PCB, Dioxin, and Chlorinated Pesticide Sources to Vancouver Lake

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Cover photo: Lake River looking north from McCuddy's Ridgefield Marina.

PCB, Dioxin, and Chlorinated Pesticide Sources to Vancouver Lake

by

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Waterbody Numbers:
WA-28-9090 Vancouver Lake
WA-28-1010 Lake River North
WA-28-1030 Lake River South
WA-28-1040 Burnt Bridge Creek

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Abstract

The Washington State Department of Ecology investigated sources of polychlorinated biphenyls (PCBs), dioxin and furans (dioxin), and chlorinated pesticides to Vancouver Lake between January and October 2010. The lake is on the Clean Water Act 303(d) list as not meeting water quality standards for these chemicals. The objective of the study was to determine if these compounds are currently being discharged to the lake.

Three seasonal samples were collected during winter, spring, and fall from Burnt Bridge Creek, the Flushing Channel, and two Lake River sites, north and south. A passive sampling technique using semipermeable membrane devices (SPMDs) was used to concentrate and measure the contaminants of interest.

The highest levels of PCBs, dioxin, and chlorinated pesticides were generally observed during the spring and fall. The National Toxics Rule (NTR) human health criterion was exceeded for total PCBs during all sample seasons. Many chlorinated pesticides were detected, but only dieldrin at Burnt Bridge Creek exceeded human health criteria. TCDD toxicity equivalents (TEQs) at Burnt Bridge Creek and the two Lake River sites exceeded the human health criterion during all three seasons.

Burnt Bridge Creek was ranked the most contaminated of the three inputs to the lake. Lake River north, Lake River south, and the Flushing Channel followed in order of most to least contaminated.

Recommendations include:

- Burnt Bridge Creek should be the focus of efforts to reduce toxics loading to Vancouver Lake. A source assessment should be conducted to identify subbasins or suspected sources within the Burnt Bridge Creek watershed in need of follow-up action.
- Once progress has been made on cleanups, Vancouver Lake fish should be collected and re-analyzed for toxics detected during this study.

Acknowledgements

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Introduction

In the winter of 2010, the Washington State Department of Ecology (Ecology) initiated a study to evaluate 303(d) listed toxic chemicals in surface waters discharging to Vancouver Lake. Recent studies have indicated polychlorinated biphenyls (PCBs), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD, commonly referred to as dioxin), and three chlorinated pesticides or breakdown products (DDE, dieldrin, and toxaphene) are exceeding the National Toxics Rule (NTR) human health criteria in edible fish tissue (Coots, 2007; Seiders and Kinney, 2004).

Surface water inputs to Vancouver Lake have not been evaluated in past studies as possible sources of these contaminants to fish. In addition, water column data for PCBs, dioxin, and chlorinated pesticides do not exist. The low solubility of these contaminants makes it difficult to detect them in whole water samples. For these reasons previous studies have focused on fish and sediment.

These pollutants tend to adsorb to sediment and bioaccumulate through the food chain. Fish and other organisms may concentrate them at levels orders of magnitude higher than in their surrounding environment.

A number of possible pathways exist as sources to the lake. One uncontrollable source is volatilization from land and water surfaces followed by wet and dry air deposition. Another source which has potential for management options is the surface water inputs to the lake. Source identification is needed to develop management strategies for reduction efforts.

In response, this study was developed to determine if those pollutants not meeting human health standards in fish are being discharged to the lake by way of surface water inputs. Prioritizing these inputs will help local water quality managers determine where source control activities are best targeted. In addition, these data will establish baseline conditions for the contaminants of concern.

Vancouver Lake is an urban lake where fish are often caught and consumed. Local Russian and Asian communities are known to take carp from the lake as a food source, although consumption patterns are not well known. Recognized for having a productive warm water fishery, Vancouver Lake has one of the few commercial carp fisheries in the state. Concern is therefore warranted for the health of fish consumers.

The surface water inputs to Vancouver Lake included in this study are Burnt Bridge Creek, the Flushing Channel, and Lake River.

Site Description

Vancouver Lake covers 2,414 acres and is situated between the city of Vancouver, Washington to the east, Vancouver Lake Wildlife Area to the south, and Shillapoo Wildlife Area to the west (Figure 1). Burnt Bridge Creek is the only natural surface water drainage, discharging directly into Vancouver Lake's southeast corner. A few other small inflows exist but are generally insignificant. Outflow is to the north into Lake River, ultimately discharging to the Columbia River.

Vancouver Lake is very shallow and historically ranged from one to four feet deep. During the early 1980s portions of the lake were dredged to roughly between five and 10 feet. A large island in the north central area of the lake was developed for wildlife habitat from the dredge spoils.

During this same period a Flushing Channel was cut, connecting Vancouver Lake with the Columbia River to provide the lake with higher quality water. The approximately one-mile-long channel is located near the lake's southwest extent (Figure 1). Due to tidal influences on the Columbia River, tide gates were installed to prevent backflow. During falling tides when the water level of the lake is higher than the Columbia River the tide gates close.

Outflow from Vancouver Lake is by way of Lake River. About 11 miles long, Lake River connects Vancouver Lake to the Columbia River to the north. Lake River is also tidally influenced but unlike the Flushing Channel has no flow control devices. Flow direction in Lake River is controlled by the tidal stage of the Columbia River. During flood tides Lake River can reverse its course and discharge back into Vancouver Lake. Ebb tides allow the lake to drain down Lake River into the Columbia.

303(d) Listings

Under section 303(d) of the federal Clean Water Act impaired waters are those not meeting water quality standards. Every two years states must create a list of waterbodies not meeting standards and submit it to the Environmental Protection Agency (EPA) for approval. Listings can be based on water, sediment, or tissue. Waterbodies can only be listed or de-listed based on water quality data supporting the action.

The 2008 303(d) listings for toxic pollutants in Vancouver Lake are the most current and shown in Table 1. Vancouver Lake is also listed for fecal coliform bacteria and total phosphorus, not shown in Table 1.

The fishery of Vancouver Lake is the main beneficial use identified as being impaired by toxic substances. The EPA National Toxics Rule (NTR) human health criteria for edible fish tissue have been exceeded by concentrations of PCBs, TCDD, DDE, dieldrin, and toxaphene. Fish tissue data for the 303(d) listings are in Appendix Table B1.

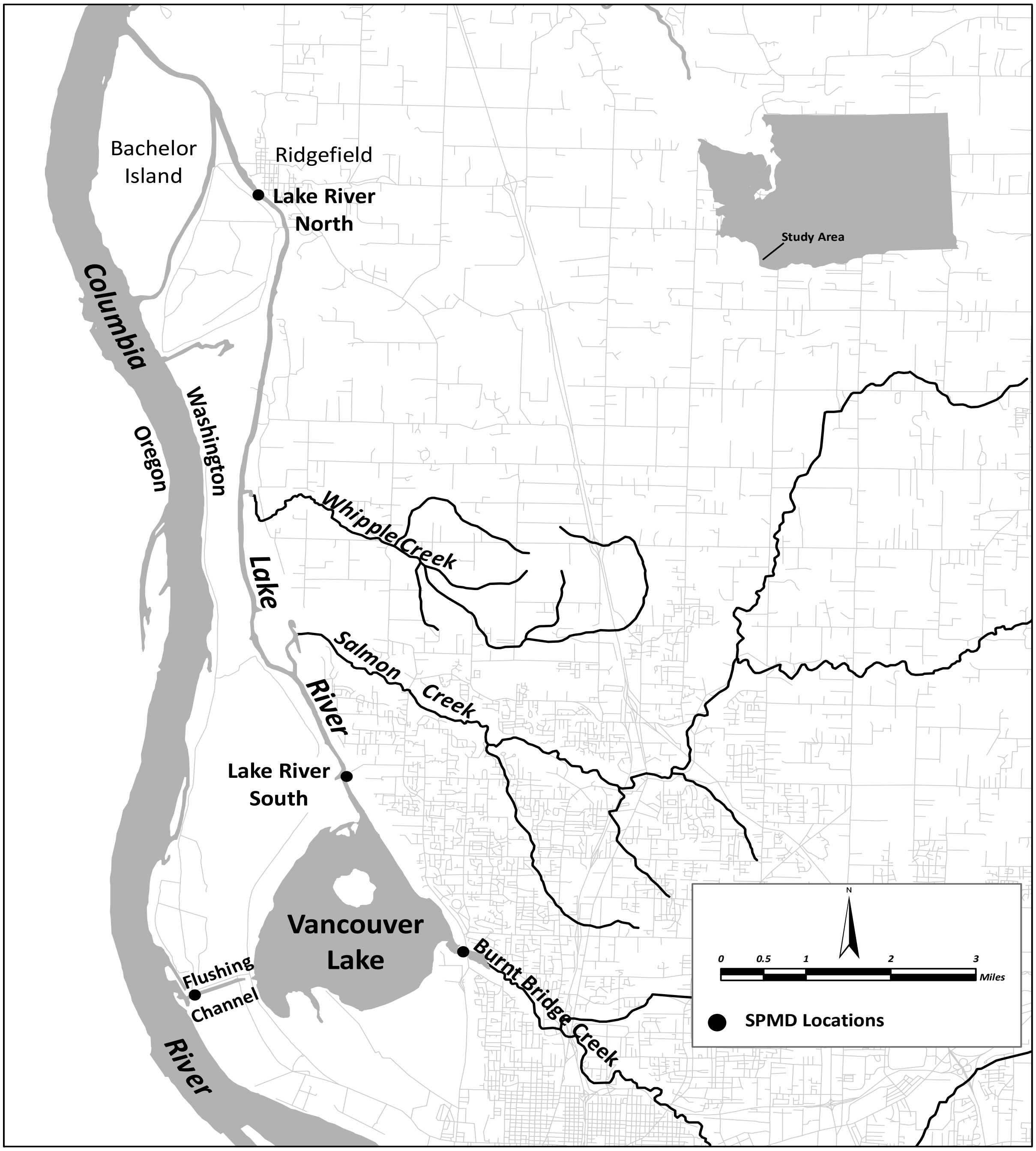

Figure 1. Study area showing sample locations.

Table 1. Vancouver Lake 2008 303(d) listings for toxics in edible fish tissue.

Waterbody	Parameter	Listing ID	Township	Range	Section
Vancouver Lake	Total PCBs	42172	T2N	R1W	5
	TCDD	53204	T2N	R1W	5
	DDE	42187	T2N	R1W	5
	Dieldrin	53205	T2N	R1W	5
	Toxaphene	42282	T2N	R1W	5

Available Data

In 1993 Ecology first reported PCBs and DDE, a metabolite of DDT, in Vancouver Lake fish exceeded the NTR human health criteria (Davis et al., 1995). A more recent Ecology study conducted in 2005-2006 reported fish from Vancouver Lake and the Lake River exceeded NTR criteria for total PCBs, dioxin, DDE, dieldrin, and toxaphene (Coots, 2007). The study also found low levels of these compounds in the sediments. A surface water quality study for PCBs and chlorinated pesticides was recommended.

In 2009 an EPA contractor analyzed sediments and Asian clams, *Corbicula fluminea*, from Vancouver Lake, the Flushing Channel, Burnt Bridge Creek, Lake River, and the Columbia River (Ecology and Environment, 2010). Asian clams are known to be collected and consumed from the study area. Total PCBs were present in sediments for two sites in Vancouver Lake and two sites in Burnt Bridge Creek. Levels were low, ranging from 8.2 to 35 *u*g/Kg dry weight (parts per billion). Three clam tissue samples from Vancouver Lake had total PCBs of 20 to 25 *u*g/Kg wet weight, while a site within the Flushing Channel had 6.2 *u*g/Kg. A background tissue sample located near the confluence of the Flushing Channel and Columbia River had the highest reported total PCB concentration at 29 *u*g/Kg.

In the fall of 2003 Hart Crowser, under contract with the Port of Vancouver evaluated Flushing Channel sediments (Hart Crowser, 2003). The purpose of this work was to characterize Flushing Channel sediments for proposed dredging operations and determine suitability for stockpiling and use as clean fill on upland properties. Ten sediment core samples were collected and analyzed for PCBs, chlorinated pesticides, semivolatile organics, tributyltin, metals, total organic carbon (TOC), and grain size. All analytes were reported below the ecological screening level values of the Dredge Material Evaluation Framework (U.S. Army Corp of Engineers, 1998).

Two water column studies of the Columbia River in the general vicinity of the Flushing Channel and Lake River have reported results for toxics. Both studies used semipermeable membrane devices (SPMDs). SPMDs are passive samplers used to concentrate hydrophobic contaminants to improve their detection in surface water.

Ecology conducted an SPMD study in the fall of 2003 through spring 2004 (Johnson and Norton, 2005). SPMDs were deployed in Lake River about 0.7 miles upstream (south) of discharge to the Columbia River. An additional SPMD site was located in the Columbia River about two miles upstream (south) of the Flushing Channel. Three seasonal samples were collected from the two sites. Estimates of total PCBs exceeded NTR criteria in at least two of three sample periods, while DDT and metabolites were generally within or slightly above criteria. The May to June sample period tended to have the highest levels of these compounds.

The United States Geological Survey (USGS) conducted an earlier SPMD study from summer 1997 through spring 1998 (McCarthy and Gale, 1999). PCBs, dioxin/furans, organochlorine pesticides, and polyaromatic hydrocarbons (PAHs) were analyzed. One sample site was located about 1.5 miles upstream from the mouth of Lake River and another near Hayden Island, just upstream of the confluence with the Willamette River. Concentrations of organochlorine compounds and PAHs were highest during late summer to early fall. Because of the overall low levels of contaminants reported for the Hayden Island site, USGS concluded that elevated concentrations in the Portland-Vancouver area are from local rather than upstream sources. The highest concentrations of PCBs were reported for tributaries in the Portland-Vancouver urban area which included the site near Lake River.

Currently the USGS is conducting a study to develop a water balance and nutrient budget for Vancouver Lake. Driven by harmful algal blooms the study will determine the role nutrients play. The water balance portion of the study will include three new gages for calculating flow into and out of the lake. Having information on flow will allow calculation of contaminant loading to the lake. The study will include a 2-year period of continuous-flow monitoring, set to end in 2013.

Using SPMDs

The present study used SPMDs to quantify PCBs, dioxin, and chlorinated pesticides in discharges to Vancouver Lake. Target analytes for the study have low solubility in water requiring special sampling and analytical methods. SPMDs are passive samplers which concentrate hydrophobic organic chemicals (Figure 2).

SPMDs were developed by the USGS, Columbia Environmental Research Center and commercially available through Environmental Sampling Technologies (EST), St. Joseph, Missouri (http://est-lab.com/). Details of SPMD construction and use can be found at wwwaux.cerc.cr.usgs.gov/SPMD/SPMD_questions.htm#12.

SPMDs are made of flat low-density polyethylene tube (91 x 2.5 cm) containing triolein, a neutral lipid. Submerged in water, only the dissolved fraction of lipophilic contaminants are diffused through the membrane wall and concentrated. Following retrieval, SPMDs are extracted and analyzed for target chemicals.

Advantages of using SPMDs over traditional water samples include the following:

- Chemicals with low water solubility are present at low concentrations in surface waters. Detection by standard sampling and analysis methods may not be possible. The large chemical residues accumulated in an SPMD improve detection capability.

- Because SPMDs provide a time-weighted average concentration over the deployment period, short-lived or event-based pollutants often missed by grab sampling can be captured.
- SPMDs mimic contaminant uptake by fish, reflecting the bioaccumulation potential of the analytes. Studies have shown PCB concentrations measured in SPMDs and caged fish agree within a factor of two, on average (Meadows et al., 1998; and Echols et al., 2000).
- SPMDs only take up the dissolved bioavailable fraction of a chemical.
- Confounding variables associated with sampling fish and other organisms, such as metabolism, growth, and movement, are not an issue with SPMDs, which are of standardized design.

Chemical concentrations reported from SPMDs are expected to be close to other low-level water sampling techniques (Huckins et al., 1993 and 2002).

Concentration Estimates

The USGS has developed spreadsheet calculators to determine water concentration from SPMD extracts. The most recent calculator (version 5) uses performance reference compounds (PRCs) to allow water concentration to be estimated based on the principal that the rate of PRC loss during deployment is proportional to contaminant uptake. Concentration estimates using PRCs is considered an improvement over earlier methods because site conditions like water turbulence and velocity, temperature, and biofouling are incorporated into the estimates. Typical PRCs are PCB congeners not normally found in the environment at significant levels, spiked into SPMDs before deployment at a known amount. PCBs 4, 14, 29, and 50 were used for this study.

Earlier spreadsheets (version 4 and before) calculated concentration estimates based on laboratory sampling rate experiments. Because of this, concentration estimates are not possible for analytes that have not had sampling rates determined. Version 4 concentration estimates compared to version 5 are expected to be within a factor of two (D. Alvarez, personnel communication, 2011).

Concentration estimates for the winter Burnt Bridge Creek and the fall Flushing Channel samples were determined using the version 4 spreadsheet. The Burnt Bridge Creek PCB sample was lost in a laboratory accident and the fall Flushing Channel sample had an unacceptably high uncertainty factor. The total PCB results for these samples should be considered biased low.

Of the 209 possible PCB congeners, 61 do not have laboratory-derived sampling rates and are not included in estimates of total PCBs. The PCB total of the 61 congeners accounted for a mean study difference of 8.4% per sample.

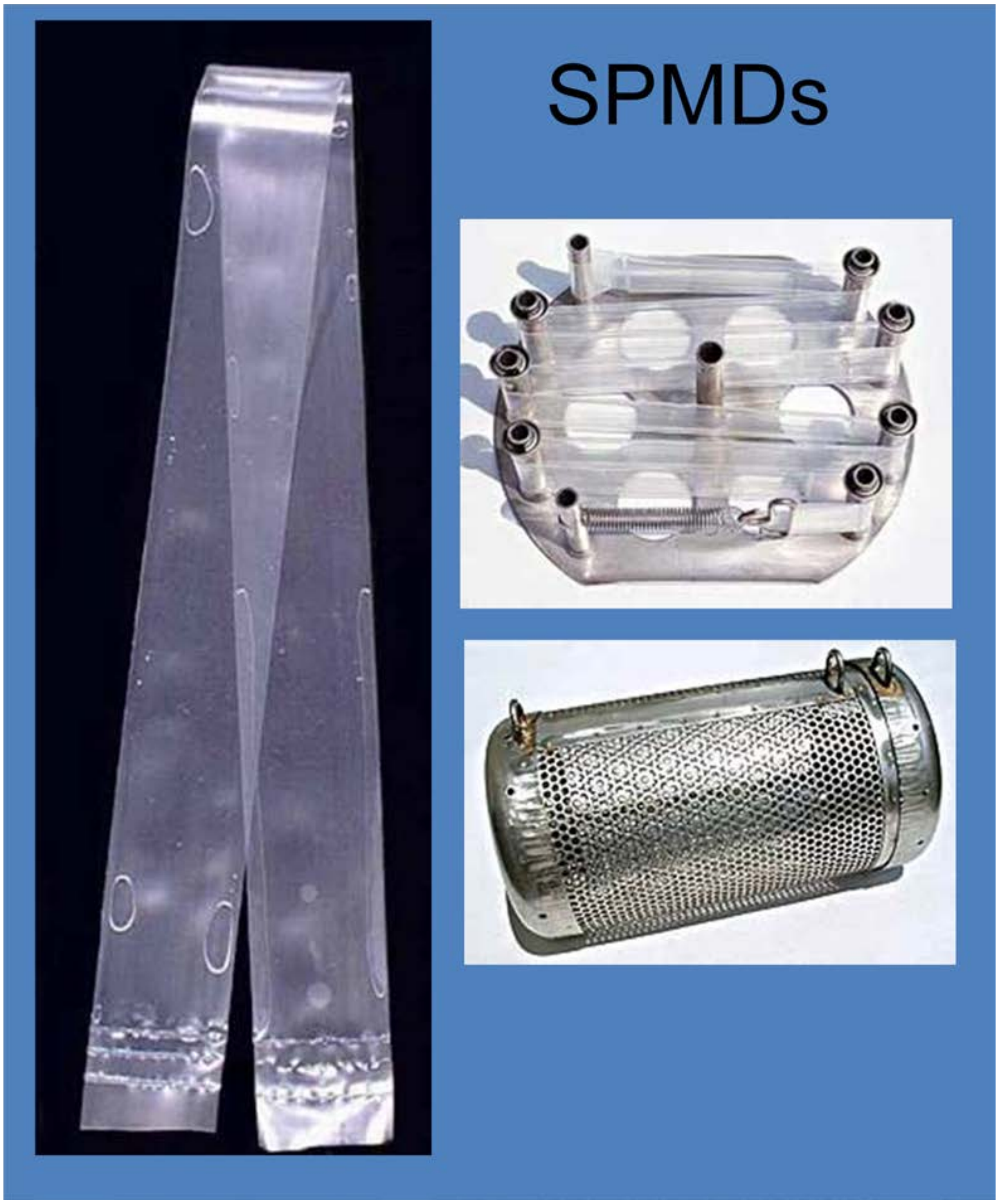

Figure 2. SPMD membrane, spindle carrier, and stainless steel canister.

Study Design

This study generated data on PCBs, dioxin and furans, and chlorinated pesticide levels in the water column of Burnt Bridge Creek, the Flushing Channel, and Lake River. The data allowed for (1) a determination of whether these contaminants are being discharged to Vancouver Lake from surface water inputs; (2) establishment of baseline conditions for these contaminants as inputs to the lake, and (3) prioritization of these inputs for corrective action. SPMDs were used as a means to concentrate and quantify the chemicals of interest.

Sample sites for each surface water source were located where a secure location was found as close to discharge into Vancouver Lake as possible. The closest samples are most representative of the surface water input.

SPMDs were deployed three times - winter, spring, and late summer 2010 - at four locations. Each deployment lasted for roughly one month. Sample periods were selected to represent the range of contaminant levels and discharge. Timing of sample collection represented winter wet weather, spring runoff, and the end of the dry season. The two previously mentioned SPMD studies in the lower Columbia River around the Vancouver and Portland area measured the highest PCB concentrations during both high flow (Johnson and Norton, 2005) and low flow (McCarthy and Gale, 1999).

Locations of sample sites are shown on Figure 1. Table 2 has the latitude, longitude, and the general description of SPMD locations.

Table 2. Sample stations, coordinates, and location.

Waterbody	Latitude	Longitude	Location
Burnt Bridge Creek	45.67523	-122.69241	Inside RR culvert 15 meters from Vancouver Lake
Flushing Channel	45.66691	-122.75497	Within the Flushing Channel 300 meters east of the Columbia River
Lake River North	45.81621	-122.75071	McCuddy's Ridgefield Marina off the northern-most boathouse
Lake River South	45.70760	-122.72245	About 25 meters west of the Felida Moorage office

Datum: NAD83 HARN.

Methods

Sampling Procedures

Passive sampling using SPMDs was conducted over a one-month period in January, May, and September of 2010. SPMDs were deployed and retrieved following guidance found in Huckins et al., (2000 and 2006) and Ecology SOP EAP001 (Johnson, 2007). Standard SPMDs (91 x 2.5 cm) each containing 1 mL of triolein, an artificial fish fat, spindle carriers that maintain the SPMDs during deployment, and stainless steel canisters (Figure 2) were purchased from Environmental Sampling Technologies (EST) http://est-lab.com/.

SPMD membranes were preloaded onto spindles by EST in a clean room environment and shipped in solvent-rinsed metal cans filled with argon gas. Each SPMD canister was deployed with five membranes. SPMD membranes were kept frozen until deployed.

At the sample site, cans containing SPMD membranes were carefully pried open. Five SPMD membranes were slid into each canister, and closed by screwing on the lid. Loading the canisters with SPMDs and submerging was done as quickly as possible as they are known to be potent air samplers. The SPMD canisters were fixed to anchors and attached to a rigid structure by lanyard. The SPMDs were situated off the bottom to prevent contact with substrate.

SPMDs were maintained submerged throughout the sampling period. Field personnel wore talc-free nitrile gloves and avoided touching membranes. The sampling period was roughly 28 days for each deployment. Retrieval followed a reverse order of deployment.

The membranes were resealed in their original container and shipped frozen to EST for dialysis and cleanup. During shipment SPMDs were maintained at or near freezing.

A Tidbit temperature logger was attached to the SPMD canister to record water temperature every five minutes. At deployment, retrieval, and in the middle of the deployment period a TOC and TSS sample was collected from each SPMD location (Table 3).

Table 3. TOC and TSS sample size, containers, preservation, and holding time requirements.

Parameter	Sample Size	Container	Preservative	Holding Time
TOC	100 mL	2-60 mL poly	1:1 HCl to pH <2.0; cool to <4 ^{o}C	28 days
TSS	1000 mL	1 L poly	Cool to <4 ^{o}C	7 days

Sample sites were located by Global Positioning System (GPS) and recorded in field logs. Procedures for establishing GPS positions of SPMD sampling locations followed SOP EAP013 – Determining Global Positioning System Coordinates (Janisch, 2006).

