# Potholes Reservoir: Screening Survey for Dieldrin, Other Chlorinated Pesticides, and PCBs in Fish, Water, and Sediments

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Cover photo: Walleye from Potholes Reservoir; photo taken by Randy Coots.

# Potholes Reservoir: Screening Survey for Dieldrin, Other Chlorinated Pesticides, and PCBs in Fish, Water, and Sediments

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# Abstract

During 2007-2008, Potholes Reservoir (Grant County) was assessed for dieldrin, other chlorinated pesticides, and PCBs. Dieldrin was the focus of the study as the reservoir is listed under Section 303(d) of the federal Clean Water Act for dieldrin failing to meet (exceeding) human health criteria in edible fish tissue.

Thirty-five fish fillet composite samples from nine species were analyzed. Dieldrin was detected in 70% of the samples. The DDT metabolite 4,4'-DDE was detected in all the samples. Dieldrin, total PCBs, and 4,4'-DDE exceeded the U.S. Environmental Protection Agency (EPA) National Toxics Rule human health criteria, with dieldrin having the most exceedances at 14 (40% of samples).

Large fish tended to have higher levels of contaminants. Lake whitefish were above the 90$^{th}$ percentile statewide for dieldrin concentrations. Species with lesser amounts of lipids had lower levels of dieldrin and other contaminants: brown bullhead, black crappie, bluegill, yellow perch, smaller-sized largemouth bass, smallmouth bass, and walleye.

Passive samplers (semi-permeable membrane devices or SPMDs) were used to estimate contaminant concentrations in water both during and after the irrigation season. Dieldrin was detected only during the non-irrigation season when groundwater dominates the wasteways and inlets entering Potholes Reservoir. Chlorpyriphos and endosulfan sulfate were detected in both seasons, with consistently higher concentrations during the spring when they are applied. Detected levels of dieldrin, other chlorinated pesticides, and PCBs did not exceed water quality criteria.

Surface sediments were collected from the outlets of Frenchman Hills Wasteway and Lind Coulee and at several sites in Potholes Reservoir. Dieldrin was not detected in any of the samples. 4,4'-DDE was detected in all the samples but did not exceed state sediment quality guidelines.

With no major current sources of dieldrin identified in the study, it is suggested that dieldrin is recycling internally in the Potholes Reservoir fish food chain and accumulating in the larger, fattier, and longer-lived fish species.

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# Introduction

Section 303(d) of the Clean Water Act requires states to prepare a list every two years of waterbodies that do not meet water quality standards. The Act requires that a Total Maximum Daily Load (TMDL) be developed for every waterbody and pollutant on the list. A TMDL includes a written, quantitative assessment of water quality problems and pollutant sources that cause the problems. The TMDL determines the amount of a pollutant that can be discharged to the waterbody and allocates that pollutant load among sources.

Potholes Reservoir has been 303(d) listed by Washington State under Category 5 for not meeting (exceeding) the human health criterion for dieldrin in edible fish tissue. Dieldrin is a legacy chlorinated pesticide. The U.S. Environmental Protection Agency (EPA) requires each state to address Category 5 waterbodies by establishing a TMDL for the pollutants of concern.

The Washington State Department of Ecology's (Ecology) Water Quality Program requested a screening-level study of Potholes Reservoir. More information was needed about the extent and significance of dieldrin contamination to determine if a TMDL technical study was warranted. Data on other chlorinated pesticides and polychlorinated biphenyls (PCBs) were also of interest. As with dieldrin, most of these are banned chemicals, no longer used.

The screening study was conducted in 2007-08 by Ecology's Environmental Assessment Program, Toxics Studies Unit.

## Dieldrin

Dieldrin is an organochlorine pesticide that was widely used in the United States from 1950 to 1974 for controlling soil-dwelling insects on cotton, corn, and other crops. Use on food products was suspended in 1974. All uses were banned in 1985 except for subsurface termite control, dipping of nonfood roots and tops, and moth proofing in closed manufacturing processes (EPA, 1992).

Dieldrin is a persistent organic pollutant that does not easily degrade in the environment. It sorbs readily to soil especially if there are substantial amounts of organic carbon present. Dieldrin also tends to bioaccumulate as it is passed along the food chain. Bioconcentration factors for dieldrin from water to fish tissue range from 400 to 68,000 in fish and aquatic invertebrates (EPA, 2000).

## Study Area Description

Potholes Reservoir is located in north-central Grant County (Figure 1). It was formed by two distinct events. The first occurred during the massive flooding from glacial Lake Missoula (12,000 years ago) when huge depressions were carved out of the earth. During the 1950s, the depressions were filled with water by the creation of O'Sullivan Dam. The dam was built by the U.S. Bureau of Reclamation to provide irrigation water for farming as part of the Columbia Basin Irrigation Project.

The northern half of the reservoir, particularly the western side, is shallow. The deepest section of the reservoir is 70 feet on the southeast side near O'Sullivan Dam (Rogowski and Davis, 1999).

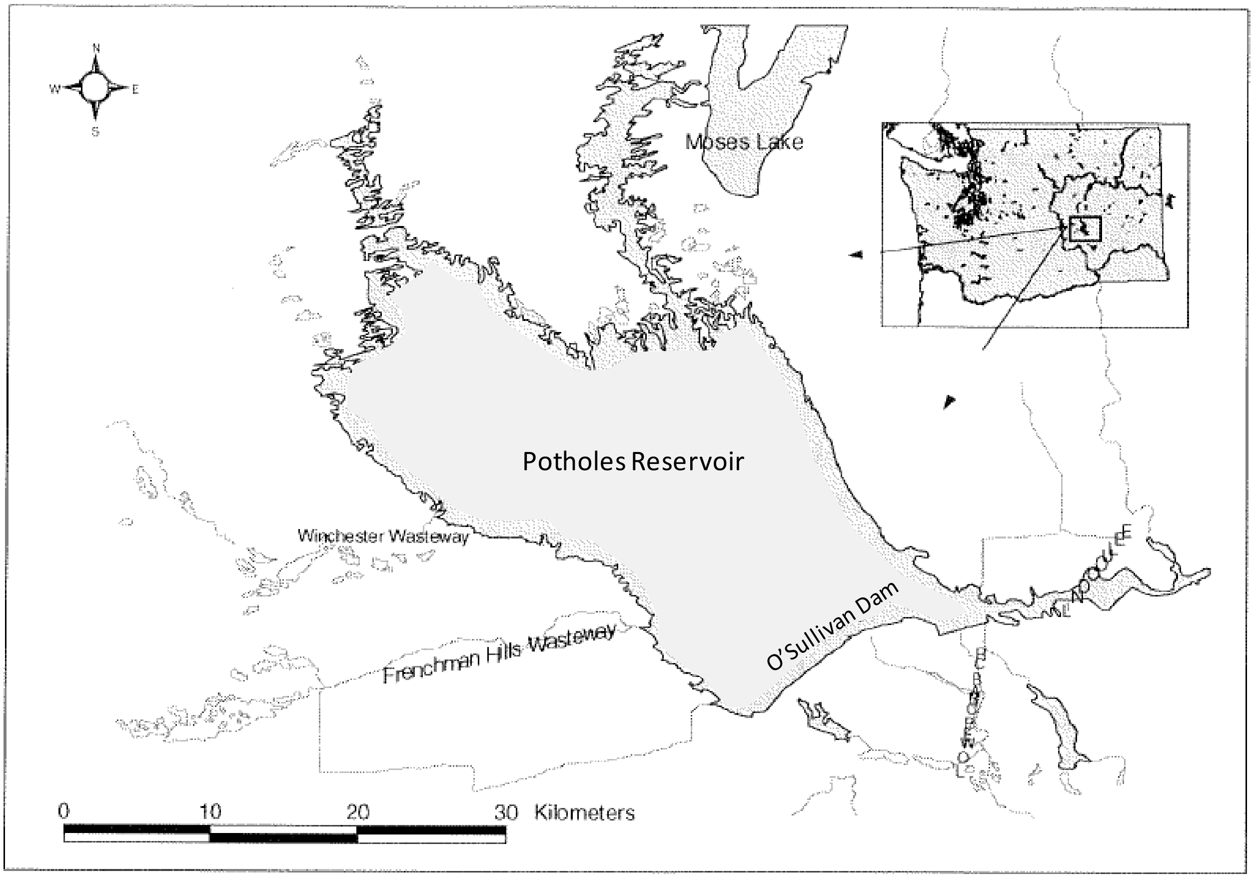


Figure 1. Potholes Reservoir.

Agriculture in Grant County is mainly irrigated wheat crops followed by hay, alfalfa, corn (grain and silage), beans, potatoes, and barley (USDA, 2006). Potholes Reservoir collects excess irrigation water from farm land in the northern part of the Columbia Basin Project for reuse in the southern part. The reservoir receives irrigation return flows from Winchester Wasteway, Frenchman Hills Wasteway, and Lind Coulee. Water also enters the reservoir from Moses Lake via Crab Creek and from groundwater. Irrigation return flows usually peak during the summer and taper off by fall.

Potholes Reservoir is a popular fishing destination. The fish community in Potholes is diverse. The most common species include: walleye, yellow perch, black crappie, lake whitefish, and smallmouth bass. According to the Potholes Reservoir walleye survey conducted by the Washington State Department of Fish and Wildlife (WDFW) in 2006, 75% of all the fish caught were walleye and yellow perch. Other species captured in smaller numbers included brown bullhead, bluegill, channel catfish, carp, yellow bullhead, and burbot (WDFW, 2007).

## Basin Contaminant History

Potholes Reservoir is located in Water Resource Inventory Area (WRIA) 41 - Lower Crab Creek. WRIA 41 has several edible fish tissue (fillet) listings on Category 5 of the 303(d) list. Listed parameters include dieldrin, the DDT breakdown product 4,4'-DDE, polychlorinated biphenyls (PCBs), and 2,3,7,8,-TCDD (dioxin), as shown in Appendix E, Table E-1.

### PCBs, DDT, and Dioxins in Potholes Reservoir

PCBs were once widely used in a variety of industrial applications as insulating fluids, as plasticizers, in inks and carbonless paper, and as heat transfer and hydraulic fluids. DDT is another organochlorine pesticide similar to dieldrin. PCBs and DDT were banned by EPA in the 1970s and 1980s for ecological and human health concerns, and like dieldrin, they persist in the environment. Dioxins are an unintended by-product of combustion, wood treatments, paper bleaching, and certain industrial processes.

The most upstream listings in WRIA 41 are for 2,3,7,8,-TCDD and total PCBs in Moses Lake in fish (Seiders and Kinney, 2004). Although these concentrations are high enough to be listed, they are relatively low compared to fish in other areas of Washington State.

### Dieldrin in Potholes Reservoir

The dieldrin listings for Potholes Reservoir are based on Serdar et al. (1994) and Seiders et al. (2007). Frenchman Hills Wasteway, a tributary, also has a dieldrin listing in its upper section (Frenchman Hills Lake) based on the EPA National Lake Fish Tissue Study (EPA, 2005). There are no additional toxics listings for Potholes or upstream waterbodies, other than Moses Lake as mentioned above.

The dieldrin data that have been collected on fish in the Potholes drainage are summarized in Table 1. This area has had some of the highest dieldrin concentrations reported for Washington State. The listing (human health) criterion for dieldrin is 0.65 ug/Kg[1] (parts per billion) in edible (fillet) tissue.

Table 1. Historical Data on Dieldrin Levels in Fish from the Potholes and Moses Lake Area.

| Study | Sampling Date | Location | Species | Tissue | # in Composite Sample | Dieldrin (ug/Kg ww) |
|---|---|---|---|---|---|---|
| Hopkins, 1991 | 1989 | Winchester WW | LMB | Fillet | 3 | 16 U |
| | | | LSS | Whole | 2 | 15 U |
| Serdar et al., 1994 | 1992 | Potholes Reservoir | LMB | Fillet | 5 | 5 J |
| | | | LWF | | 5 | 32 |
| | | | LSS | Whole | 5 | 37 |
| Munn & Gruber, 1997 | 1992 | Lind Coulee | CARP | Whole | 5 | 260 |
| | | Winchester WW | CARP | | 5 | 53 |
| EPA National Lakes Study, 2005 | 1999 | Potholes Reservoir | WALL | Fillet | 5 | 1 U |
| | | | CARP | Whole | 5 | 13 |
| | | Frenchman Hills Lake | LMB | Fillet | 5 | 7 |
| | | | CARP | Whole | 5 | 27 |
| Seiders & Kinney, 2004 | 2002 | Moses Lake | LMB | Fillet | 10 | 1.9 U |
| | | | WALL | | 9 | 1 U |
| | | | RBT | | 6 | 0.9 U |
| Seiders et al., 2007 | 2005 | Potholes Reservoir | LWF | Fillet | 5 | 3.8 U |
| | | | SMB | | 5 | 1.4 |
| | | | WALL | | 5 | 3.1 |

U = not detected.
J = estimated value.
LMB = largemouth bass; LSS = largescale sucker; LWF = lake whitefish; CARP = common carp; WALL = walleye; RBT = rainbow trout; SMB = smallmouth bass.

Lind Coulee appears to be a major source of dieldrin to Potholes. In addition to the high concentration reported in whole carp (260 ug/Kg ww), USGS detected dieldrin in 13 of 38 water samples from Lind Coulee, compared to three or fewer detections in other Central Columbia Plateau waterbodies (Greene et al., 1994). The detection limit was not provided in Green et al.

[1] Criteria for the protection of human health are applied to Washington State through the EPA National Toxics Rule (NTR) [40 CFR 131.36(14)]. The criteria are calculated using the NTR water column concentrations for consumption of organisms only and bioconcentration factors from EPA's 1980 Ambient Water Quality Criteria documents.

## Dieldrin, DDT, and PCBs Downstream of Potholes Reservoir

Downstream of Potholes there are edible fish tissue listings for dieldrin, 4,4'-DDE, and/or total PCBs in Red Rock Lake, Royal Lake, Scooteney Reservoir, and Lower Crab Creek. The dieldrin concentrations are similar to Potholes (Table 2). The 4,4'-DDE and total PCB levels in some of these waterbodies are much higher than in the Potholes/Moses Lake area (data not tabulated).

Table 2. Historical Data on Dieldrin Levels in Fish Downstream of Potholes Reservoir.

| Study | Sampling Date | Location | Species | Tissue | Dieldrin (ug/Kg ww) |
|---|---|---|---|---|---|
| Davis & Johnson, 1994 | 1992 | Lower Crab Creek | MWF | Fillet | 8 U |
| | | | LSS | Whole | 8 U |
| Munn & Gruber, 1997 | 1994 | Royal Lake | CARP | Whole | 35 |
| | | Lower Crab Creek | | | 5 U |
| Davis et al., 1998 | 1995 | Red Rock Lake | LMB sm | Fillet | 4.1 |
| | | | LMB lg | | 8.6 |
| | | Royal Lake | SMB | | 8.2 |
| | | | CARP | Whole | 42 |
| | | Scooteney Reservoir | LMB sm | Fillet | 3.2 |
| | | | LMB lg | | 9.9 |
| | | | SMB sm | | 2.9 J |
| | | | SMB lg | | 13 |
| | | | CARP | Whole | 28 |
| | | | CARP | | 19 |
| Seiders et al., 2006 | 2003 | Scooteney Reservoir | CC | Fillet | 2.4 |
| | | | WALL | | 2.3 |
| | | | YP | | 0.9 U |

U = not detected.
J = estimated value.
MWF = mountain whitefish; LMB = largemouth bass; SMB = smallmouth bass; LSS = largescale sucker; CARP = common carp; CC = channel catfish; YP = yellow perch; WALL = walleye.

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# Methods

## Project Description

Potholes Reservoir was assessed for dieldrin, other chlorinated pesticides, and PCBs. Dieldrin was the focus of the study. Dioxins were not included in the study due to the high costs of analysis and low levels relative to the other contaminants of concern (e.g., dieldrin).

The study evaluated contaminant concentrations in fish fillets, the water column, and bottom sediments. A passive sampler (semipermeable membrane device or SPMD) was used to concentrate and quantify chemical residues in water. Sampling design is explained in greater detail in the Quality Assurance Project Plan for the study (Era-Miller, 2008). See Figure 2 and Appendix B, Table B-1, for sampling location descriptions.

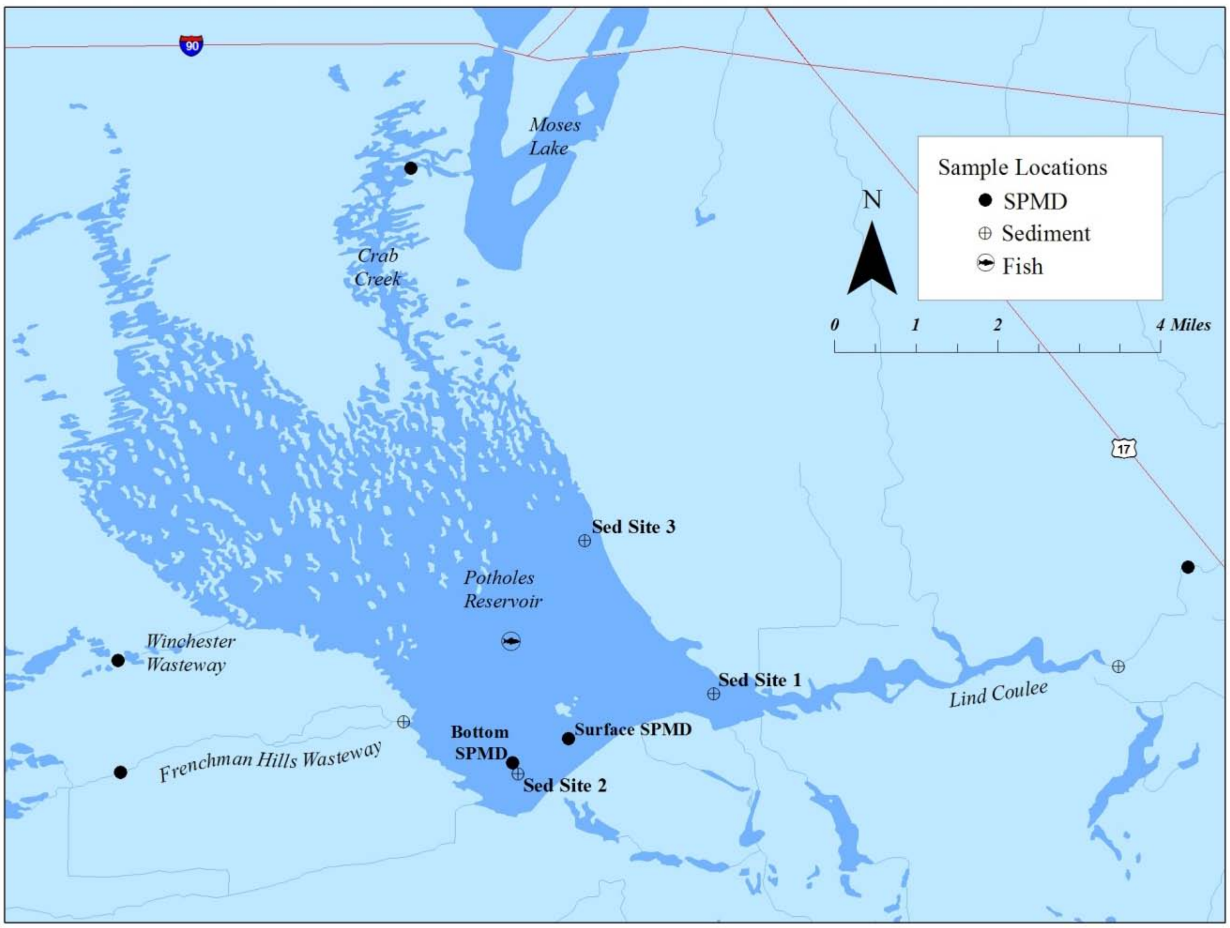


Figure 2. SPMD and Sediment Sampling Locations.

The objectives for the study include:

1. Assess current levels of dieldrin and other chlorinated contaminants in fish, water, and sediments by comparing data to Washington State and national standards and guidelines.
2. Assess the relative importance of the water column and sediments as contaminant pathways to fish.
3. Identify seasonal patterns of chlorinated pesticides in the lake water column and inflows.
4. Evaluate differences in contaminant levels among the various fish species and among different size classes of fish.
5. Provide fish tissue data to the Washington State Department of Health (DOH) to evaluate the need for a fish consumption advisory
6. Prioritize reservoir inflows as sources of dieldrin.
7. Recommend how and where to focus future work to address contaminants in Potholes Reservoir based on the results of the current study.

# Sampling Procedures

## Fish Collection

Thirty-five composite fillet samples from nine fish species were collected from Potholes Reservoir in October 2007 for this study. Large and small size classes were analyzed for largemouth bass, lake whitefish, and walleye. Biological information on the fish is included in Appendix B, Table B-2.

All the lake whitefish and some of the walleye, brown bullhead, and carp were caught by gill net in deep water near the edge of where the reservoir transitions into shallow islands at the northern part of the reservoir. Bass, yellow perch, bluegill, and the rest of the species were caught in shallow water along the western and southern edges of the reservoir.

Ecology worked with the WDFW Region 2 warmwater survey team during their fall walleye survey to collect most of the fish for the study. The fish were collected by gill netting and electrofishing.

Electrofishing was conducted with a Smith-Root 16-foot electrofishing boat with an isolated cathode array. Fish were held in an aerated live well until sampling was completed for the day; fish not selected for analysis were then released.

Fish selected for analysis were sacrificed in the field, assigned a unique identification number, and measured for total length and weight. Fish were wrapped in aluminum foil and polyethylene bags, placed on ice for up to 72 hours while in the field, and then frozen at -20 F until processed for laboratory analysis.

## Preparation of Fish Tissue Samples

Preparation of fish tissue samples followed the *Ecology Standard Operating Procedures for Resecting Finfish Whole body, Body Parts, Or Tissue Samples* (Sandvik, 2007a) and took place at Ecology's Headquarters building in Lacey, Washington.

