**890**	**860**	**1900**	**960**	**10,000**	**620**	<220	"
Endosulfan II	**1800**	<460	<460	<460	**1700**	**510**	**750**	**1000**	**1100**	**3000**	<460	<460	"
Endosulfan Sulfate	<320	<320	<320	<320	**480**	<320	**610**	**480**	<320	**990**	<320	<320	"
Hexachlorobenzene	**22**	<8.6	<8.7	<9.6	**8.2**	<9.0	<19	<5.4	**14**	**76**	**26**	<11	"
Pentachloroanisole	**16**	**16**	**25**	**20**	**7.4**	**8.0**	<14	**7.8**	**13**	**20**	**26**	<9.7	"
Toxaphene	<84	<100	<98	<100	<93	<100	<128	<80	<110	**1200**	<90	<120	"
Total Chlordane[3]	<14	<18	**8.2**	<23	<17	<22	<69	<13	<30	**85**	<16	<22	"
Dacthal	<19	<20	<20	<20	<19	<20	<22	<19	<21	**35**	**40**	<21	"
Heptachlor Epoxide	<13	<14	<14	<15	<14	<14	<20	<13	<16	**23**	<13	<16	"
Lindane	<68	<68	<68	<68	<68	<68	<69	<68	<69	**460**	<68	<69	"
Total PCBs	**250**	**180**	**230**	**150**	**130**	**90**	**280**	**49**	**270**	**180**	**540**	**59**	"

1. Total DDT is the sum of 2,4'- and 4,4' isomers of DDD, DDE, and DDT.

DDD = p,p'-dichlorodiphenyldichloroethane. DDE = p,p'-dichlorodiphenyldichloroethylene. DDT = p,p'-dichlorodiphenyltrichloroethane.

2. DDMU (1-chloro-2,2-bis(p-chlorophenyl)ethane) is a breakdown product of DDE.

3. The NTR criterion for chlordane is interpreted as the sum of five chlordane components: Total chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane.

Table L-2. Estimated Total Concentration of Pesticides and Total PCBs, September - October 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807	8424808	8424809	8424810	8424811	8424812
p,p'-DDT	<6.4	<8.5	<9.0	<7.4	**30**	**11**	**8.6**	**9.3**	<11	**14**	<6.1	<6.9	**9.7**
p,p'-DDE	**51**	<14	<17	<12	**95**	**160**	**100**	**170**	**92**	**180**	<8.9	<11	**150**
p,p'-DDD	**35**	<9.5	**26**	<8.3	**22**	**140**	**36**	**36**	**57**	**36**	<6.5	<7.6	**29**
o,p'-DDT	<6.6	<8.8	<9.5	<7.6	**7.0**	<6.5	<7.6	<5.6	<11	<7.2	<6.2	<7.1	<6.8
o,p'-DDE	<6.5	<8.7	<9.3	<7.6	<5.4	<6.5	<7.5	<5.6	<11	<7.2	<6.1	<7.0	<6.7
o,p'-DDD	**13**	<13	<16	<11	**8.5**	**57**	<13	**13**	**25**	**18**	<8.4	<10	**16**
Total DDT[1]	**100**	<14	**26**	<12	**160**	**370**	**150**	**230**	**170**	**250**	<8.9	<11	**210**
DDMU[2]	<6.4	<8.5	<9.1	<7.4	<5.3	<6.4	<7.3	<9.9	<11	<7.0	<6.1	<6.9	<6.5
Dieldrin	**13**	<12	**24**	<12	**12**	<11	<11	**65**	<14	**13**	<11	<11	**12**
Chlorpyrifos	**31**	<22	<23	<22	<22	<22	<23	**680**	**42**	**130**	<22	<22	**140**
Endosulfan I	<220	**310**	<220	<220	**1200**	<220	<220	**240**	<220	**380**	<220	<220	**360**
Endosulfan II	<460	<460	<460	<460	**1200**	<460	<460	<460	<460	**560**	<460	<460	**510**
Endosulfan Sulfate	<320	<320	<320	<320	**540**	<320	<320	**480**	<320	**700**	<320	<320	**640**
Hexachlorobenzene	**11**	<9.3	<10	<8.1	<5.6	<6.9	<8.3	<6.0	<12	**41**	**17**	<7.4	**37**
Pentachloroanisole	**19**	**43**	**17**	**15**	<5.3	<6.4	<7.2	**13**	<11	<6.9	**34**	<6.9	<6.5
Toxaphene	<92	<110	<110	<100	<85	<91	<93	**130**	<130	**550**	<180	<96	**460**
Total Chlordane[3]	<14	<19	<25	<16	<9.9	<14	<22	<13	<28	<19	<12	<15	<18
Dacthal	<19	<20	<20	<20	<19	<19	<19	<19	<22	<19	<19	<19	<19
Heptachlor Epoxide	<13	<15	<15	<14	<12	<13	<14	<13	<17	<14	<13	<14	<14
Lindane	<68	<68	<68	<68	<68	<68	<68	<68	<69	<68	<68	<68	<68
Total PCBs	**210**	**160**	**360**	**40**	**110**	**120**	**71**	**120**	**350**	**160**	**160**	**26**	**130**