SPMD membranes were shipped under chain-of-custody to EST by overnight Federal Express, in coolers packed with water ice. Other samples were returned to Ecology Headquarters under chain-of-custody and transported by courier to Manchester Environmental Laboratory (MEL) the day following collection.

Measurement Procedures

Analytical parameters, sample numbers, reporting limits, and cleanup and analysis methods used for the study are presented below in Table 4. Method selection was based on the lowest detection limits available for the proposed analysis. All 209 PCB congeners were analyzed along with the 17 2,3,7,8-substituted dioxins and furans. A complete analyte list for chlorinated pesticides by EPA method 8081 can be found in Appendix C.

All samples were placed in ice-filled coolers at or below 4^{o}C following collection. Chain-of-custody was maintained throughout the sampling and analysis process. All project samples were analyzed at MEL or a laboratory contracted by MEL.

Table 4. Laboratory parameters, number of samples, reporting limits, and analytical methods for sample analyses.

Parameter	Sample Number + QA	Reporting Limits	Sample Cleanup Method	Analytical Method
TOC (mg/L)	39	1	-	SM5310B
TSS (mg/L)	39	1	-	SM2540D
PCB Congeners[1] (ng/SPMD)	21	10	Dialysis/GPC[2]	EPA 1668A HRGC/HRMS
Dioxins and Furans[1] (ng/SPMD)	21	4.4	Dialysis/GPC[2]	EPA 1613B HRGC/HRMS
Chlorinated Pesticides[1] (ng/SPMD)	21	0.1 - 3.0	Dialysis/GPC[2]	EPA 8081

[1] Reporting limits and expected ranges of results will vary for different compounds. Reporting limits are for residue.
[2] EST SOPs E14, E15, E19, E21, E33, E44, E48 HRGC/HRMS = High Resolution Gas Chromatography / High Resolution Mass Spectrometry.

EST conducted dialysis (extraction) and gel permeation chromatography (GPC) cleanup on the SPMD membranes. This is a patented procedure as described in Huckins et al. (2000 and 2006). Following dialysis and cleanup, the extracts were sealed in glass ampoules divided for analysis by the appropriate laboratories. One extract made from two membranes was sent to MEL for

chlorinated pesticide analysis, while another made from three membranes was sent to Analytical Perspectives in North Carolina, the contract laboratory conducting PCB and dioxin/furan analysis. Laboratories reported SPMD results as total ng/sample. Additional procedural information on the use of SPMDs can be found at.
wwwaux.cerc.cr.usgs.gov/SPMD/SPMD_questions.htm#12

Data Quality Assessment

A detailed review of data quality is included in Appendix D. MEL provides written case narratives of quality for each data package analyzed in-house or from contract laboratories.Case narratives include descriptions of analytical methods and a review of holding times, instrument calibration checks, blank results, surrogate recoveries, matrix spike recoveries, laboratory control samples, and laboratory duplicate analyses. The case narratives and complete data reports can be obtained from the report authors by request.

The quality assurance review verified laboratory performance met quality control specifications outlined in the analytical methods and the Contract Laboratory Program National Functional Guidelines for the Organic Data Review. In cases where data required qualification based on more than one issue, the more restrictive qualifier was used. All data was useable as qualified.

Results and Discussion

Precipitation and Flow Conditions

Precipitation

Precipitation during the study period generally followed historical patterns for the area. From February to April and July into August precipitation was slightly lower than historical. But for May and June precipitation was higher than normal, doubling historical averages.

Shown below in Figure 3 is long-term precipitation data from a weather station located at the Portland International Airport (NOAA, Portland PDX) compared to the 2010 study period precipitation from a weather station within the study area. The 2010 data is considered provisional.

The Portland station is located about five to six miles to the southeast from the study area and reports precipitation for about 30 years (1971 through 2000). Data for the 2010 study period were collected at the Salmon Creek Wastewater Treatment Plant, located about one-half mile to the east of Lake River, along Salmon Creek.

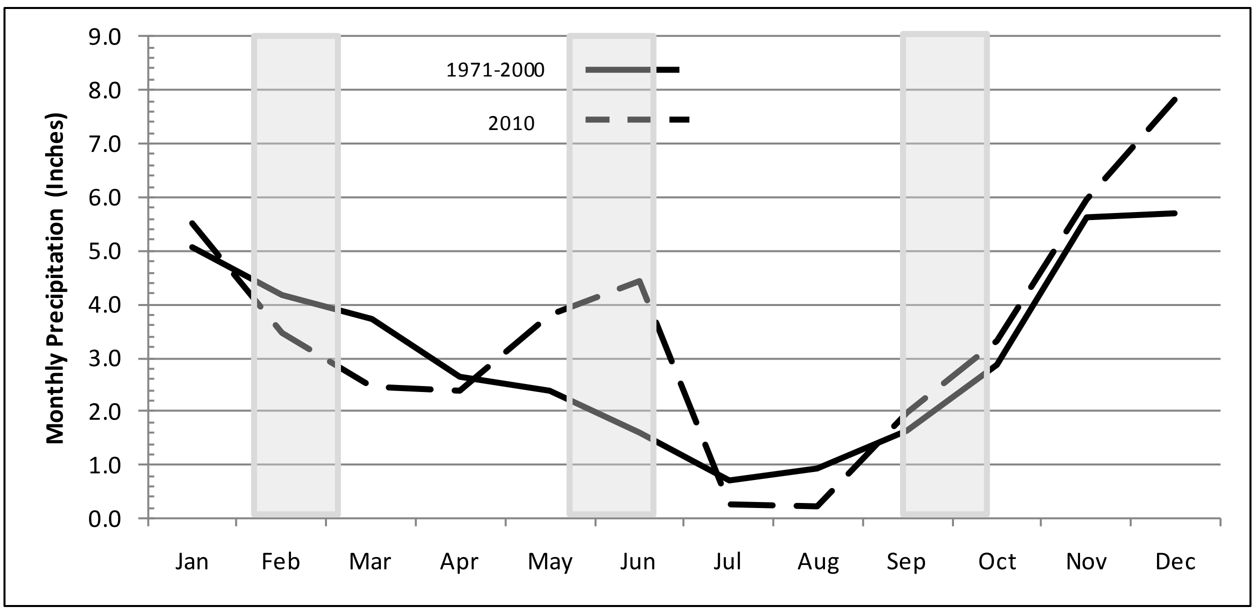

Figure 3. Monthly Precipitation of Historical (NOAA, Portland PDX) and Study Periods (Salmon Creek WTP), Showing Timing of SPMD Deployments.

Flow

Columbia River discharge can directly affect three of the four study sites. As with precipitation results, flow over the study period generally followed historical trends (Figure 4). From January into May, discharge was slightly lower than historical. June was the peak discharge month and was higher than historical averages.

High flows for the Columbia River are typical in May to June, being a snowmelt-driven system. As the precipitation data suggests, flow was likely augmented by higher than normal rainfall during May and June of the study year. From August through December, Columbia River discharge followed closely to historical averages.

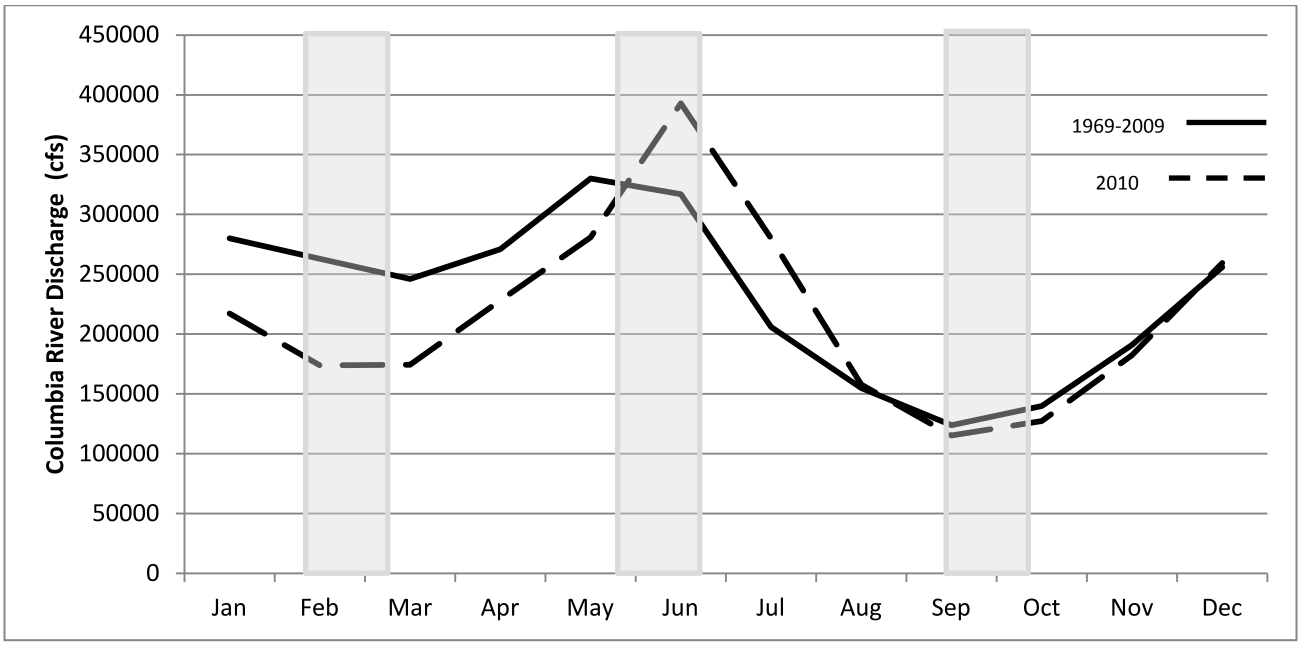

Figure 4. The Columbia River Discharge at Beaver Army Terminal (RM 45.0) for Historical and Study Periods, Showing Timing of SPMD Deployments (USGS 14246900 – mean monthly flow, 1969 to 2009).

Water Quality Parameters

TSS and TOC

All study results for the TSS and TOC analysis can be found in Appendix E. These samples were collected seasonally at each SPMD site during deployment, the mid-point of deployment, and during retrieval of the SPMDs.

TOC levels were generally consistent throughout the January to October study period ranging from 2.7 to 3.1 mg/L. TSS was higher in Lake River than in the Flushing Channel and Burnt Bridge Creek. Winter and spring samples were similar with TSS averaging about 9 mg/L, but during the fall runoff period TSS increased substantially, averaging about 24 mg/L TSS.

PCBs

A summary of the concentration estimates for total dissolved PCBs[1] along with the study mean for each site and sampling period is included in Table 5. The results are a time-weighted average dissolved concentration for each site and sample period. Results represent a deployment of 28 days for January, 29 days for May, and 26 days for September. Figure 5 plots the seasonal results showing spatial and temporal patterns. The complete concentration and residue data for PCBs can be found in Appendix F, Tables F1 through F6.

Table 5. Total Dissolved PCB Concentration Estimates from SPMDs Winter, Spring, and Fall 2010 (pg/L, parts per quadrillion, dissolved).

	Lake River North	Lake River South	Flushing Channel[1]	Burnt Bridge Creek	Aquatic Life[2]/ NTR Criterion
Winter	54	68	73[3]	LA	WA State: **Chronic = 14,000** Federal: **NTR = 170**
Spring	158	124	**240**	**463**	
Fall	**495**	**209**	**623**	**558**	
Total PCB Mean	**236**	134	**312**	**511**	

[1] Water source to the Flushing Channel is the Columbia River.
[2] Aquatic Life Criterion is for chronic exposure, the National Toxics Rule, Human Health criterion is for water and organisms.
[3] Concentration was estimated using version 4, likely biased low.
LA: Laboratory accident, sample lost.
Bold: Value exceeds human health criterion.

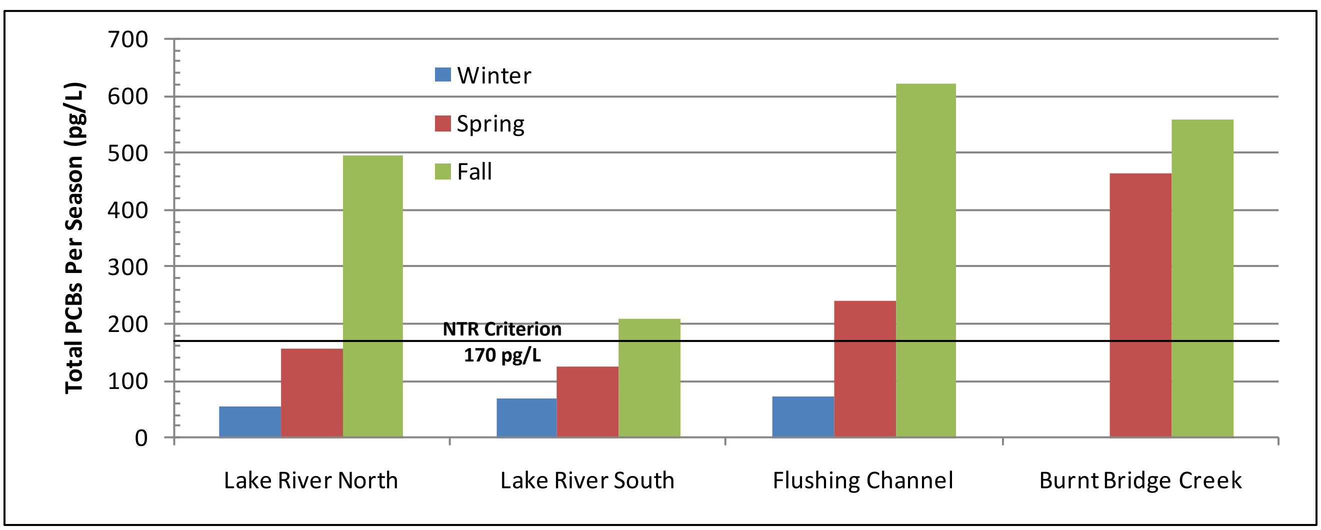

Figure 5. Total PCBs reported as Dissolved Concentration Estimates by Season and Site.

[1] Total PCBs is the sum of the detected concentrations of 209 possible PCB compounds called congeners.

Total dissolved PCB concentrations increased from winter through fall at all study sites. Burnt Bridge Creek had the highest total PCB mean for the study. The highest seasonal concentration came from the Flushing Channel in fall, showing a more than two-fold increase compared to spring. The Lake River sites and the Flushing Channel had roughly a doubling from season to season while Burnt Bridge Creek had about a 20% increase from spring to fall. The Lake River South site had the lowest mean total dissolved PCB concentration, likely due to a moderating effect from Vancouver Lake which contributes most of the water at the site.

The Vancouver Lake inputs are ranked in Table 6 below, according to the seasonal mean total PCB concentration. Numbers were assigned from 1 to 4 for the highest to the lowest concentration. The Burnt Bridge Creek site had the highest overall level of contamination. Only two seasons of data were available for this site because the winter PCB sample was lost in a laboratory accident. The Lake River South site had the lowest ranking.

Table 6. Ranking Vancouver Lake Inputs Based on Total Dissolved PCB Concentrations (1 = Highest Contamination).

Rank	Total Dissolved PCBs
1	Burnt Bridge Creek
2	Flushing Channel
3	Lake River North
4	Lake River South

Water Quality Standards

Total dissolved PCB concentration estimates for all sites and seasons never approached the Washington State Water Quality Standards for the protection of aquatic life (WAC 173-201A-240). The National Toxics Rule (NTR) human health criterion is more restrictive and is designed to provide protection to a level of 1-in-1 million (10^{-6}) additional increased cancer risk from drinking the water or eating the fish that live in the water.

The two Lake River sites exceeded the NTR criterion of 170 pg/L for total PCBs only during the fall sampling period. The Lake River North site exceeded the criterion by 2.9 times. The Lake River South site was only 1.2 times the criterion, and the only site with a mean total PCB level below the NTR (Figure 5).

The Flushing Channel and Burnt Bridge Creek sites exceeded the NTR criterion during both spring and fall. The Flushing Channel exceeded the NTR by about 1.4 and 3.7 times, while Burnt Bridge Creek exceeded by 2.7 and 3.3 times. During winter, total PCBs did not exceed the NTR criterion, although the Burnt Bridge Creek sample was lost in a laboratory accident, so results were not available (Figure 5).

Dioxin and Furans

The toxicity of dioxin and furan congeners can range over orders of magnitude. A Toxic Equivalency (TEQ) system was developed for the 17 2,3,7,8-substituted dioxins and furans, and applied by measuring them in relation to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most toxic form of dioxin.

Each of the 17 dioxin and furan congeners is assigned a Toxic Equivalency Factor (TEF) as a decimal fraction of that compounds toxicity relative to TCDD, which has a TEF of 1.0. Congeners are multiplied by their respective TEF and results are summed. The summed values are the TEQ. The TEQ can then be compared to the NTR human health water quality criterion for TCDD.

Concentration estimates for TCDD and TCDD TEQs are summarized below in Table 7. Figure 6 plots seasonal TEQ results showing spatial and temporal patterns. Dioxin and furan contributions to the TEQ are shown in Figure A1, in the Appendix. Complete SPMD concentration and residue results can be found in Tables F7 through F12, in Appendix F.

Table 7. TCDD Concentration Estimates and TCDD TEQs from SPMDs Winter, Spring, and Fall 2010 (pg/L, dissolved).

		Lake River North	Lake River South	Flushing Channel	Burnt Bridge Creek	NTR 2,3,7,8-TCDD Criterion
Winter:	TCDD	0.005 U	0.005 U	0.005 U	0.001 UJ	0.013 pg/L
	TCDD TEQ	**0.028**	**0.017**	0.0056	**0.066**	
Spring:	TCDD	0.005 U	0.005 U	0.005 U	0.012 J	
	TCDD TEQ	**0.040**	**0.026**	0.0076	**0.20**	
Fall:	TCDD	0.005 U	0.005 U	0.005 U	0.0087 J	
	TCDD TEQ	**0.12**	**0.023**	0.0050	**0.13**	
	Study Mean TCDD TEQ	**0.063**	**0.022**	0.0061	**0.13**	

U: Analyte not detected at or above the detection limit shown.
UJ: Analyte not detected at or above the estimated sample quantitation limit.
J: Estimated sample concentration.
Bold: Value exceeds human health criterion.

The Burnt Bridge Creek site had the only TCDD detections for the study. In spring, TCDD was reported just below the NTR criterion; in fall, TCDD was reported at about half the criterion. Burnt Bridge Creek also had the highest TEQ value for the study; about twice Lake River North, the next highest site, during winter and five times during spring. In fall, Burnt Bridge Creek and Lake River North TEQs were about the same.

The Lake River sites followed the same concentration increase from winter to fall, similar to PCBs (Tables F7 - F9). And like PCBs, the northern Lake River site had higher dioxin and furan concentrations than the southern site. The Flushing Channel and Burnt Bridge Creek had higher concentrations reported during spring.

The Flushing Channel had the lowest overall dioxin and furan concentrations and TEQs for the study. While the Flushing Channel had the study's highest seasonal concentration of PCBs during fall, dioxin and furans were low during this period.

Dioxin made up the bulk of the TEQ totals (Tables F7 – F9; Figure A1). The furan percentage in study samples averaged 11%, and ranged from 2.7 to 24%. The Burnt Bridge Creek site tended to have the highest sample proportion of furans.

Vancouver Lake inputs were ranked in Table 8 based on mean seasonal TCDD TEQs. As with PCBs, Burnt Bridge Creek had the highest levels of dioxin and furan contamination. Somewhat surprisingly, the Flushing Channel had the lowest, even though it had the highest single season total PCBs concentration.

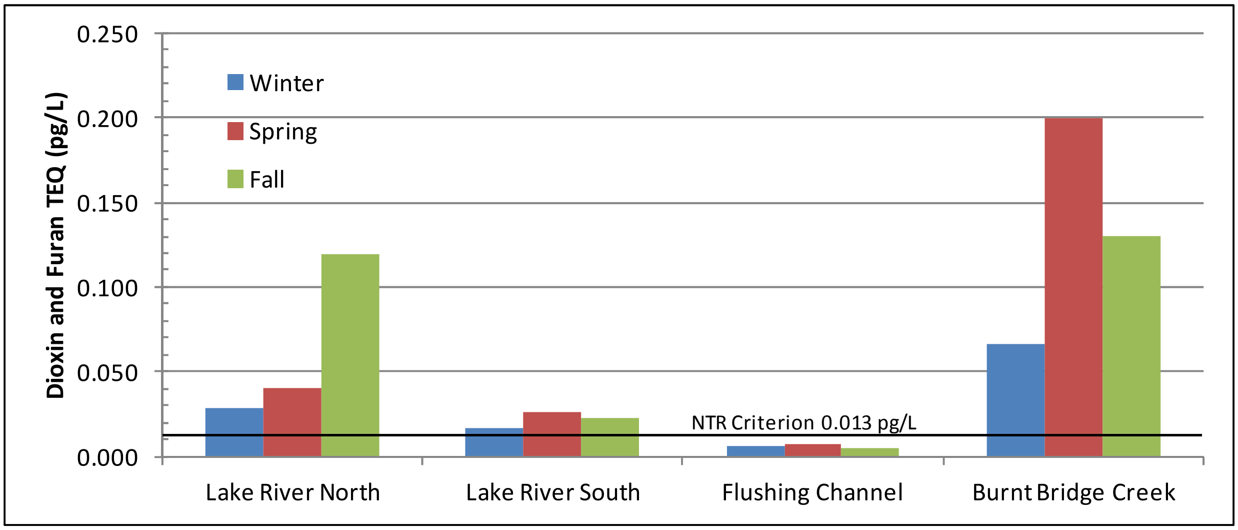

Figure 6. TCDD TEQs by Season and Site.

Table 8. Ranking of Vancouver Lake Inputs Based on TCDD TEQs (1 = Highest Contamination).

Rank	TCDD TEQ
1	Burnt Bridge Creek
2	Lake River North
3	Lake River South
4	Flushing Channel

Water Quality Standards

Currently Washington State does not have a dioxin or furan water quality criterion for the protection of aquatic life (WAC 173-201A-240). The NTR provides a criterion for only TCDD (0.013 pg/L).

Throughout the study no sample had a TCDD concentration that exceeded the NTR criterion. However, TEQs for all sites except the Flushing Channel exceeded the NTR by factors of 1.3 to 15. The Burnt Bridge Creek site had the highest increase over NTR for each season. The TCDD TEQ estimates for the Flushing Channel were roughly half the criterion (Figure 6).

Chlorinated Pesticides

The target compound list included 34 chlorinated pesticides or breakdown products (Appendix C). SPMD concentration estimates and residue results can be found in Tables F13 – F18 in the Appendix. Descriptions and information about the chlorinated pesticides that were detected in SPMD extracts during the study can be found in Appendix G.

303(d) Listed Pesticides

DDE (DDT metabolite), dieldrin, and toxaphene are currently the 303(d) listed chlorinated pesticides exceeding human health criteria in fish from Vancouver Lake. During this study DDE was always within the human health criterion. Burnt Bridge Creek had the highest estimated concentrations, with a study mean about one fifth of the criterion. Dieldrin was also reported highest in Burnt Bridge Creek with a study mean of 212 pg/L. Winter and spring seasonal samples exceeded the human health criterion of 140 pg/L. The study mean for Burnt Bridge Creek was over five times the next highest site, Lake River North. Toxaphene was not detected throughout the study at or above a detection limit range between 50 -157 pg/L.

Detection Frequency

Burnt Bridge Creek had the highest number of chlorinated pesticides or breakdown products detected in each of the three sample seasons, averaging 18 per season (Table 9). The Lake River North and South sites averaged about 13, and the Flushing Channel averaged 7.

Table 9. Chlorinated Pesticide Detection Frequency for Vancouver Lake Inputs, Winter, Spring, and Fall 2010.

	Lake River North	Lake River South	Flushing Channel	Burnt Bridge Creek
Winter	13	15	5	20
Spring	14	13	7	18
Fall	11	11	8	16
Mean	12.7	13	6.7	18

The total number of pesticide compounds detected in Burnt Bridge Creek averaged roughly one and a half times the number reported for the Lake River sites and almost three times the detections of the Flushing Channel. These results likely reflect the amount of residential/urban and industrial development in the Burnt Bridge Creek drainage.

The number of pesticide detections decreased slightly from winter to fall at Burnt Bridge Creek and Lake River South sites. Detections increased from winter to fall at the Flushing Channel; detections were about the same winter and spring and slightly fewer in fall at Lake River North. There is a higher potential for pesticides to be rainfall- and runoff-driven during winter and spring in western Washington and urban environments (Anderson et al., 2005).

Of the 34 pesticide compounds analyzed, about one-third were not detected during the study. Listed below are the chlorinated pesticides or breakdown products that were analyzed but not detected.