Samples for analysis were prepared by partially thawing the fish to remove the foil wrapper and rinsing in deionized water to remove adhering debris. The entire fillet from one or both sides of each fish was removed with stainless steel knives or scalpels and homogenized in a Kitchen-Aide or Hobart commercial blender. The fillets were de-scaled and analyzed skin-on, except skin-off for brown bullhead since the skin is not typically eaten.

Composite samples were made up of equal-weight aliquots from each of three to five fish. The samples were homogenized to uniform color and consistency and placed in jars, specifically cleaned for pesticide and PCB analyses and sent to Manchester Environmental Laboratory for analysis.

## Semipermeable Membrane Devices (SPMDs)

SPMDs were used to sample contaminants in the water column due to the low levels anticipated. An SPMD consists of a thin-walled, lay-flat polyethylene membrane filled with triolein, a neutral lipid material. SPMDs mimic the uptake of dieldrin and other lipophilic (fat-loving) chemicals by fish. In this way, minute amounts of a chemical that might normally be undetectable in a whole water sample may be detected and quantified.

SPMDs were deployed mid-November through mid-December 2007, after the irrigation season, and again mid-April through mid-May 2008, at the onset of the irrigation season. SPMDs were placed at six sites: Winchester Wasteway, Frenchman Hills Wasteway, Lind Coulee, Crab Creek, and at two sites within Potholes Reservoir (Figure 2).

Deployment and retrieval procedures for the SPMDs followed the guidance in Huckins et al. (in press) and Ecology's Standard Operating Procedures for SPMDs (Johnson, 2007). Standard SPMDs (91 x 2.5 cm membrane containing 1 mL of 99% pure triolein), the stainless steel canisters (16.5 x 29 cm), and spider carrier devices that hold the membranes during deployment were obtained from Environmental Sampling Technologies, Inc. (EST). The SPMDs were preloaded onto the carriers by EST in a clean room and shipped in solvent-rinsed metal cans under argon atmosphere.

Three SPMD membranes were used for each sample to ensure that sufficient residues were obtained for chemical analysis. The membranes were deployed in a single canister. The SPMDs were kept frozen until deployment.

SPMDs were spiked with performance reference compounds (PRCs) prior to being deployed in the field. The loss rate of PRCs is used to derive an exposure adjustment factor (EAF) to calibrate for the effects of temperature, water velocity, and biofouling on chemical uptake by the SPMD membrane. PCB congeners 4 and 29 were used as the PRCs for this project. These congeners are not present in significant amounts in the environment and are commonly used in SPMD studies.

SPMDs were deployed at two depths in Potholes Reservoir, approximately 10 feet off the bottom and in the top 20 feet of the water column. This was done to account for the effects of differences in water temperature, proximity to bottom sediments, and circulation patterns.

The near-bottom SPMDs were anchored, and a hard-shell float was attached to keep the SPMD suspended in the water column. The surface SPMDs were nestled between large boulders several feet below the water surface and anchored to the shore. The surface SPMD was located off Goose Island in the fall and off the front of O'Sullivan Dam in the spring. The bottom SPMD was in the same location for both spring and fall.

The SPMDs for the wasteways, Lind Coulee, and Crab Creek were attached to cement blocks placed on the bottom of the water column in 2-6 feet of depth and anchored to shore. This deployment method kept the SPMDs at least one foot above the bottom.

Upon arrival at the sampling site, the cans were pried open, spider spindles holding the SPMDs were slid into perforated stainless steel canisters, and the device was deployed. Field personal wore nitrile gloves and took care to not touch the membranes. The SPMDs were located out of strong currents and placed deep enough to allow for fluctuations in water level. Because SPMDs are potent air samplers, this procedure was done as quickly as possible.

The SPMDs for this study were deployed for an average of 30 days as 28 days is the approximate deployment time recommended by USGS and EST. During a 28-day deployment, chemical uptake by an SPMD is assumed to be linear and there should be no significant losses of accumulated residues. The retrieval procedure is essentially the opposite of the deployment. The cans holding the SPMDs must be carefully sealed and maintained at or near freezing until the cans arrive at EST for extraction.

At the beginning and end of each deployment period, total organic carbon (TOC), total suspended solids (TSS), nitrite/nitrate, conductivity samples, and temperature measurements were taken at each monitoring site.

## Sediments

Sediments were collected to determine if they were a potential source of dieldrin or other contaminants to fish. Fine-grained sediments (silt) were targeted over large-grained sediments (sand) to represent depositional areas. Hydrophobic and non-polar chemicals such as dieldrin tend to sorb to finer-grained sediments and thus may not be detected in larger-grained sediments. Only the top 2 cm of sediment were collected to represent more recent deposition.

Sediment samples were obtained from five sites. Three sites were located in Potholes Reservoir, and one site each was located near the mouths of Frenchman Hills Wasteway and Lind Coulee (Figure 2). Acceptable fine-grained sediments could not be found in Crab Creek or Winchester Wasteway. Sampling took place in April 2008.

Sediments were collected following Ecology's standard operating procedure for obtaining freshwater sediment samples (Blakley, 2008). Sediments were taken using a stainless steel petite ponar (0.02 $m^2$) sampler. Each sample was a composite, consisting of three individual grabs. Sampling locations were recorded from GPS, and a field log describing the quality of each grab was maintained. Detailed sediment sample descriptions can be found in Appendix B, Table B-3.

Subsamples of sediment were removed from the ponar sampler with a stainless steel spoon and placed in a large stainless steel bowl. Sediments touching the sidewalls of the grab were not taken. Once all three replicate grabs were collected, sediments were homogenized by stirring. Homogenized sediments were then placed in jars specifically cleaned for pesticide analysis.

Stainless steel implements used to collect and manipulate sediments were cleaned as described in the *Decontamination Procedures* section below. Between-sample cleaning of the petite ponar consisted of a thorough brushing with on-site water.

Sediment samples were placed on ice immediately after collection and transported to Manchester Laboratory within two business days.

## Decontamination Procedures

Precautions were taken to minimize contamination during both sample collection and sample processing. Persons collecting and preparing samples wore non-talc nitrile gloves and changed them between each sample.

Sample processing equipment for sediments and fish tissue resecting instruments were washed thoroughly with Liquinox detergent and hot tap water, followed by rinses with de-ionized water, acetone, and hexane. Instruments were then dried in a fume hood before use. After drying, sediment processing equipment was wrapped in foil to keep it clean prior to field use.

For fish tissue resection, work surfaces were covered with heavy grade aluminum foil. Gloves, aluminum foil, and dissection tools were changed between composite samples.

## Laboratory Analysis

All laboratory analyses were performed at Ecology's Manchester Laboratory, with the exception of grain size, which was performed by Columbia Analytical Services, Inc., Kelso, Washington. Analytical methods for the study are shown in Table 3. SPMD samples were prepared and extracted by EST, St. Joseph, Missouri, and sent to Manchester Laboratory for analysis.

Table 3. Analytical Methods for the Potholes Study.

| Analysis | Analytical Method |
|---|---|
| **Fish Tissue** | |
| Dieldrin | EPA 8081 |
| Chlorinated pesticides | EPA 8270 |
| PCB aroclors | EPA 8082 |
| Lipids | EPA-600 8-80-038 |
| **SPMD** | |
| Chlorinated pesticides | EPA 8270 |
| **Water** | |
| Total suspended solids | EPA 160.2 |
| Total organic carbon | EPA 145.1 |
| Nitrate/Nitrite | SM 4500-$NO3^-$ I |
| Conductivity | SM 2510B & EPA 120.1 |
| **Sediments** | |
| Chlorinated pesticides | EPA 8270† |
| PCB aroclors | EPA 8082 |
| Total organic carbon | PSEP, 1986/1997 |
| Grain size* | PSEP, 1986 |

†Toxaphene was analyzed using EPA method 8081.
*Gravel, sand, silt, and clay fractions.

# Data Quality

Every effort was made to meet the data quality objectives outlined for the study in the Quality Assurance Project Plan (Era-Miller, 2008). Measurement quality objectives (MQOs) are shown in Table C-1, Appendix C. Manchester Laboratory and the project manager reviewed all of the study data, and the data are useable as qualified. Data quality is discussed below for each sample matrix; the corresponding tables are located in Appendix C. Laboratory case narratives for data are available from the project manager upon request.

## Fish

No target chemicals were detected in any of the method blanks.

Laboratory control sample (LCS) recoveries met MQOs for the dieldrin analysis. LCS recoveries were within acceptance limits (50 – 150%) for PCBs, but 28% of all the LCS recoveries for the other pesticides were low (~40%).

The pesticide surrogate dibutylchlorendate (DBC) was spiked into all samples prior to analysis of dieldrin. DBC recoveries met study MQOs (30-130%), with the exception of two samples which recovered at 19% and 26%. Surrogates DBC, decachlorobiphenyl (DCB), and 4,4'-DDE-d8 were spiked into samples prior to the analyses of the other pesticides and PCBs. The recoveries for these surrogates met MQOs for batch 1 (sample numbers 08048820-37). Ten percent of the surrogates in batch 2 (sample numbers 08048838-54) were outside of quality control limits, recovering high for DCB and 4,4'-DDE-d8 and low for DBC.

Matrix spike recoveries are shown in Table C-2. Matrix spike recoveries for dieldrin and PCBs met MQOs. Thirty percent of the matrix spike recoveries for pesticides failed to meet MQOs, mostly recovering on the low side. Precision between matrix spike and matrix spike duplicates was acceptable, except for four pesticide matrix spike /matrix spike duplicates pairs.

Precision of laboratory duplicates is displayed in Table C-3. All the pesticides including dieldrin met study MQOs for precision. Precision could not be calculated for PCB lab duplicates since there were no detections in the samples.

A standard reference material (SRM) 1946 – Lake Superior Fish (NIST, 2003) – was analyzed with the samples. SRM results are shown in Table C-4. The majority of the SRM chemicals recovered reasonably close to their certified values, with the exception of alpha-BHC and lindane from the batch 2 samples, which recovered low. Manchester Laboratory reviewed their historical lab performance of SRM 1946 for dieldrin analyzed with EPA method 8081 and determined that the current results were typical and did not indicate any significant bias for dieldrin (Westerlund, 2009).

## SPMDs

Method blanks, LCS recoveries, and surrogate recoveries for all samples (fall 2007 and spring 2008 data sets) were within quality control limits. Matrix spike recoveries were acceptable for the majority of the chemicals as shown in Table C-5. Relative percent difference (RPD) values for precision were better in the spring samples.

No lab duplicates were analyzed for the SPMD samples. A field replicate was analyzed with spring samples (Table C-6). Although only four chemicals were detected, the RPD values for these results were very good. This field replicate represents not only precision for laboratory performance but also variability through the entire process of SPMD preparation, as well as field variability.

### Field Trip and Day0-Dialysis Blanks

Two types of blank samples were used to assess contamination during sampling: a field-trip blank and a Day0-Dialysis blank. The field-trip blank was used to assess contamination from the air during deployment and retrieval. The Day0-Dialysis blank controls for contamination during the preparation and processing of the SPMD membranes at EST laboratory.

Some analytes were detected in the field-trip and Day0-Dialysis blanks for both the fall and spring samples (raw SPMD residues are shown in Appendix D, Tables D-2 and D-3). The detections were only slightly higher in the field-trip blanks indicating that most of the blank contamination probably came from EST laboratories rather than from field exposure. SPMDs are known to be potent air samplers and are therefore susceptible to blank contamination.

There is currently no widely used or standardized procedure for blank correcting SPMD data. The SPMD data for the present study were therefore blank corrected in the same way as Ecology's Washington State Toxics Monitoring Program, a large and ongoing monitoring effort that uses SPMDs (Sandvik, 2007b).

Blank correction consisted of subtracting the highest chemical value of either the field-trip blanks or the Day0-Dialysis blanks from the chemical results for each sample prior to calculating the estimated dissolved water column concentration.

For the fall samples, the following chemicals were blank corrected: dieldrin, lindane, pentachloroanisole, cis-chlordane, trans-chlordane, trans-nonachlor, and 4,4'-DD. Blank corrections for the spring included: hexachlorobenzene, 2,4'-DDE, 4,4'-DDE, and 4,4'-DDT. All blank corrected results were qualified with a "J" to indicate them as estimates.

## Water Samples

Method blanks, LCS recoveries, and matrix spikes for all samples were within quality control limits.

Precision for laboratory duplicates and field replicates are shown in Table C-7. RPD values for all laboratory duplicates met the study MQOs of $\leq$ 20%. RPDs for the field replicates were a little higher than laboratory duplicates, but were still good overall. Only 3 out of 16 RPDs were greater than 20%.

# Sediment

Method blanks and LCS recoveries met MQOs for both the PCB and pesticide analyses, with the exception of a low LCS recovery (44%) for endosulfan sulfate.

Surrogate recoveries were acceptable for all the PCBs. Only DBC, one of several surrogate chemicals, recovered poorly in three of the pesticide samples.

Matrix spikes recoveries are given in Table C-8. Matrix spikes were acceptable for PCBs. About one-third of the pesticide samples were biased either high or low. Precision (RPDs) for all the matrix spikes were within quality control limits.

Precision, measured as RPD and RSD (relative standard deviation), of lab duplicates and field replicates are shown in Table C-9. Replicate and duplicate precision for pesticides were well within quality control limits, but there were few detected chemical results for comparison. PCBs were not detected and therefore precision was not measured. Precision for grain size was outside of quality control limits. This is partly due to the natural variability inherent in sediments and partly due to the inflation in the measured differences between values when they are low (e.g. 0.05, 0.08, and 0.12 for % gravel = 42% RSD).

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# Results

## Fish

Complete results for fish tissue are shown in Appendix D, Table D-1. About half of the chemicals analyzed for were detected, but only a few chemicals were consistently detected. DDT metabolites were the most frequently detected, with 4,4'-DDE found in all 35 samples. Dieldrin was detected in 70% of the samples (25 detections). Endosulfan I had 17 detections, followed by 16 for endosulfan sulfate, 9 for cis-chlordane, 6 for total PCBs, and the rest of the chemicals had fewer than 5 detections. Summary statistics for the most frequently detected chemicals are shown in Table 4.

Table 4. Summary Statistics for Frequently Detected Chemicals in Composite Fillet Samples from Potholes Reservoir Fish Collected in 2007 (ug/Kg ww, part per billion).

| Chemical | N = | Detection Frequency | Median | Mean | Min. | Max. | $90^{th}$ percentile |
|---|---|---|---|---|---|---|---|
| 4,4'-DDE | 35 | 100% | 2.9 | 17 | 0.6 | 141 | 35 |
| Dieldrin | 35 | 70% | 0.5 | 1.3 | 0.2 | 7.6 | 2.2 |
| Endosulfan I | 35 | 49% | 0.5 | 0.6 | 0.3 | 2.1 | 1.0 |
| Endosulfan Sulfate | 35 | 46% | 0.5 | 0.9 | 0.3 | 2.9 | 2.5 |
| Cis-Chlordane | 35 | 26% | 0.5 | 1.4 | 0.5 | 8.5 | 2.4 |
| Total PCBs | 35 | 17% | 2.5 | 3.8 | 2.4 | 14.5 | 7.8 |

Reporting limit values were used in statistical calculations for non-detected chemicals.
3-5 fish per composite sample.

Table 5 is a summary of mean concentrations for the most frequently detected chemicals by individual fish species and size classes. Largemouth bass, lake whitefish, and walleye were analyzed in both large and small size classes. Large-size lake whitefish had the highest mean concentrations for all the chemicals, with the exception of endosulfan I. The mean dieldrin concentration in the large-size lake whitefish was higher than the next highest concentration (carp), by a factor of almost 4 and an order of magnitude higher than most of the species analyzed.

Table 5. Mean Concentrations of Frequently Detected Chemicals for Individual Fish Species and Size Classes from Potholes Reservoir (ug/Kg ww, part per billion).

| Species | N = | 4,4'-DDE | Dieldrin | Endosulfan I | Endosulfan Sulfate | Cis-Chlordane | Total PCBs |
|---|---|---|---|---|---|---|---|
| Brown Bullhead | 3 | **1.7** | **0.4 J** | 0.5 U | **0.7 J** | 0.5 U | 2.5 U |
| Black Crappie | 3 | **2.0** | **0.4 J** | 0.5 U | **0.6 J** | 0.5 U | 2.5 U |
| Bluegill | 3 | **2.3** | **0.5 J** | 0.5 U | 0.5 U | 0.5 U | 2.5 U |
| Common Carp | 3 | **59** | **1.8 J** | **0.6 J** | 0.5 U | **0.7 J** | **6.0** |
| Largemouth Bass (Lg) | 3 | **9.6 J** | **1.5 J** | **0.8 J** | 1.0 UJ | **0.8 J** | **3.5 J** |
| Largemouth Bass (Sm) | 3 | **2.0** | **0.3 J** | 0.5 U | 0.5 U | 0.5 U | 2.5 U |
| Lake Whitefish (Lg) | 3 | **93 J** | **7.0 J** | 0.5 U | **7.7 J** | **1.4 J** | **9.4 J** |
| Lake Whitefish (Sm) | 2 | **13 J** | **1.6 J** | **1.6 J** | 0.5 U | **0.4 J** | 2.4 U |
| Smallmouth Bass | 3 | **3.2 J** | **0.7 J** | **1.8** | 0.5 U | 0.5 U | 2.5 U |
| Walleye (Lg) | 3 | **11 J** | **1.1** | **2.2 J** | **1.7 J** | **0.4 J** | **6.0 J** |
| Walleye (Sm) | 3 | **1.7** | 0.2 U | **1.4 J** | **1.0 J** | 0.5 U | 2.4 U |
| Yellow Perch | 3 | **1.0 J** | 0.2 U | **0.4 J** | **1.6 J** | 0.5 U | 2.5 U |

**Bolded** values indicate that the chemical was detected.
U = not detected.
J = estimated value.
UJ = not detected; detection limit is an estimate.

## Water

SPMD-derived estimates of contaminant concentrations in the Potholes Reservoir and major irrigation returns are shown in Table 6 (detected chemicals only). PCBs were not analyzed for. These results are for the dissolved fraction. The dissolved concentrations were calculated from the chemical residues accumulated in the SPMDs using the USGS SPMD Water Calculator Spreadsheet Version 5 (www.cerc.usgs.gov/Branches.aspx?BranchId=8). The residue data are in Appendix D, Tables D-2 and D-3.

Table 6. Estimates of Contaminant Concentrations for Detected Chemicals in Potholes Reservoir Water Column and Tributaries (pg/L dissolved, parts per quadrillion)*

| Parameter | Winchester Wasteway | | Frenchman Hills Wasteway | | Lind Coulee | | Lake Surface | | Lake Bottom | | Crab Creek | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fall 07 | Spring 08 | Fall 07 | Spring 08 | Fall 07 | Spring 08 | Fall 07 | Spring 08 | Fall 07 | Spring 08 | Fall 07 | Spring 08 |
| Dieldrin | 8.2 U | 10.1 U | **45.5 J** | 9.9 U | **48.9 J** | 15.0 U | **34.2 J** | 11.4 U | **18.8 J** | 12.3 U | **5.9 J** | 11.8 U |
| Endosulfan Sulfate | 265 U | **2,064** | **439 J** | **5,557** | 265 U | **1,111** | **635 J** | **1,799** | **582 J** | **1,429** | 265 U | **519** |
| Chlorpyriphos | **15.6 J** | **530** | **41.7** | 17.8 U | **22.4** | **736** | **204** | **2,891** | **134** | 19.1 U | **85.5** | **286** |
| 4,4'-DDE | **3.1 J** | 6.6 U | **15.5** | 6.2 U | **27.5** | 12.5 U | **7.1 J** | 8.2 U | **6.3 J** | 9.3 U | **12.2** | 8.6 U |
| 4,4'-DDD | 3.4 U | 6.0 U | 3.9 U | 5.7 U | **19.9 J** | 11.2 U | 6.7 U | 7.4 U | 6.4 U | 8.4 U | **6.9 J** | 7.8 U |
| 4,4'-DDT | 3.6 U | **0.6 J** | **3.8 J** | 5.7 U | **8.8** | **134 J** | **3.4 J** | 7.3 U | **5.7 J** | 8.3 U | **3.5 J** | **10.0 J** |
| 2,4'-DDD | 3.5 U | 6.4 U | **2.9 J** | 6.1 U | **13** | 12.2 U | 7.1 U | 8.0 U | 6.8 U | 9.1 U | 6.2 U | 8.5 U |
| Heptachlor | 4.1 U | 6.4 U | 4.5 U | 6.2 U | **3.3 J** | 11.2 U | **4.5 J** | 7.7 U | **4.5 J** | 8.6 U | **4.4 J** | 8.1 U |
| Hexachlorobenzene | **6.0** | **4.1 J** | 3.9 U | **2.1 J** | 4.7 U | **25.4 J** | 6.6 U | **6.5 J** | 6.3 U | **5.2 J** | **21.9** | 7.8 U |
| Cis-Chlordane | **0.1 J** | **6.6** | **0.5 J** | 5.8 U | **2.5 J** | **18.6** | **0.7 J** | 7.4 U | **0.8 J** | 8.3 U | **1.4 J** | **8.1** |
| Cis-Nonachlor | 3.6 U | 6.7 U | 4.1 U | 6.3 U | **3.5 J** | 12.8 U | 7.4 U | 8.3 U | 7.1 U | 9.5 U | 6.4 U | 8.8 U |
| Trans-Chlordane | **0.1 J** | 6.1 U | **0.7 J** | 5.8 U | **1.5 J** | 10.9 U | **1.1 J** | 7.4 U | **0.6 J** | 8.3 U | **1.3 J** | 7.8 U |
| Trans-Nonachlor | 3.8 U | 7.1 U | 4.4 U | 6.7 U | 5.5 U | **19.9** | 7.9 U | 8.9 U | 7.5 U | 10.1 U | 6.8 U | 9.4 U |
| Methoxychlor | 8.0 U | 10.0 U | 8.3 UJ | 9.7 U | **23.2 J** | 14.9 U | 10.6 UJ | 11.3 U | 10.3 UJ | 12.2 U | 9.8 UJ | 11.7 U |
| Pentachloroanisole | 3.6 U | -- U | 4.0 U | -- | 4.8 U | -- | **0.9 J** | -- | 6.3 U | -- | 5.8 U | -- |
| Endrin | 7.8 U | 9.8 U | 8.1 U | 9.5 U | 8.7 U | 14.7 U | 10.3 U | 11 U | 10.1 U | 12.0 U | **5.0 J** | 11.4 U |

*Water concentrations were calculated using raw SPMD data (ng/3 membranes) and the USGS SPMD Water Calculator Spreadsheet Version 5; concentrations were calculated after blank correction.
**Bolded** values indicate that the chemical was detected.
U = not detected.
J = estimated value.
UJ = not detected; detection limit is an estimate.
-- = not analyzed for.