1. Total DDT is the sum of 2,4'- and 4,4' isomers of DDD, DDE, and DDT.

DDD = p,p'-dichlorodiphenyldichloroethane. DDE = p,p'-dichlorodiphenyldichloroethylene. DDT = p,p'-dichlorodiphenyltrichloroethane.

2. DDMU (1-chloro-2,2-bis(p-chlorophenyl)ethane) is a breakdown product of DDE.

3. The NTR criterion for chlordane is interpreted as the sum of five chlordane components: Total chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane.

Table L-3. Estimated Total Concentration of PBDEs, May - June and September - October, 2008 (pg/L).

May – June 2008

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807	8244808	8244809	8244810	8244811	8244812
PBDE- 47	**15**	<22	<51	**16**	<27	<39	<130	<25	<49	<46	**46**	<57	no data
PBDE- 49	<3.1	<5.9	<6.8	<7.2	<5.4	<6.8	<20	<4.1	<9.4	<4.2	<4.0	<7.1	"
PBDE- 66	<4.6	<6.2	<7.1	<7.6	<5.6	<7.1	<22	<4.4	<10	<7.2	<5.3	<7.4	"
PBDE- 71	<3.3	<4.5	<4.9	<5.3	<4.0	<5.0	<13	<3.0	<6.7	<4.8	<3.8	<5.5	"
PBDE- 99	<57	<42	<75	<89.	<38	<50	<220	<36	<85	<61	**42**	<100	"
PBDE-100	**4.6**	<8.2	<16	**5.1**	<7.7	<9.2	<36	<8.1	<18	<15	**10**	**5.7**	"
PBDE-138	<260	<310	<420	<430	<300	<400	<1700	<260	<620	<440	<290	<350	"
PBDE-153	<82	<100	<130	**8.5**	<96	<130	<520	<82	<190	<140	<20	**4.2**	"
PBDE-154	<150	<180	<250	<250	<180	<240	<990	<150	<360	<260	<32	<28	"
PBDE-183	<400	<470	<640	<340	<460	<120	<2600	<400	<940	<680	<100	<79	"
PBDE-184	<2200	<2600	<3500	<3600	<2500	<3400	<1400	<2200	<5200	<3700	<2400	<2800	"
Total PBDEs	**20**	nd	nd	**30**	nd	nd	nd	nd	nd	nd	**98**	**9.9**	"

nd = not detected.

Table L-3. (continued)

September – October 2008

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807	8424808	8424809	8424810	8424811	8424812
PBDE- 47	**26**	**10**	<34	**14**	**6.2**	**10**	**14**	**14**	**11**	**8.7**	**220**	<21	**6.8**
PBDE- 49	<2.8	<6.2	<7.8	<5.3	<3.3	<4.7	<3.0	<2.2	<8.9	<2.6	<7.6	<4.9	<5.6
PBDE- 66	<4.9	<6.5	<8.3	<5.6	<3.4	<4.9	<7.2	<4.3	<9.3	<6.4	<5.5	<5.1	<5.9
PBDE- 71	<3.6	<4.8	<5.8	<4.1	<2.7	<3.6	<4.8	<3.1	<6.6	<4.4	<3.2	<3.8	<4.1
PBDE- 99	**23**	<78	<77	**22**	<37	<62	<95	<60	<110	<80	**260**	<44	<64
PBDE-100	<16	<17	<15	<15	<7.6	<12	<19	<13	<23	<18	**49**	<9.7	<13
PBDE-138	<480	<620	<960	<520	<280	<480	<900	<450	<990	<760	<340	<480	<690
PBDE-153	<110	<140	<200	<120	<62	<100	<190	<98	<220	<170	<110	<100	<150
PBDE-154	<170	<210	<310	<170	<95	<160	<280	<160	<330	<250	<150	<160	<230
PBDE-183	<720	<730	<1400	<780	<420	<730	<1400	<680	<1500	<1100	<510	<720	<1000
PBDE-184	<3900	<5100	<8000	<4200	<2200	<4000	<7600	<3700	<8300	<6300	<2700	<3900	<5800
Total PBDEs	**49**	**10**	nd	**36**	**6.2**	**10**	**14**	**14**	**11**	**8.7**	**530**	nd	**6.8**