Alpha-BHC	Endrin	Methoxychlor
Beta-BHC	Endrin Aldehyde	Mirex
Delta-BHC	Endrin Ketone	Toxaphene
Gamma-BHC (Lindane)	Heptachlor	

Vancouver Lake inputs were ranked based on mean study concentrations of 4,4'-DDE and dieldrin, the only detected 303(d) listed chlorinated pesticides (Table 10). Like the ranking of PCBs and dioxin/furans, Burnt Bridge Creek had the highest levels of 303(d) listed compounds and other chlorinated pesticides. Toxaphene, the other pesticide for which Vancouver Lake is listed, was not detected.

Table 10. Vancouver Lake Input Ranking Based on 4,4'-DDE and Dieldrin (1 = Highest Contamination).

Rank	4,4'-DDE and Dieldrin
1	Burnt Bridge Creek
2	Lake River North
3	Lake River South
4	Flushing Channel

Seasonal Trends

Many chlorinated pesticides were detected in all three seasons. The majority had an increasing or decreasing concentration from winter to fall. The Lake River and Flushing Channel sites in almost all cases had a concentration increase from winter to fall. The one exception was from the Lake River South site. A concentration decrease was measured for 2,4'-DDD (a metabolite of DDT). This suggests that contaminants reported in the Lake River and Flushing Channel sites are not runoff-driven but more related to application or irrigation through spring and summer. This is not expected as very few of the chlorinated pesticides are currently used products.

Burnt Bridge Creek showed decreasing concentrations from winter to fall in every case where detections were reported for all three seasons. A summary of concentration estimates for 303(d) listed chlorinated pesticides and other chlorinated pesticides detected during the study are shown below in Table 11.

Table 11. Chlorinated Pesticide Concentration Estimates from Vancouver Lake Inputs, Winter, Spring, and Fall, 2010 (pg/L, dissolved).

	Lake River North			**Lake River South**			**Flushing Channel**			**Burnt Bridge Creek**			**NTR**
	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring	Fall	(pg/L)
303(d) Listed Pesticides													
4,4'-DDD	8.50	26.2	27.5	8.80	17.7	12.8	5.60	14.2	23.6	242	117	79.4	830
4,4'-DDE	15.9 J	31.5	41.6	19.1 J	23.1	24.9	6.30 J	22.6	27.3	136	123	92.7	590
4,4'-DDT	3.4 J			3.30 J						94.9 J	21.9 J	6.00 J	590
Dieldrin	29.9	46.4	39.9	22.8	42.2	18.4				**397**	**141**	98.7	140
Toxaphene	52.0 U	79.7 U	112 U	50.2 U	65.9 U	72.5 U	58.1 U	103 U	ND	ND	80.4 U	157 U	730
Other Chlorinated Pesticides													
2,4'-DDD	9.60	10.3	13.0 J	11.9 J	8.30 J	7.10				103 J	62.3 J	42.9 J	
2,4'-DDE										15.2 J			
2,4'-DDT										43.8	6.20		
DDMU												73.7	
Aldrin		7.00 J		3.50 J						ND			130
Chlordane, technical	38.1 J	94.6	194	35.7 J	77.3	95.9	38.0 J	112	ND		231 J	218	570
cis-Chlordane	4.00	7.60	10.1 J	3.60	6.50	6.20				40.4	25.9	20.9	
trans-Chlordane	3.80		13.0	3.60					17.6	37.8 J	25.9	25.6	
Cis-Nonachlor											5.30 J		
Trans-Nonachlor	3.60	8.60 J	12.7	3.20	7.10 J	7.40				42.7 J	32.2 J	28.0 J	
Oxychlordane												7.40	
Chlorpyrifos	13.6 J	227 J	38.2 J	13.6 J	161 J	55.1		127 J		138 J	59.4 J	44.0	
Dacthal	15.0 J	31.1		69.7 J	14.1			35.4					
Endosulfan I		189 J		144 J	289 J	211				108 J	611 J		930,000
Endosulfan II		534								ND	812		930,000
Endosulfan Sulfate		287			207				ND	ND	1275	1275	930,000
Heptachlor Epoxide									14.1	25.2	41.2	29.6	100
Hexachlorobenzene	7.40	17.5 J	22.1	7.40	12.7 J	11.9	5.90 J	12.8 J	32.5	124 J	39.9	34.9	750
Pentachloroanisole	49.8		195	65.8	42.6	135	7.70 J	16.5 J	25.6	287	142	221	
Analytes Detected #	13	14	11	15	13	11	5	7	8	18	18	16	

J: Analyte has been positively identified; the result is considered an estimate.
U: Not detected at the detection limit shown.
ND: Not determined. Analyte concentration estimate not available due to laboratory determined sampling rate not being available.
Bold: Concentration exceeds NTR.

Water Quality Standards

Many chlorinated pesticides were detected throughout the study but very few exceeded water quality criteria. Not all chlorinated pesticides have water quality criteria. Table 11 provides the NTR criteria that are available for detected compounds.

The only chlorinated pesticide exceeding the NTR criteria during the study was from the Burnt Bridge Creek site. Dieldrin measured 397 pg/L in the winter sample, estimated at almost three times the NTR criterion of 140 pg/L, but dropped in the spring to less than half (141 pg/L) the winter estimate.

The 4,4'- species of DDT (4,4'-DDT, DDE, and DDD) were generally low and did not approach the NTR criteria. Burnt Bridge Creek had the highest concentrations for each season. 4,4'-DDT was not detected in the Flushing Channel and only at low concentrations during winter in the Lake River sites. Total DDT (sum of 4,4'-DDT + 4,4'-DDD + 4,4'-DDE) from Burnt Bridge Creek had a study mean of roughly six to nine times the average of other sites.

Toxaphene was not detected throughout the study. Reporting limits for toxaphene ranged from 50 to 157 pg/L. The NTR criterion for toxaphene is 730 pg/L.

303(d) Listed Contaminant Summary

Results for 303(d) listed chemicals detected during the study are presented below in Figure 7. Results show the study means for total PCBs, TCDD TEQs, total DDT, and dieldrin. Toxaphene was never reported above detection.

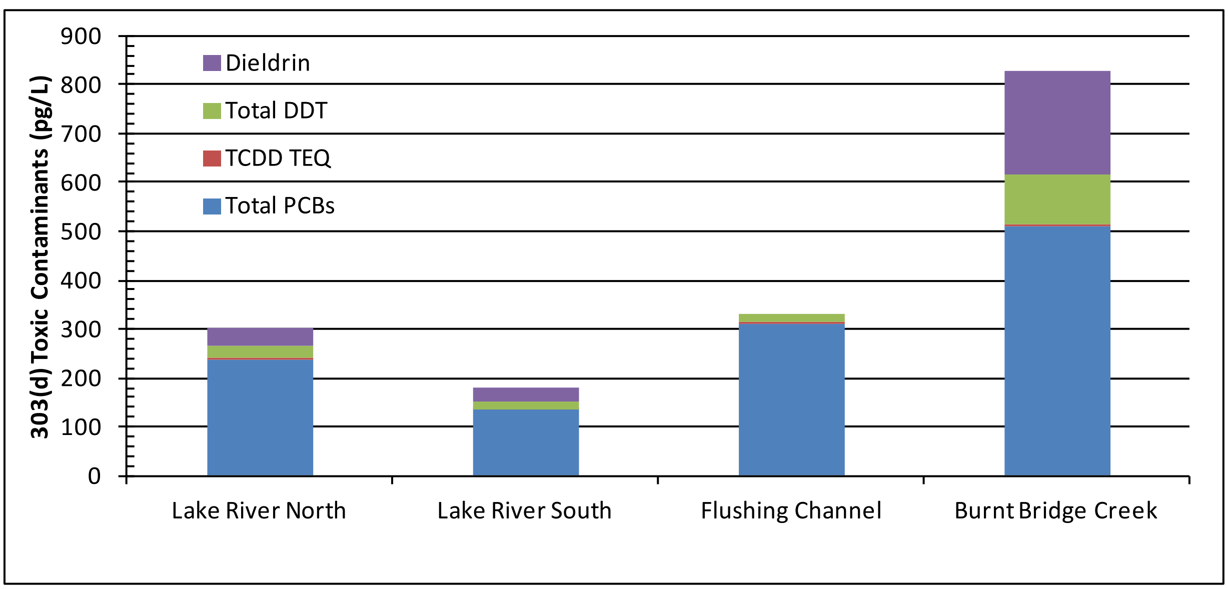

Figure 7. 303(d) Listed Contaminants Detected in SPMDs from Vancouver Lake Inputs.

As shown in Figure 7, the Lake River sites are similar in contaminants but the northern site is higher in concentrations. Impacts to the Flushing Channel are largely by PCBs and relatively minor for other 303(d) compounds. The Columbia River is the source of water to the Flushing Channel. Differences between the contaminant profile of the Flushing Channel and the Lake River sites suggest impacts from local sources.

Burnt Bridge Creek shows the highest levels of 303(d) compounds for the study. The water quality of Burnt Bridge Creek is impacted by the residential/urban and to a lesser extent industrial character of the relatively small basin. The other sites appear to benefit from greater volume and dilution from the Columbia River and Vancouver Lake.

Study Comparison

As previously described, two other SPMD studies conducted in the study area analyzed many of the same chemicals as the present study. The more recent 2003-04 study conducted by Ecology (Johnson and Norton, 2005) had a site very close to the current Lake River North site. That study described their Lake River site as 0.7 miles south of Lake River's mouth. The Lake River North site was located about 0.9 miles south of the confluence with the Columbia River.

The other SPMD study, by the USGS, in the Lower Columbia River (McCarthy and Gale, 1999) also had a sample site within Lake River near the Lake River North site. However, the USGS data are over ten years old and results were not adjusted for water velocities, membrane fouling by growth or settling solids, or temperature – all of which affect contaminant uptake. The procedure using PRCs to determine site-specific sampling rates had not been developed.

Table 12 compares Lake River results for 303(d) listed chemicals from the Ecology 2003-04 study with findings from the present study.

Table 12. Comparison of Ecology Study Results from 2003-2004 and 2010 for 303(d) Parameters Detected in SPMDs from Lake River (pg/L, dissolved).

	Winter 2004 / 2010	Spring 2004 / 2010	Fall 2003 / 2010	NTR (pg/L)
Total PCBs	<1,300 / **54.5**	**1,300 / 158**	**470 / 495**	170
4,4'-DDT	**29 / 3.4**	**59** / <12	<34 / <18	590
4,4'-DDE	**270 / 15.9**	**350 / 31.5**	**140 / 41.6**	590
4,4'-DDD	**660 / 8.5**	**620 / 26.2**	**240 / 27.5**	830
Total DDT[1]	**960 / 27.8**	**1029 / 57.7**	**380 / 69.1**	
Dieldrin	**450 / 29.9**	**220 / 46.4**	**56 / 39.9**	140

Bold: Detected compounds.
1: Sum of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD.

Much higher concentrations of 303(d) listed chemicals were measured during the 2003-04 study. The total PCBs in spring 2004 were reported at eight times the estimate reported in 2010. Fall sample estimates for 2003 were slightly lower than what was reported for 2010. The NTR was exceeded for total PCBs in spring 2004, and in fall during both studies.

NTR criteria were not exceeded for DDT or metabolites from either study. The 2003-04 study showed higher concentrations through all three seasons. During fall the 2010 study reported the highest seasonal estimated concentration while the 2003 study reported its lowest.

Dieldrin in 2003-04 showed a downward trend from winter through fall, while the 2010 study had lower estimated concentrations but did not show a seasonal trend. Winter and spring dieldrin estimates exceeded the NTR criterion in 2004. Toxaphene was not detected during either study.

Differences in the two studies' results could be due to differences in site locations or changes at the source. A Superfund site is adjacent to Lake River in the area of the two sample sites. The 2003-04 study site was closer to the Pacific Wood Treatment Superfund site and was sampled during the more active portion of the cleanup phase. The 2010 study was conducted toward the end of the cleanup. Direct impacts from the site on Lake River have not been documented, although there were studies indicating extensive onsite soil, groundwater, and surface water contamination from wood treatment chemicals (Kleinfelder, 1993).

Conclusions

Within the major inputs to Vancouver Lake, the human health criterion for total PCBs is often exceeded. Although the dioxin human health criterion was not exceeded, dioxin TEQs in Burnt Bridge Creek and Lake River were above the criterion for all seasons. Many chlorinated pesticides were detected but only dieldrin from Burnt Bridge Creek during winter and spring exceeded human health standards. Total PCBs and dieldrin were the only 303(d) listed analytes from Vancouver Lake inputs exceeding human health standards. Dioxin and 4,4'-DDE were routinely reported within criteria, while toxaphene was never reported above detection limits.

PCB concentrations increased from winter to fall at all sites, as did dioxin and furans at the Lake River sites. The Flushing Channel and Burnt Bridge Creek had winter, fall, and spring – from lowest to highest – seasonal concentrations for dioxin and furans. Chlorinated pesticides from the Lake River sites and the Flushing Channel had increasing concentrations from winter to fall, while Burnt Bridge Creek had decreasing concentrations from winter to fall.

Chemical inputs to Vancouver Lake were ranked for future investigations or management activities, based on the mean concentrations of total PCBs and dioxin TEQs. Chlorinated pesticide inputs were ranked based on dieldrin and DDE, the only 303(d) listed pesticide compounds detected during the study. Overall Burnt Bridge Creek was the most contaminated and most in need of follow-up action. The Lake River North, Lake River South, and the Flushing Channel sites followed, in order of most to least contaminated.

Recommendations

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

1. Surface water managers should focus efforts on Burnt Bridge Creek to determine sources of PCBs, dioxin and furans, and dieldrin detected during this study. A source assessment should be conducted to identify subbasins or suspected sources needing corrective actions. Sample collection should target seasons reporting the highest concentrations of specific analytes from this study.

2. Fish tissue data that resulted in the 303(d) listings for Vancouver Lake are over five years old. After corrective actions have been taken, fish from Vancouver Lake and Lake River should be analyzed to re-evaluate human health concerns for fish consumers. The potential for fish to move in and out of the system should be taken into account.

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Appendices

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Appendix A. Dioxin TEQs Figure

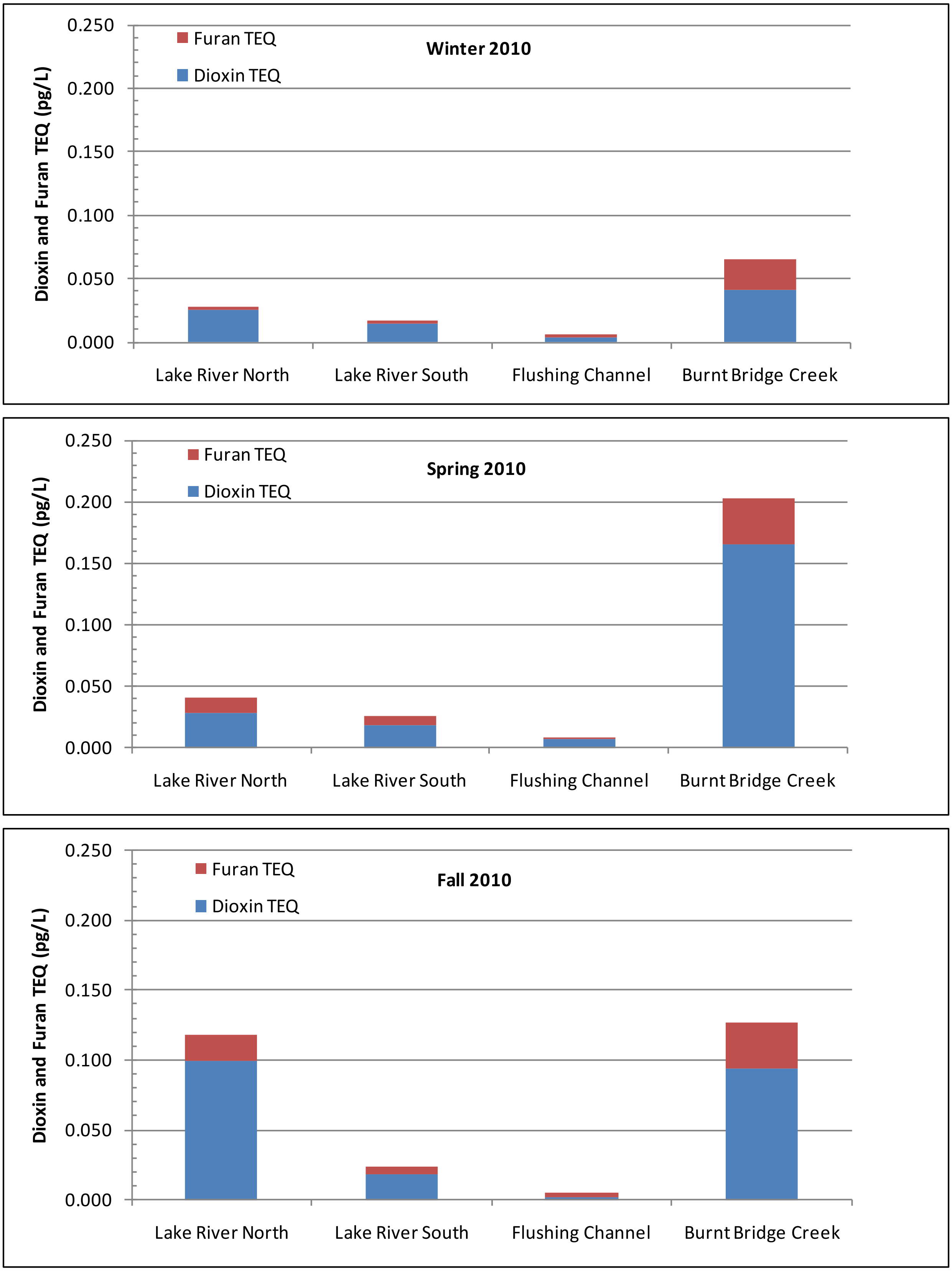

Figure A1. Dioxin TEQs by Site and Season.

Appendix B. 303(d) Listed Fish Tissue Exceedances of NTR Human Health Criteria

Table B1. Fish tissue results for toxics causing 303(d) listing for Vancouver Lake (Coots, 2007).

Sample Identification (06):	Largescale Sucker			Common Carp			Largemouth Bass	NTR Criteria[1]
	194210	194209	194208	194217	194215	194216	194211	
Lipid (%)	2.1	1.4	1.5	3.2	1.2	9.7	2.2	
PCB - 1242	4.8 U	4.8 U	5.0 U	9.6 UJ	4.7 U	4.9 U	**8.0**	
PCB - 1254	**29 J**	**18 J**	**33 J**	**185 J**	**25 J**	**62 J**	**53**	
PCB - 1260	**16 J**	**10 J**	**21 J**	77 UJ	**26 J**	**20 J**	**22 J**	
Total PCBs	**45J**	**28J**	**54J**	**185J**	**51J**	**82J**	**83J**	**5.3**
4,4'-DDE	**24**	**10**	**23**	**96 J**	**27**	**37 J**	**34**	**31.6**
4,4'-DDD	**3.8**	**1.4**	**3.5**	**22 J**	**1.4**	**7.0 J**	**5.2**	**45.0**
4,4'-DDT	**1.4 J**	0.48 U	**1.7 J**	**3.3 J**	**1.1 J**	**1.4 J**	**2.6 J**	**31.6**
Dieldrin	0.48 UJ	0.48 UJ	0.50 UJ	0.48 UJ	0.94 UJ	0.49 UJ	**1.1 J**	**0.65**
Toxaphene	9.6 UJ	9.7 UJ	9.9 UJ	96 UJ	9.4 UJ	9.9 UJ	**28 J**	**9.6**
2,3,7,8-TCDD (ng/Kg)		**0.103**			**0.069**			**0.07**

[1] Units are *u*g/Kg except for 2,3,7,8-TCDD which is ng/Kg.
Bold: Visual aid for detected compounds.
U: Not found at the detection limit shown.
UJ: Not found at the estimated detection limit shown.
J: The analyte has been positively identified; the result is considered an estimate.

Appendix C. Manchester Laboratory Target Compound List for Chlorinated Pesticides

Chlorinated pesticides analyzed by EPA Method 8081.

Aldrin	Dieldrin
alpha-BHC	Endosulfan I
beta-BHC	Endosulfan II
delta-BHC	Endosulfan Sulfate
gamma-BHC (Lindane)	Endrin
Chlorpyrifos	Endrin Aldehyde
cis-Chlordane (*alpha*-Chlordane)	Endrin Ketone
trans-Chlordane (*gamma*)	Heptachlor
Chlordane (Tech)	Heptachlor Epoxide
Dacthal (DCPA)[1]	Hexachlorobenzene
2,4'-DDD	Methoxychlor
4,4'-DDD	Mirex
2,4'-DDE	*cis*-Nonachlor
4,4'-DDE	*trans*-Nonachlor
4,4’-DDMU[1]	Oxychlordane
2,4'-DDT	Pentachloroanisole[1]
4,4'-DDT	Toxaphene

[1] These compounds have inconsistent and poor recoveries.

Surrogates

Tetrachloro-m-xylene (TCMX)
4,4’-dibromo octafluoro biphenyl (DBOB)

Appendix D. Data Quality Assessment and Quality Control Results for Study Data

Data Quality of Study Results

Conventional Analytes

Conventional analyses included total suspended solids (TSS) and total organic carbon (TOC). To determine the quality of the data generated for the study, quality control sample results were compared to measurement quality objectives established in the Quality Assurance Project Plan (Coots, 2010).

Laboratory quality control data indicate TSS and TOC results met all measurement quality objectives for the study. No problems were encountered during the analyses and no qualification of TSS or TOC data was required. Quality control samples included method blanks, spiked blanks, duplicates, and matrix spikes. Laboratory duplicates for TSS met acceptance limits with a relative percent difference (RPD) $\leq$20%, ranging from 0 to 19%, and a mean of 6.5%. TOC laboratory pairs were similar with a mean RPD of less than 1%. All analytical holding times were met and no target analytes were detected in method blanks. Results for the quality control samples analyzed for TSS and TOC are shown in Tables D3 and D4.

Field replicates were analyzed to assess the precision of the entire sampling and analysis process (MEL, 2006). Overall variability was low. TSS field replicate pairs had a mean RPD of 3.4%. Field replicate samples for TOC had a mean RPD of 5.4%. The results for the field replicates are shown in Table D5.

PCBs

Analytes detected outside the calibration range were qualified as estimates ("J" flag). Some congeners were "J" qualified due to the reported concentration being below the lowest calibration standard.

All calibration standards were within 20% relative standard deviation (RSD) for all target analytes and 35% for labeled reference compounds. Calibration verification standard recoveries were within method limits of 70% to 130% for target analytes and 50% to 150% for labeled reference compounds.

Congeners reported as detected met the isotopic abundance ratio and retention time criteria for positive identification with a few exceptions. These exceptions were qualified with an "NJ" which is defined as an analyte that has been "tentatively identified" with the numerical value an approximate concentration.

Analytical Perspectives, the laboratory conducting the PCB analysis, used an in-house matrix spiking solution of PCB congeners and calculated the percent recoveries of those compounds. Recoveries of target compounds were within the method quality control limits of 50 to 150%, with a few exceptions. The matrix spike congener PCB 015 recovered high for all three sample events ranging from 224 to 240%. Co-eluting congeners PCB 156/157 for the winter and spring samples also recovered high at 185 and 186%, respectively. Additionally, during analysis of the spring samples PCB 001 recover high at 171%.

Analysis of laboratory blanks reported no target compounds for the winter and fall samples. In the laboratory blank for the spring samples low levels of certain target compounds were detected. These same congeners were detected in samples. Because all sample concentrations were greater than 10 times the blank concentration the contamination in the blank was not considered significant relative to the native concentration. Results are not qualified in this situation.

All extraction and analysis for PCB congeners was conducted within required holding times for the method.

Dioxin and Furans

Dioxin and furans detected outside the calibration range or below the lowest calibration standard were qualified as estimates ("J" flag).

The calibration standards were reported within 20% relative standard deviation (RSD) for all target analytes and 30% for labeled reference compounds. Calibration verification standard recoveries were within method limits for all target and labeled analytes.

Each detected dioxin and furan congener met the isotopic abundance ratio and retention time criteria for a positive identification.

Results from the On-going Precision and Recovery/Laboratory Control Samples for evaluation of the dialysis procedure found good recovery for target analytes ranging from 91 to 120% for winter, 99 to 122% for spring, and 94 to 116% for fall samples.

No analytes of interest were detected in any laboratory method blanks and all extraction and analysis was conducted for dioxin and furans within required holding times for the method.

Chlorinated Pesticides

The initial calibrations, calibration verification and continuing calibrations for fall samples were within QC limits. Winter and spring samples were also within QC limits, with a few exceptions. Some of these analytes had responses that exceeded control limits which could indicate a high bias. If the analyte was also detected in field samples it was qualified with a "J" as an estimated value. Table D1 below shows the affected analytes, samples, and qualifier.

Table D1. Chlorinated pesticide samples requiring qualification as estimates due to calibration analytes exceeding QC limits.