Dieldrin was detected only in the fall with the highest concentrations in Lind Coulee and Frenchman Hills Wasteway, followed by Potholes Reservoir and Crab Creek, in that order (Figure 3). Within the reservoir, surface water had slightly higher concentrations than bottom water. Non-detects (ND) are graphed in the following three figures at detection limit.

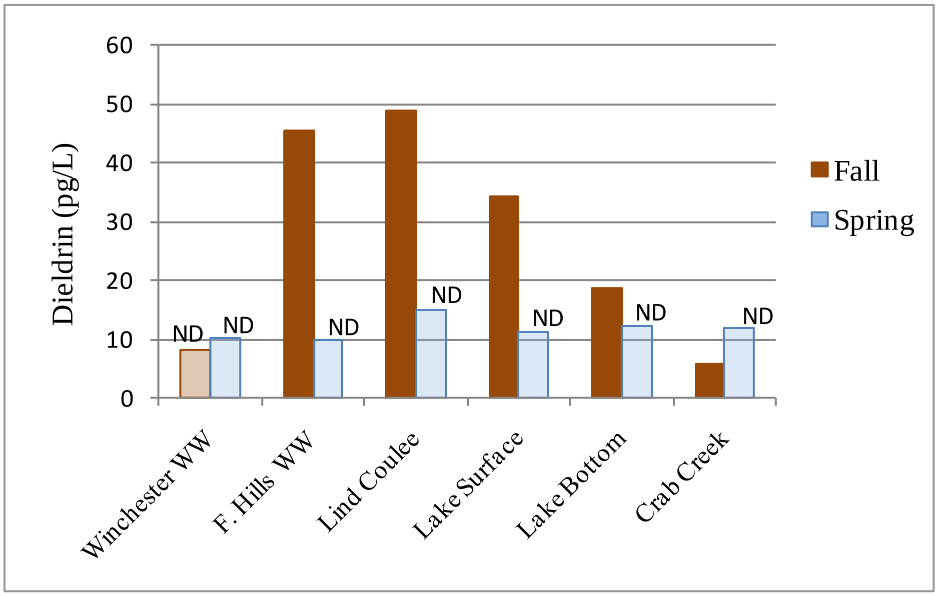


Figure 3. Fall and Spring Estimated Water Concentrations for Dieldrin, 2007-08 (pg/L, parts per quadrillion, dissolved).

The highest chemical concentrations were found for endosulfan sulfate (an endosulfan breakdown product) and chlorpyriphos. Endosulfan and chlorpyrifos are currently used insecticides. These pesticides were detected in both spring and fall, with concentrations being consistently higher in the spring (Figures 4 and 5). The seasonal trend for these chemicals is the opposite of dieldrin. Frenchman Hills Wasteway had the highest concentration of endosulfan sulfate, and the lake surface had the highest concentration of chlorpyriphos for the study.

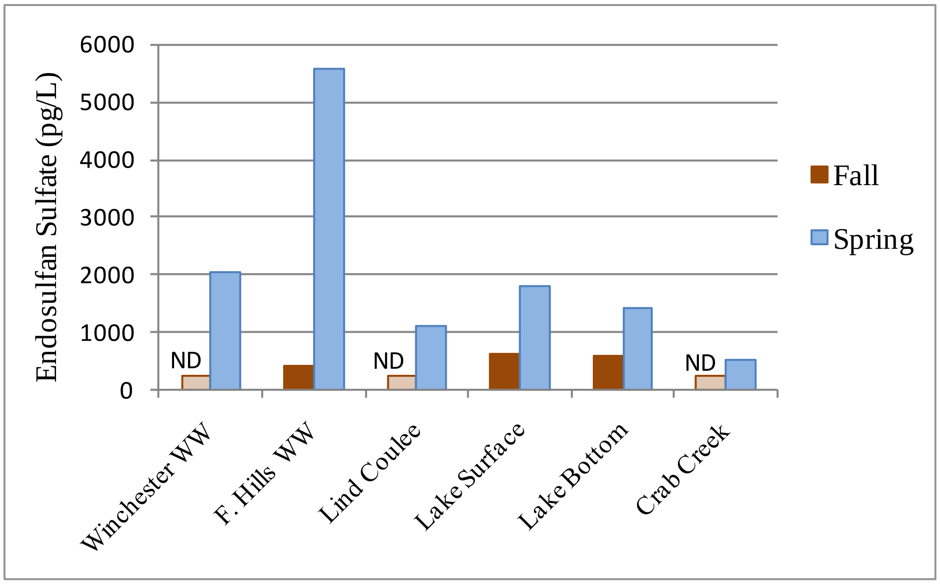


Figure 4. Fall and Spring Estimated Water Concentrations for Endosulfan Sulfate, 2007-08 (pg/L, parts per quadrillion, dissolved).

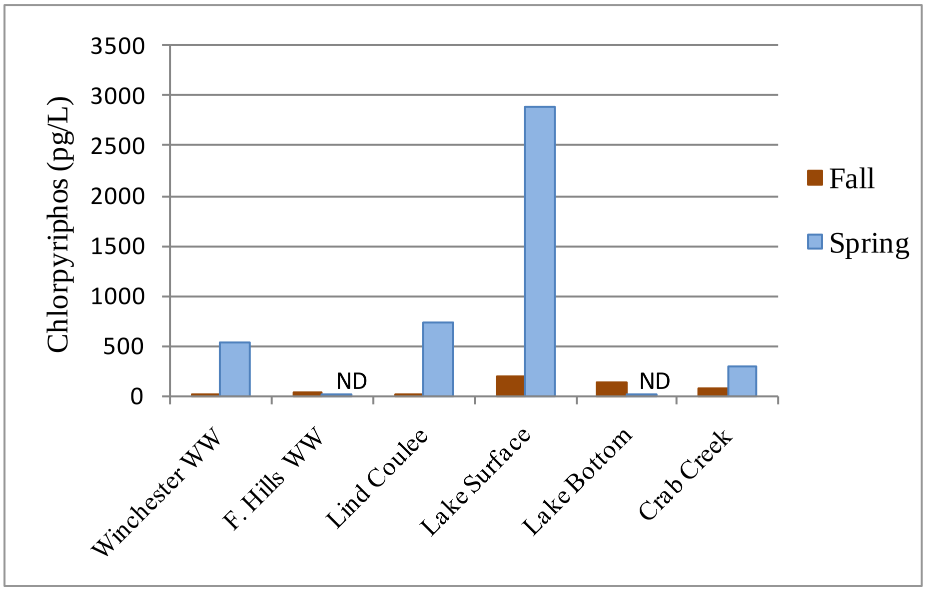


Figure 5. Fall and Spring Estimated Water Concentrations for Chlorpyriphos, 2007-08 (pg/L, parts per quadrillion, dissolved).

The reservoir surface and bottom samples had similar patterns of chemical detections and concentrations during both fall and spring, with the exception that chlorpyriphos was not detected in the lake bottom during the spring.

4,4'-DDE was detected only in the fall samples, while the parent compound 4,4'-DDT was detected during both seasons. The highest concentration of 4,4'-DDT was found in Lind Coulee. About 70% (11 out of 16) of the highest concentrations for detected chemicals occurred in Lind Coulee.

Patterns of detection and concentration for the other chemicals were less dramatic and were not even discernable for some. Heptachlor and trans-chlordane were detected only in the fall samples, but at low concentrations. Hexachlorobenzene and cis-chlordane were detected during both seasons.

## Ancillary Water Quality Parameters

Ancillary water quality parameter values are shown in Table 7. All the results can be found in Appendix D, Table D-6. These parameters were analyzed to support the SPMD data and to help differentiate between groundwater and surface water as sources of pesticides and PCBs.

Table 7. Mean Water Quality Values for Potholes Reservoir and Wasteways

| Site Name | Season | N = | Temperature | Conductivity | TSS | TOC | Nitrite-Nitrate |
|---|---|---|---|---|---|---|---|
| | | | deg C | umhos/cm | mg/L | mg/L | mg/L |
| Lind Coulee | Fall | 2 | 7.5 | 537 | 2 | 1.7 | 4.6 |
| | Spring | 2 | 13.6 | 210 | 113 | 1.8 | 0.7 |
| Frenchman Hills | Fall | 2 | 3.4 | 598 | 4 | 2.3 | 6.3 |
| | Spring | 2 | 14.4 | 301 | 14 | 2.3 | 1.3 |
| Winchester | Fall | 2 | 2.7 | 489 | 1.5 | 2.1 | 2.8 |
| | Spring | 2 | 15 | 366 | 9.5 | 3.2 | 0.8 |
| Crab Creek | Fall | 2 | 4.9 | 319 | 3.5 | 3.2 | 0.7 |
| | Spring | 2 | 14.4 | 253 | 4.5 | 2.3 | 0.05 |
| Lake Surface | Fall | 2 | 6.2 | 354 | 11 | 3.8 | 0.7 |
| | Spring | 2 | 16 | 339 | 2.5 | 3.2 | 0.7 |
| Lake Bottom | Fall | 2 | 5.4 | 384 | 11 | 3.5 | 1.3 |
| | Spring | 2 | 11.8 | 365 | 5.5 | 3.4 | 0.7 |

There were major differences in temperature, conductivity, TSS, and nitrite-nitrates between spring and fall. TOC did not vary as much seasonally. Much of this had to do with groundwater and surface water influences and is explained in greater detail in the *Discussion* section of this report.

## Sediments

Sediment results are shown in Table 8 (dieldrin and detected chemicals only). All the results are given in Appendix D, Table D-7. There were few detections overall. Dieldrin was not detected in any of the samples, with detection limits ranging from 0.95 to 4.7 ug/Kg dw. 4,4'-DDE was detected in all the samples. Chlorpyrifos was detected only in Frenchman Hills Wasteway. Endosulfan sulfate was detected only in one sample from the Reservoir. Trans-nonachlor, 4,4'-DDT, 4,4'-DDD, and 2,4'-DDD were detected only in Lind Coulee.

Table 8. Contaminant Concentrations in Potholes Reservoir and Tributary Sediments, Spring 2008 (ug/Kg, part per billion, dry weight).

| Site Name: | Frenchman Hills Wasteway | Lind Coulee | Reservoir 1 | Reservoir 2 | Reservoir 3 |
|---|---|---|---|---|---|
| Sample No.: | 08168912 | 08168913 | 08168914 | 08168915 | 08168916 |
| TOC (%) | 5.2 | 1.3 J | 2.3 J | 4.3 | 3.5 |
| Fines (%) | 42 J | 88 | 59 | 55 J | 46 J |
| Dieldrin | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ |
| 4,4'-DDT | 2.4 U | **0.69 J** | 2.2 U | 4.7 U | 3.7 U |
| 4,4'-DDE | **3.6** | **4.3** | **3.9** | **4.8** | **2.9 J** |
| 4,4'-DDD | 2.4 U | **0.51 J** | 2.2 U | 4.7 U | 3.7 U |
| 2,4'-DDD | 2.4 U | **0.31 J** | 2.2 U | 4.7 U | 3.7 U |
| Trans-Nonachlor | 2.4 U | **0.48 J** | 2.2 U | 4.7 U | 3.7 U |
| Endosulfan Sulfate | 2.4 UJ | 0.95 UJ | 2.2 UJ | **2.4 J** | 3.7 UJ |
| Chlorpyriphos | **1.0 J** | 0.95 UJ | 2.2 UJ | 4.7 UJ | 3.7 UJ |

**Bolded** values indicate analyte detections.
U = not detected.
J = estimated value.
UJ = not detected; detection limit is an estimate.
Fines = Silt fractions (0.0039 mm to 0.0625 mm) + clay fractions (<0.0039 mm).

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# Discussion

## Fish

### Comparisons to National Toxics Rule Criteria

Ecology uses the National Toxics Rule (NTR) water column human health criteria and EPA bioconcentration factors to screen toxics in fish tissue for violations of water quality standards (Ecology, 2006). Three chemicals in Potholes fish exceeded the NTR fish tissue criteria: dieldrin, 4,4'-DDE, and total PCBs. The NTR fish tissue screening criteria are given in Table 9.

Table 9. National Toxics Rule Criteria for Fish Tissue.

| Parameter | NTR Freshwater Criterion* (ng/L) | EPA Bioconcentration Factor | NTR Tissue Criterion (ug/Kg wet weight) |
|---|---|---|---|
| Dieldrin | 0.14 | 4,670 | 0.65 |
| 4,4'-DDE | 0.59 | 53,600 | 32 |
| Total PCBs | 0.17 | 31,200 | 5.3 |

*For consumption of water and organisms.

Exceedance factors for dieldrin, 4,4'-DDE, and total PCBs are shown in Figure 6. The uppermost criteria exceedances for all 3 chemicals were found in lake whitefish. The highest concentration of dieldrin exceeded the NTR criteria by a factor of almost 12. DDE and total PCB concentrations were up to 3-4 times higher than the NTR criteria.

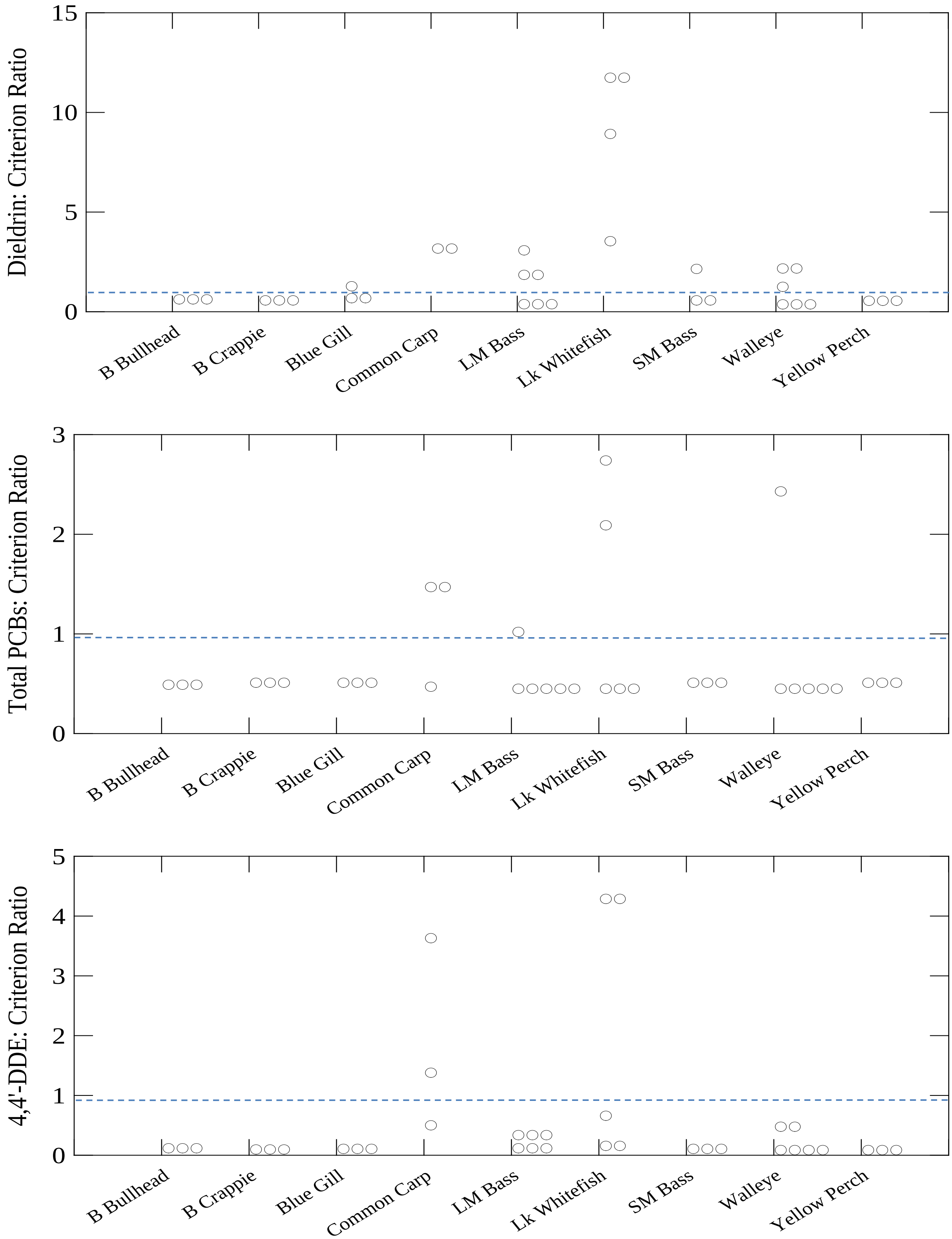


Figure 6. Fish Tissue Contaminant Concentrations from This Study Compared to National Toxics Rule Fish Tissue Criteria (Values >1 exceed criterion).

## Washington State Department of Health Review

Ecology provided fish tissue data from the 2007-08 Potholes Reservoir study to the Washington State Department of Health (DOH). DOH is responsible for issuing advisories about human health risks from fish consumption in Washington State. DOH reviewed the Potholes data and prepared the following statement:

> *"Ecology asked the Washington State Department of Health (DOH) to evaluate the concentrations (of) pesticides and PCBs measured in fish tissues collected from the Potholes Reservoir to determine whether there could be health concerns from eating the fish. Based on the reported concentrations of the various pesticides and PCBs and detection limits that were sufficiently low, DOH noted no potential health concerns from consuming these fish.*
>
> *While several contaminants measured in fish tissue exceed the National Toxics Rule criteria values, the measured concentrations do not exceed concentrations that would result in DOH consumption recommendations of less than two meals per week. All concentrations were too low to be of health concern, even for people who might consume the fish several times per week."*

## Dieldrin Compared to Other Fish Tissue Data

Trends in dieldrin concentrations in Potholes Reservoir fish are difficult to assess due to the lack of comparable historical data. In the past, the highest concentrations were found in whole carp (53 and 260 ug/Kg ww) and whole suckers (37 ug/Kg ww), whiled the current study analyzed fillets (see Table 1 for historical data).

Lake whitefish data provide some indication that dieldrin concentrations have decreased in Potholes Reservoir since the 1990s. The highest historical whitefish fillet concentration was 32 ug/Kg ww in a composite sample collected by Ecology in 1992. The highest dieldrin concentration in whitefish fillets from the current study was 7.6 ug/Kg ww.

For several species, current dieldrin concentrations are similar to recent samples collected by Ecology in 2005 (Seiders et al., 2007) as shown in Figure 7. These samples were composed of fish with comparable lengths, weights, and lipid content.

To put the dieldrin levels in Potholes fish in perspective, the results were compared to 165 fish fillet samples collected statewide between 1999 and 2007 (Figure 8). Detected only results were used for comparison.

Three of the large-size lake whitefish samples from the current study had among the highest dieldrin concentrations reported in the state for fillets. These samples were within the $98^{th}$ to $100^{th}$ percentile for dieldrin statewide. Lake whitefish, carp, and one of the large-size largemouth bass samples were above the $75^{th}$ percentile. About half of the Potholes fish samples were below the $50^{th}$ percentile statewide.

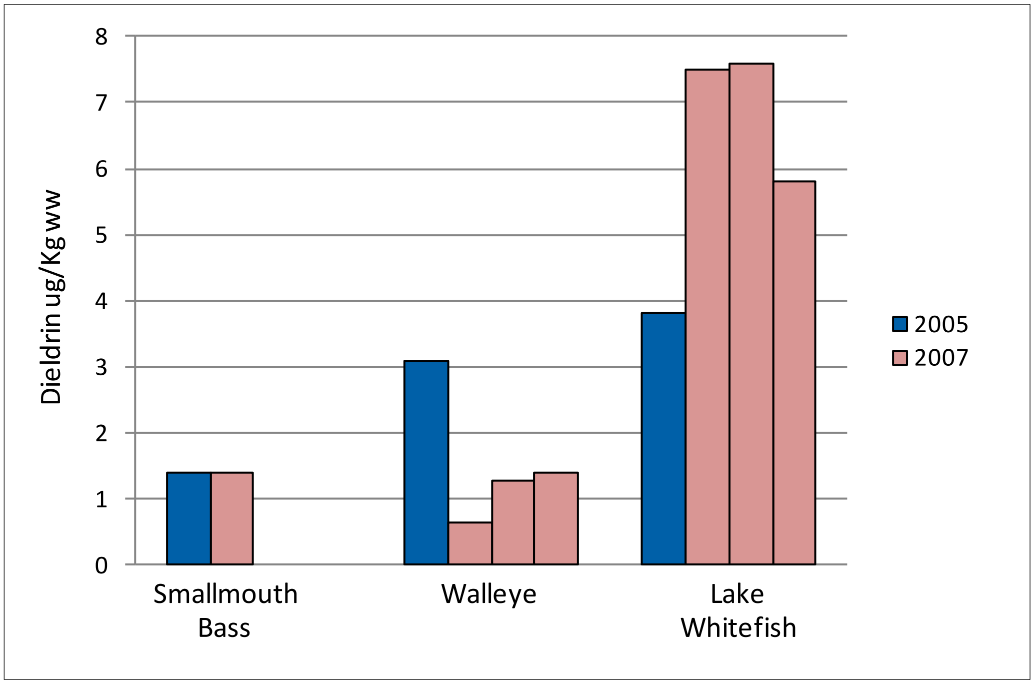


Figure 7. Dieldrin Concentrations in Potholes Fish Fillet Composite Samples Collected by Ecology, 2005 and 2007.