nd = not detected.

Table L-4. Estimated Total Concentration of PAHs, May - June 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8244800	8244801	8244802	8244803	8244804	8244805	8244806	8244807	8244808	8244809	8244810	8244811	8244812
Naphthalene	**1900**	<3800	**2900**	**4000**	<1100	<2000	<3200	<2700	<4000	<2000	<1400	<1500	no data
2-Methylnaphthalene	**1400**	**940**	**2400**	**2800**	<1100	<1700	**770**	<1900	**850**	<1400	<1200	<1200	"
1-Methylnaphthalene	**940**	**610**	**1500**	**1700**	<260	<660	**530**	**240**	**570**	<470	<330	<310	"
2-Chloronaphthalene	<210	<210	<210	<210	<210	<220	<220	<210	<210	<210	<210	<220	"
Acenaphthylene	**49**	**19**	**95**	**56**	**0.56**	**16**	**29**	**7.6**	**34**	**2.8**	<23	<24	"
Acenaphthene	**140**	**120**	**140**	**100**	**14**	**21**	**42**	**51**	**40**	**25**	**35**	**4.4**	"
Dibenzofuran	**220**	**140**	**220**	**250**	**21**	**81**	**150**	**79**	**120**	**62**	**28**	**16**	"
Fluorene	**220**	**99**	**260**	**160**	<59	**71**	**98**	**65**	**94**	**48**	**67**	<55	"
Phenanthrene	**1300**	**560**	**970**	**780**	**270**	**400**	**670**	**340**	**430**	**300**	**340**	<410	"
Anthracene	**83**	**18**	**66**	**40**	**4.4**	**16**	**11**	**10**	**38**	<48	**61**	**6.6**	"
Carbazole	<1000	<1000	<1000	<1000	<1000	**1200**	**1500**	<1000	<1000	**1200**	**1700**	<1000	"
Fluoranthene	**980**	**310**	**1200**	**250**	**270**	**270**	**250**	**130**	**320**	**190**	**790**	**24**	"
Pyrene	**690**	**220**	**780**	**160**	**130**	**74**	**130**	**71**	<37	**120**	**480**	**25**	"
Retene	**5500**	**1200**	**260**	**570**	**3200**	**1600**	**3800**	**330**	**1200**	**590**	**15,000**	**110**	"
Benzo(a)anthracene	**79**	<25	**140**	<21	<20	<10	<32	<8.5	<40	<16	**80**	<50	"
Chrysene	**91**	**53**	**330**	<31	**31**	<22	<44	<14	<33	**34**	**110**	<40	"
Benzo(b)fluoranthene	**40**	<26	**200**	<16	<11	<9.5	<28	<8.0	<14	<15	**38**	<45	"
Benzo(k)fluoranthene	<27	<16	<10	<9.4	<7.1	<6.4	<21	<4.8	<91	<45	<17	<69	"
Benzo(a)pyrene	<28	<12	<54	<14	<6.2	<7.3	<22	<8.0	<120	<87	<22	<14	"
Indeno(1,2,3-cd)pyrene	<77	<36	<190	<26	<12	<16	<68	<8.6	<310	<220	<150	<190	"
Dibenzo(a,h)anthracene	<42	<16	<30	<12	<7.2	<7.5	<22	<4.1	<170	<120	<88	<120	"
Benzo(ghi)perylene	<118	<60	<290	<45	<22	<29	<130	<19	<460	<330	<220	<280	"
∑LPAH[1]	**3700**	**820**	**4400**	**5100**	**290**	**520**	**850**	**470**	**630**	**370**	**510**	**11**	"
∑HPAH[2]	**1900**	**590**	**2700**	**410**	**430**	**350**	**390**	**200**	**320**	**350**	**1500**	**48**	"
∑PAH[3]	**5600**	**1410**	**7100**	**5510**	**720**	**870**	**1240**	**670**	**950**	**720**	**2010**	**59**	"