Compound	Sample Identification	Qualifier
Chlorpyrifos	1002036-06, 1002036-07, 1002036-09, 1006033-06, 1006033-07, 1006033-08, 1006033-09,	J
2,4'-DDD	1002036-07, 1002036-09	J
Endosulfan I	1006033-06, 1006033-07	J

J: The analyte was positively identified, the related result is an estimate.

All surrogate spike recoveries were within the established QC limits of 30 to 130%. An exception, as previously explained was the spiking error of laboratory control samples 1002036-11 and 1006033-11 instead of samples 1002036-12 and 1006033-12. No sample results were qualified by MEL based on the surrogate recoveries.

Qualitative identification is determined using the concentration of an analyte from two analytical columns. When the RPDs for the two results exceed QC limits a higher degree of uncertainty exists for identification of the analyte. If there is confirmation of an analyte with a RPD exceeding limits the result is “J” qualified, as an estimated value. Otherwise the reporting limit is raised to the level of the interference and qualified as “UJ”, the analyte was not detected at or above the estimated sample quantitation limit. Table D2 shows the analytes “J” and “UJ” qualified as estimates and the estimated sample quantitation limit, respectively.

Table D2. Chlorinated pesticide samples requiring qualification as estimates due to RPDs from analytical columns exceeding QC limits.

Compound	Sample Identification	Qualifier
2,4'-DDD	1002036-07, 1002036-09, 1006033-07, 1006033-09, 1011016-07, 1011016-09	J
2,4'-DDE	1002036-09	J
	1006033-06, 1006033-09, 1011016-09	UJ
4,4'-DDE	1002036-06, 1002036-07, 1002036-08	J
4,4'-DDT	1002036-06, 1002036-07, 1002036-09, 1006033-09, 1011016-09	J
Aldrin	1002036-07, 1002036-09, 1006033-06	J
	1011016-06	UJ
Beta-BHC	1002036-06 thru 1002036-10, 1006033-06, 1006033-07, 1006033-09, 1006033-10, 1011016-06 thru 1011016-10	UJ
cis-Chlordane	1011016-06	J
trans-Chlordane	1002036-09, 1011016-08	J
Chlorpyrifos	1002036-06, 1002036-07, 1006033-06 thru 1006033-08, 1011016-06	J
	1011016-10	UJ
Dacthal	1002036-06, 1002036-07	J
	1006033-09	UJ
DDMU	1006033-06 thru 1006033-09, 1011016-06, 1011016-07	UJ
Endosulfan I	1002036-07, 1002036-09, 1006033-06, 1006033-07, 1006033-09	J
	1011016-06, 1011016-09	UJ
Endosulfan II	1002036-09	J
Heptachlor epoxide	1002036-06, 1002036-07	UJ
Hexachlorobenzene	1002036-08, 1002036-09, 1006033-06 thru 1006033-08	J
cis-Nonachlor	1006033-09	J
trans-Nonachlor	1002036-09, 1006033-06, 1006033-07, 1006033-09, 1011016-09	J
Pentachloroanisole	1002036-08, 1006033-08	J
Toxaphene	1006033-09, 1011016-09	UJ

No target analytes were detected in laboratory method blanks during chlorinated pesticides analysis and all samples were prepared within required holding times for the method.

Table D3. Laboratory Quality Control Results for TOC.

Sample Number	QC Sample Type	Result	Spike Level	QC Result	% Recovery	% Rec Limits	RPD	RPD Limit
B10A179-BLK1	Lab Blank	1.0 U						
B10B089-BLK1	Lab Blank	1.0 U						
B10B180-BLK1	Lab Blank	1.0 U						
B10E157-BLK1	Lab Blank	1.0 U						
B10F012-BLK1	Lab Blank	1.0 U						
B10F050-BLK1	Lab Blank	1.0 U						
B10F055-BLK1	Lab Blank	1.0 U						
B10I156-BLK1	Lab Blank	1.0 U						
B10I233-BLK1	Lab Blank	1.0 U						
B10J123-BLK1	Lab Blank	1.0 U						
B10A179-BS1	LCS	5.0	5		101	80-120		
B10B089-BS1	LCS	5.0	5		99	80-120		
B10B180-BS1	LCS	5.0	5		100	80-120		
B10E157-BS1	LCS	5.0	5		99	80-120		
B10F012-BS1	LCS	4.9	5		98	80-120		
B10F050-BS1	LCS	5.1	5		102	80-120		
B10F055-BS1	LCS	5.0	5		101	80-120		
B10I156-BS1	LCS	5.1	5		102	80-120		
B10I233-BS1	LCS	5.3	5		106	80-120		
B10J123-BS1	LCS	4.9	5		99	80-120		
B10A179-DUP1	Duplicate	1.6		1.6			0	20
B10B089-DUP1	Duplicate	1.6		1.6			0	20
B10B180-DUP1	Duplicate	1.0 U		1.0 U				20
B10E157-DUP1	Duplicate	1.0		1.0 U				20
B10F012-DUP1	Duplicate	10.6		10.5			0.9	20
B10F050-DUP1	Duplicate	6.7		6.7			0	20
B10F055-DUP1	Duplicate	1.7		1.8			5.7	20
B10I156-DUP1	Duplicate	1.0 U		1.0 U				20
B10I233-DUP1	Duplicate	3.5		3.5			0	20
B10J123-DUP1	Duplicate	1.6		1.6			0	20
B10A179-MS1	Matrix Spike	3.5	2.5	0.9	103	75-125		
B10B089-MS1	Matrix Spike	4.2	2.5	1.6	104	75-125		
B10B180-MS1	Matrix Spike	3.0	2.5	0.5	99	75-125		
B10E157-MS1	Matrix Spike	3.3	2.5	0.8	99	75-125		
B10F012-MS1	Matrix Spike	9.9	2.5	7.0	117	75-125		
B10F050-MS1	Matrix Spike	8.2	2.5	5.5	108	75-125		
B10F055-MS1	Matrix Spike	4.0	2.5	1.4	105	75-125		
B10I156-MS1	Matrix Spike	3.3	2.5	0.8	98	75-125		
B10I233-MS1	Matrix Spike	9.8	2.5	7.3	101	75-125		
B10J123-MS1	Matrix Spike	4.1	2.5	1.6	100	75-125		

U: Not found at the detection limit shown.
RPD: Relative percent difference.
LCS: Laboratory control sample (spiked blanks).

Table D4. Laboratory Quality Control Results for TSS.

Sample Number	QC Sample Type	Result	Spike Level	QC Result	% Recovery	% Rec Limits	RPD	RPD Limit
B10A161-BLK1	Blank	1.0 U						
B10B041-BLK1	Blank	1.0 U						
B10B126-BLK1	Blank	1.0 U						
B10E051-BLK1	Blank	1.0 U						
B10E051-BLK1	Blank	1.0 U						
B10F036-BLK1	Blank	1.0 U						
B10I057-BLK1	Blank	1.0 U						
B10I162-BLK1	Blank	1.0 U						
B10J073-BLK1	Blank	1.0 U						
B10A161-BS1	LCS	51	51.5		98	80-120		
B10B041-BS1	LCS	50	50.6		100	80-120		
B10B126-BS1	LCS	51	50.2		102	80-120		
B10E051-BS1	LCS	52	50.7		103	80-120		
B10E217-BS1	LCS	50	50		99	80-120		
B10F036-BS1	LCS	50	50		100	80-120		
B10I057-BS1	LCS	49	51.8		95	80-120		
B10I162-BS1	LCS	49	50.6		97	80-120		
B10J073-BS1	LCS	48	50		97	80-120		
B10A161-DUP1	Duplicate	10		10			0	20
B10B041-DUP1	Duplicate	5		6			18	20
B10B041-DUP2	Duplicate	10		11			10	20
B10B126-DUP1	Duplicate	16		15			6	20
B10B126-DUP2	Duplicate	208		200			4	20
B10E051-DUP1	Duplicate	17		17			0	20
B10E051-DUP2	Duplicate	7		6			15	20
B10E217-DUP1	Duplicate	15		15			0	20
B10E217-DUP2	Duplicate	29		33			13	20
B10F036-DUP1	Duplicate	23		23			0	20
B10F036-DUP2	Duplicate	12		12			0	20
B10I057-DUP1	Duplicate	13		14			7	20
B10I057-DUP2	Duplicate	40		40			0	20
B10I162-DUP1	Duplicate	18		17			6	20
B10I162-DUP2	Duplicate	61		61			0	20
B10J073-DUP1	Duplicate	9		8			12	20
B10J073-DUP2	Duplicate	57		69			19	20

U: Not found at the detection limit shown.
RPD: Relative percent difference.
LCS: Laboratory control sample (spiked blanks).

Table D5. Field Replicate Results TSS and TOC.

Sample Numbers	Sample Date	TSS (mg/L)	RPD	TOC (mg/L)	RPD
1001062-01/05[1]	1/19/2010	12/10	18	3.3/3.0	10
1002025-01/05[1]	2/2/2010	9/9	0	2.4/2.4	0
1002026-02/05[2]	2/16/2010	15/17	13	2.6/2.8	7
1005051-04/05[3]	5/4/2010	3/3	0	3.4/3.2	6
1005052-04/05[3]	5/18/2010	10/10	0	4.4/4.4	0
1006032-04/05[3]	6/2/2010	6/6	0	4.7/4.1	14
1009041-12/13[3]	9/9/2010	2/2	0	4.9/5.1	4
1009074-04/05[3]	9/21/2010	1/1	0	5.0/4.6	8
1010025-04/05[3]	10/5/2010	2/2	0	2.0/2.0	0
		Mean RPD	3.4		5.4

1: McCuddy's Marina (LRN).
2: Felida Moorage (LRS).
3: Burnt Bridge Creek (BBC).

Appendix E. Conventional Water Quality Data

Table E1. Water Column Results for TSS and TOC.

Site	Sample Number	Sample Date	SPMD Timing	TSS (mg/L)	TOC (mg/L)
Lake River North	1001062-01/05	1/19/2010	Deployment	11[1]	3.2[1]
Lake River South	1001062-02	1/19/2010	Deployment	18	2.3
Flushing Channel	1001062-03	1/19/2010	Deployment	5	1.4
Burnt Bridge Creek	1001062-04	1/19/2010	Deployment	5	4.9
Lake River North	1002025-01/05	2/2/2010	Mid-Check	9[1]	2.4[1]
Lake River South	1002025-02	2/2/2010	Mid-Check	11	2.6
Flushing Channel	1002025-03	2/2/2010	Mid-Check	2	1.3
Burnt Bridge Creek	1002025-04	2/2/2010	Mid-Check	5	3.0
Lake River North	1002026-01	2/16/2010	Retrieval	14	3.1
Lake River South	1002026-02/05	2/16/2010	Retrieval	16[1]	2.7[1]
Flushing Channel	1002026-03	2/16/2010	Retrieval	3	1.6
Burnt Bridge Creek	1002026-04	2/16/2010	Retrieval	9	4.0
Lake River North	1005051-01	5/4/2010	Deployment	11	3.5
Lake River South	1005051-02	5/4/2010	Deployment	9	3.6
Flushing Channel	1005051-03	5/4/2010	Deployment	10	2.5
Burnt Bridge Creek	1005051-04/05	5/4/2010	Deployment	3[1]	3.3[1]
Lake River North	1005052-01	5/18/2010	Mid-Check	13	2.2
Lake River South	1005052-02	5/18/2010	Mid-Check	15	3.0
Flushing Channel	1005052-03	5/18/2010	Mid-Check	7	2.2
Burnt Bridge Creek	1005052-04/05	5/18/2010	Mid-Check	10[1]	4.4[1]
Lake River North	1006032-01	6/2/2010	Retrieval	12	3
Lake River South	1006032-02	6/2/2010	Retrieval	13	3.3
Flushing Channel	1006032-03	6/2/2010	Retrieval	5	2.3
Burnt Bridge Creek	1006032-04/05	6/2/2010	Retrieval	6[1]	4.4[1]
Lake River North	1009041-09	9/9/2010	Deployment	14	1.9
Lake River South	1009041-10	9/9/2010	Deployment	40	3.9
Flushing Channel	1009041-11	9/9/2010	Deployment	2	1.6
Burnt Bridge Creek	1009041-12/13	9/9/2010	Deployment	2[1]	5.0[1]
Lake River North	1009074-01	9/21/2010	Mid-Check	42	2.6
Lake River South	1009074-02	9/21/2010	Mid-Check	61	2.7
Flushing Channel	1009074-03	9/21/2010	Mid-Check	4	2.0
Burnt Bridge Creek	1009074-04/05	9/21/2010	Mid-Check	1[1]	4.8[1]
Lake River North	1010025-01	10/5/2010	Retrieval	49	2.5
Lake River South	1010025-02	10/5/2010	Retrieval	69	2.4
Flushing Channel	1010025-03	10/5/2010	Retrieval	5	1.4
Burnt Bridge Creek	1010025-04/05	10/5/2010	Retrieval	2[1]	2.0[1]

1: Mean of a field replicate pair.

Appendix F. SPMD Concentration and Residue Results for PCBs, Dioxin, and Chlorinated Pesticides

Table F1. PCB Concentration Estimates from Inputs to Vancouver Lake, Winter 2010.

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08	
PCB Congener - Units = pg/L						
1	0.55		1.1		2.5	
2	0.072		0.16		0.048	
3	0.10		0.19		0.36	
4	SUR		SUR		SUR	
5	0.019		0.072		0.019	
6	0.32		0.64		0.66	
7	0.055		0.12		0.057	
8	1.4		3.0		1.8	
9	0.092		0.19		0.11	
10	0.078		0.14		0.28	
11	6.9		3.5		8.7	
12/13	0.13		0.21		0.21	
13	CE		CE		CE	
14	PRC		PRC		PRC	
15	0.93		1.5		1.3	
16	1.0		1.8		0.67	
17	1.1		2.0		2.1	
18/30	2.3		4.1		3.5	
19	0.49		0.69		1.8	
20/28	2.3		3.5		2.9	
21/33	1.0		1.8		0.86	
22	0.67		1.0		0.76	
23	0.014	U	0.012		0.022	U
24	0.039		0.063		0.034	
25	0.30		0.19		0.81	
26/29	CE		CE		CE	
27	0.28		0.45		0.73	
28	CE		CE		CE	
29	PRC		PRC		PRC	
30	CE		CE		CE	
31	1.6		2.5		2.6	
32	0.60		0.89		1.6	
33	CE		CE		CE	
34	0.030		0.042		0.044	
35	0.067		0.061		0.085	
36	0.012	U	0.010	U	0.018	U
37	0.47		0.66		0.51	
38	0.014	U	0.012	U	0.021	U
39	0.013	U	0.012	U	0.020	U
40/71	0.75		0.99		1.6	

Table F1 cont'd. PCB Concentration Estimates for Inputs to Vancouver Lake, Winter 2010.

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08	
PCB Congener - Units = pg/L						
41	0.17		0.23		0.20	
42	0.53		0.72		0.86	
43	0.067		0.11		0.12	
44/47/65	2.2		2.8		3.4	
45	0.26		0.41		0.69	
46	0.14		0.17		0.33	
47	CE		CE		CE	
48	0.34		0.46		0.44	
49/69	1.5		1.9		2.7	
50/53	PRC		PRC		PRC	
51	0.11		0.088		0.22	
52	2.3		2.9		4.0	
53	CE		CE		CE	
54	0.021		0.026		0.048	
55	0.020		0.026		0.035	
56	0.57		0.79		0.86	
57	0.010	U	0.024		0.016	U
58	0.010	U	0.011	NJ	0.014	U
59/62/75	0.22		0.29		0.30	
60	0.33		0.44		0.48	
61/70/74/76	2.1		2.7		2.9	
62	CE		CE		CE	
63	0.088		0.11		0.12	
64	1.0		1.3		1.6	
65	CE		CE		CE	
66	1.3		1.6		2.0	
67	0.047		0.060		0.073	
68	0.025		0.025		0.046	
69	CE		CE		CE	
70	CE		CE		CE	
71	CE		CE		CE	
72	0.028		0.030		0.039	
73	0.012		0.013		0.028	
74	CE		CE		CE	
75	CE		CE		CE	
76	CE		CE		CE	
77	0.081		0.099		0.17	
78	SUR		SUR		SUR	
79	0.010	U	0.010	U	0.013	U

Table F1 cont'd. PCB Concentration Estimates for Inputs to Vancouver Lake, Winter 2010.

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08	
PCB Congener - Units = pg/L						
80	0.010	U	0.010	U	0.015	U
81	0.010	U	0.010	U	0.016	U
82	0.19		0.21		0.19	
83	0.096		0.096		0.072	
84	0.39		0.45		0.42	
85/116	0.32		0.36		0.29	
86/87/97/108/119/125	1.1		1.2		0.93	
87	CE		CE		CE	
88	0.020	U	0.016	U	0.030	U
89	0.043		0.044		0.065	
90/101/113	1.7		1.9		1.3	
91	0.27		0.34		0.39	
92	0.33		0.36		0.24	
93/100	0.028		0.043		0.047	
94	0.019		0.017	U	0.032	U
95	1.2		1.4		1.1	
96	0.029		0.034		0.050	
97	CE		CE		CE	
98	0.031		0.019		0.029	U
99	0.74		0.81		0.64	
100	CE		CE		CE	
101	CE		CE		CE	
102	0.082		0.10		0.18	
103	0.026		0.029		0.032	
104	0.010	U	0.010	U	0.016	U
105	0.48		0.50		0.53	
106	0.014	U	0.011	U	0.022	U
107/124	0.067		0.063		0.053	
108	CE		CE		CE	
109	0.11		0.11		0.094	
110	1.7		2.0		1.4	
111	0.015	U	0.012	U	0.023	U
112	0.013	U	0.011	U	0.021	U
113	CE		CE		CE	
114	0.039		0.040		0.052	
115	0.012	U	0.010	U	0.018	U
116	CE		CE		CE	
117	0.073		0.074		0.089	
118	1.2		1.3		1.1	
119	CE		CE		CE	

Table F1 cont'd. PCB Concentration Estimates for Inputs to Vancouver Lake, Winter 2010

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08	
PCB Congener - Units = pg/L						
120	0.013	U	0.010	U	0.020	U
121	0.015	U	0.012	U	0.023	U
122	0.024		0.026		0.024	U
123	0.037		0.043		0.051	
124	CE		CE		CE	
125	CE		CE		CE	
126	0.010	U	0.010	U	0.013	U
127	0.015	U	0.012	U	0.022	U
128/166	0.15		0.15		0.082	
129/138/163	1.2		1.2		0.75	
130	0.095		0.089	NJ	0.062	
131	0.011	U	0.019		0.016	U
132	0.27		0.31		0.19	
133	0.027		0.029	NJ	0.018	U
134	0.086		0.079		0.064	
135/151	0.34		0.41		0.33	
136	0.099		0.12		0.093	
137	0.067		0.056		0.017	U
138	CE		CE		CE	
139/140	0.027	NJ	0.035		0.017	U
140	CE		CE		CE	
141	0.17		0.18		0.15	
142	0.013	U	0.014	U	0.016	U
143	0.013	U	0.014	U	0.020	U
144	0.037		0.046		0.041	
145	0.010	U	0.010	U	0.014	U
146	0.18		0.20		0.14	
147/149	0.74		0.82		0.58	
148	0.012	U	0.012	U	0.018	U
149	CE		CE		CE	
150	0.010	U	0.010	U	0.014	U
151	CE		CE		CE	
152	0.027	U	0.033	U	0.0068	
153/168	1.1		1.1		0.69	
154	0.021		0.020		0.014	U
155	0.010	U	0.010	U	0.012	U
156/157	0.14		0.14		0.12	
157	CE		CE		CE	
158	0.093		0.079		0.074	

Table F1. PCB Concentration Estimates for Inputs to Vancouver Lake, Winter 2010.

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08	
PCB Congener - Units = pg/L						
159	0.010	U	0.010	U	0.014	U
160	0.010	U	0.010	U	0.014	U
161	0.010	U	0.010	U	0.014	U
162	0.010	U	0.010	U	0.016	U
163	CE		CE		CE	
164	0.097		0.10		0.077	
165	0.010	U	0.010	U	0.014	U
166	CE		CE		CE	
167	0.063		0.052		0.048	
168	CE		CE		CE	
169	0.010	U	0.013	U	0.020	U
170	0.19		0.17		0.15	
171/173	0.067		0.073		0.018	U
172	0.042		0.054		0.018	U
173	CE		CE		CE	
174	0.15		0.18		0.13	
175	0.012	U	0.013	U	0.018	U
176	0.021		0.027		0.025	
177	0.10		0.11		0.11	
178	0.066		0.058		0.049	
179	0.067		0.091		0.084	
180/193	0.37		0.37		0.25	
181	0.013	U	0.014	U	0.019	U
182	0.011	U	0.011	U	0.016	U
183	0.088		0.10		0.062	
184	0.010	U	0.010	U	0.014	U
185	0.031		0.030		0.057	
186	SUR		SUR		SUR	
187	0.29		0.32		0.25	
188	0.010	U	0.010	U	0.013	U
189	0.010	U	0.010	U	0.016	U
190	0.048		0.046		0.016	U
191	0.010	U	0.010	U	0.014	U
192	0.010	U	0.011	U	0.015	U
193	CE		CE		CE	
194	0.083		0.093		0.027	U
195	0.033		0.027	NJ	0.027	U
196	0.056		0.057		0.021	U

Table F1 cont'd. PCB Concentration Estimates for Inputs to Vancouver Lake, Winter 2010.

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08	
PCB Congener - Units = pg/L						
197	0.010	U	0.010	U	0.015	U
198/199	0.19		0.16		0.14	
199	CE		CE		CE	
200	0.010	U	0.022		0.016	U
201	0.032		0.033		0.017	U
202	0.047	NJ	0.049	NJ	0.059	
203	0.091		0.091		0.020	U
204	0.025	NJ	0.010	U	0.052	
205	0.013	U	0.016	U	0.025	U
206	0.073		0.075		0.030	U
207	0.012	U	0.012	U	0.020	U
208	0.013	U	0.032		0.023	U
209	0.067	U	0.23		0.087	
Total PCBs	55.0		68.5		73.6	

CE: Co-eluting congener; concentration incorporated into total for all co-elution congeners.
ND: Concentration not determined.
PRC: Performance Reference Compound, values not included in PCB totals.
SUR: Surrogate compound spiked into sample for laboratory quality control, values not included in PCB totals.
U: Not detected at the level shown; detection levels are for residue, concentrations not calculated for non-detects.
NJ: The analyte was tentatively identified, results are considered estimates.

Table F2. PCB Concentration Estimates from Inputs to Vancouver Lake, Spring 2010.

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
1	0.48	U	0.43	U	6.1		0.31	U
2	0.15		0.27		0.15		0.18	
3	0.12		0.091		0.65		0.098	
4	PRC		PRC		PRC		PRC	
5	0.016		0.018		0.0010		0.044	
6	0.48		0.36		1.1		0.91	
7	0.060		0.064		0.07		0.10	
8	1.8		1.6		3.4		2.2	
9	0.11		0.10		0.17		0.17	
10	0.21		0.093		1.2		0.12	
11	34	E	7.9		35		6.4	
12/13	0.29		0.21		0.70		0.44	
13	CE		CE		CE		CE	
14	SUR		SUR		SUR		SUR	
15	2.1		1.4		4.4		5.7	
16	1.3		1.5		2.0		4.6	
17	2.3		1.9		5.4		4.6	
18/30	4.0		3.6		8.4		10	
19	1.3		0.78		4.8		2.6	
20/28	5.3		4.6		9.1		19	
21/33	1.8		1.9		1.8		6.0	
22	1.2		1.2		1.9		5.0	
23	0.0074		0.0039		0.0039	J	0.014	
24	0.044		0.062		0.093		0.25	
25	0.65		0.36		1.9		1.7	
26/29	CE		CE		CE		CE	
27	0.88		0.68		3.1		1.8	
28	CE		CE		CE		CE	
29	PRC		PRC		PRC		PRC	
30	CE		CE		CE		CE	
31	3.8		3.0		8.0		10	
32	1.5		0.76		4.1		4.7	
33	CE		CE		CE		CE	
34	0.054		0.050		0.11		0.15	
35	0.097		0.052		0.11		0.23	
36	0.020		0.0087		0.015		0.036	
37	1.2		1.1		1.9		6.8	
38	0.010	NJ	0.012		0.012		0.029	
39	0.046		0.041		0.08		0.033	

Table F2 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Spring 2010.