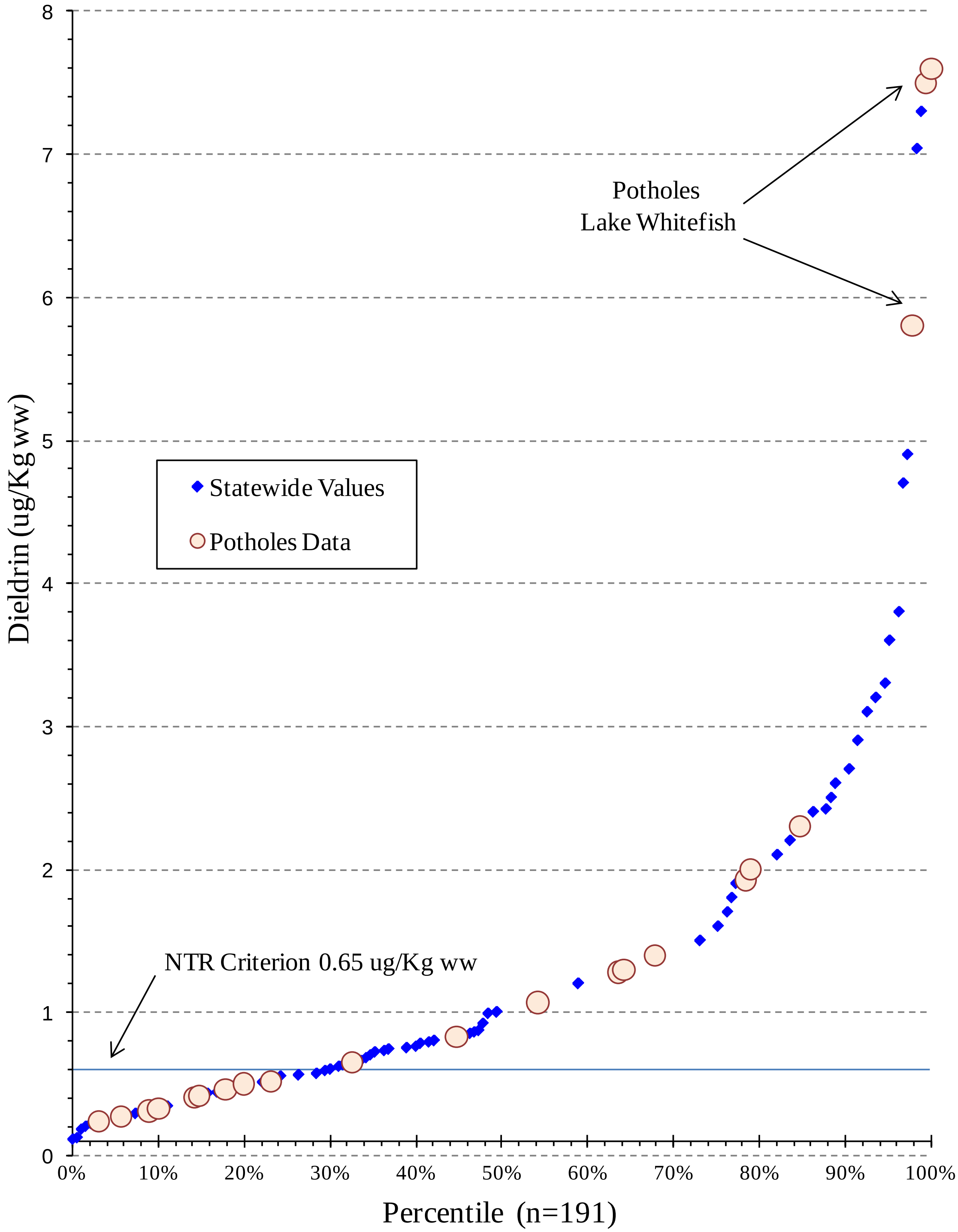


Figure 8. Cumulative Frequency Distribution of Dieldrin in Fish Fillets (1999 – 2007 data; accessed from the Ecology EIM Database in January 2009).

## Correlation with Fish Size and Lipid Content

**Contaminants vs. Fish Size**

Lake whitefish, walleye, and largemouth bass were analyzed in both small-size and large-size classes to determine if there was a difference in contaminant concentrations between sizes. Average lengths of the fish for each composite sample were compared to chemical results. If a chemical was not detected in two or more samples for each species, it was not used for comparison.

Fish length for all three species correlated well with dieldrin as shown in Figure 9. The $R^2$ ranged from 0.66 – 0.89. Walleye and largemouth bass length correlated well with total DDT ($R^2$ = 0.71 and 0.95), while the relationship was not as strong between lake whitefish and total DDT ($R^2$ = 0.36) (Figure 10).

Lake whitefish also showed a correlation between length and cis-chlordane, endosulfan sulfate, chlorpyrifos and total PCBs.

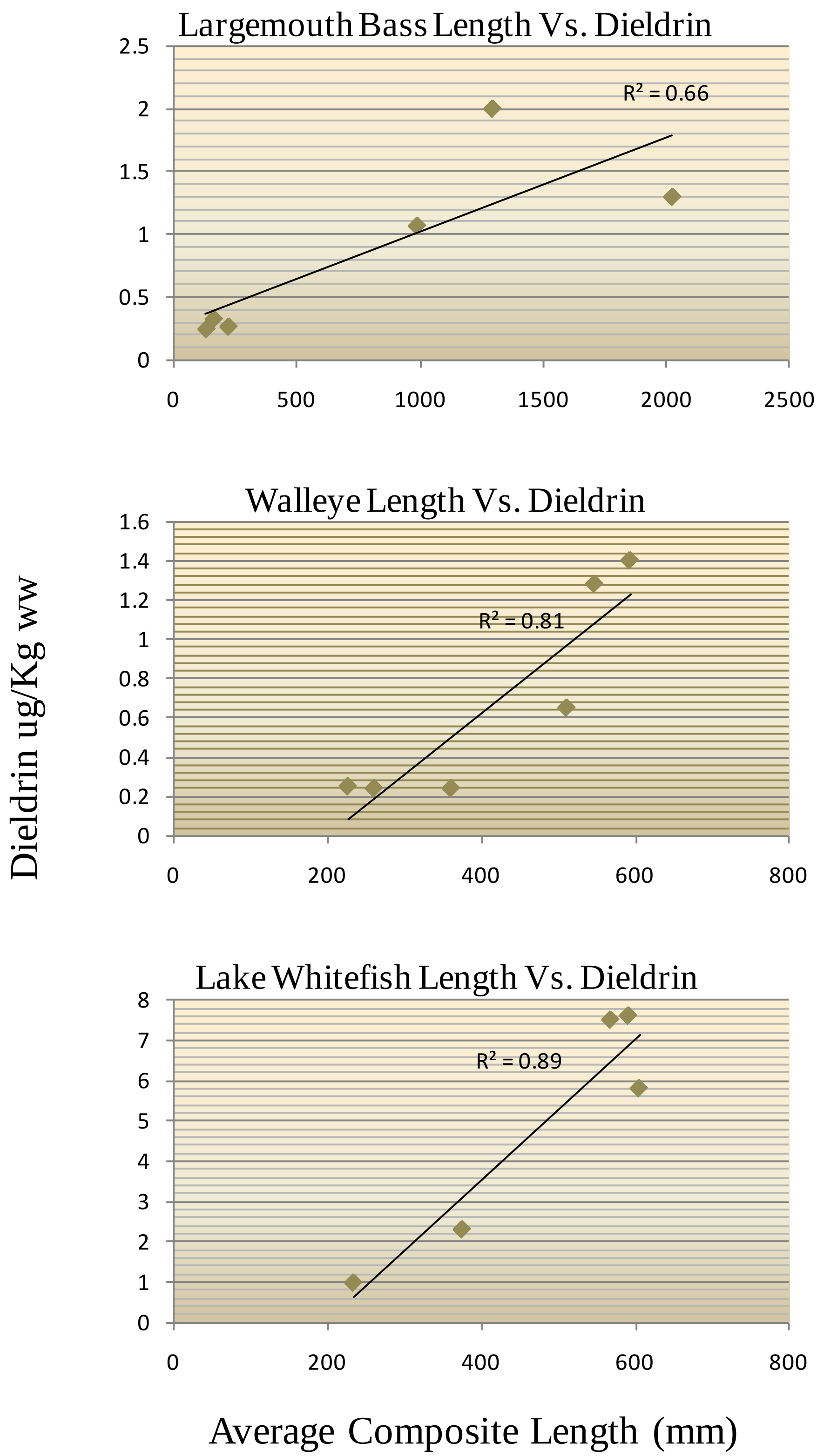


Figure 9. Fish Length versus Dieldrin Concentrations in Fish Fillet Tissue.

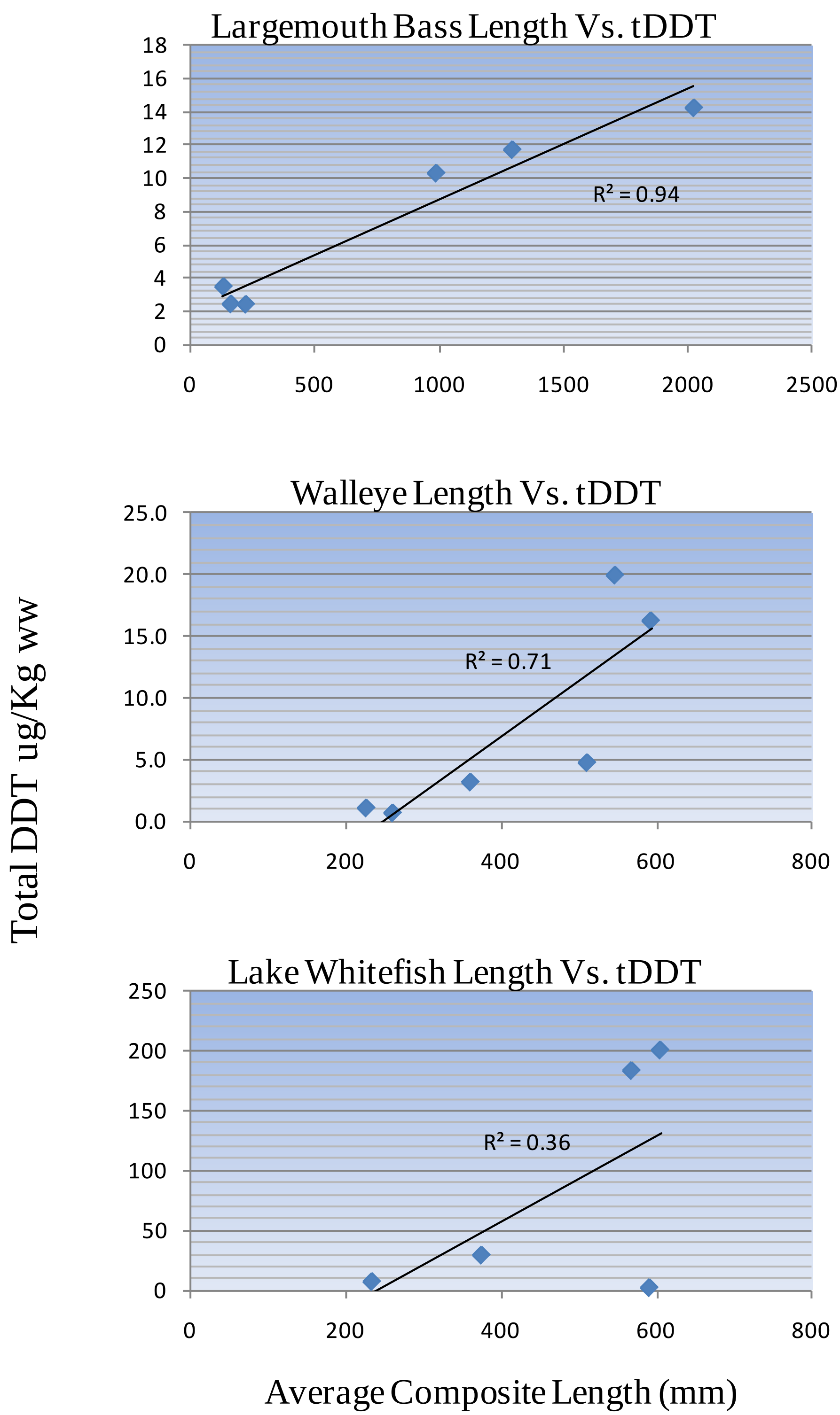


Figure 10. Fish Length versus Total DDT Concentrations in Fish Fillet Tissue.

**Contaminants vs. Lipids**

Lipids can be an important factor in the uptake and retention of chemical residues in fish tissue. Species with high lipid content such as carp and whitefish have been well documented as having elevated concentrations of lipophilic contaminants like dieldrin, DDT compounds, and PCBs (e.g., Serdar, 2003; Johnson et al., 2007).

The large-size lake whitefish, walleye, and largemouth bass from Potholes Reservoir had higher lipids than the small-size fish of the same species. This may explain why the larger fish tended to have higher concentrations of dieldrin, DDT compounds, and PCBs. Fish age, feeding habits, sex, and individual chemical properties can also play a role in overall chemical concentrations in fish tissue.

Figure 11 shows that dieldrin was strongly correlated to lipids ($R^2$ = 0.88) for lake whitefish, walleye, and largemouth bass. The highest concentrations of dieldrin were found in the large-size lake whitefish, which also had the highest lipid contents in the study at 11–15%.

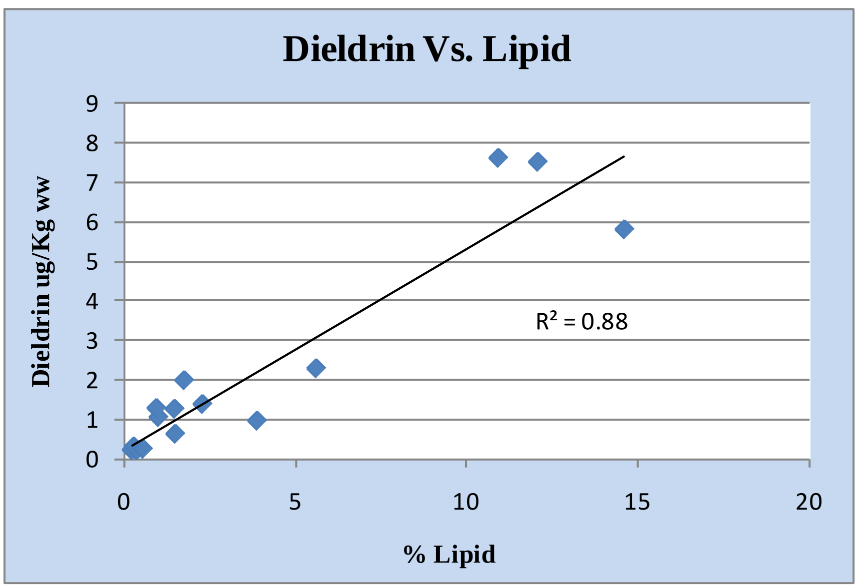


Figure 11. Correlation between Dieldrin and Lipids for Lake Whitefish, Walleye, and Largemouth Bass.

Fish species with lower lipids (< 1%) such as brown bullhead, black crappie, yellow perch, and the small-sized largemouth bass and walleye had much lower concentrations of dieldrin and other contaminants and no exceedances of the NTR fish tissue criteria.

# Water

## Comparisons to Water Quality Criteria

The dissolved fraction of a chemical in water is generally considered to be a good predictor of chemical uptake by fish. However, the NTR human health water quality criteria apply to the total amount. Total concentrations were calculated from the dissolved concentrations measured in the Potholes study using the equation $C_{w\text{-}tot} = C_w (1 + TOC (K_{oc}/M_w))$ where $C_w$ is the dissolved concentration, $K_{oc}$ is the organic carbon-water equilibrium partition coefficient, and $M_w$ is the mass of water (Meadows et al., 1998). The total concentrations were only slightly higher than the dissolved concentrations for dieldrin and most of the chemicals analyzed (Table D-4). None of the total or dissolved concentrations exceeded human health or aquatic life criteria. Applicable water quality criteria are listed in Table D-5.

While water concentrations in Potholes Reservoir did not exceed any of the applicable water quality criteria, screening levels for fish tissue were exceeded for dieldrin, 4,4'-DDE, and total PCBs. This can be explained by the fact that these chemicals bioaccumulate in the fatty tissues of fish. Even trace levels of chemicals in the environment can build up in the tissues of living organisms.

## Groundwater vs. Surface Water Inputs

Differences in water quality parameters between fall and spring reflect the relative importance of groundwater vs. surface water inputs to the Potholes system. Figures 12 and 13 illustrate that nitrite/nitrate and conductivity were substantially higher in the fall for Frenchman Hills Wasteway, Winchester Wasteway, and Lind Coulee, and slightly higher for Crab Creek.

The U.S. Geological Survey (USGS) conducted comprehensive groundwater and surface water monitoring in the Central Columbia Plateau during 1992-1995 (Williamson et al., 1998). They concluded that in winter months (November – February) when farms are not irrigating, baseflow in the wasteways is derived entirely from shallow groundwater discharges. Groundwater was found to be the predominant source of nitrate to surface water. Nitrate levels in Frenchman Hills Wasteway measured by USGS during the winter baseflow period averaged 6 mg/L.

In the present study, nitrite/nitrate averaged 6.6 mg/L in Frenchman Hills Wasteway during the fall-winter sampling period and 1.3 mg/L in the spring. The higher nitrite/nitrate and conductivity levels found during the fall-winter baseflow period are thus likely indicative of groundwater inputs to wasteways.

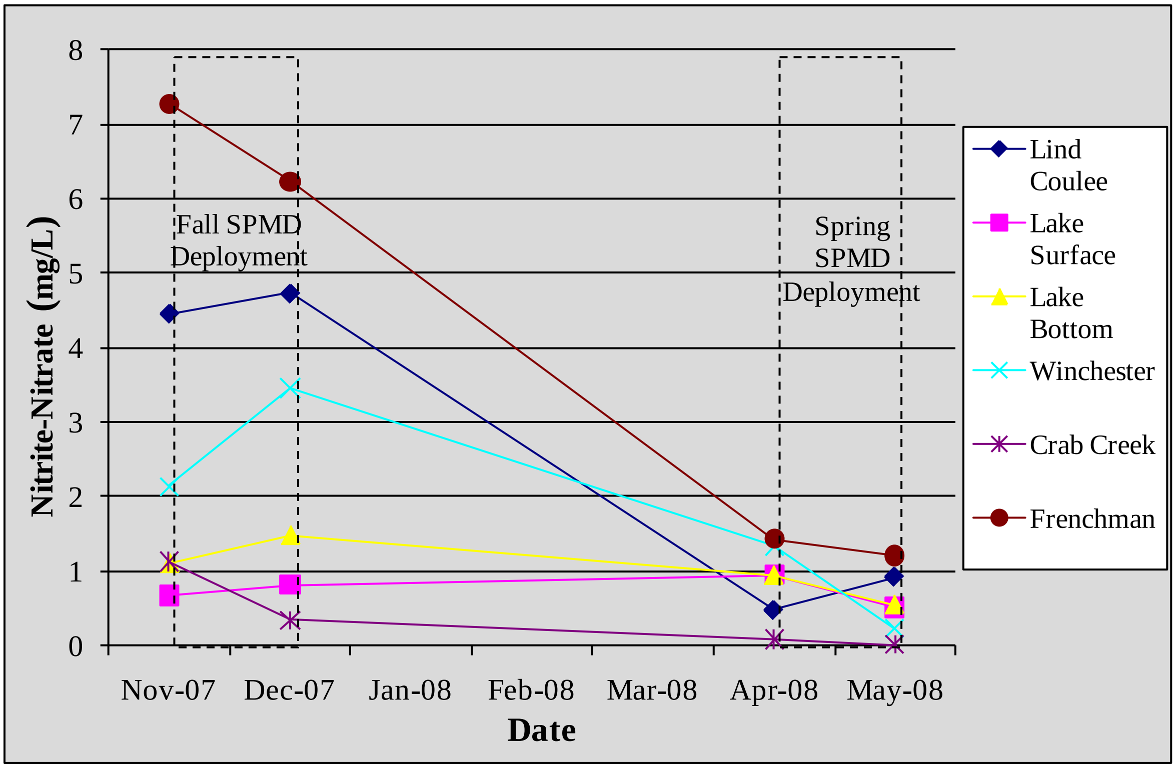


Figure 12. Nitrite-Nitrate Concentrations During Fall and Spring SPMD Deployments, 2007-08.

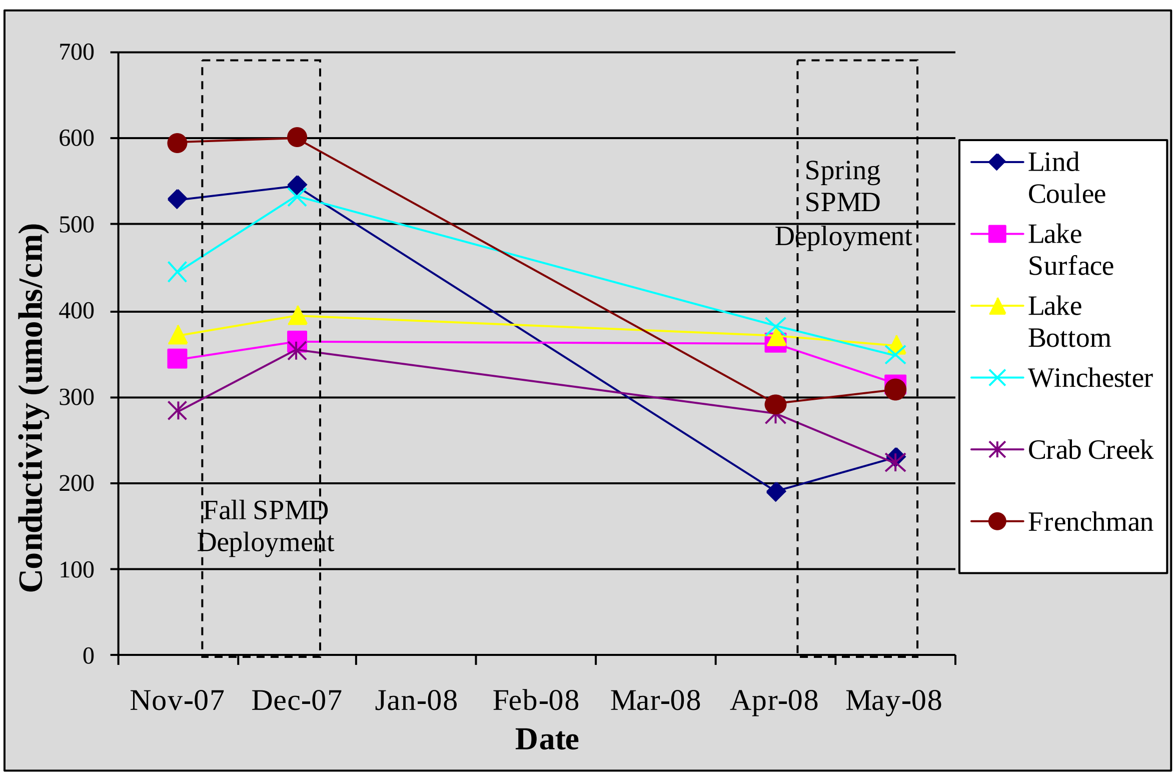


Figure 13. Conductivity During Fall and Spring SPMD Deployments, 2007-08.