1. ∑LPAH is low molecular weight PAH: naphthalene, anthracene, acenaphthylene, acenaphthene, phenanthrene, and fluorene.
2. ∑HPAH is high molecular weight PAH: fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
3. ∑PAH is the sum of LPAH and HPAH.

Table L-5. Estimated Total Concentration of PAHs, September - October 2008 (pg/L).

Site	Lower Columbia River	Duwamish River	Lake Washington	Snohomish River	Wenatchee River	Upper Columbia River	Okanogan River	Yakima River	Middle Columbia River	Walla Walla River	Spokane River	Queets River	Rep Walla
Sample No.	8424800	8424801	8424802	8424803	8424804	8424805	8424806	8424807	8424808	8424809	8424810	8424811	8424812
Naphthalene	<1100	<1600	<920	<1000	<820	<930	<1200	<1800	<1100	<1800	<1500	<1200	<3800
2-Methylnaphthalene	<1000	<1200	<1000	<1200	<890	<840	<990	<1400	<1200	<1300	<1200	<1000	<1400
1-Methylnaphthalene	<660	<940	<570	<660	<560	<470	<610	<840	<670	<750	<650	<470	<750
2-Chloronaphthalene	<210	<210	**260**	<210	<210	<210	<210	<210	<220	<210	<210	<210	<210
Acenaphthylene	<110	<87	<120	<110	<83	<110	<110	<110	<120	<110	<110	<110	<110
Acenaphthene	**130**	**1200**	<88	<85	**550**	<88	**120**	**290**	**120**	<84	<83	<84	**210**
Dibenzofuran	**100**	**160**	<320	<310	**250**	<300	**100**	**180**	**84**	**100**	**77**	<280	**150**
Fluorene	<370	<440	<320	<300	<390	<280	<320	<330	<370	<310	<320	<270	<330
Phenanthrene	**650**	**960**	**200**	<350	**970**	<330	**370**	**560**	**280**	**510**	**260**	<290	**520**
Anthracene	**73**	<54	<54	<50	**990**	<47	**500**	<45	**470**	<46	<47	<49	<46
Carbazole	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	**1200**	<1000	<1000
Fluoranthene	**1500**	**760**	**1200**	**220**	**360**	**260**	**160**	**190**	**270**	**150**	**280**	<48	**140**
Pyrene	**1200**	**590**	**920**	**310**	**140**	**83**	**49**	**56**	**100**	**54**	**160**	**12**	**51**
Retene	**2500**	**460**	**400**	**760**	**280**	**350**	**350**	**40**	**220**	**60**	**430**	**140**	**55**
Benzo(a)anthracene	**140**	**61**	**150**	**39**	<18	<28	<42	<28	<59	<33	<20	<34	<36
Chrysene	**150**	**180**	**300**	**49**	**32**	<24	<31	<23	<46	<29	**40**	<28	<27
Benzo(b)fluoranthene	**72**	**120**	**170**	<31	<15	<29	<36	<25	<52	<33	<26	<31	<31
Benzo(k)fluoranthene	<45	<42	**84**	<52	<33	<45	<66	<40	<86	<58	<38	<48	<54
Benzo(a)pyrene	<54	<77	<1000	<65	<40	<57	<88	<51	<110	<77	<47	<60	<71
Indeno(1,2,3-cd)pyrene	<130	<170	<160	<140	<82	<130	<220	<120	<260	<190	<99	<130	<180
Dibenzo(a,h)anthracene	<77	<100	<140	<87	<52	<78	<120	<70	<150	<110	<62	<80	<100
Benzo(ghi)perylene	<190	<250	<320	<200	<120	<190	<330	<170	<380	<280	<140	<190	<260
∑LPAH[1]	**860**	**2200**	**200**	nd	**2500**	nd	**990**	**850**	**870**	**510**	**260**	nd	**730**
∑HPAH[2]	**3000**	**1700**	**2900**	**620**	**530**	**340**	**210**	**250**	**380**	**210**	**480**	**12**	**200**
∑PAH[3]	**3860**	**3900**	**3100**	**620**	**3030**	**340**	**1200**	**1100**	**1250**	**720**	**740**	**12**	**930**

1. ∑LPAH is low molecular weight PAH: naphthalene, anthracene, acenaphthylene, acenaphthene, phenanthrene, and fluorene.
2. ∑HPAH is high molecular weight PAH: fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
3. ∑PAH is the sum of LPAH and HPAH.