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08	Burnt Bridge Creek 09
PCB Congener - Units = pg/L						
40/71	2.1		1.8		4.5	7.5
41	0.35		0.32		0.39	1.1
42	1.4		1.3		2.7	5.1
43	0.26		0.23		0.43	0.73
44/47/65	5.9		5.5		11	18
45	0.77		0.52		1.5	2.7
46	0.38		0.30		0.68	1.3
47	CE		CE		CE	CE
48	0.81		0.75		1.1	2.3
49/69	4.2		3.6		9.0	12
50/53	PRC		PRC		PRC	PRC
51	0.23		0.23		0.44	0.86
52	7.0		6.4		13	21
53	CE		CE		CE	CE
54	0.045		0.037		0.13	0.061
55	0.047		0.041		0.077	0.20
56	1.8		1.8		3.5	6.9
57	0.035		0.030		0.073	0.13
58	0.016	J	0.028		0.031	0.092
59/62/75	0.58		0.53		1.0	2.3
60	0.98		0.94		2.0	2.6
61/70/74/76	6.4		5.8		11	20
62	CE		CE		CE	CE
63	0.26		0.24		0.56	0.64
64	3.0		2.7		5.7	8.2
65	CE		CE		CE	CE
66	3.9		3.4		8.0	14
67	0.12		0.10		0.24	0.49
68	0.058		0.050		0.13	0.22
69	CE		CE		CE	CE
70	CE		CE		CE	CE
71	CE		CE		CE	CE
72	0.067		0.054		0.16	0.29
73	0.032		0.027		0.078	0.048
74	CE		CE		CE	CE
75	CE		CE		CE	CE
76	CE		CE		CE	CE
77	0.36		0.28		0.87	1.8
78	SUR		SUR		SUR	SUR
79	0.050		0.052	NJ	0.066	0.19

Table F2 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Spring 2010.

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
80	0.010	U	0.010	U	0.010	U	0.010	U
81	0.010	U	0.043		0.077		0.11	
82	0.55		0.58		0.83		2.6	
83	0.30		0.30		0.30		1.4	
84	1.2		1.3		1.6		5.7	
85/116	1.2		1.1		1.9		4.4	
86/87/97/108/119/125	3.2		3.4		4.1		15	
87	CE		CE		CE		CE	
88	0.039		0.063		0.062		0.094	
89	0.072		0.062		0.12		0.28	
90/101/113	5.0		5.4		5.7		24	
91	0.90		0.84		1.6		4.0	
92	1.0		1.1		1.2		5.0	
93/100	0.072		0.064		0.15		0.23	
94	0.063		0.055		0.13		0.15	
95	3.6		3.6		4.2		17	
96	0.058		0.052		0.12		0.18	
97	CE		CE		CE		CE	
98	0.022		0.021		0.041		0.054	
99	2.0		2.0		2.8		9.1	
100	CE		CE		CE		CE	
101	CE		CE		CE		CE	
102	0.20		0.17		0.48		0.73	
103	0.056		0.051		0.097		0.22	
104	0.010	U	0.0044	NJ	0.010	U	0.010	U
105	1.7		1.6		2.8		6.3	
106	0.010	U	0.010	U	0.010	U	0.010	U
107/124	0.16		0.17		0.23		0.76	
108	CE		CE		CE		CE	
109	0.29		0.31		0.38		1.2	
110	5.0		5.5		6.3		26	
111	0.010	U	0.012	U	0.010	U	0.031	
112	0.022		0.020		0.039		0.046	
113	CE		CE		CE		CE	
114	0.12		0.12		0.21		0.33	
115	0.30		0.045		0.14		0.58	
116	CE		CE		CE		CE	
117	0.13		0.18		0.23		0.57	
118	3.9		3.8		5.5		18	

Table F2 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Spring 2010.

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
119	CE		CE		CE		CE	
120	0.010	U	0.022		0.028	J	0.12	
121	0.010	U	0.012	U	0.010	U	0.012	NJ
122	0.074		0.074		0.11		0.29	
123	0.095	NJ	0.10		0.19		0.43	
124	CE		CE		CE		CE	
125	CE		CE		CE		CE	
126	0.037	NJ	0.031		0.054		0.11	
127	0.010	U	0.011	U	0.010	U	0.010	U
128/166	0.49		0.50		0.46		2.6	
129/138/163	3.4		3.7		3.2		18	
130	0.25		0.29		0.23		1.4	
131	0.047		0.049		0.048		0.21	
132	0.87		0.97		0.80		5.2	
133	0.096		0.082		0.096		0.33	
134	0.14	NJ	0.18		0.15		1.0	
135/151	1.0		1.1		1.0		5.3	
136	0.32		0.37		0.33		1.8	
137	0.16		0.19		0.15		0.92	
138	CE		CE		CE		CE	
139/140	0.067	NJ	0.077		0.080		0.35	
140	CE		CE		CE		CE	
141	0.49		0.55		0.41		2.6	
142	0.010	U	0.0066	J	0.022	J	0.012	J
143	0.0088	U	0.0033		0.00031		0.026	
144	0.14		0.14		0.11		0.66	
145	0.0055		0.0075	U	0.00058	J	0.0035	
146	0.51		0.56		0.47		2.4	
147/149	2.2		2.4		2.2		12	
148	0.010	U	0.010	J	0.025	J	0.026	
149	CE		CE		CE		CE	
150	0.010	U	0.0066	J	0.010	U	0.021	
151	CE		CE		CE		CE	
152	0.010	U	0.036	U	0.00052		0.0098	
153/168	3.0		3.2		2.7		15	
154	0.058		0.055		0.084		0.21	
155	0.010	U	0.010	U	0.010	U	0.010	U
156/157	0.39		0.43		0.42		1.9	

Table F2 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Spring 2010.

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
157	CE		CE		CE		CE	
158	0.29		0.32		0.32		1.9	
159	0.010	U	0.027		0.035	J	0.010	U
160	0.010	U	0.0050	NJ	0.010	U	0.010	U
161	0.010	U	0.010	U	0.010	U	0.010	U
162	0.010	U	0.027		0.010	U	0.077	
163	CE		CE		CE		CE	
164	0.24		0.28		0.24		1.4	
165	0.010	U	0.010	U	0.010	U	0.0071	NJ
166	CE		CE		CE		CE	
167	0.14		0.15		0.15		0.84	
168	CE		CE		CE		CE	
169	0.010	U	0.010	U	0.010	U	0.010	U
170	0.36		0.36		0.44		1.5	
171/173	0.14		0.13		0.14		0.52	
172	0.10		0.10		0.098		0.35	
173	CE		CE		CE		CE	
174	0.45		0.46		0.49		1.8	
175	0.044		0.036	NJ	0.047		0.10	
176	0.050		0.053		0.061		0.21	
177	0.32		0.30		0.35		1.1	
178	0.16		0.16		0.18		0.52	
179	0.22		0.19		0.23		0.77	
180/193	0.99		0.93		1.1		3.7	
181	0.010	U	0.013		0.010	U	0.029	NJ
182	0.010	U	0.010	U	0.010	U	0.015	J
183	0.26		0.26		0.28		0.99	
184	0.010	U	0.010	U	0.010	U	0.010	U
185	0.094		0.070		0.070		0.30	
186	SUR		SUR		SUR		SUR	
187	0.91		0.85		0.88		2.8	
188	0.010	U	0.010	U	0.010	U	0.010	U
189	0.010	U	0.025	J	0.041	J	0.091	
190	0.11		0.097		0.13		0.40	
191	0.030	J	0.024	J	0.040	J	0.085	
192	0.010	U	0.010	U	0.010	U	0.010	U
193	CE		CE		CE		CE	

Table F2 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Spring 2010.

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
194	0.20		0.17		0.27		0.53	
195	0.074		0.056		0.096		0.18	
196	0.088	NJ	0.098		0.14		0.29	
197	0.010	U	0.0069	NJ	0.013	NJ	0.030	
198/199	0.38		0.37		0.42		0.94	
199	CE		CE		CE		CE	
200	0.037		0.028		0.035		0.083	
201	0.047		0.047		0.044		0.11	
202	0.091		0.093		0.086		0.21	
203	0.19		0.17		0.23		0.48	
204	0.0057		0.018	U	0.019	U	0.019	U
205	0.010	U	0.019	J	0.010	U	0.047	
206	0.22		0.19		0.24		0.40	
207	0.010	U	0.021	NJ	0.010	U	0.042	
208	0.074		0.071		0.071		0.13	
209	0.19		0.066		0.11		0.15	
Total PCBs	158		124		246		463	

CE: Co-eluting congener; concentration incorporated into total for all co-elution congeners.
ND: Concentration not determined.
PRC: Performance Reference Compound, values not included in PCB totals.
SUR: Surrogate compound spiked into sample for laboratory quality control, values not included in PCB totals.
U: Not detected at the level shown; detection levels are for residue, concentrations not calculated for non-detects.
E :Values exceed calibration range.
NJ: The analyte was tentatively identified, results are considered estimates.
J: The analyte was positively identified, the result is considered an estimate.

Table F3. PCB Concentration Estimates from Inputs to Vancouver Lake, Fall 2010.

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
1	2.0		0.34	U	ND		0.31	U
2	0.28		0.47		ND		0.45	
3	1.1		0.21		ND		0.26	
4	PRC		PRC		PRC		PRC	
5	0.059		0.056		0.011		0.085	
6	2.8		0.73		1.6		1.2	
7	0.40		0.15		0.097		0.18	
8	16		3.2		3.8		3.9	
9	0.38		0.16		0.19		0.30	
10	1.5		0.15		0.73		0.16	
11	26		3.9		11		4.9	
12/13	0.98		0.33		ND		0.63	
13	CE		CE		CE		CE	
14	SUR		SUR		SUR		SUR	
15	12		2.3		6.2		7.8	
16	5.0		2.1		3.3		5.2	
17	16		3.6		13		5.3	
18/30	16		5.6		5.1		12	
19	10		1.6		15		2.5	
20/28	27		8.8		30		22	
21/33	7.0		3.3		ND		7.8	
22	5.3		2.3		8.0		6.4	
23	0.043		0.012		ND		0.024	
24	0.16		0.081		0.19		0.23	
25	3.6		0.92		8.4		2.2	
26/29	PRC		PRC		PRC		PRC	
27	4.9		1.0		6.8		1.6	
28	CE		CE		CE		CE	
29	CE		CE		CE		CE	
30	CE		CE		CE		CE	
31	19		5.8		25		14	
32	8.4		0.97		9.2		3.9	
33	CE		CE		CE		CE	
34	0.36		0.097		0.40		0.19	
35	0.26		0.087		0.20		0.27	
36	0.038		0.0082		0.010	U	0.029	
37	5.3		2.1		6.0		9.5	
38	0.035		0.022		ND		0.044	
39	0.010	U	0.010	U	0.010	U	0.010	U
40/71	8.0		3.3		16		8.5	

Table F3 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Fall 2010.

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
41	1.2		0.71		2.1		1.6	
42	5.4		2.5		11		6.5	
43	1.2		0.45		1.6		0.84	
44/47/65	22		10		35		22	
45	3.5		1.3		4.6		3.7	
46	1.5		0.61		3.8		1.4	
47	CE		CE		CE		CE	
48	3.3		1.6		8.0		3.1	
49/69	16		7.0		40		16	
50/53	PRC		PRC		PRC		PRC	
51	1.0		0.30		2.7		0.71	
52	24		12		44		27	
53	CE		CE		CE		CE	
54	0.27		0.086		0.46		0.068	
55	0.19		0.094		0.39		0.27	
56	6.5		3.2		14		8.7	
57	0.15		0.056		0.30		0.17	
58	0.072		0.032		0.10		0.10	
59/62/75	2.3		1.0		4.2		2.9	
60	3.6		1.7		8.1		3.6	
61/70/74/76	23		10		ND		25	
62	CE		CE		CE		CE	
63	1.0		0.42		2.3		0.81	
64	11		5.1		17		10	
65	CE		CE		CE		CE	
66	15		6.5		36		19	
67	0.47		0.21		1.0		0.61	
68	0.23		0.091		ND		0.28	
69	CE		CE		CE		CE	
70	CE		CE		CE		CE	
71	CE		CE		CE		CE	
72	0.27		0.098		0.64		0.35	
73	0.098		0.029		ND		0.056	
74	CE		CE		CE		CE	
75	CE		CE		CE		CE	
76	CE		CE		CE		CE	
77	1.3		0.49		5.6		2.3	
78	SUR		SUR		SUR		SUR	
79	0.17		0.10		0.24		0.27	
80	0.010	U	0.010	U	0.010	U	0.010	U

Table F3 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Fall 2010.

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
81	0.16		0.069		0.26		0.15	
82	1.7		0.97		4.3		3.1	
83	0.79		0.43		1.7		1.9	
84	4.1		2.3		8.7		6.6	
85/116	3.1		1.6		7.1		4.6	
86/87/97/108/119/125	9.6		5.7		18		17	
87	CE		CE		CE		CE	
88	0.010	U	0.010	U	0.010	U	0.010	U
89	0.22		0.12		ND		0.30	
90/101/113	15		9.3		16		28	
91	2.6		1.3		6.8		4.1	
92	3.1		1.8		4.2		6.0	
93/100	0.25		0.12		ND		0.27	
94	0.19		0.092		ND		0.18	
95	12		6.7		14		21	
96	0.22		0.091		0.67		0.19	
97	CE		CE		CE		CE	
98	0.010	U	0.010	U	ND		0.066	
99	6.6		3.8		12		11	
100	CE		CE		CE		CE	
101	CE		CE		CE		CE	
102	0.78		0.35		2.2		0.78	
103	0.17		0.084		ND		0.25	
104	0.0069	J	0.0025	J	ND		0.0022	NJ
105	4.8		2.6		11		7.5	
106	0.010	U	0.010	U	0.010	U	0.010	U
107/124	0.48		0.26		0.6		0.83	
108	CE		CE		CE		CE	
109	0.83		0.47		1.4		1.4	
110	16		9.5		20		31	
111	0.010	U	0.010	U	ND		0.027	
112	0.010	U	0.010	U	0.010	U	0.010	U
113	CE		CE		CE		CE	
114	0.32		0.18		0.74		0.39	
115	0.18		0.096		0.53		0.31	
116	CE		CE		ND		CE	
117	0.52		0.37		1.3		0.89	
118	12		6.8		19		22	
119	CE		CE		CE		CE	
120	0.052		0.029		ND		0.13	

Table F3 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Fall 2010.

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
121	0.010	U	0.010	J	0.010	U	0.010	U
122	0.17		0.10		0.37		0.33	
123	0.31		0.17		0.49		0.49	
124	CE		CE		CE		CE	
125	CE		CE		CE		CE	
126	0.056		0.029		0.12		0.10	
127	0.010	U	0.010	U	0.010	U	0.010	U
128/166	1.3		0.80		1.3		3.1	
129/138/163	9.0		5.6		10		19	
130	0.66		0.42		0.63		1.4	
131	0.11		0.068		0.12		0.23	
132	2.5		1.6		2.9		5.7	
133	0.20		0.12		0.24		0.36	
134	0.47		0.30		0.53		1.2	
135/151	3.0		1.8		ND		6.1	
136	1.1		0.65		1.3		2.2	
137	0.52		0.36		0.59		0.96	
138	CE		CE		CE		CE	
139/140	0.18		0.12		0.21		0.37	
140	CE		CE		CE		CE	
141	1.4		0.90		1.1		2.8	
142	0.010	U	0.0011	J	ND		0.0051	J
143	0.0072		0.010		ND		0.010	U
144	0.38		0.25		0.39		0.75	
145	0.0038		0.0028		ND		0.0095	
146	1.4		0.88		1.1		2.8	
147/149	6.2		3.9		7.2		13	
148	0.029	J	0.014	J	ND		0.027	
149	CE		CE		CE		CE	
150	0.020	J	0.010	U	ND		0.023	
151	CE		CE		CE		CE	
152	0.018		0.0089		ND		0.016	
153/168	7.7		4.7		8.3		16	
154	0.16		0.079		ND		0.21	
155	0.0055	J	0.010	U	ND		0.0034	J
156/157	1.1		0.70		1.4		2.2	
157	CE		CE		CE		CE	
158	0.78		0.47		0.83		1.8	
159	0.078		0.010	U	0.010	U	0.010	U
160	0.010	U	0.010	U	0.010	U	0.010	U

Table F3 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Fall 2010.

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
161	0.010	U	0.010	U	0.010	U	0.010	U
162	0.055		0.033		ND		0.10	
163	CE		CE		CE		CE	
164	0.57		0.36		0.46		1.4	
165	0.010	U	0.010	U	ND		0.010	U
166	CE		CE		CE		CE	
167	0.38		0.25		0.29		0.95	
168	CE		CE		CE		CE	
169	0.016	J	0.0087	J	0.021	J	0.024	
170	1.0		0.71		1.4		1.9	
171/173	0.40		0.24		0.54		0.65	
172	0.24		0.17		0.59		0.41	
173	CE		CE		CE		CE	
174	1.2		0.79		1.6		2.3	
175	0.064		0.048		0.099		0.11	
176	0.17		0.11		0.44		0.30	
177	0.75		0.50		1.2		1.3	
178	0.41		0.27		0.56		0.64	
179	0.64		0.40		1.6		1.0	
180/193	2.5		1.6		3.1		4.4	
181	0.010	U	0.020	J	ND		0.036	
182	0.010	U	0.010	U	ND		0.010	U
183	0.79		0.51		0.90		1.3	
184	0.010	U	0.010	U	ND		0.010	U
185	0.15		0.098		0.22		0.35	
186	SUR		SUR		SUR		SUR	
187	2.2		1.4		2.4		3.4	
188	0.010	U	0.010	U	ND		0.0082	J
189	0.059	J	0.040		0.062		0.11	
190	0.26		0.17		0.35		0.50	
191	0.053	J	0.033	J	0.068		0.097	
192	0.010	U	0.010	U	ND		0.010	U
193	CE		CE		CE		CE	
194	0.47		0.35		1.1		0.71	
195	0.18		0.13		0.41		0.27	
196	0.28		0.21		0.49		0.38	
197	0.027	J	0.018	J	0.049	J	0.026	J
198/199	0.94		0.68		1.6		1.3	
199	CE		CE		CE		CE	
200	0.075		0.054		0.20		0.13	

Table F3 cont'd. PCB Concentration Estimates from Inputs to Vancouver Lake, Fall 2010.

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09	
PCB Congener - Units = pg/L								
201	0.12		0.091		0.21		0.16	
202	0.23		0.16		0.49		0.29	
203	0.48		0.36		0.83		0.68	
204	0.0048		0.022	U	0.022	U	0.022	U
205	0.031	J	0.024	J	0.054	J	0.046	J
206	0.34		0.37		0.69		0.58	
207	0.040	J	0.038		0.055	J	0.050	
208	0.14		0.12		0.18		0.16	
209	0.22		0.17		ND		0.22	
Total PCBs	495		210		623		558	

CE: Co-eluting congener; concentration incorporated into total for all co-elution congeners.
ND: Concentration not determined.
PRC: Performance Reference Compound, value not included in PCB total.
SUR: Surrogate compound spiked into sample for laboratory quality control, value not included in PCB total.
U: Not detected at the SPMD residue level shown; concentrations not calculated for non-detects.
J: The analyte was positively identified, the result is considered an estimate.
NJ: The analyte was tentatively identified, results are considered estimates.

Table F4. PCB Congener Residue Measured in SPMD Extracts from Inputs to Vancouver Lake, Winter 2010 (ng/3 membranes).
No results for Burnt Bridge Creek – laboratory accident.

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08		Air Blank 10	
PCB Congener								
1	0.263		0.532		1.13		0.688	
2	0.0497		0.112		0.0299		0.0623	
3	0.0710		0.138		0.222		0.195	
4[1]	63.6[1]	E	64.7[1]	E	64.6[1]	E	60.3[1]	E
5	0.0181		0.0744		0.0155		0.0566	
6	0.338		0.722		0.581		0.388	
7	0.0580		0.133		0.051		0.101	
8	1.45		3.44		1.62		2.06	
9	0.0970		0.211		0.093		0.16	
10	0.0657		0.122		0.206		0.0763	
11	8.40		4.68		8.66		1.22	
12/13	0.153		0.267		0.203		0.205	
14[2]	51.0[2]	E	44.3[2]	E	64.2[2]	E	65.3[2]	E
15	1.15		1.95		1.33		1.03	
16	1.17		2.16		0.63		1.22	
17	1.35		2.54		2.04		1.32	
18/30	2.76		5.32		3.42		2.98	
19	0.500		0.754		1.54		0.396	
20/28	3.14		5.29		3.13		3.20	
21/33	1.37		2.62		0.91		1.99	
22	0.914		1.55		0.814		0.936	
23	0.0144	U	0.0183		0.022	U	0.0148	U
24	0.0487		0.0873		0.0347		0.0397	
25	0.410		0.290		0.870		2.44	
26/29[2]	52.7[2]	E	48.2[2]	E	62.1[2]	E	56.3[2]	E
27	0.366		0.652		0.761		0.203	
31	2.25		3.82		2.73		2.83	
32	0.783		1.27		1.70		0.887	
34	0.0413		0.0643		0.0469		0.0131	U
35	0.0921		0.0947		0.0903		0.0136	U
36	0.0115	U	0.0103	U	0.0176	U	0.0119	U
37	0.643		1.02		0.543		0.507	
38	0.0138	U	0.0124	U	0.0212	U	0.0142	U
39	0.0132	U	0.0119	U	0.0203	U	0.0137	U
40/71	1.03		1.52		1.71		0.584	
41	0.23		0.347		0.209		0.168	
42	0.731		1.11		0.921		0.409	

Table F4 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Winter 2010 (ng/3 membranes).

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08		Air Blank 10	
PCB Congener								
43	0.0927		0.176		0.130		0.0873	
44/47/65	2.98		4.31		3.59		1.53	
45	0.348		0.607		0.733		0.307	
46	0.187		0.253		0.352		0.126	
48	0.474		0.715		0.466		0.405	
49/69	2.05		2.91		2.82		1.06	
50/53[2]	126[2]	E	115[2]	E	149[2]	E	128[2]	E
51	0.145		0.133		0.235		0.111	
52	3.18		4.55		4.27		1.82	
54	0.0246		0.0335		0.046		0.0139	U
55	0.0272		0.0391		0.0351		0.0286	
56	0.759		1.18		0.869		0.301	
57	0.01	U	0.0359		0.0156	U	0.0117	U
58	0.01	U	0.0169	NJ	0.0137	U	0.0103	U
59/62/75	0.294		0.45		0.316		0.173	
60	0.432		0.653		0.485		0.18	
61/70/74/76	2.78		4.11		2.98		1.45	
63	0.116		0.165		0.121		0.0454	
64	1.37		2.06		1.61		0.617	
66	1.65		2.36		1.92		0.679	
67	0.0606		0.0876		0.0716		0.0344	
68	0.032		0.036		0.044		0.126	
72	0.0351		0.0428		0.0371		0.01	U
73	0.0156		0.0192		0.0282		0.0273	
77	0.100		0.138		0.154		0.0461	
78[1]	24.3[1]	E	23.9[1]	E	25.1[1]	E	22.9[1]	E
79	0.01	U	0.01	U	0.0127	U	0.01	U
80	0.01	U	0.01	U	0.0147	U	0.011	U
81	0.01	U	0.01	U	0.0162	U	0.0122	U
82	0.241		0.310		0.189		0.0413	
83	0.122		0.138		0.0692		0.0255	U
84	0.523		0.681		0.433		0.161	
85/116	0.407		0.516		0.273		0.0744	
86/87/97/108/119/125	1.38		1.76		0.898		0.362	
88	0.0196	U	0.0157	U	0.0303	U	0.0249	U
89	0.0575		0.0672		0.0661		0.0227	U
90/101/113	2.08		2.70		1.18		0.713	
91	0.358		0.509		0.385		0.111	

Table F4 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Winter 2010 (ng/3 membranes).

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08		Air Blank 10	
PCB Congener								
92	0.408		0.500		0.221		0.122	
93/100	0.0383		0.0653		0.0483		0.0967	
94	0.0251		0.0167	U	0.0323	U	0.0265	U
95	1.57		2.06		1.07		0.686	
96	0.0401		0.0529		0.0531		0.016	U
98	0.0409		0.029		0.0289	U	0.0238	U
99	0.905		1.13		0.581		0.185	
102	0.107		0.151		0.182		0.0204	U
103	0.0337		0.0425		0.0309		0.0189	U
104	0.01	U	0.01	U	0.0158	U	0.0156	U
105	0.517		0.619		0.430		0.0674	
106	0.014	U	0.0112	U	0.0217	U	0.0178	U
107/124	0.0699		0.0752		0.0415		0.0175	U
109	0.129		0.147		0.0827		0.0159	U
110	2.03		2.72		1.26		0.408	
111	0.0147	U	0.0118	U	0.0228	U	0.0187	U
112	0.0134	U	0.0108	U	0.0208	U	0.0171	U
114	0.0423		0.0493		0.0417		0.0169	U
115	0.0118	U	0.01	U	0.0183	U	0.015	U
117	0.0862		0.0997		0.0786		0.0225	U
118	1.25		1.48		0.869		0.211	
120	0.0127	U	0.0102	U	0.0196	U	0.0161	U
121	0.0146	U	0.0117	U	0.0226	U	0.0186	U
122	0.0257		0.0317		0.0239	U	0.0183	U
123	0.0379		0.0511		0.0394		0.0188	U
126	0.01	U	0.01	U	0.0131	U	0.0146	U
127	0.0146	U	0.0124	U	0.0222	U	0.0172	U
128/166	0.155		0.174		0.0633		0.0315	
129/138/163	1.25		1.40		0.576		0.290	
130	0.0949		0.102	NJ	0.0463		0.0202	U
131	0.0109	U	0.0248		0.0165	U	0.0179	U
132	0.299		0.397		0.156		0.114	
133	0.0257		0.0321	NJ	0.0183	U	0.0198	U
134	0.098		0.102		0.0539		0.0204	U
135/151	0.367		0.508		0.265		0.318	
136	0.128		0.168		0.090		0.138	
137	0.0663		0.0625		0.0173	U	0.0188	U
139/140	0.0294	NJ	0.0422		0.0173	U	0.0187	U

Table F4 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Winter 2010 (ng/3 membranes).