As shown in Figures 12 and 13, Crab Creek had a very subtle groundwater signal in the fall while Potholes Reservoir surface and bottom water showed negligible seasonal differences. This can be explained by the fact that water from Crab Creek is mainly comprised of surface water from Moses Lake. A 2000-2001 Ecology study determined that 82% of the total inflow to Moses Lake was from surface water and 18% was from groundwater (Carroll, 2006). Approximately 66% of the total inflow to Moses Lake was from irrigation feed water originating from the Columbia River.

As shown in Figure 14, TSS levels were higher in Frenchman Hills Wasteway, Winchester Wasteway, and Lind Coulee in the spring. Higher TSS concentrations in the spring for the wasteways likely reflect soil erosion during the onset of the irrigation season. The major source of surface water to the wasteways in the spring is irrigation returns.

Potholes Reservoir had the opposite pattern of the wasteways, with TSS decreasing in the spring in both surface and bottom water (Figure 14). There were no seasonal differences in TSS for Crab Creek. The consistent seasonal TSS concentrations of Crab Creek and drop in TSS from fall to spring in the reservoir may be explained by the influence of Moses Lake on Crab Creek and Potholes Reservoir. The irrigation water from the Columbia River that feeds Moses Lake is used to fill Potholes Reservoir via Crab Creek in the winter. This feed water is naturally low in TSS. By spring, Potholes Reservoir is at full pool height, and its water quality may be more influenced by feed water from Moses Lake than by the wasteways.

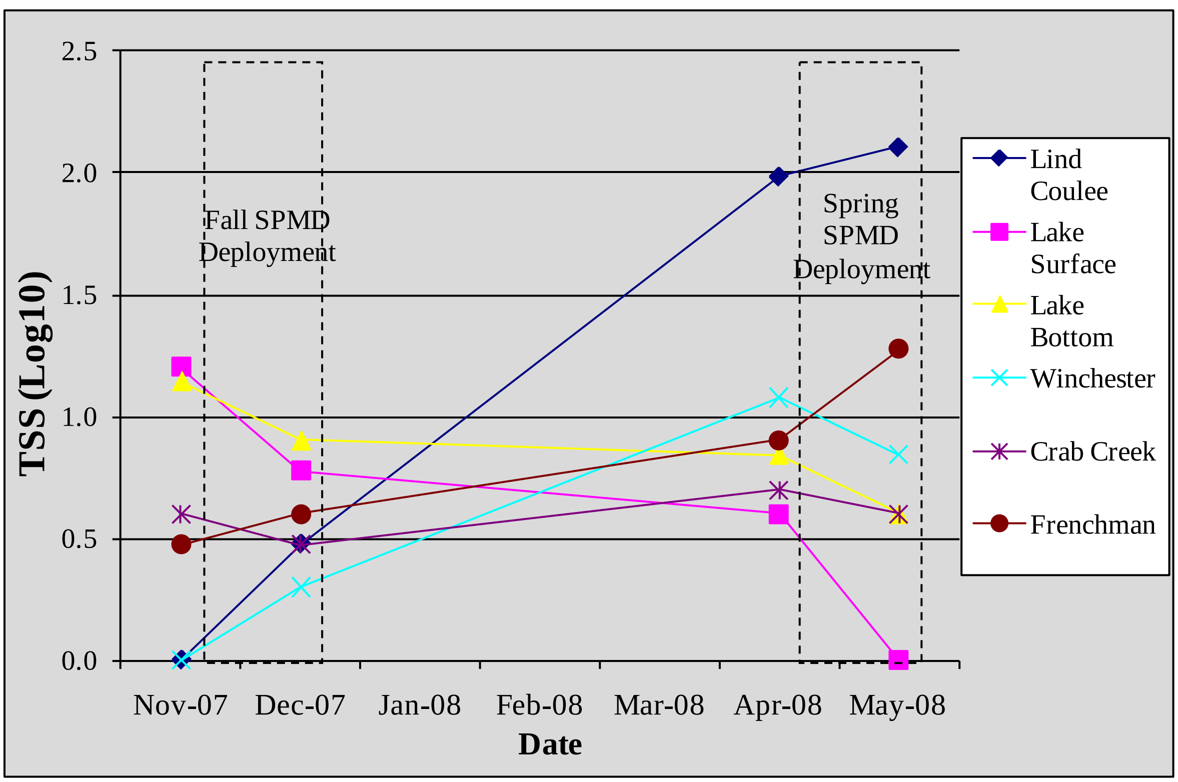


Figure 14. TSS Concentrations During Fall and Spring SPMD Deployments, 2007-08.

## Dieldrin in Groundwater

Dieldrin was detected only in the fall sampling period when groundwater predominates in the irrigation returns, thus dieldrin may be entering into Potholes Reservoir primarily through groundwater. This theory is supported by several studies:

- A USGS report on pesticides in water nationwide (USGS, 1999) found that one of the most frequently detected insecticides in groundwater was dieldrin, though it was only found in 1 to 2% of wells. According to USGS: "The relative abundance of dieldrin was unexpected because of its low mobility in water compared with many currently used pesticides. Dieldrin, however, is one of the more mobile compounds within the historically used organochlorine group. Moreover, it is long-lived in the environment, which results in its great persistence in the ground-water flow system."
- USGS also reported that dieldrin was detected in 4% of shallow groundwater wells (40 -140 ft deep) monitored as part of the Agricultural Pesticides in Shallow Ground Water of the Quincy and Pasco Basins, Washington study (Jones and Roberts, 1996).
- A 2005-06 Ecology study of dieldrin in Wide Hollow Creek in the Yakima River Basin (Johnson and Burke, 2006) found that dieldrin was inversely correlated with discharge and weakly correlated with conductivity. The authors suggested that subsurface flow was a major source of dieldrin to Wide Hollow Creek.

## Endosulfan Sulfate and Chlorpyriphos in Surface Water

The current-use pesticides, chlorpyriphos and endosulfan sulfate (breakdown product of pesticide endosulfan), were higher during the spring sampling period. This is probably due to surface water dominating the irrigation returns in the spring when these chemicals are typically applied.

# Sediments

## Comparisons to Sediment Quality Guidelines

Formal sediment standards have not yet been adopted for freshwater sediments in Washington State. On a case-by-case basis, Ecology uses recommended sediment quality values for Washington State (Avocet, 2003) or other established guidelines to screen freshwater sediments for significant chemical contamination.

The Avocet (2003) and most other sediment quality guidelines are based on direct toxicity to benthic aquatic organisms and do not account for bioaccumulation of sediment-associated contaminants up the food chain to higher organisms such as fish.

To assess whether or not Potholes Reservoir surface sediments may be toxic to benthic aquatic organisms, contaminant concentrations were compared to Washington's Lowest Apparent Affects Threshold (LAET) and Canadian Interim Sediment Quality Guideline (ISQG) values

(CCME, 1999). The ISQG value is highly protective in that concentrations below the ISQG are not expected to be associated with any biological effects on benthic organisms.

Dieldrin was not detected in sediments and therefore only the detection limit values could be compared to guidelines. Detection limits for the Frenchman Hills Wasteway, Lind Coulee, and Reservoir 1 samples fell below the dieldrin ISQG value of 2.85 ug/Kg dw. Detection limits for Reservoir 2 and 3 were slightly above the ISQG. This indicates that dieldrin concentrations in surface sediments are probably low enough to not cause any adverse effects to benthic aquatic life. A Washington State LAET guideline value has not yet been established for dieldrin.

4,4'-DDE exceeded the ISQG value of 1.42 ug/Kg dw (Figure 15). However, none of the samples exceeded Washington's LAET value for 4,4'-DDE (21 ug/kg dw).

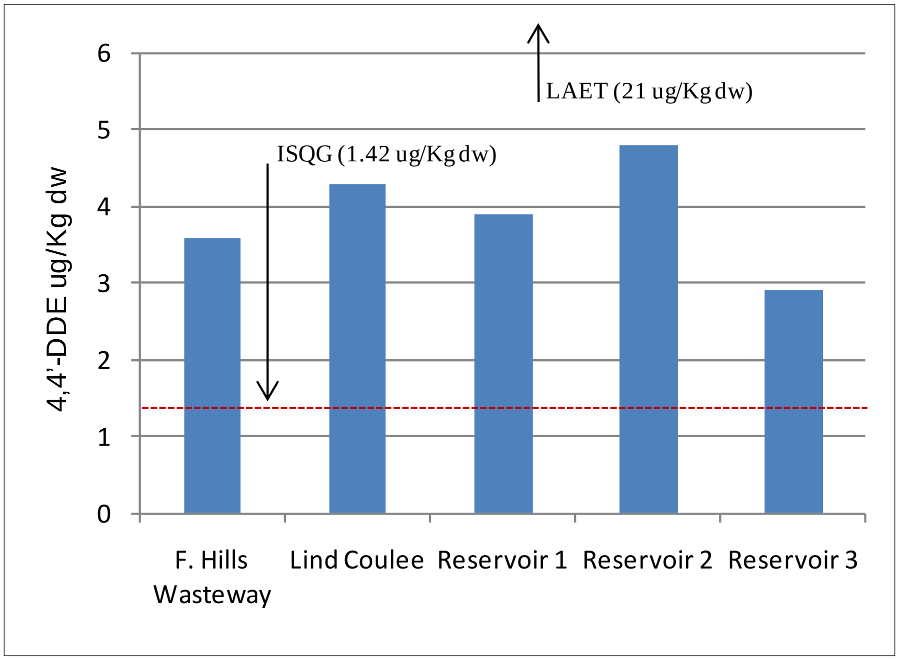


Figure 15. 4,4'-DDE Compared to Sediment Quality Guidelines

The other chemicals detected in sediment (chlorpyrifos, endosulfan sulfate, trans-nonachlor, 2,4'-DDD, 4,4'-DDD, and 4,4'-DDT) either did not exceed sediment guidelines or guidelines have not been established for them.

## Sediment Bioaccumulation

Though dieldrin was not detected in sediments and 3 of 5 sample detection limits were below sediment quality guidelines for toxicity to benthic organisms, sediments should not be dismissed as a potential bioaccumulation pathway to fish. If lower detection limits had been used in the study, they may have been able to pick up trace concentrations of dieldrin.

A recent study on PCBs in surface sediments (2 cm) of Lake Washington revealed that though concentrations of PCBs were relatively low, concentrations were still high enough to cause PCB burden in tissues of northern pike minnow (Era-Miller et al., 2010).

The Potholes Reservoir results do not indicate that surface sediments are a bioaccumulation pathway of dieldrin to fish. However, it is possible that trace dieldrin concentrations in surface sediments could be contributing to the fish food chain.

## Dieldrin Cycle in Potholes Reservoir

The half-life of dieldrin in soil ranges from months to several years or more according to numerous studies (Mackay et al., 1997). At a soil application rate of 1.1-3.4 kg/hectare, dieldrin was estimated to have a 95% disappearance rate from soil in 8 years (ATSDR, 2002). A 2002 study of farmland in Tokyo, Japan suggested that it takes 25 years for a 90% disappearance of dieldrin in soil (Hashimoto, 2005).

It has been well over 30 years since dieldrin was used on food crops in the United States, so it is likely that dieldrin in the farmland soils that drain to the Potholes Reservoir would contain little residual dieldrin. This is supported by the fact that there were no detections of dieldrin in the wasteways during the spring when irrigation runoff dominates the flow. Dieldrin was detected at low concentrations in the wasteways during the fall sampling when groundwater dominates flow, suggesting some subsurface inputs to the reservoir.

Dieldrin is still present in the fillet tissue of most fish species in Potholes Reservoir. In fact, dieldrin concentrations are quite elevated in the larger and fattier fish species such as lake whitefish. Surface sediments, along with surface water from the wasteways in the spring, do not appear to be significant sources of dieldrin to the reservoir. Groundwater-dominated surface water from the wasteways in the fall appears to be a continuing, low-level source of dieldrin to the reservoir.

The continued presence of elevated dieldrin concentrations in Potholes Reservoir fish may be largely due to internal recycling. This could act to maintain significant dieldrin levels in the fish food chain, accumulating in the larger, fattier, and likely longer-lived fish species. This is a likely scenario for a persistent chemical like dieldrin that has a strong affinity for lipids.

Concentrations of dieldrin in fish tissue will likely continue to decline in Potholes Reservoir over time. But without more extensive study, it is difficult to predict when concentrations will begin to consistently meet NTR human health criteria, especially in the large fatty fish.

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# Conclusions

The 2007-08 Potholes Reservoir study supports the following conclusions.

## Fish

Nine fish species and 35 fillet composite samples were analyzed for dieldrin and other chlorinated compounds. Dieldrin was detected in 70% of the fish tissue samples. The DDT metabolite, 4,4'-DDE, was detected in all the samples. Dieldrin, total PCBs, and 4,4'-DDE did not meet (exceeded) NTR criteria, with dieldrin having the most exceedances at 14 out of 35 samples.

Lake whitefish, walleye, and largemouth bass were analyzed in small-size and large-size classes. The large-size classes had higher concentrations of contaminants. The larger fish also tended to have higher lipid levels than the smaller fish of the same species. Dieldrin was strongly correlated to both fish length and lipids.

Lake whitefish were above the $90^{th}$ percentile statewide for dieldrin concentrations. Fish with lesser amounts of lipids – such as brown bullhead, black crappie, yellow perch, and small-sized largemouth bass – and walleye had lower levels of contaminants.

The Washington State Department of Health reviewed the fish tissue data and determined that study concentrations were too low to be of health concern, even for people who might consume the fish several times per week.

## Water

SPMDs were used to estimate dissolved water concentrations of dieldrin and other chlorinated compounds during both the non-irrigation season (fall 2007) and the irrigation season (spring 2008). Dieldrin was detected only during the non-irrigation season when groundwater dominates baseflow in the wasteways and inlets entering Potholes Reservoir. Chlorpyriphos and endosulfan sulfate were detected during both seasons, with consistently higher concentrations in the spring irrigation season when these chemicals are being used. None of the target analytes exceeded water quality criteria.

## Sediments

Surface sediments were collected from the outlets of Frenchman Hills Wasteway and Lind Coulee and at three sites in Potholes Reservoir. Dieldrin was not detected in any of the samples, while 4,4'-DDE was detected in all 5 samples.

Detection limits for dieldrin were either below or just above the Canadian Interim Sediment Quality Guideline (ISQG), indicating that dieldrin concentrations in surface sediments are probably low enough to not cause any adverse effects to benthic aquatic life. 4,4'-DDE exceeded the more protective ISQG value but did not exceed Washington State sediment guidelines.

Though dieldrin was not detected in sediments, sediments should not be ruled out as a potential bioaccumulation pathway to fish.

## Dieldrin Cycle in Potholes Reservoir

Dieldrin is present in most of the fish species in Potholes Reservoir. Surface sediments, along with surface water from the wasteways in the spring irrigation season, do not appear to be significant sources of dieldrin to the reservoir. Groundwater-dominated surface water from the wasteways in the fall (non-irrigation season) seems to be only a minor source of dieldrin to the reservoir.

Based on the results of the study, dieldrin appears to be mostly recycling internally in Potholes Reservoir. It is cycling in the fish food chain of the reservoir and accumulating in the larger, fattier, and likely longer-lived fish species.

Concentrations of dieldrin in fish tissue should continue to decline in Potholes Reservoir over time, but it is difficult to predict when concentrations will fall below the NTR criteria for fish tissue (0.65 ug/Kg ww), especially in the large fatty fish.

# Recommendations

The following recommendations are based on the results of the 2007-08 Potholes Reservoir study:

- The Washington State Department of Health reviewed the fish tissue data from Potholes Reservoir and determined the concentrations were too low to be of health concern, even for people who might consume the fish several times per week. However, limiting consumption of the fattier and larger fish from Potholes Reservoir, such as lake whitefish and common carp, will reduce any potential risk to human health.

- The only measureable source of dieldrin to Potholes Reservoir in this study was groundwater. Sediment-biota accumulation is also likely to occur, although dieldrin concentrations were below detection limits in sediment. Given these sources, it would be difficult to reduce the dieldrin loading to the reservoir. A total maximum daily load (TMDL) study is therefore not recommended for dieldrin in Potholes Reservoir. Natural attenuation is the most practical course of action for reducing dieldrin in fish tissue from the reservoir.

- Lake whitefish, carp, walleye, and bass from Potholes Reservoir should be re-analyzed for dieldrin, DDT, and PCBs every five years to determine if concentrations are decreasing.

- Concentrations of dieldrin and 4,4'-DDE are low in Potholes Reservoir surface sediments. However, analysis of a sediment core could provide an important record of contaminant loading to the reservoir over the last century. Knowledge of contaminant levels in the subsurface sediments could also prove useful for lake management decisions. This work could potentially be combined with Ecology's long-term Persistent Bioaccumulative Toxic (PBT) chemical trend study using age-dated sediment cores in Washington lakes. An analytical method that can detect low levels of dieldrin would need to be used.

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# Appendices

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# Appendix A.  Glossary, Acronyms, and Abbreviations

## Glossary

**Aquatic invertebrates:** For example, mayflies, snails, worms.

**Baseflow:** Groundwater discharge. The component of total streamflow that originates from direct groundwater discharges to a stream.

**Benthic:** Bottom-dwelling organisms.

**Bioaccumulate:** Build up in the food chain.

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

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

**Exceeded criterion:** Did not meet or violated the criterion.

**Grab sample:** A discrete sample from a single point in the water column or sediment surface.

**Interim Sediment Quality Guideline (ISQG):** A Canadian Sediment Quality Guideline that represents the **s**ediment chemical concentrations below which adverse biological effects are not expected to occur in aquatic organisms.

**Lowest apparent effects threshold (LAET):** The level above which at least one acute Microtox, Hyalella, or acute Chironomid test has always failed unless considered an outlier. The LAET guideline removed the highest concentration in the no-hit distribution only if it was 3 times higher than the second highest concentration. No more than 2 data points were removed from the no-hit distribution for LAET calculations. Uses Microtox, 10-day Hyalella, and 10-day Chironomid bioassays to determine the hit/no-hit distributions. (Ecology, 2003b.)

**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.

**pH:** A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

**Point source:** Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

**Pollution:** Such 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.

**Salmonid:** Any fish that belong to the family *Salmonidae*. Basically, any species of salmon, trout, or char. www.fws.gov/le/ImpExp/FactSheetSalmonids.htm

**Sediment:** Solid fragmented material (soil and organic matter) that is transported and deposited by water and covered with water (example, river or lake bottom).

**Semi Permeable Membrane Device (SPMD):** A type of passive sampler deployed in the water column that absorbs and concentrates lipophilic (fat-loving) contaminants like PCBs and certain pesticides.