Appendix M. Water Quality Criteria for Chemicals Analyzed

Table M-1. Water Quality Criteria for Chemicals Analyzed in the PBT Trends Study Using SPMDs (pg/L).

Chemical	Washington[a]				EPA (2006) Recommended Criteria[c]			
	Aquatic Life		Human Health (NTR)[b]		Aquatic Life		Human Health	
	Freshwater Acute	Freshwater Chronic	Water + fish Consumption	Fish Consumption	Freshwater Acute	Freshwater Chronic	Water + fish Consumption	Fish Consumption
p,p'-DDT	-	-	590	590	-	-	220	220
p,p'-DDE	-	-	590	590	-	-	220	220
p,p'-DDD	-	-	830	840	-	-	310	310
o,p'-DDT	-	-	-	-	-	-	-	-
o,p'-DDE	-	-	-	-	-	-	-	-
o,p'-DDD	-	-	-	-	-	-	-	-
DDT and metabolites[d]	1,100,000	1,000	-	-	1,100,000	1,000	-	-
DDMU[e]	-	-	-	-	-	-	-	-
Dieldrin	-	-	140	140	240,000	56,000	52	54
Aldrin	-	-	130	140	3,000,000	-	49	50
Dieldrin and aldrin[f]	2,500,000	1,900	-	-	-	-	-	-
Chlorpyrifos	83,000	41,000	-	-	83,000	41,000	-	-
Endosulfan[g]	220,000	56,000	-	-	220,000[h]	56,000[h]		
Endosulfan I (alpha)	-	-	930,000	2,000,000	220,000[h]	56,000[h]	62,000,000	89,000,000
Endosulfan-II (beta)	-	-	930,000	2,000,000	220,000[h]	56,000[h]	62,000,000	89,000,000
Endosulfan Sulfate	-	-	930,000	2,000,000	-	-	62,000,000	89,000,000
Hexachlorobenzene (HCB)	-	-	750	770	-	-	280	290
Pentachloroanisole (PCA)	-	-	-	-	-	-	-	-
Toxaphene	730,000	200	730	750	730,000	2,000	280	280
Total Chlordane[i]	2,400,000	4,300	570	590	2,400,000	4,300	800	810
Dacthal	-	-	-	-	-	-	-	-
Heptachlor	520,000	3,800	210	210	520,000	3,800	79	79
Heptachlor Epoxide	-	-	100	110	520,000	3,800	39	39

Chemical	Washington[a]				EPA (2006) Recommended Criteria[c]			
	Aquatic Life		Human Health (NTR)[b]		Aquatic Life		Human Health	
	Freshwater Acute	Freshwater Chronic	Water + fish Consumption	Fish Consumption	Freshwater Acute	Freshwater Chronic	Water + fish Consumption	Fish Consumption
alpha-Benzenehexachloride (a-BHC)	-	-	3,900	13,000	-	-	2,600	4,900
beta-Benzenehexachloride (b-BHC)	-	-	14,000	46,000	-	-	9,100	17,000
delta-Benzenehexachloride (d-BHC)	-	-	-	-	-	-	-	-
gamma - Benzenehexachloride (g-BHC) (Lindane)	2,000,000	80,000	19,000	63,000	950,000	-	980,000	1,800,000
Endrin	180,000	2,300	760,000	810,000	86,000	36,000	59,000	60,000
Endrin ketone	-	-	-	-	-	-	-	-
Endrin aldehyde	-	-	760,000	810,000	-	-	290,000	300,000
Mirex	-	-	-	-	-	1,000	-	-
p,p'-Methoxychlor	-	-	-	-	-	-	-	-
Total PCBs[j]	2,000,000	14,000	170	170	-	14,000	64	64
Total PBDEs[k]	-	-	-	-	-	-	-	-
PAHs	-	-	-	-	-	-	-	-

a - Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC (Ecology 2006a).