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08		Air Blank 10	
PCB Congener								
141	0.166		0.207		0.110		0.0826	
142	0.0133	U	0.0138	U	0.0165	U	0.0219	U
143	0.0131	U	0.0136	U	0.0198	U	0.0215	U
144	0.0402		0.0568		0.0327		0.0522	
145	0.01	U	0.01	U	0.0135	U	0.015	U
146	0.176		0.218		0.0967		0.0523	
147/149	0.803		1.02		0.472		0.477	
148	0.0119	U	0.0124	U	0.0181	U	0.0196	U
150	0.01	U	0.01	U	0.0137	U	0.0153	U
152	0.027	U	0.033	U	0.0066		0.0337	
153/168	1.04		1.17		0.480		0.338	
154	0.0215		0.0238		0.0144	U	0.0156	U
155	0.01	U	0.01	U	0.0119	U	0.0133	U
156/157	0.110		0.126		0.0707		0.0218	U
158	0.0820		0.0800		0.0484		0.0290	
159	0.01	U	0.01	U	0.0143	U	0.0128	U
160	0.01	U	0.01	U	0.0144	U	0.0156	U
161	0.01	U	0.01	U	0.0135	U	0.0146	U
162	0.01	U	0.0111	U	0.0162	U	0.0144	U
164	0.0852		0.105		0.0504		0.0128	U
165	0.01	U	0.01	U	0.0143	U	0.0155	U
167	0.0469		0.0444		0.0263		0.0147	U
169	0.0103	U	0.0127	U	0.0197	U	0.019	U
170	0.141		0.142		0.0852		0.0187	U
171/173	0.0557		0.0694		0.0182	U	0.0186	U
172	0.0305		0.0446		0.0181	U	0.0185	U
174	0.122		0.176		0.0788		0.0912	
175	0.0124	U	0.0132	U	0.0182	U	0.0186	U
176	0.0218		0.0319		0.0188		0.0227	NJ
177	0.0851		0.108		0.0681		0.0349	NJ
178	0.0538		0.0542		0.0297		0.0275	
179	0.0697		0.108		0.0647		0.0953	
180/193	0.262		0.298		0.127		0.0967	
181	0.013	U	0.0137	U	0.019	U	0.0194	U
182	0.0108	U	0.0114	U	0.0158	U	0.0161	U
183	0.0694		0.0914		0.0359		0.0636	
184	0.01	U	0.01	U	0.0136	U	0.0122	U
185	0.0255		0.0283		0.0348		0.022	U

Table F4 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Winter 2010 (ng/3 membranes).

1002036-	Lake River North 06		Lake River South 07		Flushing Channel 08		Air Blank 10	
PCB Congener								
186[1]	23.2[1]	E	23.4[1]	E	22.5[1]	E	22.4[1]	E
187	0.232		0.293		0.145		0.136	
188	0.01	U	0.01	U	0.0126	U	0.0113	U
189	0.01	U	0.01	U	0.0157	U	0.0146	U
190	0.0316		0.0342		0.0163	U	0.0153	U
191	0.01	U	0.0105	U	0.0145	U	0.0149	U
192	0.0102	U	0.0108	U	0.015	U	0.0153	U
194	0.0426		0.0545		0.0274	U	0.0222	U
195	0.0199		0.019	NJ	0.0272	U	0.022	U
196	0.0319		0.0373		0.0206	U	0.0181	U
197	0.01	U	0.01	U	0.0153	U	0.0134	U
198/199	0.109		0.110		0.0599		0.0191	U
200	0.01	U	0.0188		0.0165	U	0.0145	U
201	0.0186		0.0221		0.0167	U	0.0147	U
202	0.0359	NJ	0.0427	NJ	0.0334		0.0165	U
203	0.0519		0.0598		0.0195	U	0.0171	U
204	0.0181	NJ	0.01	U	0.028		0.0146	U
205	0.0127	U	0.0161	U	0.0252	U	0.0204	U
206	0.0297		0.0351		0.0303	U	0.034	U
207	0.0115	U	0.012	U	0.0202	U	0.0227	U
208	0.013	U	0.0198		0.0227	U	0.0256	U
209	0.067	U	0.101		0.0245		0.0925	

1: Surrogate – values not included in PCB totals.
2: PRC – values not included in PCB totals.
E: Surrogate and PRC values exceed calibration range and were not included in PCB totals.
U: Analyte not detected at the reporting limit shown.
NJ: The analyte was tentatively identified, results are considered estimates.

Table F5. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (ng/3 membranes).

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
1	0.477	U	0.430	U	1.77		0.311	U	0.511	
2	0.069		0.15		0.052		0.098		0.053	
3	0.055		0.05		0.232		0.053		0.194	
4[1]	12.7[1]		8.71[1]		25.3[1]	E	6.72[1]		28.3[1]	E
5	0.0089		0.0128		0.0004		0.0300		0.0503	
6	0.279		0.264		0.475		0.662		0.388	
7	0.0349		0.0479		0.0319		0.0749		0.0901	
8	1.03		1.16		1.46		1.61		1.88	
9	0.066		0.0750		0.075		0.125		0.133	
10	0.110		0.0590		0.475		0.078		0.051	
11	21.2	E	6.43		15.7		5.11		1.02	
12/13	0.179		0.169		0.313		0.342		0.161	
14[2]	19.3[2]		18.8[2]		18.6[2]		18.7[2]		19.5[2]	
15	1.34		1.15		1.97		4.58		1.03	
16	0.800		1.18		0.880		3.51		1.22	
17	1.45		1.56		2.42		3.59		1.26	
18/30	2.49		2.89		3.76		7.84		2.86	
19	0.761		0.563		2.04		1.83		0.259	
20/28	3.40		3.91		4.14		15.4		2.85	
21/33	1.13		1.64		0.840		4.95		1.82	
22	0.751		1.00		0.881		4.18		0.919	
23	0.00474		0.00334		0.00176	J	0.0116		0.00796	J
24	0.0281		0.0513		0.0422		0.205		0.0437	
25	0.413		0.308		0.839		1.40		0.551	
26/29[2]	11.3[1]		10.4[1]		13.0[1]		10.8[1]		11.9[1]	
27	0.560		0.575		1.42		1.44		0.21	
31	2.43		2.53		3.58		8.39		2.51	
32	0.926		0.636		1.85		3.83		0.814	
34	0.0341		0.0422		0.0496		0.125		0.0153	
35	0.0606		0.0435		0.0485		0.188		0.0514	
36	0.0123		0.00727		0.00637		0.0292		0.00903	J
37	0.731		0.921		0.811		5.55		0.529	
38	0.00651	NJ	0.00991		0.00531		0.0241		0.00649	NJ
39	0.0284		0.0341		0.0349		0.0269		0.00564	NJ
40/71	1.36		1.54		2.03		6.23		0.582	
41	0.224		0.269		0.174		0.883		0.157	
42	0.910		1.09		1.21		4.19		0.4	
43	0.161		0.192		0.190		0.600		0.0922	

Table F5 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (ng/3 membranes).

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
44/47/65	3.72		4.64		4.73		14.7		1.46	
45	0.492		0.443		0.692		2.24		0.257	
46	0.241		0.253		0.309		1.04		0.118	
48	0.508		0.632		0.507		1.92		0.378	
49/69	2.60		2.99		3.92		9.81		0.991	
50/53[2]	12.9[1]		11.7[1]		13.1[1]		12.3[1]		12.6[1]	
51	0.148		0.200		0.197		0.716		0.138	
52	4.36		5.32		5.82		17.1		1.67	
54	0.0274		0.0296		0.0561		0.0473		0.00833	J
55	0.0274		0.0324		0.0310		0.150		0.0288	
56	1.02		1.39		1.40		5.25		0.307	
57	0.0200		0.0233		0.0288		0.100		0.00759	J
58	0.00922	J	0.0218		0.0122		0.0688		0.01	U
59/62/75	0.352		0.435		0.435		1.87		0.163	
60	0.567		0.741		0.789		1.96		0.186	
61/70/74/76	3.76		4.65		4.64		15.3		1.38	
63	0.149		0.187		0.221		0.476		0.0433	
64	1.81		2.24		2.41		6.55		0.612	
66	2.18		2.59		3.09		10.6		0.65	
67	0.0685		0.0775		0.0925		0.366		0.0405	
68	0.0319		0.0372		0.0505		0.159		0.0419	
72	0.0366		0.0406		0.0619		0.209		0.00627	J
73	0.0187		0.0216		0.0322		0.0371		0.0225	
77	0.189		0.202		0.317		1.28		0.041	
78[1]	22.7[2]	E	22.1[2]	E	22.8[2]	E	22.1[2]	E	23.1[2]	E
79	0.0255		0.0363	NJ	0.0234		0.126		0.01	U
80	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
81	0.01	U	0.0308		0.0279		0.0764		0.01	U
82	0.306		0.441		0.322		1.92		0.047	
83	0.165		0.222		0.113		1.02		0.017	
84	0.734		1.02		0.658		4.42		0.143	
85/116	0.637		0.776		0.707		3.12		0.0869	
86/87/97/108/119/125	1.79		2.57		1.58		10.7		0.331	
88	0.0229		0.0504		0.0254		0.0723		0.01	U
89	0.0422		0.0494		0.0477		0.216		0.0252	
90/101/113	2.64		3.90		2.05		16.4		0.641	
91	0.518		0.654		0.630		3.03		0.101	
92	0.529		0.758		0.428		3.51		0.102	

Table F5 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (ng/3 membranes).

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
93/100	0.0423		0.0513		0.0616		0.180		0.0126	NJ
94	0.0364		0.0432		0.0502		0.117		0.01	U
95	2.08		2.85		1.66		13.1		0.582	
96	0.0365		0.0444		0.0543		0.147		0.0138	
97	0.0128		0.0165		0.0165		0.0411		0.01	U
98	1.04		1.42		1.00		6.22		0.166	
99	0.113		0.130		0.188		0.545		0.0281	
100	0.0312		0.0385		0.0375		0.163		0.01	U
101	0.01	U	0.00368	NJ	0.01	U	0.01	U	0.01	U
102	0.754		0.984		0.872		3.78		0.0658	
103	0.01	U	0.0105	U	0.01	U	0.01	U	0.01	U
104	0.0704		0.103		0.0692		0.443		0.00994	J
105	0.145		0.213		0.130		0.799		0.0103	
106	2.48		3.75		2.17		16.9		0.329	
107/124	0.01	U	0.0117	U	0.01	U	0.0174		0.01	U
108	0.0112		0.0136		0.0135		0.0306		0.01	U
109	0.0559		0.0761		0.0672		0.198		0.01	U
110	0.147		0.0306		0.0468		0.379		0.00862	NJ
111	0.0625		0.121		0.0796		0.379		0.00669	NJ
112	1.67		2.25		1.64		10.2		0.196	
113	0.01	U	0.0126		0.00801	J	0.065		0.01	U
114	0.01	U	0.0118	U	0.01	U	0.00718	NJ	0.01	U
115	0.0337		0.0466		0.0332		0.179		0.01	U
116	0.0411	NJ	0.0611		0.0561		0.245		0.01	U
117	0.0146	NJ	0.0171		0.0147		0.0573		0.01	U
118	0.01	U	0.011	U	0.01	U	0.01	U	0.01	U
119	0.211		0.299		0.137		1.52		0.0199	J
120	1.48		2.23		0.946		10.6		0.294	
130	0.105		0.165		0.0663		0.764		0.0167	
131	0.0223		0.0316		0.0157		0.130		0.01	U
132	0.408		0.629		0.261		3.25		0.115	
133	0.0384		0.0454		0.0266		0.178		0.01	U
134	0.0688	NJ	0.118		0.0504		0.640		0.0233	
135/151	0.466		0.686		0.328		3.21		0.284	
136	0.177		0.278		0.129		1.33		0.131	
137	0.0658		0.106		0.0416		0.501		0.00873	J
139/140	0.0301	NJ	0.0473		0.0248		0.210		0.01	U
141	0.202		0.310		0.117		1.42		0.0789	

Table F5 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (ng/3 membranes).

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
142	0.01	U	0.00444	J	0.00735	J	0.00777	J	0.01	U
143	0.00884	U	0.0021		0.00010		0.0160		0.0142	
144	0.0608		0.0888		0.0331		0.397		0.0442	
145	0.00304		0.00747	U	0.00022	J	0.00254		0.00916	J
146	0.202		0.306		0.127		1.28		0.0479	
147/149	1.02		1.50		0.694		7.26		0.456	
148	0.01	U	0.00611	J	0.00744	J	0.0149		0.01	U
150	0.01	U	0.00481	J	0.01	U	0.0148		0.01	U
152	0.01	U	0.0363	U	0.0002		0.0072		0.0367	
153/168	1.15		1.72		0.713		7.65		0.367	
154	0.0245		0.0323		0.0246		0.117		0.01	U
155	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
156/157	0.127		0.195		0.0938		0.850		0.0182	J
158	0.107		0.161		0.0796		0.906		0.0294	
159	0.01	U	0.0118		0.00752	J	0.01	U	0.01	U
160	0.01	U	0.00265	NJ	0.01	U	0.01	U	0.01	U
161	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
162	0.01	U	0.0115		0.01	U	0.0324		0.01	U
164	0.0873		0.140		0.0596		0.700		0.0207	
165	0.01	U	0.01	U	0.01	U	0.00336	NJ	0.01	U
167	0.0430		0.0653		0.0309		0.346		0.00756	J
169	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
170	0.110		0.151		0.0932		0.602		0.0368	
171/173	0.0462		0.0624		0.0334		0.239		0.0172	NJ
172	0.0300		0.0424		0.0199		0.139		0.0091	NJ
174	0.155		0.217		0.115		0.827		0.0803	
175	0.0145		0.0162	NJ	0.0107		0.0456		0.01	U
176	0.0215		0.0313		0.0180		0.121		0.0271	
177	0.112		0.143		0.0832		0.498		0.0398	
178	0.0525		0.0741		0.0405		0.235		0.0256	
179	0.0947		0.116		0.0687		0.448		0.0873	
180/193	0.286		0.370		0.217		1.41		0.107	
181	0.01	U	0.00621	J	0.01	U	0.0133	NJ	0.01	U
182	0.01	U	0.01	U	0.01	U	0.00641	J	0.01	U
183	0.0821		0.116		0.0631		0.427		0.0559	
184	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
185	0.0320		0.0332		0.0165		0.140		0.0104	
186[2]	21.7[2]	E	20.9[2]	E	21.2[2]	E	21.5[2]	E	22.9[2]	E

Table F5 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (ng/3 membranes).

1006033-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
187	0.298		0.387		0.200		1.24		0.124	
188	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
189	0.01	U	0.00782	J	0.00622	J	0.0272		0.01	U
190	0.0283		0.0361		0.0243		0.145		0.0104	
191	0.00743	J	0.00829	J	0.00696	J	0.0287		0.01	U
192	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
193	0.0415		0.0501		0.0380		0.148		0.0147	
194	0.0184		0.0192		0.0165		0.0594		0.00935	J
195	0.0205	NJ	0.0317		0.0222		0.0899		0.0111	
196	0.01	U	0.00288	NJ	0.00265	NJ	0.012		0.01	U
198/199	0.0914		0.123		0.0688		0.300		0.0246	NJ
200	0.0114		0.0120		0.00739		0.0340		0.00601	J
201	0.0113		0.0155		0.00726		0.0364		0.00644	NJ
202	0.0284		0.0404		0.0186		0.0869		0.0117	
203	0.0447		0.0563		0.0373		0.149		0.015	
204	0.0017		0.0183	U	0.0187	U	0.0188	U	0.0194	
205	0.01	U	0.0047	J	0.01	U	0.0112		0.01	U
206	0.0363		0.0436		0.0274		0.0888		0.01	U
207	0.01	U	0.0063	NJ	0.01	U	0.0122		0.01	U
208	0.0165		0.022		0.0108		0.0398		0.01	U
209	0.0290		0.0141		0.0113		0.0318		0.026	

1: PRC – values not included in PCB totals.
2: Surrogate – values not included in PCB totals.
U: Analyte not detected at the reporting limit shown.
E: Surrogate and PRC values exceed calibration range and were not included in PCB totals.
J: The analyte was positively identified, results are considered an estimate.
NJ :The analyte was tentatively identified, results are considered an estimate.

Table F6. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (ng/3 membranes).

1011016-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
PCB Congener					
1	0.536	0.345 U	2.276	0.311 U	0.494
2	0.0912	0.238	0.0862	0.210	0.0448
3	0.376	0.105	0.426	0.123	0.150
4[1]	20.9[1]	9.48[1]	29.1[1]	8.97[1]	33.2[1]
5	0.0227	0.0352	0.0132	0.0481	0.0414
6	1.12	0.480	1.81	0.693	0.327
7	0.159	0.0965	0.113	0.107	0.0745
8	6.52	2.12	4.36	2.31	1.62
9	0.150	0.106	0.215	0.179	0.138
10	0.541	0.0884	0.841	0.0854	0.0316
11	10.8	2.75	12.4	3.10	0.849
12/13	0.402	0.227	0.993	0.397	0.147
14[2]	27.4[2]	26.5[2]	25.5[2]	26.9[2]	26.9[2]
15	4.81	1.67	7.14	4.99	0.838
16	2.02	1.44	1.73	3.19	0.973
17	6.48	2.51	6.67	3.33	1.04
18/30	6.62	3.91	9.37	7.46	2.23
19	3.96	1.06	6.22	1.47	0.262
20/28	11.1	6.43	15.6	14.7	2.55
21/33	2.90	2.41	2.66	5.08	1.65
22	2.21	1.70	3.55	4.15	0.804
23	0.0176	0.00884	0.00814	0.0153	0.00656 J
24	0.0660	0.0583	0.100	0.146	0.039
25	1.47	0.670	3.75	1.40	0.213
26/29[2]	13.7[1]	11.9[1]	18.0[1]	13.1[1]	14.6[1]
27	2.05	0.764	3.56	1.04	0.169
31	7.64	4.22	13.5	9.15	2.35
32	3.49	0.706	4.81	2.52	0.744
34	0.147	0.0711	0.211	0.122	0.0118
35	0.102	0.0623	0.105	0.174	0.0507
36	0.0150	0.00580	0.01 U	0.0179	0.0122
37	2.09	1.53	3.11	5.99	0.487
38	0.0141	0.0159	0.0216	0.0279	0.00779 J
39	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
40/71	3.27	2.41	7.98	5.48	0.526
41	0.470	0.517	1.04	1.03	0.191
42	2.18	1.82	5.33	4.15	0.389

Table F6 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (ng/3 membranes).

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
43	0.473		0.327		0.773		0.537		0.0712	
44/47/65	9.02		7.44		20.2		14.0		1.38	
45	1.47		0.961		2.81		2.42		0.279	
46	0.613		0.450		1.30		0.940		0.11	
48	1.33		1.17		2.17		1.96		0.366	
49/69	6.31		5.02		16.5		9.95		0.946	
50/53[2]	15.4[1]		14.7[1]		18.2[1]		14.9[1]		15.6[1]	
51	0.425		0.221		1.01		0.464		0.0866	
52	9.69		8.39		21.4		17.1		1.61	
54	0.110		0.0599		0.206		0.0426		0.00673	J
55	0.0709		0.0630		0.175		0.156		0.0269	
56	2.38		2.16		6.44		5.10		0.281	
57	0.0537		0.0369		0.133		0.101		0.00733	J
58	0.0257		0.0212		0.0451		0.0596		0.00176	J
59/62/75	0.871		0.709		1.85		1.81		0.159	
60	1.33		1.17		3.59		2.12		0.185	
61/70/74/76	8.43		7.15		19.6		15.2		1.31	
63	0.367		0.275		0.970		0.469		0.0403	
64	4.13		3.53		10.1		6.47		0.579	
66	5.15		4.20		14.7		10.9		0.664	
67	0.165		0.134		0.414		0.350		0.0362	
68	0.0789		0.0579		0.234		0.157		0.0511	
72	0.0928		0.0621		0.285		0.196		0.00521	J
73	0.0368		0.0197		0.147		0.0339		0.0304	
77	0.423		0.297		1.26		1.24		0.0377	
78[1]	28.6[2]		28.4[2]		28.2[2]		29.2[2]		29.1[2]	
79	0.0528		0.0588		0.0956		0.140		0.00406	J
80	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
81	0.0534		0.0418		0.0858		0.0821		0.01	U
82	0.595		0.626		1.47		1.79		0.0418	
83	0.272		0.272		0.638		1.07		0.0256	
84	1.54		1.56		2.99		3.98		0.143	
85/116	1.06		0.984		2.66		2.54		0.0757	
86/87/97/108/119/125	3.35		3.68		6.44		9.51		0.319	
88	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
89	0.0817		0.0797		0.246		0.181		0.0283	
90/101/113	5.07		5.63		7.75		14.9		0.638	

Table F6 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (ng/3 membranes).

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
91	0.948		0.887		2.33		2.37		0.0923	
92	1.04		1.11		1.73		3.21		0.102	
93/100	0.0951		0.0790		0.281		0.161		0.0129	J
94	0.0704		0.0608		0.190		0.105		0.00574	J
95	4.19		4.42		6.66		12.0		0.615	
96	0.0905		0.0666		0.247		0.126		0.0135	
97	0.01	U	0.01	U	0.0289		0.0387		0.01	U
98	2.13		2.25		4.24		5.98		0.172	
99	0.280		0.232		0.807		0.453		0.0325	
100	0.0611		0.0542		0.138		0.144		0.00406	NJ
101	0.00277	J	0.00177	J	0.00672	J	0.00138	NJ	0.0017	J
102	1.36		1.35		3.47		3.45		0.0644	
103	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
104	0.130		0.133		0.256		0.372		0.00878	J
105	0.258		0.267		0.524		0.720		0.0116	
106	5.05		5.47		8.81		15.8		0.325	
107/124	0.01	U	0.01	U	0.00743	J	0.0116		0.01	U
108	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
109	0.0911		0.0972		0.255		0.179		0.00576	J
110	0.0551		0.0550		0.193		0.154		0.00739	J
111	0.162		0.214		0.461		0.452		0.0115	NJ
112	3.36		3.42		7.01		9.81		0.192	
113	0.0135		0.014		0.0244		0.0569		0.01	U
114	0.01	U	0.00545	J	0.01	U	0.01	U	0.01	U
115	0.0494		0.0538		0.134		0.155		0.00256	J
116	0.0848		0.0847		0.181		0.213		0.00465	J
117	0.0139		0.0134		0.0207		0.0414		0.00711	J
118	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
119	0.349		0.402		0.446		1.37		0.0231	
120	2.43		2.84		2.78		8.59		0.248	
130	0.171		0.202		0.196		0.613		0.0148	
131	0.0315		0.0371		0.0370		0.110		0.0046	J
132	0.730		0.889		0.918		2.74		0.102	
133	0.0497		0.0543		0.0766		0.148		0.0045	J
134	0.141		0.167		0.198		0.584		0.0241	
135/151	0.850		0.970		1.15		2.85		0.28	

Table F6 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (ng/3 membranes).

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
136	0.372		0.418		0.517		1.22		0.136	
137	0.133		0.169		0.161		0.401		0.00818	J
139/140	0.0503		0.0606		0.0658		0.167		0.00397	NJ
141	0.369		0.429		0.413		1.17		0.0768	
142	0.01	U	0.00063	J	0.00132	J	0.00252	J	0.00592	J
143	0.0021		0.0055		0.0108		0.01	U	0.013	
144	0.108		0.130		0.126		0.342		0.0413	
145	0.0013		0.0018		0.0023		0.0053		0.0114	
146	0.341		0.404		0.422		1.14		0.0442	
147/149	1.76		2.05		2.30		6.14		0.437	
148	0.00799	J	0.00683	J	0.0253		0.012		0.01	U
150	0.0066	J	0.01	U	0.0166		0.0123		0.01	U
152	0.0063		0.0057		0.0106		0.0093		0.041	
153/168	1.85		2.10		2.07		6.30		0.321	
154	0.0424		0.0392		0.0926		0.0919		0.00179	J
155	0.00176	J	0.01	U	0.00267	NJ	0.00176	J	0.01	U
156/157	0.214		0.266		0.279		0.732		0.0151	J
158	0.177		0.198		0.228		0.651		0.0241	
159	0.0153		0.01	U	0.01	U	0.01	U	0.01	U
160	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
161	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
162	0.0107		0.0119		0.0106		0.0327		0.01	U
164	0.129		0.153		0.147		0.528		0.016	
165	0.01	U	0.01	U	0.00774	J	0.01	U	0.01	U
167	0.0729		0.0892		0.0923		0.299		0.00639	J
169	0.00271	J	0.00279	J	0.00342	J	0.00684		0.00356	J
170	0.193		0.252		0.283		0.590		0.026	
171/173	0.0858		0.0958		0.110		0.227		0.0182	J
172	0.0445		0.0595		0.0596		0.122		0.00719	J
174	0.256		0.314		0.378		0.792		0.0757	
175	0.0132		0.0183		0.0200		0.0383		0.00521	J
176	0.0458		0.0539		0.0762		0.130		0.0248	
177	0.163		0.202		0.250		0.472		0.0363	
178	0.0864		0.104		0.135		0.219		0.0226	
179	0.173		0.199		0.274		0.449		0.0838	
180/193	0.444		0.543		0.628		1.28		0.0853	

Table F6 cont'd. PCB Congener Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (ng/3 membranes).