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

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

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

**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.

| | |
|---|---|
| DDD | Dichloro-diphenyl-dichloroethane |
| DDE | Dichloro-diphenyl-dichloroethylene |
| DDT | Dichloro-diphenyl-trichloroethane |
| DOH | Washington State Department of Health |
| Ecology | Washington State Department of Ecology |
| EIM | Environmental Information Management database |
| EPA | U.S. Environmental Protection Agency |
| EST | Environmental Sampling Technologies, Inc. |
| GIS | Geographic Information System software |
| GPS | Global Positioning System |
| ISQG | (See Glossary above) |
| LAET | (See Glossary above) |
| LCS | Laboratory control sample |
| MQO | Measurement quality objectives |
| NTR | National Toxics Rule |
| PBT | Persistent, bioaccumulative, and toxic substance |
| PCBs | Polychlorinated biphenyls |
| RM | River mile |
| RPD | Relative percent difference |
| RSD | Relative standard deviation |
| SPMD | (See Glossary above) |
| SRM | Standard reference materials |
| TMDL | (See Glossary above) |
| TOC | Total organic carbon |
| TSS | (See Glossary above) |
| USGS | U.S. Geological Survey |
| WAC | Washington Administrative Code |
| WDFW | Washington Department of Fish and Wildlife |
| WRIA | Water Resources Inventory Area |
| WW | Wasteway |

*Units of Measurement*

| | |
|---|---|
| °C | degrees centigrade |
| dw | dry weight |
| ft | feet |
| g | gram, a unit of mass |

| | |
|---|---|
| kg | kilograms, a unit of mass equal to 1,000 grams. |
| mg | milligrams |
| mg/L | milligrams per liter (parts per million) |
| mm | millimeters |
| ng/L | nanograms per liter (parts per trillion) |
| pg/L | picograms per liter (parts per quadrillion) |
| ug/Kg | micrograms per kilogram (parts per billion) |
| umhos/cm | micromhos per centimeter |
| ww | wet weight |

# Appendix B. Location and Sample Information

Table B-1. Sediment and SPMD Sampling Location Descriptions.

| Site Name | Date | Water Depth (ft) | Latitude North | Longitude West | Location Description |
|---|---|---|---|---|---|
| **Sediment Sites** | | | | | |
| Lind Coulee | 4/16/08 | 15 | **46.99032** | **-119.16624** | About a mile downstream of SPMD site on sharp river bend. |
| Frenchman Hills Wasteway | 4/17/08 | 18 | **46.98393** | **-119.35353** | At the confluence of the forks near the reservoir and campground. |
| Reservoir Site 1 | 4/16/08 | 76 | **46.98837** | **-119.26816** | Southeast corner of the reservoir. |
| Reservoir Site 2 | 4/17/08 | 69 | **46.97506** | **-119.32231** | Near the SPMD site for the reservoir bottom. |
| Reservoir Site 3 | 4/17/08 | 50 | **47.01661** | **-119.30392** | Northeast side of the reservoir off Medicare Beach. |
| **SPMD Sites** | | | | | |
| Lind Coulee | 11/14/07 - 12/14/07 | 2 | **47.00870** | **-119.14799** | Left bank 50 yards downstream of well house structure. |
| | 4/22/08 - 5/21/08 | 4 | 47.00920 | -119.14116 | Left bank 75 yards downstream of well house structure. |
| Frenchman Hills Wasteway | 12/13/07 - 1/11/08 | 2 | **46.97421** | **-119.42922** | Right bank above C Road culvert on the metal platform structure. |
| | 4/22/08 - 5/21/08 | 3 | 46.97453 | -119.42944 | Left bank just above C Road culvert at the hawthorn tree. |
| Winchester Wasteway | 11/14/07 - 12/13/07 | 3 | **46.99505** | **-119.42461** | At the end of C Road: 100 yards downstream of foot bridge. |
| | 4/22/08 - 5/21/08 | 3 | | | |
| Crab Creek | 11/15/07 - 12/13/07 | 4 | 47 04.950 | -119.34657 | Left bank on a major bend of the creek; 3/4 river mile from Moses Lk. |
| | 4/23/08 - 5/22/08 | 6 | **47.08174** | **-119.34463** | 250 yards upstream of previous sampling site on left bank. |
| Reservoir Surface | 11/15/07 - 12/27/07 | 5 | 46.98499 | -119.31161 | Near the northwest side of Goose Island. |
| | 4/23/08 - 5/22/08 | 7 | 46.97452 | -119.30728 | Near the dam face at the "57" marker. |
| | n/a | n/a | **46.97989** | **-119.31069** | Centroid location of the fall and spring surface SPMD sites. |
| Reservoir Bottom | 11/15/07 - 12/13/07 | 60 | **46.97881** | **-119.32355** | Open water between Goose Island and west bank of reservoir. |
| | 4/23/08 - 5/22/08 | 69 | 46.97660 | -119.32534 | |

n/a = not applicable.
**Bold** coordinates were used for study locations in Ecology's Environmental Information (EIM) system; all coordinates taken with Datum NAD83.

Table B-2. Fish Tissue Sample Biological Information.

| Composite ID | Manchester Lab ID | Collection Date | Species | Weight (g) | Total Length (mm) | Sex (M/F) |
|---|---|---|---|---|---|---|
| POT BB-1 | 08-048820 | 10/30/07 | BB | 226 | 268 | F |
| " | " | 10/31/07 | " | 301 | 261 | F |
| " | " | 10/30/07 | " | 213 | 265 | M? |
| " | " | 10/30/07 | " | 212 | 264 | F |
| " | " | 10/30/07 | " | 208 | 264 | M |
| | | | **Mean** | **232** | **264** | **n/a** |
| POT BB-2 | 08-048821 | 10/31/07 | BB | 281 | 281 | M |
| " | " | 10/31/07 | " | 413 | 308 | F |
| " | " | 10/30/07 | " | 417 | 317 | F |
| " | " | 10/30/07 | " | 409 | 332 | F |
| " | " | 10/30/07 | " | 243 | 285 | F |
| | | | **Mean** | **353** | **305** | **n/a** |
| POT BB-3 | 08-048822 | 10/30/07 | BB | 571 | 345 | M |
| " | " | 10/31/07 | " | 503 | 336 | F |
| " | " | 11/1/07 | " | 680 | 385 | F |
| " | " | 10/30/07 | " | 477 | 339 | M |
| " | " | 10/30/07 | " | 474 | 335 | M? |
| | | | **Mean** | **541** | **348** | **n/a** |
| POT BC-1 | 08-048823 | 10/24/07 | BC | 89 | 174 | M |
| " | " | 10/24/07 | " | 82 | 186 | M |
| " | " | 10/29/07 | " | 65 | 160 | I |
| " | " | 10/29/07 | " | 66 | 160 | F? |
| " | " | 10/30/07 | " | 89 | 178 | M |
| | | | **Mean** | **78** | **172** | **n/a** |
| POT BC-2 | 08-048824 | 10/24/07 | BC | 138 | 203 | M |
| " | " | 10/24/07 | " | 130 | 206 | M |
| " | " | 10/24/07 | " | 113 | 190 | F |
| " | " | 10/30/07 | " | 154 | 204 | M |
| " | " | 10/31/07 | " | 115 | 192 | F |
| | | | **Mean** | **130** | **199** | **n/a** |
| POT BC-3 | 08-048825 | 10/24/07 | BC | 451 | 284 | F |
| " | " | 10/24/07 | " | 324 | 269 | M |
| " | " | 10/24/07 | " | 173 | 213 | M |
| " | " | 10/24/07 | " | 171 | 217 | F |
| " | " | 10/24/07 | " | 141 | 218 | M |
| | | | **Mean** | **252** | **240** | **n/a** |
| POT Bg-1 | 08-048826 | 10/29/07 | BG | 67 | 147 | F |
| " | " | 10/29/07 | " | 85 | 159 | F |
| " | " | 10/29/07 | " | 67 | 148 | F |
| | | | **Mean** | **73** | **151** | **n/a** |

| Composite ID | Manchester Lab ID | Collection Date | Species | Weight (g) | Total Length (mm) | Sex (M/F) |
|---|---|---|---|---|---|---|
| POT Bg-2 | 08-048827 | 10/30/07 | BG | 112 | 175 | F |
| " | " | 10/31/07 | " | 102 | 165 | M |
| " | " | 10/31/07 | " | 92 | 160 | F |
| | | | **Mean** | **102** | **167** | **n/a** |
| POT Bg-3 | 08-048828 | 10/31/07 | BG | 138 | 182 | M? |
| " | " | 10/31/07 | " | 157 | 183 | M |
| " | " | 10/31/07 | " | 156 | 183 | F |
| | | | **Mean** | **150** | **183** | **n/a** |
| POT CARP-1 | 08-048829 | 10/24/07 | CARP | 863 | 395 | M |
| " | " | 10/24/07 | " | 1086 | 425 | M |
| " | " | 10/24/07 | " | 1898 | 514 | M |
| " | " | 10/24/07 | " | 2999 | 561 | F |
| " | " | 10/24/07 | " | 2331 | 539 | F |
| | | | **Mean** | **1835** | **487** | **n/a** |
| POT CARP-2 | 08-048830 | 10/24/07 | CARP | 2442 | 586 | M |
| " | " | 10/24/07 | " | 2764 | 603 | M |
| " | " | 10/24/07 | " | 2711 | 592 | M |
| " | " | 10/24/07 | " | 3304 | 603 | M |
| " | " | 10/24/07 | " | 2733 | 602 | F |
| | | | **Mean** | **2791** | **597** | **n/a** |
| POT CARP-3 | 08-048831 | 10/24/07 | CARP | 3535 | 615 | F |
| " | " | 10/24/07 | " | 3707 | 650 | F |
| " | " | 10/24/07 | " | 2793 | 617 | M |
| " | " | 10/24/07 | " | 3394 | 634 | M |
| " | " | 10/24/07 | " | 3236 | 625 | M |
| | | | **Mean** | 3333 | 628 | n/a |
| POT LMB Lg-1 | 08-048832 | 10/24/07 | LMB | 822 | 351 | F |
| " | " | 10/29/07 | " | 1285 | 399 | F |
| " | " | 10/29/07 | " | 1023 | 384 | F |
| " | " | 10/29/07 | " | 824 | 374 | F |
| " | " | 10/29/07 | " | 976 | 377 | M |
| | | | **Mean** | **986** | **377** | **n/a** |
| POT LMB Lg-2 | 08-048833 | 10/29/07 | LMB | 1373 | 421 | M |
| " | " | 10/29/07 | " | 1158 | 401 | F |
| " | " | 10/29/07 | " | 1256 | 410 | F |
| " | " | 10/30/07 | " | 1324 | 414 | F |
| " | " | 10/30/07 | " | 1356 | 421 | M |
| | | | **Mean** | **1293** | **413** | **n/a** |
| POT LMB Lg-3 | 08-048834 | 10/24/07 | LMB | 2416 | 515 | F |
| " | " | 10/24/07 | " | 1706 | 456 | F |
| " | " | 10/29/07 | " | 2198 | 468 | F |

| Composite ID | Manchester Lab ID | Collection Date | Species | Weight (g) | Total Length (mm) | Sex (M/F) |
|---|---|---|---|---|---|---|
| " | " | 10/29/07 | " | 2195 | 478 | F |
| " | " | 10/30/07 | " | 1612 | 475 | M |
| | | | **Mean** | **2025** | **478** | **n/a** |
| POT LMB sm-1 | 08-048835 | 10/29/07 | LMB | 146 | 222 | F |
| " | " | 10/29/07 | " | 133 | 218 | F |
| " | " | 10/29/07 | " | 126 | 218 | M |
| " | " | 10/29/07 | " | 118 | 213 | F |
| " | " | 10/29/07 | " | 121 | 209 | M? |
| | | | **Mean** | **129** | **216** | **n/a** |
| POT LMB sm-2 | 08-048836 | 10/24/07 | LMB | 198 | 233 | F |
| " | " | 10/24/07 | " | 157 | 228 | F |
| " | " | 10/24/07 | " | 110 | 225 | M? |
| " | " | 10/29/07 | " | 174 | 237 | M |
| " | " | 10/29/07 | " | 156 | 229 | F |
| | | | **Mean** | **159** | **230** | **n/a** |
| POT LMB sm-3 | 08-048837 | 10/24/07 | LMB | 251 | 253 | M |
| " | " | 10/24/07 | " | 245 | 248 | M |
| " | " | 10/29/07 | " | 221 | 243 | F |
| " | " | 10/29/07 | " | 192 | 238 | M |
| " | " | 10/29/07 | " | 188 | 238 | F |
| | | | **Mean** | **219** | **244** | **n/a** |
| POT LWF Lg-1 | 08-048838 | 10/24/07 | LWF | 1965 | 574 | M |
| " | " | 10/24/07 | " | 2215 | 570 | M |
| " | " | 10/24/07 | " | 2365 | 573 | F |
| " | " | 10/24/07 | " | 1961 | 551 | M |
| " | " | 11/1/07 | " | 2292 | 574 | M |
| | | | **Mean** | **2160** | **568** | **n/a** |
| POT LWF Lg-2 | 08-048839 | 10/24/07 | LWF | 2850 | 598 | M |
| " | " | 10/24/07 | " | 2039 | 594 | M |
| " | " | 11/1/07 | " | 2618 | 595 | M |
| " | " | 11/1/07 | " | 2296 | 576 | M |
| | | | **Mean** | **2451** | **591** | **n/a** |
| POT LWF Lg-3 | 08-048840 | 10/24/07 | LWF | 2898 | 605 | M |
| " | " | 10/24/07 | " | 2681 | 609 | M |
| " | " | 10/24/07 | " | 2808 | 605 | M |
| " | " | 10/24/07 | " | 2740 | off scale | F |
| | | | **Mean** | **2782** | **n/a** | **n/a** |
| POT LWF sm-1 | 08-048841 | 10/24/07 | LWF | 122 | 229 | I |
| " | " | 10/24/07 | " | 139 | 235 | F |
| " | " | 10/24/07 | " | 134 | 238 | F |
| " | " | 10/24/07 | " | 116 | 229 | I |

| Composite ID | Manchester Lab ID | Collection Date | Species | Weight (g) | Total Length (mm) | Sex (M/F) |
|---|---|---|---|---|---|---|
| " | " | 10/24/07 | " | 132 | 237 | I |
| | | | **Mean** | **129** | **234** | **n/a** |
| POT LWF sm-2 | 08-048842 | 11/1/07 | LWF | 699 | 370 | M |
| " | " | 10/24/07 | " | 588 | 382 | M? |
| " | " | 10/24/07 | " | 566 | 372 | M |
| " | " | 10/24/07 | " | 577 | 375 | M |
| | | | **Mean** | **608** | **375** | **n/a** |
| POT SMB-1 | 08-048843 | 10/24/07 | SMB | 87 | 201 | F |
| " | " | 10/29/07 | " | 89 | 197 | F? |
| " | " | 10/29/07 | " | 83 | 196 | F |
| " | " | 10/29/07 | " | 82 | 194 | M |
| " | " | 10/29/07 | " | 86 | 193 | M? |
| | | | **Mean** | **85** | **196** | **n/a** |
| POT SMB-2 | 08-048844 | 10/24/07 | SMB | 145 | 227 | M |
| " | " | 10/29/07 | " | 97 | 200 | F |
| " | " | 10/29/07 | " | 98 | 201 | M |
| " | " | 10/29/07 | " | 114 | 210 | F |
| " | " | 10/29/07 | " | 114 | 229 | F |
| | | | **Mean** | **114** | **213** | **n/a** |
| POT SMB-3 | 08-048845 | 10/24/07 | SMB | 1142 | 414 | M |
| " | " | 10/24/07 | " | 1202 | 420 | F |
| " | " | 10/24/07 | " | 1265 | 432 | F |
| " | " | 10/24/07 | " | 1162 | 421 | M |
| " | " | 10/24/07 | " | 662 | 348 | F |
| | | | **Mean** | **1087** | **407** | **n/a** |
| POT WAL Lg-1 | 08-048846 | 10/24/07 | WALL | 1472 | 505 | ? |
| " | " | 10/24/07 | " | 1325 | 506 | ? |
| " | " | 10/24/07 | " | 1031 | 496 | ? |
| " | " | 10/24/07 | " | 1857 | 533 | ? |
| " | " | 10/29/07 | " | 1394 | 517 | F? |
| | | | **Mean** | **1416** | **511** | **n/a** |
| POT WAL Lg-2 | 08-048847 | 10/24/07 | WALL | 1896 | 552 | ? |
| " | " | 10/24/07 | " | 1521 | 537 | ? |
| " | " | 10/24/07 | " | 1927 | 559 | ? |
| " | " | 10/24/07 | " | 1877 | 539 | ? |
| " | " | 10/29/07 | " | 1968 | 549 | M |
| | | | **Mean** | **1838** | **547** | **n/a** |
| POT WAL Lg-3 | 08-048848 | 10/24/07 | WALL | 2104 | 590 | ? |
| " | " | 10/24/07 | " | 1979 | 560 | ? |
| " | " | 10/29/07 | " | 3158 | 641 | F |
| " | " | 10/29/07 | " | 2783 | 612 | F |

| Composite ID | Manchester Lab ID | Collection Date | Species | Weight (g) | Total Length (mm) | Sex (M/F) |
|---|---|---|---|---|---|---|
| " | " | 10/29/07 | " | 2042 | 560 | F |
| | | | **Mean** | **2413** | **593** | **n/a** |
| POT WAL sm-1 | 08-048849 | 10/24/07 | WALL | 121 | 241 | I |
| " | " | 10/24/07 | " | 119 | 232 | I |
| " | " | 10/24/07 | " | 122 | 237 | I |
| " | " | 10/24/07 | " | 121 | 235 | I |
| " | " | 10/29/07 | " | 55 | 192 | I |
| | | | **Mean** | **108** | **227** | **n/a** |
| POT WAL sm-2 | 08-048850 | 10/24/07 | WALL | 158 | 254 | I |
| " | " | 10/24/07 | " | 235 | 288 | I |
| " | " | 10/24/07 | " | 151 | 254 | I |
| " | " | 10/29/07 | " | 134 | 246 | F? |
| | | | **Mean** | **170** | **261** | **n/a** |
| POT WAL sm-3 | 08-048851 | 10/24/07 | WALL | 489 | 371 | I |
| " | " | 10/24/07 | " | 445 | 354 | I |
| " | " | 10/24/07 | " | 490 | 364 | I |
| " | " | 10/24/07 | " | 456 | 361 | I |
| " | " | 11/1/07 | " | 423 | 355 | I |
| | | | **Mean** | **461** | **361** | **n/a** |
| POT YP-1 | 08-048852 | 10/24/07 | YP | 112 | 211 | F |
| " | " | 10/24/07 | " | 105 | 204 | F |
| " | " | 10/24/07 | " | 102 | 210 | F |
| " | " | 10/24/07 | " | 104 | 196 | F |
| " | " | 10/24/07 | " | 112 | 210 | F |
| | | | **Mean** | **107** | **206** | **n/a** |
| POT YP-2 | 08-048853 | 10/24/07 | YP | 108 | 212 | F |
| " | " | 10/24/07 | " | 122 | 220 | F |
| " | " | 10/24/07 | " | 105 | 212 | F |
| " | " | 10/24/07 | " | 105 | 215 | F |
| " | " | 10/24/07 | " | 107 | 216 | F |
| | | | **Mean** | **109** | **215** | **n/a** |
| POT YP-3 | 08-048854 | 10/24/07 | YP | 200 | 254 | F |
| " | " | 10/24/07 | " | 168 | 243 | F |
| " | " | 10/24/07 | " | 142 | 232 | M |
| " | " | 10/24/07 | " | 116 | 221 | F |
| " | " | 10/24/07 | " | 113 | 220 | F |
| | | | **Mean** | **148** | **234** | **n/a** |

BB = brown bullhead
BC = black crappie
BG = bluegill
CARP = carp
LMB = largemouth bass
LWF = lake whitefish
SMB = smallmouth bass
WALL = walleye
YP = yellow perch
I = sex immature
? = sex unknown

Table B-3. Descriptions of Sediments Collected in Potholes Reservoir and Wasteways.

| Site Name | Sample No. | Collection Date | Water Depth (ft) | Mean Penetration Depth (cm) | No. of Grabs in Composite | Sediment Quality Description |
|---|---|---|---|---|---|---|
| Frenchman Hills Wasteway | 08-168912 | 4/17/08 | 18 | 7.5 | 3 | 1. Brown silt and sand mixture with pieces of organic hair-like debris.<br>2. Same as No. 1 with some rocks and shells.<br>3. Same as No. 1 with more hair-like debris. |
| Lind Coulee | 08-168913 | 4/16/08 | 15 | 7 | 3 | 1. Homogenous light olive brown mud with a dark sandy gravel layer on the bottom.<br>2. Same.<br>3. Same. |
| Reservoir Site 1 | 08-168914 | 4/16/08 | 76 | 8.5 | 3 | 1. Dark gray fluffy silt with a thin rusty brown layer on top.<br>2. Same.<br>3. Same. |
| Reservoir Site 2 | 08-168915 | 4/17/08 | 69 | 8.5 | 3 | 1. Homogenous dark gray mud with a thin mottled white layer on top and some organic hair-like debris throughout.<br>2. Same.<br>3. Same. |
| Reservoir Site 3 | 08-168916 | 4/17/08 | 50 | 8.5 | 3 | 1. Homogenous dark gray mud with a thin mottled white layer on top.<br>2. Homogenous dark gray mud with a thin rusty brown layer on top.<br>3. Same as No. 2. |

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# Appendix C. Data Quality Information

Table C-1. Analytical Measurement Quality Objectives for the Potholes Study.[1]

| Parameter | Laboratory Control Samples | Duplicate Samples | Matrix Spikes | Matrix Spike Duplicates | Surrogate Standards |
|---|---|---|---|---|---|
| | % recovery limits | RPD | % recovery limits | RPD | % recovery limits |
| **Fish Tissue** | | | | | |
| Percent lipids | n/a | ≤ 20 | n/a | n/a | n/a |
| PCB aroclors | 50-150 | ≤ 50 | 50-150 | ≤ 50 | 30-130 |
| Chlorinated pesticides | 50-150 | ≤ 50 | 50-150 | ≤ 50 | 30-130 |
| **Sediments** | | | | | |
| Total organic carbon | 75-125 | ≤ 15 | n/a | n/a | n/a |
| PCB aroclors | 50-150 | ≤ 50 | 50-150 | ≤ 50 | 50-150 |
| Chlorinated pesticides | 50-150 | ≤ 50 | 50-150 | ≤ 40 | 50-150 |
| Grain size | n/a | ≤ 15 | n/a | n/a | n/a |
| **SPMDs** | | | | | |
| PCB aroclors | 50-150 | ≤ 50 | 50-150 | ≤ 50 | 50-150 |
| Chlorinated pesticides | 50-150 | ≤ 50 | 50-150 | ≤ 50 | 50-150 |
| **Water (for SPMDs)** | | | | | |
| Total organic carbon | 80-120 | ≤ 20 | 75-125 | ≤ 20 | n/a |
| Total suspended solids | 80-120 | ≤ 20 | n/a | n/a | n/a |
| Nitrate/Nitrite | 80-120 | ≤ 20 | 75-125 | ≤ 20 | n/a |
| Conductivity | 80-120 | ≤ 20 | n/a | n/a | n/a |

[1]Quality control limits from personal communication with Manchester Laboratory.
RPD = Relative Percent Difference.