b - EPA 1992 National Toxics Rule.

c - National Recommended Water Quality Criteria (EPA 2006).

d - Total DDT is the sum of 2,4'- and 4,4'- isomers of DDD, DDE, and DDT as defined by Ecology, 2006b.

e - DDMU is a breakdown product of DDE.

f - Aldrin is metabolically converted to Dieldrin. Therefore, the sum of the Aldrin and Dieldrin concentrations are compared with the Dieldrin criteria.

g - Endosulfan is the sum of alpha and beta endosulfan.

h - Value derived from endosulfan and is appropriately applied to the sum of alpha- and beta-endosulfan (EPA 2006).

i - Total chlordane is the sum of cis- and trans- chlordane, cis- and trans- nonachlor, and oxychlordane as defined by Ecology, 2006b.

j - Total PCBs is the sum of Aroclors or congeners.

k - Total PBDEs is the sum of the congeners.

Appendix N. Glossary, Acronyms, and Abbreviations

Glossary

Analyte: Water quality constituent being measured (parameter).

Anthropogenic: Human-caused.

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period. The calculation is performed by either: (1) taking the nth root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Parameter: Water quality constituent being measured (analyte). A physical, chemical, or biological property whose values determine environmental characteristics or behavior.

Point source: Source of pollution that discharges at a specific location.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and watercourses within the jurisdiction of Washington State.

Total Maximum Daily Load (TMDL): Water cleanup plan. A distribution of a substance in a waterbody designed to protect it from exceeding water quality standards. A TMDL is equal to the sum of all of the following: (1) individual wasteload allocations for point sources, (2) the load allocations for nonpoint sources, (3) the contribution of natural sources, and (4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

Total suspended solids (TSS): The suspended particulate matter in a water sample as retained by a filter.

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

90th percentile: A statistical number obtained from a distribution of a data set, above which 10% of the data exists and below which 90% of the data exists.

Acronyms and Abbreviations

BHC	benzene hexachloride (alpha-, beta-, gamma (gamma- also known as Lindane)
CP	chlorinated pesticides
DDD	dichlorodiphenyldichloroethane (o,p’ and p,p’; 2,4’ and 4,4’)
DDE	dichlorodiphenyldichloroethylene (o,p’ and p,p’; 2,4’ and 4,4’)
DDMU	1-chloro-2, 2-bis (p-chlorophenyl) ethane (a breakdown product of DDE)
DDT	dichlorodiphenyltrichloroethane (o,p’ and p,p’; 2,4’ and 4,4’)
EAF	exposure adjustment factor
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
EST	Environmental Sampling Technologies
GC-ECD	gas chromatography – electron capture detection
GC-MS	gas chromatography – mass spectrometry
GPC	gel permeation chromatography
HPAH	high molecular PAH
K_{oc}	carbon-water partition coefficient
K_{ow}	octanol-water partition coefficient
LPAH	low molecular weight PAH
MEL	Manchester Environmental Laboratory
NTR	National Toxics Rule
PACE	Pacific Analytical Services Laboratories
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PBT	persistent, bioaccumulative, and toxic substance
PCB	polychlorinated biphenyl
PCDD/Fs	polychlorinated dibenzo-p-dioxins and -furans
PRC	permeability/performance reference compounds
QA	quality assurance
Rep	replicate
RM	river mile
RPD	relative percent difference
RSD	relative standard deviation
SOP	standard operating procedures
SPMD	semipermeable membrane device
TCDD	tetrachlorodibenzo-p-dioxin (most toxic of PCDD/Fs)
T-DDT	total DDT
TMDL	Total Maximum Daily Load
T-PCBs	total PCBs (sum of detected congeners)
TOC	total organic carbon

TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WRIA	Water Resources Inventory Area
WSTMP	Washington State Toxics Monitoring Program
WWTP	wastewater treatment plant

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
cm	centimeter
ft	feet
kcfs	1000 cubic feet per second
mg	milligrams
mg/L	milligrams per liter (parts per million)
mL	milliliter
ng	nanogram
pg/L	picograms per liter (parts per quadrillion)
ug/Kg	micrograms per kilogram (parts per billion)
um	micrometer
μS/cm	microsiemen per centimeter, a unit of conductivity