1011016-	Lake River North 06		Lake River South 07		Flushing Channel 08		Burnt Bridge Creek 09		Air Blank 10	
PCB Congener										
181	0.01	U	0.00792	J	0.0068	J	0.0124		0.01	U
182	0.01	U	0.01	U	0.00397	NJ	0.01	U	0.01	U
183	0.158		0.192		0.218		0.412		0.0527	
184	0.01	U	0.01	U	0.00153	NJ	0.01	U	0.01	U
185	0.0311		0.0391		0.0450		0.122		0.0104	
186[2]	26.9[2]		25.9[2]		25.7[2]		27.3[2]		26.4[2]	
187	0.455		0.518		0.646		1.15		0.119	
188	0.01	U	0.01	U	0.00374	J	0.00346	J	0.01	U
189	0.00819	J	0.0104		0.0125		0.0245		0.01	U
190	0.0434		0.0520		0.0710		0.138		0.00707	J
191	0.00828	J	0.00953	J	0.0138		0.0248		0.01	U
192	0.01	U	0.01	U	0.00153	J	0.01	U	0.01	U
193	0.0613		0.0852		0.112		0.151		0.0148	
194	0.0284		0.0363		0.0513		0.0692		0.00597	J
195	0.0406		0.0557		0.0617		0.0913		0.0107	
196	0.00507	J	0.00620	J	0.00612	J	0.00782	J	0.000919	NJ
198/199	0.139		0.189		0.202		0.307		0.0334	
200	0.0144		0.0193		0.0249		0.0400		0.00591	J
201	0.0178		0.0254		0.0259		0.0388		0.0071	J
202	0.0446		0.0577		0.0608		0.0933		0.0127	
203	0.0698		0.0967		0.104		0.163		0.0193	
204	0.0009		0.0223	U	0.0225	U	0.0221	U	0.0226	
205	0.00344	J	0.00495	J	0.00668	J	0.00845	J	0.00142	J
206	0.0356		0.0720		0.0856		0.0976		0.0264	
207	0.0054	J	0.00973		0.00681	J	0.0110		0.00277	J
208	0.0194		0.0301		0.0222		0.0356		0.00613	J
209	0.0212		0.0306		0.0152		0.0354		0.0185	

1: PRC – values not included in PCB totals.
2: Surrogate – values not included in PCB totals.
U: Analyte not detected at the reporting limit shown.
J: The analyte was positively identified, results are considered an estimate.
NJ: The analyte was tentatively identified, results are considered an estimate.

Table F7. Dioxin/Furans Concentration Estimates and Dioxin TEQs from Inputs to Vancouver Lake, Winter 2010 (pg/L).

1002036-		Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09
Dioxin	TEF[1]				
2,3,7,8-Tetra CDD	1	0.005 U	0.005 U	0.005 U	0.00102 UJ
1,2,3,7,8-Penta CDD	1	**0.016 J**	**0.0077 J**	0.025 U	**0.021 J**
1,2,3,4,7,8-Hexa CDD	0.1	**0.012 J**	**0.0098 J**	0.025 U	**0.028 J**
1,2,3,6,7,8-Hexa CDD	0.1	**0.024 J**	**0.024 J**	0.025 U	**0.057 J**
1,2,3,7,8,9-Hexa CDD	0.1	**0.015 J**	**0.018 J**	**0.021 J**	**0.036 J**
1,2,3,4,6,7,8-Hepta CDD	0.01	**0.41 J**	**0.21 J**	**0.17 J**	**0.78 J**
Octa-CDD	0.0001	**1.10 J**	**0.50 J**	**0.39 J**	**1.00 J**
Dioxin Total		1.6	0.77	0.58	1.9
Furans					
2,3,7,8-Tetra CDF	0.1	**0.0037 J**	**0.0034 J**	**0.0026 J**	**0.021 J**
1,2,3,7,8-Penta CDF	0.05	0.025 U	0.025 U	0.025 U	**0.0070 J**
2,3,4,7,8-Penta CDF	0.5	**0.0030 J**	**0.0017 J**	**0.0021 J**	**0.031 J**
1,2,3,4,7,8-Hexa CDF	0.1	**0.0020 J**	**0.0017 J**	**0.0036 J**	**0.026 J**
1,2,3,6,7,8-Hexa CDF	0.1	**0.0013 J**	**0.0015 J**	0.025 U	**0.025 J**
2,3,4,6,7,8-Hexa CDF	0.1	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,7,8,9-Hexa CDF	0.1	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,4,6,7,8-Hepta CDF	0.01	**0.020 J**	**0.010 J**	**0.0077 J**	**0.17 J**
Octa-CDF	0.0001	**0.089 J**	**0.095 J**	0.05 U	**0.31 J**
Furans Total		0.12	0.11	0.016	0.59
Total Dioxin/Furans		1.7	0.88	0.60	2.5
Dioxin TEQ		0.028	0.017	0.0056	0.066

1: WHO, 2005.
U: The analyte was not detected at or above the sample quantitation limit shown; Nondetects are from SPMD residue analysis.
J: Analyte was positively detected, the result is an estimate.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
Bolding is a visual aid for detected compounds.

Table F8. Dioxin/Furans Concentration Estimates and Dioxin TEQs from Inputs to Vancouver Lake, Spring 2010 (pg/L).

1006033-		Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09
Dioxin	TEF[1]				
2,3,7,8-Tetra CDD	1	0.005 U	0.005 U	0.005 U	**0.012 J**
1,2,3,7,8-Penta CDD	1	0.025 U	0.025 U	0.025 U	**0.077 J**
1,2,3,4,7,8-Hexa CDD	0.1	0.025 U	**0.026 J**	0.025 U	**0.11 J**
1,2,3,6,7,8-Hexa CDD	0.1	**0.11 J**	**0.064 J**	**0.034 J**	**0.26 J**
1,2,3,7,8,9-Hexa CDD	0.1	**0.053 J**	**0.040 J**	0.025 U	**0.14 J**
1,2,3,4,6,7,8-Hepta CDD	0.01	**1.17 J**	**0.51 J**	**0.31 J**	**2.53 J**
Octa-CDD	0.0001	**1.88 J**	**0.97 J**	**0.42 J**	**3.79 J**
Dioxin Total		3.2	1.6	0.76	6.9
Furans					
2,3,7,8-Tetra CDF	0.1	**0.018 J**	**0.017 J**	**0.0084 J**	**0.061 J**
1,2,3,7,8-Penta CDF	0.05	**0.0081 J**	**0.0043 J**	0.025 U	**0.012 J**
2,3,4,7,8-Penta CDF	0.5	**0.014 J**	**0.0096 J**	0.025 U	**0.046 J**
1,2,3,4,7,8-Hexa CDF	0.1	**0.0074 J**	**0.0057 J**	0.025 U	**0.018 J**
1,2,3,6,7,8-Hexa CDF	0.1	**0.0061 J**	**0.0028 J**	0.025 U	**0.014 J**
2,3,4,6,7,8-Hexa CDF	0.1	**0.010 J**	0.025 U	0.025 U	**0.026 J**
1,2,3,7,8,9-Hexa CDF	0.1	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,4,6,7,8-Hepta CDF	0.01	**0.065 J**	**0.031 J**	**0.018 J**	**0.15 J**
Octa-CDF	0.0001	**0.17 J**	**0.10 J**	**0.072 J**	**0.41 J**
Furans Total		0.30	0.17	0.098	0.74
Total Dioxin/Furans		3.5	1.8	0.86	7.6
Dioxin TEQ		0.040	0.026	0.0076	0.20

1: WHO, 2005.
U: The analyte was not detected at or above the sample quantitation limit shown; Nondetects values are from SPMD residue analysis.
J: Analyte was positively detected, the result is an estimate.
Bolding is a visual aid for detected compounds.

Table F9. Dioxin/Furans Concentration Estimates and Dioxin TEQs from Inputs to Vancouver Lake, Fall 2010 (pg/L).

1011016-		Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09
Dioxin	TEF[1]				
2,3,7,8-Tetra CDD	1	0.005 U	0.005 U	0.005 U	**0.0087 J**
1,2,3,7,8-Penta CDD	1	**0.035 J**	0.025 U	0.025 U	**0.046 J**
1,2,3,4,7,8-Hexa CDD	0.1	**0.044 J**	0.025 U	0.025 U	**0.066 J**
1,2,3,6,7,8-Hexa CDD	0.1	**0.25 J**	**0.063 J**	0.025 U	**0.11 J**
1,2,3,7,8,9-Hexa CDD	0.1	**0.11 J**	**0.040 J**	0.025 U	**0.089 J**
1,2,3,4,6,7,8-Hepta CDD	0.01	**2.37**	**0.78**	**0.21 J**	**1.27**
Octa-CDD	0.0001	**4.44**	**1.71**	**0.39 J**	**2.35**
Dioxin Total		7.2	2.6	0.60	3.9
Furan					
2,3,7,8-Tetra CDF	0.1	**0.032**	**0.010**	**0.024 J**	**0.042**
1,2,3,7,8-Penta CDF	0.05	**0.010 J**	0.025 U	0.025 U	**0.011 J**
2,3,4,7,8-Penta CDF	0.5	**0.020 J**	**0.0060 J**	0.025 U	**0.032 J**
1,2,3,4,7,8-Hexa CDF	0.1	**0.019 J**	0.025 U	0.025 U	**0.013 J**
1,2,3,6,7,8-Hexa CDF	0.1	**0.0081 J**	0.025 U	0.025 U	**0.042 J**
2,3,4,6,7,8-Hexa CDF	0.1	**0.016 J**	**0.0060 J**	0.025 U	**0.011 J**
1,2,3,7,8,9-Hexa CDF	0.1	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,4,6,7,8-Hepta CDF	0.01	**0.097 J**	**0.039 J**	**0.049 J**	**0.58 NJ**
Octa-CDF	0.0001	**0.35 J**	**0.17 J**	0.05 U	**0.29 J**
Furans Total		0.55	0.23	0.073	1.0
Total Dioxin/Furans		7.8	2.8	0.67	4.9
Dioxin TEQ		0.12	0.023	0.0050	0.13

1: WHO, 2005.
U: The analyte was not detected at or above the reported sample quantitation limit shown; nondetects are from residue analysis.
J: Analyte was positively detected, the result is an estimate.
NJ: The analyte was "tentatively identified" and the numerical value represents an approximate concentration.
Bolding is a visual aid for detected compounds.

Table F10. Dioxin/Furans Congener Residue Measured in SPMD Extracts from Inputs to Vancouver Lake, Winter 2010 (ng/3 membranes).

1002036-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
Congener					
2,3,7,8-TCDD	0.005 U	0.005 U	0.005 U	0.00102 UJ	0.005 U
1,2,3,7,8-PeCDD	**0.0035 J**	**0.00193 J**	0.025 U	**0.00315 J**	0.025 U
1,2,3,4,7,8-HxCDD	**0.00174 J**	**0.00159 J**	0.025 U	**0.00328 J**	0.025 U
1,2,3,6,7,8-HxCDD	**0.00344 J**	**0.0039 J**	0.025 U	**0.00668 J**	0.025 U
1,2,3,7,8,9-HxCDD	**0.00216 J**	**0.00293 J**	**0.00217 J**	**0.00392 J**	0.025 U
1,2,3,4,6,7,8-HpCDD	**0.0389 J**	**0.0223 J**	**0.012 J**	**0.0455 J**	0.025 U
OCDD	**0.145 J**	**0.0753 J**	**0.0384 J**	**0.111 J**	0.05 U
Dioxin Total:	0.20	0.11	0.053	0.17	
2,3,7,8-TCDF	**0.00393 J**	**0.00414 J**	**0.00201 J**	**0.00448 J**	0.005 U
1,2,3,7,8-PeCDF	0.025 U	0.025 U	0.025 U	**0.00117 J**	0.025 U
2,3,4,7,8-PeCDF	**0.00205 J**	**0.00134 J**	**0.00104 J**	**0.00495 J**	0.025 U
1,2,3,4,7,8-HxCDF	**0.00111 J**	**0.00109 J**	**0.00146 J**	**0.00259 J**	0.025 U
1,2,3,6,7,8-HxCDF	**0.000716 J**	**0.000928 J**	0.025 U	**0.00256 J**	0.025 U
2,3,4,6,7,8-HxCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,7,8,9-HxCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,4,6,7,8-HpCDF	**0.00683 J**	**0.00398 J**	**0.00196 J**	**0.0102 J**	0.025 U
1,2,3,4,7,8,9-HpCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
OCDF	**0.00959 J**	**0.0116 J**	0.05 U	**0.013 J**	0.05 U
Furan Total:	0.024	0.023	0.0065	0.039	

U: The analyte was not detected at or above the reported sample quantitation limit shown.
J: Analyte was positively detected, the result is an estimate.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
Bolding is a visual aid for detected compounds.

Table F11. Dioxin/Furans Congener Residue Measured in SPMD Extracts from Inputs to Vancouver Lake, Spring 2010 (ng/3 membranes).

1006033-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
Congener					
2,3,7,8-TCDD	0.005 U	0.005 U	0.005 U	**0.00672 J**	0.005 U
1,2,3,7,8-PeCDD	0.025 U	0.025 U	0.025 U	**0.00923 J**	0.025 U
1,2,3,4,7,8-HxCDD	0.025 U	**0.00208 J**	0.025 U	**0.00883 J**	0.025 U
1,2,3,6,7,8-HxCDD	**0.00633 J**	**0.00524 J**	**0.0014 J**	**0.0204 J**	0.025 U
1,2,3,7,8,9-HxCDD	**0.00312 J**	**0.00326 J**	0.025 U	**0.0113 J**	0.025 U
1,2,3,4,6,7,8-HpCDD	**0.0485 J**	**0.0285 J**	**0.00908 J**	**0.138 J**	0.025 U
OCDD	**0.104 J**[1]	**0.0743 J**[1]	**0.0161 J**[1]	**0.280 J**[1]	**0.0068 J**
Dioxin Total:	0.16	0.11	0.027	0.47	
2,3,7,8-TCDF	**0.00807 J**	**0.0106 J**	**0.00256 J**	**0.0361 J**	0.005 U
1,2,3,7,8-PeCDF	**0.00228 J**	**0.00166 J**	0.025 U	**0.00437 J**	0.025 U
2,3,4,7,8-PeCDF	**0.00378 J**	**0.00372 J**	0.025 U	**0.0171 J**	0.025 U
1,2,3,4,7,8-HxCDF	**0.00166 J**	**0.00176 J**	0.025 U	**0.00531 J**	0.025 U
1,2,3,6,7,8-HxCDF	**0.00136 J**	**0.000882 J**	0.025 U	**0.00414 J**	0.025 U
2,3,4,6,7,8-HxCDF	**0.00225 J**	0.025 U	0.025 U	**0.00783 J**	0.025 U
1,2,3,7,8,9-HxCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,4,6,7,8-HpCDF	**0.00922 J**	**0.00602 J**	**0.00177 J**	**0.029 J**	0.025 U
1,2,3,4,7,8,9-HpCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
OCDF	**0.00786 J**	**0.00644 J**	**0.00231 J**	**0.0251 J**	0.05 U
Furan Total:	0.036	0.031	0.0066	0.13	

U: The analyte was not detected at or above the reported sample quantitation limit shown.
J: Analyte was positively detected, the result is an estimate.
1: The result was air blank corrected.
Bolding is a visual aid for detected compounds.

Table F12. Dioxin/Furans Congener Residue Measured in SPMD Extracts from Inputs to Vancouver Lake, Fall 2010 (ng/3 membranes).

1011016-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
Congener					
2,3,7,8-TCDD	0.005 U	0.005 U	0.005 U	**0.00371 J**	0.005 U
1,2,3,7,8-PeCDD	**0.00193 J**	0.025 U	0.025 U	**0.00422 J**	0.025 U
1,2,3,4,7,8-HxCDD	**0.00164 J**	0.025 U	0.025 U	**0.00398 J**	0.025 U
1,2,3,6,7,8-HxCDD	**0.00909 J**	**0.0043 J**	0.025 U	**0.00683 J**	0.025 U
1,2,3,7,8,9-HxCDD	**0.00405 J**	**0.00277 J**	0.025 U	**0.00537 J**	0.025 U
1,2,3,4,6,7,8-HpCDD	**0.0623**	**0.0372**	**0.0115 J**	**0.0537**	0.025 U
OCDD	**0.154**	**0.11**	**0.0396 J**	**0.133**	0.05 U
Dioxin Total:	0.23	0.15	0.051	0.21	
2,3,7,8-TCDF	**0.00878**	**0.0052**	**0.00465 J**	**0.0187**	0.005 U
1,2,3,7,8-PeCDF	**0.00179 J**	0.025 U	0.025 U	**0.00319 J**	0.025 U
2,3,4,7,8-PeCDF	**0.00353 J**	**0.00195 J**	0.025 U	**0.00911 J**	0.025 U
1,2,3,4,7,8-HxCDF	**0.0026 J**	0.025 U	0.025 U	**0.00292 J**	0.025 U
1,2,3,6,7,8-HxCDF	**0.00113 J**	0.025 U	0.025 U	**0.00968 J**	0.025 U
2,3,4,6,7,8-HxCDF	**0.00227 J**	**0.00157 J**	0.025 U	**0.00241 J**	0.025 U
1,2,3,7,8,9-HxCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
1,2,3,4,6,7,8-HpCDF	**0.00852 J**	**0.00637 J**	**0.0027 J**	**0.0843 NJ**	0.025 U
1,2,3,4,7,8,9-HpCDF	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
OCDF	**0.0103 J**	**0.00897 J**	0.05 U	**0.0135 J**	0.05 U
Furan Total:	0.039	0.024	0.0074	0.14	

U: The analyte was not detected at or above the reported sample quantitation limit shown.
J: The analyte was positively detected, the result is an estimate.
NJ: The analyte was tentatively identified, the result is an estimate.
Bolding is a visual aid for detected compounds.

Table F13. Chlorinated Pesticide Concentrations Detected in SPMD Extracts from Vancouver Lake Inputs, Winter 2010 (pg/L).

1002036-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09
2,4'-DDD	**9.60**	**11.9 J**	2.5 U	**103 J**
2,4'-DDE	2.5 U	2.5 U	2.5 U	**15.2 J**
2,4'-DDT	2.5 U	2.5 U	2.5 U	**43.8**
4,4'-DDD	**8.50**	**8.80**	**5.60**	**242**
4,4'-DDE	**15.9 J**	**19.1 J**	**6.30 J**	**136**
4,4'-DDT	**3.4 J**	**3.30 J**	2.5 U	**94.9 J**
DDMU	2.5 U	2.5 U	2.5 U	**23.6**
Aldrin	2.5 U	**3.50 J**	2.5 U	**14.4**
Chlordane, technical	**38.1 J**	**35.7 J**	**38.0 J**	**274**
cis-Chlordane	**4.00**	**3.60**	2.5 U	**40.4**
trans-Chlordane	**3.80**	**3.60**	2.5 U	**37.8 J**
Cis-Nonachlor	2.5 U	2.5 U	2.5 U	2.5 U
Trans-Nonachlor	**3.60**	**3.20**	2.5 U	**42.7 J**
Oxychlordane	2.5 U	2.5 U	2.5 U	2.5 U
Chlorpyrifos	**13.6 J**	**13.6 J**	2.5 U	**138 J**
Dacthal	**15.0 J**	**69.7 J**	2.5 U	2.5 U
Dieldrin	**29.9**	**22.8**	2.5 U	**397**
Endosulfan I	2.5 U	**144 J**	2.5 U	**108 J**
Endosulfan II	2.5 U	2.5 U	2.5 U	ND
Endosulfan Sulfate	2.5 U	2.5 U	2.5 U	ND
Heptachlor Epoxide	5.4 UJ	12 UJ	2.5 U	**25.2**
Hexachlorobenzene	**7.40**	**7.40**	**5.90 J**	**124 J**
Pentachloroanisole	**49.8**	**65.8**	**7.70 J**	**287**

J: The analyte was positively detected; the result is an estimate.
U: The analyte was not detected at or above the sample quantitation limit shown. The "U" and "UJ" non-detects are for SPMD residue; concentration has not been estimated. The non-detect value is expressed in units of ng/2 SPMDs.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
ND: Concentration not estimated from residue values; sampling rates have not been laboratory determined.
Bolding is a visual aid for detected compounds.

Table F14. Chlorinated Pesticide Concentrations Detected in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (pg/L).

1006033-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09
2,4'-DDD	**10.3**	**8.30 J**	2.5 U	**62.3 J**
2,4'-DDE	2.6 UJ	2.5 U	2.5 U	6.5 UJ
2,4'-DDT	2.5 U	2.5 U	2.5 U	**6.20**
4,4'-DDD	**26.2**	**17.7**	**14.2**	**117**
4,4'-DDE	**31.5**	**23.1**	**22.6**	**123**
4,4'-DDT	2.5 U	2.5 U	2.5 U	**21.9 J**
DDMU	2.5 UJ	4.3 UJ	4.1 UJ	9.3 UJ
Aldrin	**7.00 J**	2.5 U	2.5 U	2.5 U
Chlordane, technical	**94.6**	**77.3**	**112**	**231 J**
cis-Chlordane	**7.60**	**6.50**	2.5 U	**25.9**
trans-Chlordane	2.5 U	2.5 U	2.5 U	**25.9**
Cis-Nonachlor	2.5 U	2.5 U	2.5 U	**5.30 J**
Trans-Nonachlor	**8.60 J**	**7.10 J**	2.5 U	**32.2 J**
Oxychlordane	2.5 U	2.5 U	2.5 U	2.5 U
Chlorpyrifos	**227 J**	**161 J**	**127 J**	**59.4 J**
Dacthal	**31.1**	**14.1**	**35.4**	4.9 UJ
Dieldrin	**46.4**	**42.2**	2.5 U	**141**
Endosulfan I	**189 J**	**289 J**	2.5 U	**611 J**
Endosulfan II	**534**	2.5 U	2.5 U	**812**
Endosulfan Sulfate	**287**	**207**	2.5 U	**1275**
Heptachlor Epoxide	2.5 U	2.5 U	2.5 U	**41.2**
Hexachlorobenzene	**17.5 J**	**12.7 J**	**12.8 J**	**39.9**
Pentachloroanisole	2.5 U	**42.6**	**16.5 J**	**142**

J: The analyte was positively detected; the result is an estimate.
U: The analyte was not detected at or above the reported sample quantitation limit shown. The “U” and “UJ” non-detects are for residue; concentration has not been estimated. Value is expressed in units of ng/2 SPMDs.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
ND: Concentration not estimated from residue values; sampling rates have not been laboratory determined.
Bolding is a visual aid for detected compounds.

Table F15. Chlorinated Pesticide Concentrations Detected in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (pg/L).

1011016-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09
2,4'-DDD	**13.0 J**	**7.10**	2.5 U	**42.9 J**
2,4'-DDE	2.5 U	2.5 U	2.5 U	19 UJ
2,4'-DDT	2.5 U	2.5 U	2.5 U	2.5 U
4,4'-DDD	**27.5**	**12.8**	**23.6**	**79.4**
4,4'-DDE	**41.6**	**24.9**	**27.3**	**92.7**
4,4'-DDT	2.5 U	2.5 U	2.5 U	**6.00 J**
DDMU	3.2 UJ	4.0 UJ	2.5 U	**73.7**
Aldrin	3.1 UJ	2.5 U	2.5 U	2.5 U
Chlordane, technical	**194**	**95.9**	ND	**218**
cis-Chlordane	**10.1 J**	**6.20**	2.5 U	**20.9**
trans-Chlordane	**13.0**	2.5 U	**17.6**	**25.6**
Cis-Nonachlor	2.5 U	2.5 U	2.5 U	2.5 U
Trans-Nonachlor	**12.7**	**7.40**	2.5 U	**28.0 J**
Oxychlordane	2.5 U	2.5 U	2.5 U	**7.40**
Chlorpyrifos	**38.2 J**	**55.1**	2.5 U	**44.0**
Dacthal	2.5 U	2.5 U	2.5 U	2.5 U
Dieldrin	**39.9**	**18.4**	2.5 U	**98.7**
Endosulfan I	2.6 UJ	**211**	2.5 U	2.5 UJ
Endosulfan II	2.5 U	2.5 U	2.5 U	2.5 U
Endosulfan Sulfate	2.5 U	2.5 U	ND	**1275**
Heptachlor Epoxide	2.5 U	2.5 U	**14.1**	**29.6**
Hexachlorobenzene	**22.1**	**11.9**	**32.5**	**34.9**
Pentachloroanisole	**195**	**135**	**25.6**	**221**

J: The analyte was positively detected; the result is an estimate.
U: The analyte was not detected at or above the reported sample quantitation limit shown. The "U" and "UJ" non-detects are for residue; concentration has not been estimated. Value is expressed in units of ng/2 SPMDs.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
ND: Concentration not estimated from residue values; sampling rates have not been laboratory determined.
Bolding is a visual aid for detected compounds.