Table C-2. Precision of Laboratory Matrix Spikes for Fish Tissue.

| Parameter | Batch 1 | | | | Batch 2 | | |
|---|---|---|---|---|---|---|---|
| | MS | MSD | RPD | | MS | MSD | RPD |
| Dieldrin | 88 | 68 | **26%** | | 65 | 68 | **5%** |
| Alpha-BHC | 52 | 62 | **18%** | | 93 | 94 | **1%** |
| Beta BHC | 55 | 51 | **8%** | | 21 | 33 | **44%** |
| Lindane | 58 | 57 | **2%** | | 65 | 88 | **30%** |
| Delta BHC | 52 | 49 | **6%** | | 45 | 15 | **100%** |
| Aldrin | 43 | 46 | **7%** | | 13 | 5.6 | **80%** |
| Heptachlor | 78 | 81 | **4%** | | 120 | 111 | **8%** |
| Heptachlor Epoxide | 55 | 57 | **4%** | | 71 | 60 | **17%** |
| Cis-Chlordane | 52 | 58 | **11%** | | 80 | 71 | **12%** |
| Trans-Chlordane | 53 | 59 | **11%** | | 69 | 69 | **0%** |
| Methoxychlor | 92 | 82 | **11%** | | 162 | 158 | **3%** |
| Endrin | 52 | 52 | **0%** | | 65 | 79 | **19%** |
| Endrin Ketone | 46 | 45 | **2%** | | 0 | 0 | nc |
| Endrin Aldehyde | 41 | 41 | **0%** | | 5 | 3.8 | **27%** |
| Endosulfan Sulfate | 53 | 49 | **8%** | | 123 | 103 | **18%** |
| Endosulfan I | 57 | 57 | **0%** | | 17 | 16 | **6%** |
| Endosulfan II | 47 | 41 | **14%** | | 59 | 28 | **71%** |
| Chlorpyriphos | 90 | 86 | **5%** | | 54 | 6.9 | **155%** |
| 4,4'-DDE | 56 | 61 | **9%** | | 87 | 86 | **1%** |
| 4,4'-DDD | 49 | 53 | **8%** | | 84 | 92 | **9%** |
| 4,4'-DDT | 74 | 80 | **8%** | | 78 | 83 | **6%** |
| PCB-1016 | 96 | 95 | **1%** | | 95 | 108 | **13%** |
| PCB-1260 | 109 | 109 | **0%** | | 99 | 98 | **1%** |
| | | **Mean RPD** | **7%** | | | **Mean RPD** | **28%** |

Shaded values failed to meet measurement quality objectives.
MS = Matrix Spike.
MSD = Matrix Spike Duplicate.
RPD = Relative Percent Difference.
nc = not calculated.

Table C-3. Precision of Laboratory Duplicates for Fish Tissue Results* (ug/Kg ww).

| Parameter | Result | Duplicate | RPD | | Result | Duplicate | RPD |
|---|---|---|---|---|---|---|---|
| % lipids | 1.01 | 1.08 | **7%** | | 0.25 | 0.26 | **4%** |
| Dieldrin | 1.93 | 2.25 | **15%** | | 0.244 | 0.301 | **21%** |
| Aldrin | nd | nd | nc | | 0.32 | 0.29 | **10%** |
| Cis-Chlordane | 0.28 | 0.26 | **7%** | | nd | nd | nc |
| Endosulfan Sulfate | nd | nd | nc | | 0.65 | 0.84 | **26%** |
| Endosulfan I | 0.28 | 0.28 | **0%** | | 1.3 | 1.1 | **17%** |
| 4,4'-DDE | 8.1 | 7.3 | **10%** | | 0.70 | 0.74 | **6%** |
| 4,4'-DDD | 1.2 | 1.3 | **8%** | | nd | nd | nc |
| 4,4'-DDT | 0.99 | 0.93 | **6%** | | nd | nd | nc |

* = Most analytes were not detected and therefore precision was not calculated for them..
RPD = Relative Percent Difference.
nc = not calculated.
nd = not detected.

Table C-4. Results for Fish Tissue Standard Reference Material (SRM[1]) (ug/Kg, part per billion, wet weight).

| Parameter | Certified Values | | Method EPA 8270 | | | Method EPA 8081 | |
|---|---|---|---|---|---|---|---|
| | | | Batch 1 | Batch 2 | | Batch 1 | Batch 2 |
| Dieldrin | **32.5** | ± 3.5 | -- | -- | | 45 | 20 |
| Alpha-BHC | **5.72** | ± 0.65 | 8.3 | 0.7 | J | -- | -- |
| Lindane | **1.14** | ± 0.18 | 5.0 | 0.4 | J | -- | -- |
| Heptachlor Epoxide | **5.50** | ± 0.23 | 8.2 | 6.4 | | -- | -- |
| Trans-Chlordane | **8.36** | ± 0.91 | 14 | 9.7 | | -- | -- |
| Cis-Chlordane | **32.5** | ± 1.8 | 34 | 30 | | -- | -- |
| 4,4'-DDE | **373** | ± 48 | 392 | 340 | | -- | -- |
| 4,4'-DDD | **17.7** | ± 2.8 | 21 | 30 | | -- | -- |
| 4,4'-DDT | **37.2** | ± 3.5 | 59 | 23 | | -- | -- |

[1] = NIST, 2003.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.

Table C-5. Precision of Laboratory Matrix Spikes for SPMDs.

| Parameter | Fall 2007 Deployment | | | | Spring 2008 Deployment | | |
|---|---|---|---|---|---|---|---|
| | MS | MSD | RPD | | MS | MSD | RPD |
| Dieldrin | 68 | 98 | **36%** | | 102 | 105 | **3%** |
| Alpha-BHC | 70 | 34 | **69%** | | 29 | 29 | **0%** |
| Beta BHC | 96 | 60 | **46%** | | REJ | REJ | nc |
| Lindane | 89 | 73 | **20%** | | 78 | 73 | **7%** |
| Delta BHC | 25 | 26 | **4%** | | 62 | 67 | **8%** |
| Aldrin | 66 | 105 | **46%** | | 88 | 91 | **3%** |
| Heptachlor | 105 | 108 | **3%** | | 95 | 96 | **1%** |
| Heptachlor Epoxide | 96 | 105 | **9%** | | 87 | 96 | **10%** |
| Cis-Chlordane | 60 | 88 | **38%** | | 73 | 75 | **3%** |
| Trans-Chlordane | 60 | 94 | **44%** | | 76 | 77 | **1%** |
| Cis-Nonachlor | 52 | 90 | **54%** | | 74 | 74 | **0%** |
| Methoxychlor | 46 | 40 | **14%** | | 45 | 42 | **7%** |
| Endrin | 95 | 121 | **24%** | | 115 | 121 | **5%** |
| Endrin Ketone | 162 | 174 | **7%** | | 88 | 94 | **7%** |
| Endrin Aldehyde | 64 | 69 | **8%** | | 36 | 31 | **15%** |
| Endosulfan Sulfate | 70 | 82 | **16%** | | 82 | 84 | **2%** |
| Endosulfan I | 62 | 88 | **35%** | | 103 | 104 | **1%** |
| Endosulfan II | 77 | 99 | **25%** | | 116 | 113 | **3%** |
| Chlorpyriphos | 70 | 31 | **77%** | | 60 | 55 | **9%** |
| 2,4'-DDE | 74 | 637 | **158%** | | 97 | 106 | **9%** |
| 2,4'-DDD | 81 | 101 | **22%** | | 120 | 120 | **0%** |
| 2,4'-DDT | 88 | 96 | **9%** | | 81 | 91 | **12%** |
| 4,4'-DDE | 56 | 101 | **57%** | | 85 | 88 | **3%** |
| 4,4'-DDD | 85 | 95 | **11%** | | 123 | 121 | **2%** |
| 4,4'-DDT | 93 | 95 | **2%** | | 109 | 117 | **7%** |
| Toxaphene | 92 | 92 | **0%** | | 92 | 98 | **6%** |
| | | **Mean RPD** | **32%** | | | **Mean RPD** | **5%** |

Shaded values failed to meet measurement quality objectives.
MS = Matrix Spike.
MSD = Matrix Spike Duplicate.
RPD = Relative Percent Difference.
REJ = data rejected; failed to meet laboratory quality control criteria.
nc = not calculated.

Table C-6. Precision of Field Replicates for the Spring SPMDs (ng/3 membranes).

| Parameter* | Result | Replicate | RPD |
|---|---|---|---|
| Hexachlorobenzene | 11 | 10 | **10%** |
| Endosulfan Sulfate | 34 | 31 | **9%** |
| Chlorpyriphos | 779 | 682 | **13%** |
| 4,4'-DDT | 8 | 8 | **0%** |

* = Dieldrin and the other organics were not detected and therefore precision was not calculated for them.
RPD = Relative Percent Difference.

Table C-7. Precision of Field Replicates and Laboratory Duplicates for Water Samples.

| Site Name | Date | Replicate Type | Sample ID | Conductivity umhos/cm | TSS mg/L | TOC mg/L | Nitrite-Nitrate mg/L |
|---|---|---|---|---|---|---|---|
| Frenchman Hills Wasteway | 11/14/07 | Field | 07-468999 | 524 | 2 | 2.1 | 5.52 |
| | | | 07-469004 | 525 | 3 | 2 | 5.39 |
| | | | **RPD** | **0%** | **40%** | **5%** | **2%** |
| Lind Coulee | 12/14/07 | Field | 07-509000 | 545 | 3 | 1.8 | 4.73 |
| | | | 07-509004 | 544 | 3 | 1.7 | 5.08 |
| | | | **RPD** | **0%** | **0%** | **6%** | **7%** |
| Crab Creek | 4/23/08 | Field | 08-178923 | 281 | 5 | 2.4 | 0.09 |
| | | | 08-178926 | 281 | 6 | 2.3 | 0.09 |
| | | | **RPD** | **0%** | **18%** | **4%** | **1%** |
| Lake Bottom | 5/22/08 | Field | 08-218925 | 360 | 4 | 3.1 | 0.55 |
| | | | 08-218926 | 367 | 8 | 6.1 | 0.52 |
| | | | **RPD** | **2%** | **67%** | **65%** | **6%** |
| Frenchman Hills Wasteway | 11/14/07 | Lab | 07-469004 | 525 | | | |
| | | | 07-469004 | 525 | | | |
| | | | **RPD** | **0%** | | | |
| Lake Surface | 11/15/07 | Lab | 07-469002 | | 16 | | |
| | | | 07-469002 | | 17 | | |
| | | | **RPD** | | **6%** | | |
| Winchester Wasteway | 12/13/07 | Lab | 07-508998 | 532 | | 2.0 | |
| | | | 07-508998 | 532 | | 2.0 | |
| | | | **RPD** | **0%** | | **0%** | |
| Lake Surface | 12/13/07 | Lab | 07-509002 | | 6 | | 0.82 |
| | | | 07-509002 | | 6 | | 0.82 |
| | | | **RPD** | | **0%** | | **0%** |
| Lind Coulee | 12/14/07 | Lab | 07-509000 | | | | 4.46 |
| | | | 07-509000 | | | | 4.47 |
| | | | **RPD** | | | | **0%** |
| Crab Creek | 12/27/07 | Lab | 07-528999 | | 3 | | |
| | | | 07-528999 | | 3 | | |
| | | | **RPD** | | **0%** | | |
| Frenchman Hills Wasteway | 12/27/07 | Lab | 07-528998 | 594 | | 2.1 | |
| | | | 07-528998 | 595 | | 2.0 | |
| | | | **RPD** | **0%** | | **5%** | |
| | 4/22/08 | | 08-178921 | | 8 | | |
| | | | 08-178921 | | 9 | | |
| | | | **RPD** | | **12%** | | |
| Winchester Wasteway | 4/22/08 | Lab | 08-178920 | 382 | | 3.4 | |
| | | | 08-178920 | 382 | | 3.6 | |
| | | | **RPD** | **0%** | | **6%** | |
| | 5/21/08 | | 08-218920 | | | 2.9 | |
| | | | 08-218920 | | | 3.0 | |
| | | | **RPD** | | | **3%** | |

| Site Name | Date | Replicate Type | Sample ID | Conductivity umhos/cm | TSS mg/L | TOC mg/L | Nitrite-Nitrate mg/L |
|---|---|---|---|---|---|---|---|
| Lake Bottom | 5/22/08 | Lab | 08-218925<br>08-218925<br>**RPD** | | | 3.1<br>3.3<br>**6%** | |

TSS = Total Suspended Solids.
TOC = Total Organic Carbon.
RPD = Relative Percent Difference.

Appendix C-8. Laboratory Matrix Spikes for Sediment.

| Parameter | MS | MSD | RPD |
|---|---|---|---|
| Dieldrin | 60 | 61 | **2%** |
| Alpha-BHC | 117 | 122 | **4%** |
| Beta BHC | 94 | 99 | **5%** |
| Lindane | 170 | 185 | **8%** |
| Delta BHC | 103 | 106 | **3%** |
| Aldrin | 0 | 0 | **0%** |
| Heptachlor | 32 | 34 | **6%** |
| Heptachlor Epoxide | 64 | 65 | **2%** |
| Cis-Chlordane | 110 | 121 | **10%** |
| Trans-Chlordane | 59 | 79 | **29%** |
| Methoxychlor | 59 | 48 | **21%** |
| Endrin | 110 | 115 | **4%** |
| Endrin Ketone | 63 | 50 | **23%** |
| Endrin Aldehyde | 108 | 110 | **2%** |
| Endosulfan Sulfate | 106 | 112 | **6%** |
| Endosulfan I | 80 | 86 | **7%** |
| Endosulfan II | 89 | 96 | **8%** |
| Chlorpyriphos | 173 | 187 | **8%** |
| 2,4'-DDE | 149 | 169 | **13%** |
| 2,4'-DDD | 149 | 171 | **14%** |
| 2,4'-DDT | 149 | 168 | **12%** |
| 4,4'-DDE | 127 | 146 | **14%** |
| 4,4'-DDD | 210 | 232 | **10%** |
| 4,4'-DDT | 100 | 120 | **18%** |
| PCB-1016 | 77 | 72 | **7%** |
| PCB-1260 | 80 | 74 | **8%** |
| | | **Mean RPD** | **9%** |

Shaded values failed to meet measurement quality objectives.
MS = Matrix Spike.
MSD = Matrix Spike Duplicate.
RPD = Relative Percent Difference.
nc = not calculated.

Appendix C-9. Precision of Field Replicates and Laboratory Duplicates for Sediment Results.

| Sample Type | Field Replicate | | | Laboratory Duplicate | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Result | Replicate | RPD | Result | Duplicate | RPD | |
| *Organics (ug/Kg ww)** | | | | | | | |
| Endosulfan Sulfate | nd | 2.4 | nc | nd | nd | nc | |
| 4,4'-DDE | 4.8 | 4.9 | **2%** | 2.9 | 3.5 | **19%** | |
| Sample Type | Field Replicate | | | Laboratory Triplicate | | | |
| Parameter | Result | Replicate | RPD | Result | Duplicate | Triplicate | RSD |
| % TOC (70° C) | 4.33 | 4.53 | **5%** | -- | -- | -- | -- |
| % gravel | 2.6 | 10.1 | **118%** | 0.05 | 0.12 | 0.08 | **42%** |
| % sand | 31.0 | 21.2 | **38%** | 81.7 | 81.3 | 81.8 | **0%** |
| % silt | 41.2 | 40.8 | **1%** | 11.4 | 11.3 | 10.6 | **4%** |
| % clay | 13.7 | 15.5 | **12%** | 0.82 | 1.59 | 1.18 | **32%** |
| | grain size average RPD | | **42%** | grain size average RSD | | | **20%** |

* = Dieldrin and the other organics were not detected, and therefore precision was not calculated for them.
RPD = Relative Percent Difference.
RSD = Relative Standard Deviation.
-- = not analyzed for.
nc = not calculated.
nd = not detected.

## Appendix D.  Data and Criteria

Table D-1. Chemical Data for Potholes Reservoir Fish Collected in Fall 2007 (ug/Kg, part per billion, wet weight).

| Sample ID | POT BB-1 | | POT BB-2 | | POT BB-3 | | POT BC-1 | | POT BC-2 | | POT BC-3 | | POT BG-1 | | POT BG-2 | | POT BG-3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | 08048820 | | 08048821 | | 08048822 | | 08048823 | | 08048824 | | 08048825 | | 08048826 | | 08048827 | | 08048828 | |
| Species | Brown | | Brown | | Brown | | Black | | Black | | Black | | | | | | | |
| Parameter | Bullhead | | Bullhead | | Bullhead | | Crappie | | Crappie | | Crappie | | Blue Gill | | Blue Gill | | Blue Gill | |
| Lipids (%) | 0.73 | | 0.5 | | 0.88 | | 0.55 | | 0.73 | | 0.47 | | 0.56 | | 1.02 | | 1.27 | |
| Alpha-BHC | 0.5 | UJ | 0.48 | UJ | 0.5 | UJ | 0.49 | UJ | 0.5 | UJ | 0.49 | UJ | 0.5 | UJ | 0.5 | UJ | 0.5 | UJ |
| Beta-BHC | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Delta-BHC | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Lindane | 0.5 | UJ | 0.48 | UJ | 0.5 | UJ | 0.49 | UJ | 0.5 | UJ | 0.49 | UJ | 0.5 | UJ | 0.5 | UJ | 0.5 | UJ |
| Heptachlor | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Heptachlor Epoxide | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| 4,4'-DDT | **0.57** | **J** | **0.27** | **J** | **0.3** | **J** | **0.38** | **J** | **0.75** | **J** | 0.49 | U | **0.31** | **J** | **0.36** | **J** | **0.79** | **J** |
| 4,4'-DDE | **1.5** | | **1.5** | | **2.1** | | **2.1** | | **2.9** | | **1.1** | | **1.2** | | **1.9** | | **3.7** | |
| 4,4'-DDD | **0.76** | **J** | **0.8** | **J** | **0.88** | **J** | **0.36** | **J** | **0.63** | **J** | **0.42** | **J** | **0.38** | **J** | **0.42** | **J** | **0.63** | |
| Total DDT | **2.8** | **J** | **2.6** | **J** | **3.3** | **J** | **2.8** | **J** | **4.3** | **J** | **1.5** | **J** | **1.9** | **J** | **2.7** | **J** | **5.1** | **J** |
| Aldrin | 0.5 | UJ | 0.48 | UJ | 0.5 | UJ | 0.49 | UJ | 0.5 | UJ | 0.49 | UJ | 0.5 | UJ | 0.5 | UJ | 0.5 | UJ |
| Dieldrin* | **0.27** | **J** | **0.41** | | **0.5** | **J** | **0.24** | | **0.42** | | **0.52** | **J** | **0.31** | | **0.5** | **J** | **0.83** | **J** |
| Endrin | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | **0.26** | **J** | 0.5 | U |
| Endrin Aldehyde | **0.39** | **J** | **0.27** | **J** | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Endrin Ketone | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Cis-Chlordane | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Trans-Chlordane | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Endosulfan I | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Endosulfan II | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Endosulfan Sulfate | **0.85** | **J** | **0.67** | **J** | **0.6** | **J** | **0.64** | **J** | 0.5 | U | **0.77** | **J** | 0.5 | U | 0.5 | U | 0.5 | U |
| Methoxychlor | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| Toxaphene | 5 | U | 4.8 | U | 5 | U | 4.9 | U | 5 | U | 4.9 | U | 5 | U | 5 | U | 5 | U |
| Chlorpyriphos | 0.5 | U | 0.48 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.49 | U | 0.5 | U | 0.5 | U | 0.5 | U |
| PCB-aroclor 1016 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| PCB-aroclor 1221 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| PCB-aroclor 1232 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| PCB-aroclor 1242 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| PCB-aroclor 1248 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| PCB-aroclor 1254 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| PCB-aroclor 1260 | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |
| Total PCBs | 2.5 | U | 2.4 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U | 2.5 | U |

**Bolded** values indicate that the chemical was detected; Shaded values exceed the National Toxics Rule criteria.

* = Dieldrin was analyzed through method EPA 8081 and the rest of the parameters were analyzed through method EPA 8270.

U = The analyte was not detected at or above the reported sample quantitation limit.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.

UJ = The analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte.

E = Reported result is an estimate, the concentration exceeds the calibration range.

| Sample ID | POTCARP-1 | POTCARP-2 | POTCARP-3 | POTLMBLG1 | POTLMBLG2 | POTLMBLG3 | POTLMBSM1 | POTLMBSM2 | POTLMBSM3 |
|---|---|---|---|---|---|---|---|---|---|
| Sample No. | 08048829 | 08048830 | 08048831 | 08048832 | 08048833 | 08048834 | 08048835 | 08048836 | 08048837 |
| Species | Common Carp | Common Carp | Common Carp | Largemouth Bass | Largemouth Bass | Largemouth Bass | Largemouth Bass | Largemouth Bass | Largemouth Bass |
| Parameter | | | | | | | | | |
| Lipids (%) | 5.99 | 7.36 | 6.4 | 1.01 | 1.76 | 0.95 | 0.23 | 0.29 | 0.56 |
| Alpha-BHC | 0.49 UJ | 0.49 UJ | 0.5 UJ | 0.5 UJ | 1.9 UJ | 0.5 UJ | 0.49 UJ | 0.5 UJ | 0.49 UJ |
| Beta-BHC | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Delta-BHC | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Lindane | 0.49 UJ | 0.49 UJ | 0.5 UJ | 0.5 UJ | 1.9 UJ | 0.5 UJ | 0.49 UJ | 0.5 UJ | 0.49 UJ |
| Heptachlor | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Heptachlor Epoxide | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| 4,4'-DDT | **0.58** | **0.43 J** | **0.61** | **0.99 J** | **1.1 J** | **0.82 J** | **0.44 J** | **0.42 J** | **0.43 J** |
| 4,4'-DDE | **16** | **44** | **116** | **8.1** | **8.7 J** | **12** | **2.6** | **1.6** | **1.7** |
| 4,4'-DDD | **4.3** | **5.7** | **8** | **1.2 J** | 1.9 UJ | **1.4 J** | **0.42 J** | **0.39 J** | **0.26 J** |
| Total DDT | **21** | **50** | **125** | **10.3 J** | **9.8 J** | **14 J** | **3.5 J** | **2.4 J** | **2.4 J** |
| Aldrin | 0.49 UJ | 0.49 UJ | 0.28 UJ | 0.5 UJ | 1.9 UJ | 0.5 UJ | 0.49 UJ | 0.5 UJ | 0.49 UJ |
| Dieldrin* | **1.93** | 1.6 UJ | **2 J** | **1.07** | **2 J** | **1.3 J** | 0.25 U | **0.33** | **0.27 J** |
| Endrin | **0.35 J** | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Endrin Aldehyde | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Endrin Ketone | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Cis-Chlordane | **0.45 J** | **0.56** | **0.99** | **0.28 J** | 1.9 UJ | **0.35 J** | 0.49 U | 0.5 U | 0.49 U |
| Trans-Chlordane | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Endosulfan I | **0.53** | **0.49 J** | **0.77 J** | **0.28 J** | 1.9 UJ | **0.31 J** | 0.49 U | 0.5 U | 0.49 U |
| Endosulfan II | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Endosulfan Sulfate | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| Methoxychlor | 0.49 U | 0.49 UJ | 0.5 UJ | 0.5 U | 1.9 UJ | 0.5 UJ | 0.49 U | 0.5 U | 0.49 U |
| Toxaphene | 4.9 U | 4.9 U | 5 U | 5 U | 9.7 UJ | 5 U | 4.9 U | 5 U | 4.9 U |
| Chlorpyriphos | 0.49 U | 0.49 U | 0.5 U | 0.5 U | 1.9 UJ | 0.5 U | 0.49 U | 0.5 U | 0.49 U |
| PCB-aroclor 1016 | 2.5 U | 2.5 U | 2.5 U | 2.5 U | 9.7 UJ | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| PCB-aroclor 1221 | 2.5 U | 2.5 U | 2.5 U | 2.5 U | 9.7 UJ | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| PCB-aroclor 1232 | 2.5 U | 2.5 U | 2.5 U | 2.5 U | 9.7 UJ | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| PCB-aroclor 1242 | 2.5 U | 2.5 U | 2.5 U | 2.5 U | 9.7 UJ | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| PCB-aroclor 1248 | 2.5 U | 2.5 U | 2.5 U | 2.5 U | 9.7 UJ | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| PCB-aroclor 1254 | **7.6** | 2.5 U | **8** | 2.5 U | **5.4 J** | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| PCB-aroclor 1260 | 2.5 U | 2.5 U | 2.5 U | 2.5 U | 9.7 UJ | 2.5 U | 2.4 U | 2.5 U | 2.5 U |
| Total PCBs | **7.6** | 2.5 U | **8** | 2.5 U | **5.4 J** | 2.5 U | 2.4 U | 2.5 U | 2.5 U |

**Bolded** values indicate that the chemical was detected; Shaded values exceed the National Toxics Rule criteria.

* = Dieldrin was analyzed through method EPA 8081 and the rest of the parameters were analyzed through method EPA 8270.