Table F16. Chlorinated Pesticide Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Winter 2010 (ng/2 SPMDs).

1002036-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
2,4'-DDD	**8.5**	**12 J**	2.5 U	**19 J**	2.5 U
2,4'-DDE	2.5 U	2.5 U	2.5 U	**2.7 J**	2.5 U
2,4'-DDT	2.5 U	2.5 U	2.5 U	**5.3**	2.5 U
4,4'-DDD	**7.7**	**8.9**	**3.9**	**41**	2.5 U
4,4'-DDE	**14 J**	**19 J**	**4.1 J**	**41**	2.5 U
4,4'-DDT	**2.9 J**	**3.2 J**	2.5 U	**17 J**	2.5 U
DDMU	2.5 U	2.5 U	2.5 U	**6.2**	2.5 U
Aldrin	2.5 U	**3.6 J**	2.5 U	**3.7 J**	2.5 U
Alpha-BHC	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Beta-BHC	7.0 UJ	12 UJ	12 UJ	13 UJ	14 UJ
Delta-BHC	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Gamma-BHC (Lindane)	2.5 U[1]	2.5 U[1]	2.5 U[1]	2.5 U[1]	**4.4**
Chlordane, technical	**31 J**	**33 J**	**23 J**	**72**	25 U
cis-Chlordane	**3.4**	**3.3**	2.5 U	**8.6**	2.5 U
trans-Chlordane	**3.1**	**3.3**	2.5 U	**7.4 J**	2.5 U
Cis-Nonachlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Trans-Nonachlor	**2.9**	**3.0**	2.5 U	**8.5 J**	2.5 U
Oxychlordane	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Chlorpyrifos	**2.6 J**	**2.6 J**	2.5 U	**23 J**	2.5 U
Dacthal	**3.1 J**	**15 J**	2.5 U	2.5 U	2.5 U
Dieldrin	**12**	**9.4**	2.5 U	**40**	2.5 U
Endosulfan I	2.5 U	**2.5 J**	2.5 U	**5.3 J**	2.5 U
Endosulfan II	2.5 U	2.5 U	2.5 U	**5.3 J**	2.5 U
Endosulfan Sulfate	2.5 U	2.5 U	2.5 U	**11**	2.5 U
Endrin	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endrin Aldehyde	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endrin Ketone	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Heptachlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Heptachlor Epoxide	5.4 UJ	12 UJ	2.5 U	**8.1**	2.5 U
Hexachlorobenzene	**6.8**	**7.5**	**4.2 J**	**18 J**	2.5 U
Methoxychlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Mirex	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Pentachloroanisole	**44**	**64**	**5.3 J**	**82**	2.5 U
Toxaphene	25 U	25 U	25 U	25 U	25 U

J: The analyte was positively detected; the result is an estimate.
U: The analyte was not detected at or above the reported sample quantitation limit shown.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
[1] The result was air blank corrected.
Bolding is a visual aid for detected compounds.

Table F17. Chlorinated Pesticide Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Spring 2010 (ng/2 SPMDs).

1006033-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
2,4'-DDD	**4.0**	**4.3 J**	2.5 U	**31 J**	2.5 U
2,4'-DDE	2.6 UJ	2.5 U	2.5 U	6.5 UJ	2.5 U
2,4'-DDT	2.5 U	2.5 U	2.5 U	**3.3**	2.5 U
4,4'-DDD	**11**	**10**	**4.1**	**63**	2.5 U
4,4'-DDE	**12**	**12**	**5.9**	**62**	2.5 U
4,4'-DDT	2.5 U	2.5 U	2.5 U	**12 J**	2.5 U
DDMU	2.5 UJ	4.3 UJ	4.1 UJ	9.3 UJ	2.5 U
Aldrin	**2.8 J**	2.5 U	2.5 U	2.5 U	2.5 U
Alpha-BHC	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Beta-BHC	6.2 UJ	6.1 UJ	6.9 UJ	5.2 UJ	6.2 UJ
Delta-BHC	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Gamma-BHC (Lindane)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Chlordane, technical	**34**	**38**	**28**	**110 J**	25 U
cis-Chlordane	**3.1**	**3.5**	2.5 U	**14**	2.5 U
trans-Chlordane	2.5 U	2.5 U	2.5 U	**14**	2.5 U
Cis-Nonachlor	2.5 U	2.5 U	2.5 U	**2.5 J**	2.5 U
Trans-Nonachlor	**2.9 J**	**3.4 J**	2.5 U	**15 J**	2.5 U
Oxychlordane	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Chlorpyrifos	**40 J**	**30 J**	**20 J**	**11 J**	2.5 U
Dacthal	**5.6**	**2.8**	**5.4**	4.9 UJ	2.5 U
Dieldrin	**13**	**14**	2.5 U	**46**	2.5 U
Endosulfan I	**3.3 J**	**5.1 J**	2.5 U	**11 J**	2.5 U
Endosulfan II	**4.6**	2.5 U	2.5 U	**7.0**	2.5 U
Endosulfan Sulfate	**3.5**	**2.5**	2.5 U	**16**	2.5 U
Endrin	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endrin Aldehyde	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endrin Ketone	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Heptachlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Heptachlor Epoxide	2.5 U	2.5 U	2.5 U	**12**	2.5 U
Hexachlorobenzene	**7.4 J**	**7.1 J**	**3.8 J**	**21**	2.5 U
Methoxychlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Mirex	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Pentachloroanisole	2.5 U	**24**	**5.0 J**	**78**	2.5 U
Toxaphene	25 U	25 U	25 U	30 UJ	25 U

J: The analyte was positively detected; the result is an estimate.
U: The analyte was not detected at or above the reported sample quantitation limit shown.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
Bolding is a visual aid for detected compounds.

Table F18. Chlorinated Pesticide Residue Measured in SPMD Extracts from Vancouver Lake Inputs, Fall 2010 (ng/2 SPMDs).

1011016-	Lake River North 06	Lake River South 07	Flushing Channel 08	Burnt Bridge Creek 09	Air Blank 10
2,4'-DDD	**3.1 J**	**3.2**	2.5 U	**17 J**	2.5 U
2,4'-DDE	2.5 U	2.5 U	2.5 U	19 UJ	2.5 U
2,4'-DDT	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
4,4'-DDD	**7.4**	**6.2**	**3.7**	**34**	2.5 U
4,4'-DDE	**10**	**11**	**7.8**	**36**	2.5 U
4,4'-DDT	2.5 U	2.5 U	2.5 U	**2.6 J**	2.5 U
DDMU	3.2 UJ	4.0 UJ	2.5 U	**31**	2.5 U
Aldrin	3.1 UJ	2.5 U	2.5 U	2.5 U	2.5 U
Alpha-BHC	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Beta-BHC	7.8 UJ	4.2 UJ	3.0 UJ	3.0 UJ	5.6 UJ
Delta-BHC	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Gamma-BHC (Lindane)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Chlordane, technical	**43**	**40**	**48**	**80**	25 U
cis-Chlordane	**2.8 J**	**2.9**	2.5 U	**8.9**	2.5 U
trans-Chlordane	**3.6**	2.5 U	**3.1 J**	**11**	2.5 U
Cis-Nonachlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Trans-Nonachlor	**2.8**	**2.9**	2.5 U	**10 J**	2.5 U
Oxychlordane	2.5 U	2.5 U	2.5 U	**3.2**	2.5 U
Chlorpyrifos	**5.8 J**	**10**	2.5 U	**7.8**	49 UJ
Dacthal	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Dieldrin	**8.2**	**5.5**	2.5 U	**28**	2.5 U
Endosulfan I	2.6 UJ	**3.8**	2.5 U	2.5 UJ	2.5 U
Endosulfan II	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endosulfan Sulfate	2.5 U	2.5 U	**2.6**	**16**	2.5 U
Endrin	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endrin Aldehyde	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Endrin Ketone	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Heptachlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Heptachlor Epoxide	2.5 U	2.5 U	**4.7**	**7.6**	2.5 U
Hexachlorobenzene	**6.0**	**5.8**	**4.4**	**15**	2.5 U
Methoxychlor	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Mirex	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Pentachloroanisole	**54**	**65**	**6.7**	**95**	2.5 U
Toxaphene	25 U	25 U	25 U	50 UJ	25 U

J: The analyte was positively detected; the result is an estimate.
U: The analyte was not detected at or above the reported sample quantitation limit shown.
UJ: The analyte was not detected at or above the estimated sample quantitation limit shown.
Bolding is a visual aid for detected compounds.

Appendix G. Background Information on Chlorinated Pesticides Detected in Burnt Bridge Creek, the Flushing Channel, and Lake River

Chlordane – A persistent contact organochlorine insecticide used in the United State from 1948 to 1988 for agricultural crops, lawns, and gardens. It has also been used in control of termites, cockroaches, ants, and other household pests. Chlordane is not a single chemical, but a mixture of many related chemicals, of which about 10 are major components. Some of these components include trans-chlordane, cis-chlordane, beta-chlordane, heptachlor, and trans-nonachlor. Chlordane was banned in 1983 except for termite control in homes, and then completely cancelled in the United States in 1988. Manufacture for export has continued and use in other countries may still exist. Chlordane has low water solubility and binds well to soils, but breaks down in the atmosphere reacting with light and some chemicals. It is long-lived and can travel great distances to be deposited to land and water surfaces far from the source. Chlordane stays in the environment for many years and can still be found in food, air, water, and soils. It was classified toxicity class II: moderately toxic by the EPA. Chlordane is slightly to moderately toxic to birds and highly toxic to fish and invertebrates. It can bioaccumulate and is commonly found in some form in the fat of fish, birds, mammals, and in almost all humans. Common trade names for chlordane are Octachlor® and Velsicol 1068® (ATSDR, 1994, Extoxnet, 1996d).

Chlorpyrifos – A chlorinated organophosphorus insecticide that was widely used in the home and on the farm. In the home chlorpyrifos has been used to control cockroaches, fleas, and termites; also as an active ingredient in some flea and tick collars. On the farm it is used to control ticks on cattle and to control crop pests. In 1997, manufacturer Dow Chemical voluntarily withdrew registration of chlorpyrifos for most indoor and pet uses in the United States. In 2001 all home uses were stopped and crop application was severely restricted. Although restricted it is still widely used in agriculture and the manufacturer continues to market it for home use in developing countries. Chlorpyrifos is considered a possible human carcinogen, a neurotoxin, a suspected endocrine disruptor, and has been associated with asthma, reproductive and developmental disorders. The EPA classifies chlorpyrifos as class II: moderately toxic. It is highly toxic to some species of fish and aquatic invertebrates, and it appears to bioaccumulate in aquatic organisms. Chlorpyrifos is moderately persistent in soils. Volatilization is the major route chlorpyrifos disperses after application. Once in the environment chlorpyrifos degrades rapidly and is broken down by sunlight, bacteria, or other chemical processes. Chlorpyrifos is the active ingredient in commercial insecticides including Dursban®, Lorsban®, Detmol UA, Brodan, Dowco 179, Empire, Eradex, Paqeant, Scout, Stipend, and Piridane, (ATSDR, 1997, Extoxnet, 1996c).

Dacthal or DCPA – A persistent organochlorine herbicide first registered in the United States in 1958 Dacthal is a trade name for the active ingredient DCPA. Dacthal is used as a pre-emergent herbicide for the control of grasses and broad leaf weeds and applied to home gardens, nurseries, and a number of fruit and vegetable crops. About half of the Dacthal use in the United States is for home and gardens. Although there are no known toxicological issues with Dacthal per se, the product contains very small amounts of dioxin (2,3,7,8-TCDD) and hexachlorobenzene (HCB) as impurities which have considerable toxicological problems. DCPA and its metabolites (breakdown products) have been repeatedly found in groundwater and surface waters. DCPA metabolites were the most commonly detected pesticides in the EPA's National Pesticide Survey where about 6,000 community water system wells and about 264,000 rural domestic wells contained DCPA metabolites. Other trade name products containing DCPA are DAC 893, Dacthalor, Dacthal G-25, and Dacthal W-75 (Cox, 1991 and Extoxnet, 1993).

DDT (dichloro-diphenyl-trichloroethane) – Discovered in 1939 DDT is an organochlorine insecticide first used extensively during World War II to control mosquitoes which can spread malaria and typhus. In agriculture, DDT was historically used on a variety of crops for the control of insects before being banned in 1972 due to harmful impacts on wildlife. DDT was implicated as the toxic chemical responsible for eggshell thinning in eagles, and was a subject of the book *Silent Spring* - thought to be an initiator of the environmental movement. DDT is still used in some countries to control insects. DDE and DDD are metabolites (breakdown products) of DDT and contaminants of commercial preparations. They are also toxic and typically found at higher concentrations in the environment than DDT. While DDE had no commercial use, DDD was used as a pesticide but its use was also banned. DDT, DDE, and DDD are rapidly broken down by sunlight, with a half-life of two days. Hydrophobic and lipophilic DDT binds strongly to soils, breaking down to DDE and DDD by micro-organisms with a half-life of two to 15 years depending on soil type. Because of low solubility, groundwater is less threatened. However, DDT buildup in plants and fatty tissue of fish, birds, and other animals can be a significant problem. Bioaccumulation and biomagnification through the food chain cause the top predators to be most at risk from these long-lived toxic chemicals. The EPA has determined that DDT, DDE, and DDD are probable human carcinogens (ATSDR, 2002c).

Dieldrin and Aldrin – The organochlorine insecticides dieldrin and aldrin have similar chemical structure and commercial uses. There are no natural sources of dieldrin or aldrin. Aldrin rapidly breaks down to dieldrin in plants and animals when exposed to sunlight or bacteria so we mostly find dieldrin in the environment. From the 1950s through the 1970s, dieldrin and aldrin were mainly used for the control of soil insects for crops like corn and cotton. Humans were exposed to these by eating contaminated foods like root crops, fish, or seafood. It is considered a probable human carcinogen. In 1970 the U.S. Department of Agriculture cancelled all uses of dieldrin and aldrin due to concerns about severe damage to aquatic ecosystems and the insecticides' potential carcinogenic properties. In 1972 the EPA lifted the cancellation to allow for use in termite control. Then in 1987, dieldrin and aldrin were again banned for use of termite control. Trade names for dieldrin include Alvit, Dieldrix, Octalox, Quintox, and Red Shield. Trade names used for aldrin include Aldrec, Aldrex, Drinox, Octalene, Seedrin, and Compound 118 (ATSDR, 2002a, USEPA, 2010).

Dioxin and Furans – Dioxin and furans, or the combination of the two is often referred to as dioxin, are a group of chlorinated compounds that are found in very small amounts in the environment, including air, water, and soils. Persistent and likely the most toxic chemicals ever produced. Of the 210 possible congeners, 17 are considered toxic (7 dioxins and 10 furans). Largely formed as an unintended byproduct of industrial processes or incomplete combustion, dioxin is ubiquitous in the environment, resistant to metabolism, and has a high affinity to lipids. Small amounts of the total generated are thought to come from forest fires or volcanic eruptions. Toxicity of the different dioxin compounds range over orders of magnitude. The most toxic of the dioxin congeners is 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin). TCDD is commonly recognized as the contaminant that was found in Agent Orange, and at Love Canal, New York, and Times Beach, Missouri. Backyard burn barrels, garbage incinerators, and medical waste incinerators are some of the largest sources of dioxin. For most people, about 90% of the human exposure occurs from ingesting foods containing the compounds. Dioxin released to the atmosphere can travel long distances. In fact some of the highest levels found in humans have been from the Arctic, hundreds of miles from any source. Dioxin is considered a "human carcinogen" and is known to cause other non-cancer effects including reproductive, developmental, immunological, and endocrine effects in both animals and humans (ATSDR, 1999, Health Canada, 2005).

Endosulfan – Endosulfan is a DDT-era organochlorine pesticide and acaricide first registered in the 1950s. There are currently about 80 endosulfan products primarily used for insect control but also as a wood preservative. Endosulfan is applied to a variety of food crops including tea, coffee, fruits, and vegetables as well as rice, cereals, maize, and sorghum, or other grains. Entering the environment through manufacture and use, Endosulfan is one of the most abundant pesticides in the global atmosphere. Unlike most organochlorine pesticides that were banned in the 1970s, concentrations have been increasing since the 1980s in the Arctic and other remote ecosystems. Application is often by spray and can travel long distances before landing on crops, soil, or water. Applied to crops, break-down takes a few weeks; but attached to soil particles, it can take years to completely break down. Endosulfan has low solubility and in surface water is most often found attached to floating particles or in the substrate. With low water solubility, fish and other aquatic organisms are at risk of bioaccumulation. Endosulfan is highly toxic to some fish and invertebrates at low concentrations. The highest potential for endosulfan exposure to humans is through eating contaminated foods. Endosulfan was a class I Restricted Use Pesticide recently banned by the EPA in November 2010. The current plan is to completely phase out use by 2016 (ATSDR, 2000; Extoxnet, 1996; and Common Dreams, 2010).

Heptachlor Epoxide –Heptachlor epoxide was never produced commercially and does not occur naturally. It is formed by the chemical and biological transformation of heptachlor, an organochlorine pesticide, used in the control of termites in homes and buildings, and on farms to control insects on seed grains and food crops. It is resistant to biodegradation, photolysis, oxidation, and hydrolysis in the environment. Heptachlor epoxide degrades more slowly than heptachlor, so it is more persistent in the environment and may be more toxic than the parent compound. Moderately bound to soils, heptachlor epoxide slowly photo-degrades on the soil surface and because of its limited mobility does not leach significantly to lower soil layers. In aquatic environments it is associated with suspended or bottom sediments. Both heptachlor epoxide and heptachlor bioaccumulate in terrestrial and aquatic organisms and have significant biomagnification potential. Heptachlor epoxide is highly toxic to most fish species and bioaccumulates in fish, mollusks, insects, plankton, and algae. Heptachlor and another organochlorine pesticide chlordane are structurally related, with each technical-grade product containing 10 to 20% of the other compound. This suggests the source of heptachlor epoxide could be the result of either heptachlor or chlordane application (Extoxnet, 1996a and ATSDR, 2007).

Hexachlorobenzene – Hexachlorobenzene is a chlorinated hydrocarbon that does not occur naturally but is formed as a by-product during the process to manufacture chemicals used as solvents, other chlorine containing compounds, and pesticides. Small amounts can also be produced during combustion processes such as municipal waste burning or as a by-product in waste streams of chlor-alkali and wood-preserving plants. First introduced in 1945 the major use of hexachlorobenzene has been as an agricultural fungicide, particularly as a seed dressing to prevent fungal diseases of grain, onions, and other field crops. Use as a fungicide was discontinued, with production ceasing in 1965 and its pesticide registration voluntarily cancelled in 1984. Hexachlorobenzene also had industrial uses as a chemical intermediate and was used to make fireworks, ammunition, and synthetic rubber. Hexachlorobenzene is persistent in the environment, with a half-life ranging from 2.7 to 22.9 years in soils, 2.7 to 5.7 years in surface waters, 5.3 to 11.4 years released to groundwater, and in the atmosphere 0.63 to 6.28 years. It is considered to be moderately to strongly bound to soils and has low solubility in water but dissolves well in fats, oils, and organic solvents. When released into the environment hexachlorobenzene degrades to pentachlorophenol and related compounds. Although hexachlorobenzene is slightly to moderately toxic to bird and fish it has a significant potential for bioaccumulation. Currently the only production is as a by-product as there are no commercial uses in the United States (ATSDR, 2002b, Extoxnet, 1996b, USFWS, 2002).

PCBs (Polychlorinated biphenyls) – There are no natural sources of PCBs. In the United States PCB production began in 1929 by the Monsanto Company. Because PCBs are resistant to thermal breakdown, they were developed as a mixture of compounds widely used in industrial applications as insulating fluids, plasticizers, in inks and carbonless paper, as heat transfer and hydraulic fluids, and a variety of other uses. They were also used as stabilizing additives in the manufacture of flexible PVC coatings for electrical wiring and electronics to enhance the heat and fire resistance of the PVC. The commercial utility was based largely on their chemical stability which is also responsible for their persistence in the environment. As persistent organic pollutants, PCBs enter the environment through both use and disposal and are considered a likely carcinogen. In wildlife, PCBs demonstrate a trend to bioaccumulate and biomagnify in the food chain. Environmental transport is nearly global in scale. Due to PCBs' toxicity and persistence in the environment, production was banned by the United States Congress in 1979 and the Stockholm Convention on Persistent Organic Pollutants in 2001. Despite regulatory actions and an effective ban since the 1970s, PCBs still persist and are likely one of the most often detected groups of toxic chemicals in the environment today. There are a possible 209 different PCB congeners. Congeners are organic compounds each defined by the number and location of chlorine atoms located around a pair of biphenyl rings, i.e., two bonded hexagonal carbon rings. Toxicity among PCB congeners ranges widely, with 12 of the 209 considered toxic. These 12 have similar structure and properties of dioxin and furans and are referred to as dioxin-like compounds. From 1930 to 1977 Monsanto marketed and sold mixtures of PCB congeners under the trade name Aroclors. The combinations of congeners were mixed to create what was best suited for a specific application. The EPA started restrictions on the manufacture of PCBs in 1977 and by 1985 phased out use of PCBs through regulation. The biggest reservoir for PCBs is the planet's hydrosphere, followed by soils, then organisms. Even with low water solubility oceans are vast and can dissolve a large amount of PCBs (ExtoxNet, 1997; ATSDR, 2000; ATSDR, 2001; USFWS, 2002).

Pentachloroanisole – Even though there is no commercial production pentachloroanisole, (PCA) has wide low-level distribution in the environment and in food products. PCA's most probable source is as a biotic transformation of the widely used biocide, pentachlorophenol (PCP). PCA is the main degradation product of PCP. It is a chlorinated aromatic generally insoluble in water and a suspected carcinogen. When soil microbes methylate PCP, it forms PCA, becoming more lipid-soluble. PCA is not expected to have much mobility in soils as it has a high affinity to the organic carbon fraction of soil, although volatilization may occur from moist soils. Like the PCA formation from PCP, it can be biotransformed back to PCP. PCA is favored in an aerobic environment and PCP is favored in an anaerobic environment. Nonetheless, PCA can persist in soils for many years. In surface waters PCA will primarily be lost through volatilization. Although it is easily evaporated, once in the atmosphere it is relatively stable. It can travel far and is found in remote areas like the Arctic. PCA can be removed from the air by wet and dry deposition. Due to PCA's relative stability in the environment it has a high potential to bioaccumulate. The most likely exposure to humans is through foods - especially oil and fat - and the air (USFWS, 2002; Toxnet, 2011; UNECE, 2010).

Appendix H. Glossary, Acronyms, and Abbreviations

Glossary

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.

Dioxin and Furans – Also known as dioxin, or TCDD, dioxin and furans are a group of chlorinated compounds that are found in very small amounts in the environment, including air, water, and soils. Small amounts of the total generated are thought to come from forest fires or volcanic eruptions. Persistent and likely the most toxic chemicals ever produced, of the 210 possible congeners, 17 are considered toxic (7 dioxins and 10 furans). Largely formed as an unintended byproduct of industrial processes or incomplete combustion, dioxin is ubiquitous in the environment, resistant to metabolism, and has a high affinity to lipids. Toxicity of the different dioxin compounds range over orders of magnitude. The most toxic of the dioxin congeners is 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin).

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

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

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and water courses 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 not meeting (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.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

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.

Acronyms and Abbreviations

Following are acronyms and abbreviations used frequently in this report.

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
MEL	Manchester Environmental Laboratory
NTR	National Toxics Rule
PBT	Persistent, bioaccumulative, and toxic substance
RPD	Relative percent difference
SOP	Standard operating procedures
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEF	Toxic equivalency factor
TEQ	Toxic equivalent
TMDL	(See Glossary above)
USGS	U.S. Geological Survey
WAC	Washington Administrative Code

Units of Measurement

cfs	cubic feet per second
ft	feet
g	gram, a unit of mass
mg	milligram
mg/L	milligrams per liter (parts per million)
*u*g/L	micrograms per liter (parts per billion)
ng/L	nanograms per liter (parts per trillion)
pg/L	picograms per liter (parts per quadrillion)