U = The analyte was not detected at or above the reported sample quantitation limit.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.

UJ = The analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte.

E = Reported result is an estimate, the concentration exceeds the calibration range.

| Parameter | Sample ID: POTLWFLG1<br>Sample No.: 08048838<br>Species: Lake Whitefish | POTLWFLG2<br>08048839<br>Lake Whitefish | POTLWFLG3<br>08048840<br>Lake Whitefish | POTLWFSM1<br>08048841<br>Lake Whitefish | POTLWFSM2<br>80488442<br>Lake Whitefish | POTSMB1<br>08048843<br>Smallmouth Bass | POTSMB2<br>08048844<br>Smallmouth Bass | POTSMB3<br>08048845<br>Smallmouth Bass | POTWALLG1<br>08048846<br>Walleye |
|---|---|---|---|---|---|---|---|---|---|
| Lipids (%) | 12.05 | 10.9 | 14.57 | 3.88 | 5.6 | 0.33 | 0.36 | 2.42 | 1.5 |
| Alpha-BHC | 0.97 UJ | 1 UJ | 0.99 UJ | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ |
| Beta-BHC | 0.97 UJ | 1 UJ | 0.99 UJ | 0.48 U | 0.48 U | 0.49 U | 0.49 U | 0.49 U | 0.49 U |
| Delta-BHC | 0.97 UJ | 1 UJ | 0.99 UJ | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ |
| Lindane | 0.97 UJ | 1 UJ | 0.99 UJ | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ |
| Heptachlor | 0.49 UJ | 0.5 UJ | 0.49 UJ | 0.48 U | 0.48 U | 0.49 U | 0.49 U | 0.49 U | 0.49 U |
| Heptachlor Epoxide | 0.97 UJ | 1 UJ | 0.99 UJ | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | **0.4 J** |
| 4,4'-DDT | **13 J** | 1 UJ | **16 J** | **0.32 J** | **2.6 J** | 0.49 UJ | 0.49 UJ | **0.42 J** | **0.3 J** |
| 4,4'-DDE | **135 E** | **2.9** | **141 E** | **5.9 J** | **21 E** | **1.3 J** | **2.6 J** | **5.7 J** | **3.9 J** |
| 4,4'-DDD | **35** | 1 UJ | **43 E** | **1.7 J** | **6.3 J** | 0.49 U | 0.49 UJ | **1 J** | **0.58 J** |
| Total DDT | **183 J** | **2.9** | **200 J** | **7.9 J** | **30 J** | **1.3 J** | **2.6 J** | **7 J** | **4.8 J** |
| Aldrin | 0.49 UJ | 0.5 UJ | 0.49 UJ | 0.48 U | 0.48 U | **0.63 J** | 0.49 U | 0.49 U | 0.49 U |
| Dieldrin* | **7.5** | **7.6 J** | **5.8 J** | 0.98 UJ | **2.3** | 0.24 U | **0.46 J** | **1.4 J** | **0.65** |
| Endrin | 0.49 U | 0.5 U | 0.49 U | **0.66 J** | 0.48 U | 0.49 U | 0.49 U | 0.49 U | 0.49 U |
| Endrin Aldehyde | 0.49 U | 0.5 U | 0.49 U | **0.9 J** | 0.48 U | 0.49 U | 0.49 U | 0.49 U | 0.49 U |
| Endrin Ketone | 0.49 UJ | 0.5 UJ | 0.49 UJ | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ |
| Cis-Chlordane | **1.2 J** | 1 UJ | **2.1 J** | 0.48 U | **0.33 J** | 0.49 U | 0.49 U | 0.49 U | 0.49 U |
| Trans-Chlordane | 0.97 UJ | 1 UJ | **1 J** | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ |
| Endosulfan I | 0.49 U | 0.5 U | 0.49 U | **0.63 J** | **2.5** | **2.3** | **2.6** | 0.49 U | **2.9** |
| Endosulfan II | 0.49 U | 0.5 U | 0.49 U | 0.48 UJ | 0.48 U | 0.49 U | 0.49 U | 0.49 U | 0.49 U |
| Endosulfan Sulfate | **7.2 J** | **7.5 J** | **8.5 J** | 0.48 UJ | 0.48 U | 0.49 U | 0.49 U | 0.49 U | **2.2** |
| Methoxychlor | **4.9 J** | 0.5 UJ | 0.49 UJ | 0.48 UJ | 0.48 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ | 0.49 UJ |
| Toxaphene | 4.9 U | 5 U | 4.9 U | 4.8 U | 4.8 U | 4.9 U | 4.9 U | 4.9 U | 4.9 U |
| Chlorpyriphos | **3.5** | **6.9** | **1.4** | 0.48 UJ | 0.48 U | 0.49 U | 0.49 U | 0.49 UJ | 0.49 U |
| PCB-aroclor 1016 | 2.4 U | 2.5 U | 2.5 U | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| PCB-aroclor 1221 | 2.4 U | 2.5 U | 2.5 U | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| PCB-aroclor 1232 | 2.4 U | 2.5 U | 2.5 U | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| PCB-aroclor 1242 | 2.4 U | 2.5 U | 2.5 U | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| PCB-aroclor 1248 | **5.3 J** | 2.5 U | **5.5 J** | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| PCB-aroclor 1254 | **9.2 J** | 2.5 U | **5.6 J** | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| PCB-aroclor 1260 | 2.4 U | 2.5 U | 2.5 U | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |
| Total PCBs | **14.5 J** | 2.5 U | **11.1 J** | 2.4 U | 2.4 U | 2.5 U | 2.5 U | 2.5 U | 2.5 U |

**Bolded** values indicate that the chemical was detected; Shaded values exceed the National Toxics Rule criteria.

* = Dieldrin was analyzed through method EPA 8081 and the rest of the parameters were analyzed through method EPA 8270.

U = The analyte was not detected at or above the reported sample quantitation limit.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.

UJ = The analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte.

E = Reported result is an estimate, the concentration exceeds the calibration range.

| Sample ID | POTWALLG2 | | POTWALLG3 | | POTWALSM1 | | POTWALSM2 | | POTWALSM3 | | POTYP1 | | POTYP2 | | POTYP3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | 08048847 | | 08048848 | | 08048849 | | 08048850 | | 08048851 | | 08048852 | | 08048853 | | 08048854 | |
| Species | | | | | | | | | | | Yellow | | Yellow | | Yellow | |
| Parameter | Walleye | | Walleye | | Walleye | | Walleye | | Walleye | | Perch | | Perch | | Perch | |
| Lipids (%) | 1.48 | | 2.29 | | 0.36 | | 0.25 | | 0.4 | | 0.24 | | 0.34 | | 0.13 | |
| Alpha-BHC | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Beta-BHC | 0.5 | U | 0.49 | U | 0.48 | U | 0.48 | U | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Delta-BHC | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Lindane | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Heptachlor | 0.5 | U | 0.49 | U | 0.48 | U | 0.48 | U | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Heptachlor Epoxide | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| 4,4'-DDT | **2.7** | **J** | **1.5** | **J** | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| 4,4'-DDE | **16** | | **13** | **J** | **1.1** | | **0.7** | | **3.2** | | **0.6** | **J** | **1.3** | | **1.1** | |
| 4,4'-DDD | **1.3** | | **1.8** | **J** | 0.48 | U | 0.48 | U | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Total DDT | **20** | **J** | **16** | **J** | **1.1** | | **0.7** | | **3.2** | | **0.6** | **J** | **1.3** | | **1.1** | |
| Aldrin | 0.5 | UJ | 0.49 | U | **0.46** | **J** | **0.32** | **J** | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Dieldrin* | **1.28** | | **1.4** | | 0.25 | UJ | 0.24 | UJ | 0.24 | U | 0.24 | U | 0.25 | UJ | 0.23 | U |
| Endrin | 0.5 | UJ | 0.49 | U | 0.48 | U | 0.48 | U | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Endrin Aldehyde | 0.5 | UJ | 0.49 | U | 0.48 | U | 0.48 | U | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Endrin Ketone | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Cis-Chlordane | **0.32** | **J** | **0.36** | **J** | 0.48 | U | 0.48 | U | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Trans-Chlordane | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Endosulfan I | **2.4** | **J** | **1.3** | | **2.5** | | **1.3** | | **0.4** | **J** | 0.5 | UJ | **0.33** | **J** | **0.4** | **J** |
| Endosulfan II | 0.5 | UJ | 0.49 | U | 0.48 | U | 0.48 | U | 0.48 | U | 0.5 | UJ | 0.5 | U | 0.49 | U |
| Endosulfan Sulfate | 0.5 | U | **2.5** | **J** | **0.99** | **J** | **0.65** | **J** | **1.4** | **J** | **1.5** | **J** | **1.5** | **J** | **1.7** | **J** |
| Methoxychlor | 0.5 | UJ | 0.49 | UJ | 0.48 | UJ | 0.48 | UJ | 0.48 | UJ | 0.5 | UJ | 0.5 | UJ | 0.49 | UJ |
| Toxaphene | 5 | U | 4.9 | U | 4.8 | U | 4.8 | U | 4.8 | U | 5 | UJ | 5 | U | 4.9 | U |
| Chlorpyriphos | 0.5 | U | 0.49 | U | 0.48 | U | 0.48 | U | 0.48 | UJ | 0.5 | UJ | 0.5 | U | 0.49 | U |
| PCB-aroclor 1016 | 2.5 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| PCB-aroclor 1221 | 2.5 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| PCB-aroclor 1232 | 2.5 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| PCB-aroclor 1242 | 2.5 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| PCB-aroclor 1248 | 2.5 | U | **6.9** | **J** | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| PCB-aroclor 1254 | 2.5 | U | **6** | **J** | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| PCB-aroclor 1260 | 2.5 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |
| Total PCBs | 2.5 | U | **13** | **J** | 2.4 | U | 2.4 | U | 2.4 | U | 2.5 | UJ | 2.5 | U | 2.5 | U |

**Bolded** values indicate that the chemical was detected; Shaded values exceed the National Toxics Rule criteria.

* = Dieldrin was analyzed through method EPA 8081 and the rest of the parameters were analyzed through method EPA 8270.

U = The analyte was not detected at or above the reported sample quantitation limit.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.

UJ = The analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte.

E = Reported result is an estimate, the concentration exceeds the calibration range.

Table D-2. Potholes Reservoir SPMD Residues for Fall 2007 (ng per 3 membranes*).

| Parameter | Winchester Wasteway | | Frenchman Hills Wasteway | | Lind Coulee | | Lake Surface | | Lake Bottom | | Crab Creek | | Air/trip Blank | | Day Zero Blank | | Fresh Day Zero Blank | | Solvent Blank | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08034015 | | 08034016 | | 08034017 | | 08034018 | | 08034019 | | 08034020 | | 08034021 | | 08034022 | | 08034026 | | 08034025 | |
| Dieldrin | **10** | | **37** | | **37** | | **26** | | **19** | | **13** | | **10** | | **9.7** | | **3.1** | **J** | 5 | U |
| Alpha-BHC | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | U | 5 | U |
| Beta-BHC | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | UJ | 5 | U | 5 | U |
| Gamma-BHC (Lindane) | **4.6** | **J** | **5.1** | | **6.1** | | **9.5** | | **9.1** | | **11** | | **12** | | **7** | | **4.4** | **J** | 5 | U |
| Delta-BHC | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | U | 5 | U |
| Pentachloroanisole | 5 | U | **2.9** | **J** | 5 | U | **4** | **J** | 5 | U | 5 | U | **3.3** | **J** | **3.1** | **J** | 5 | U | 5 | U |
| Aldrin | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Heptachlor | 5 | U | 5 | U | **3.1** | **J** | **3.2** | **J** | **3.3** | **J** | **3.5** | **J** | 5 | U | 5 | U | **2.6** | **J** | 5 | U |
| Heptachlor Epoxide | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Hexachlorobenzene | **8.7** | | 5 | U | 5 | U | 5 | U | 5 | U | **19** | | 5 | U | 5 | U | 5 | U | 5 | U |
| Cis-Chlordane | **3.4** | **J** | **3.9** | **J** | **5.8** | | **3.8** | **J** | **3.9** | **J** | **4.5** | **J** | **3.3** | **J** | **2.7** | **J** | **2.7** | **J** | 5 | U |
| Cis-Nonachlor | 5 | U | 5 | U | **3.4** | **J** | 5 | U | 5 | U | 5 | U | 5 | U | 5 | UJ | 5 | U | 5 | U |
| Trans-Chlordane | **3.9** | **J** | **4.6** | **J** | **5.3** | | **4.6** | **J** | **4.3** | **J** | **4.9** | **J** | **3.8** | **J** | **3.2** | **J** | **3** | **J** | 5 | U |
| Trans-Nonachlor | 5 | U | 5 | U | **4** | **J** | 5 | U | 5 | U | 5 | U | 5 | U | **3.9** | **J** | 5 | U | 5 | U |
| Oxychlordane | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Methoxychlor | 5 | UJ | 5 | UJ | **13** | **J** | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | U | 5 | U |
| Endrin | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | **2.6** | **J** | 5 | U | 5 | U | 5 | U | 5 | U |
| Endrin Ketone | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | UJ | 5 | U | 5 | U |
| Endrin Aldehyde | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Endosulfan Sulfate | 5 | U | **8.3** | **J** | 5 | U | **12** | **J** | **11** | **J** | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Endosulfan I | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | **3.7** | **J** | 5 | U | 5 | U |
| Endosulfan II | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Mirex | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | UJ | 5 | U | 5 | U |
| Chlorpyriphos | **4.5** | **J** | **12** | | **6.4** | | **56** | | **37** | | **24** | | 5 | U | 5 | U | 5 | U | 5 | U |
| Toxaphene | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 5 | U | 5 | U |

| Parameter | Winchester Wasteway | | Frenchman Hills Wasteway | | Lind Coulee | | Lake Surface | | Lake Bottom | | Crab Creek | | Air/trip Blank | | Day Zero Blank | | Fresh Day Zero Blank | | Solvent Blank | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08034015 | | 08034016 | | 08034017 | | 08034018 | | 08034019 | | 08034020 | | 08034021 | | 08034022 | | 08034026 | | 08034025 | |
| 2,4'-DDE | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| 2,4'-DDD | 5 | U | **3.6** | **J** | **13** | | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| 2,4'-DDT | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| 4,4'-DDE | **4.3** | **J** | **19** | | **27** | | **4.9** | **J** | **4.5** | **J** | **9.7** | | 5 | U | 5 | U | **3** | **J** | **2.8** | **J** |
| 4,4'-DDD | 5 | U | 5 | U | **26** | | 5 | U | 5 | U | **11** | | 5 | U | **4.8** | **J** | **2.6** | **J** | 5 | U |
| 4,4'-DDT | 5 | U | **4.7** | **J** | **9.1** | | **2.6** | **J** | **4.5** | **J** | **3** | **J** | 5 | U | 5 | U | 5 | U | 5 | U |

**Bolded** values indicate that the chemical was detected.
* = Concentrations reported as ng per 3 membranes, except ng per 1 membrane for the fresh day zero and solvent blanks.
U = The analyte was not detected at or above the reported simple quantitation limit.
UJ = The analyte was not detected at or above the reported simple quantitation limit. The reported quantitation limit is an estimate.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Table D-3. Potholes Reservoir SPMD Residues for Spring 2008 (ng per 3 membranes*).

| Parameter | Winchester Wasteway | | Frenchman Hills Wasteway | | Lind Coulee | | Lake Surface | | Lake Surface (Replicate) | | Lake Bottom | | Crab Creek | | Air/trip Blank | | Day Zero Blank | | Fresh Day Zero Blank | | Solvent Blank | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08224105 | | 08224106 | | 08224107 | | 08224108 | | 08224112 | | 08224109 | | 08224110 | | 08224111 | | 08224113 | | 08034026 | | 08034025 | |
| Dieldrin | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Alpha-BHC | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ |
| Beta-BHC | | REJ | | REJ | | REJ | | REJ | | REJ | | REJ | | REJ | | REJ | | REJ | | REJ | | REJ |
| Gamma-BHC (Lindane) | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Delta-BHC | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Pentachloroanisole | -- | | -- | | -- | | -- | | -- | | -- | | -- | | -- | | -- | | -- | | -- | |
| Aldrin | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Heptachlor | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Heptachlor Epoxide | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Hexachlorobenzene | **10** | | **8.4** | | **18** | | **11** | | **10** | | **9.7** | | **6.6** | | **6.6** | | **6.6** | | **6.4** | | **6.2** | |
| Cis-Chlordane | **5.4** | | 5 | U | **8.5** | | 5 | U | 5 | U | 5 | U | **5.2** | | 5 | U | 5 | U | 5 | U | 5 | U |
| Cis-Nonachlor | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Trans-Chlordane | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | **6.2** | | **6.1** | |
| Trans-Nonachlor | 5 | U | 5 | U | **7.3** | | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Oxychlordane | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Methoxychlor | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ |
| Endrin | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Endrin Ketone | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Endrin Aldehyde | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ | 5 | UJ |
| Endosulfan Sulfate | **39** | | **105** | | **21** | | **34** | | **31** | | **27** | | **9.8** | | 5 | U | 5 | U | 5 | U | 5 | U |
| Endosulfan I | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Endosulfan II | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Mirex | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| Chlorpyriphos | **148** | | 5 | U | **175** | | **779** | | **682** | | 5 | U | **76** | | 5 | U | 5 | U | 5 | U | 5 | U |
| Toxaphene | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U | 25 | U |

| Parameter | Winchester Wasteway | | Frenchman Hills Wasteway | | Lind Coulee | | Lake Surface | | Lake Surface (Replicate) | | Lake Bottom | | Crab Creek | | Air/trip Blank | | Day Zero Blank | | Fresh Day Zero Blank | | Solvent Blank | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08224105 | | 08224106 | | 08224107 | | 08224108 | | 08224112 | | 08224109 | | 08224110 | | 08224111 | | 08224113 | | 08034026 | | 08034025 | |
| 2,4'-DDE | 5 | U | 5 | U | **6.2** | | 5 | U | 5 | U | 5 | U | 5 | U | **7.2** | | 5 | U | 5 | U | 5 | U |
| 2,4'-DDD | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| 2,4'-DDT | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| 4,4'-DDE | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | **11** | | **10** | | **8.4** | | **8.3** | |
| 4,4'-DDD | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U | 5 | U |
| 4,4'-DDT | **9** | | 5 | U | **70** | | **8** | | **8** | | 5 | U | **15** | | **8.5** | | **6** | | 5 | U | 5 | U |

**Bolded** values indicate that the chemical was detected.
* = Concentrations reported as ng per 3 membranes, except ng per 1 membrane for the fresh day zero and solvent blanks.
(--) = Data not analyzed for.
U = The analyte was not detected at or above the reported simple quantitation limit.
UJ = The analyte was not detected at or above the reported simple quantitation limit.  The reported quantitation limit is an estimate.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
REJ = The result was rejected by the laboratory for failing quality control measures.

Table D-4. Potholes Reservoir Water Concentrations Estimated from SPMDs, both Dissolved and Total (pg/L parts per quadrillion).

| Parameter | Winchester Wasteway | | Frenchman Hills Wasteway | | Lind Coulee | | Lake Surface | | Lake Bottom | | Crab Creek | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fall 07 08034015 | Spring 08 08224105 | Fall 07 08034016 | Spring 08 08224106 | Fall 07 08034017 | Spring 08 08224107 | Fall 07 08034018 | Spring 08 08224108 | Fall 07 08034019 | Spring 08 08224109 | Fall 07 08034020 | Spring 08 08224110 |
| | dissolved/total results | | dissolved/total results | | dissolved/total results | | dissolved/total results | | dissolved/total results | | dissolved/total results | |
| Dieldrin | ND | ND | **45.5/47.1 J** | ND | **48.9/50.7 J** | ND | **34.2/35.4 J** | ND | **18.8/19.5 J** | ND | **5.9/6.1 J** | ND |
| Alpha-BHC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Beta-BHC | ND | REJ | ND | REJ | ND | REJ | ND | REJ | ND | REJ | ND | REJ |
| Gamma-BHC (Lindane) | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Delta-BHC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Pentachloroanisole | ND | -- | ND | -- | ND | -- | **0.9/1.1 J** | -- | ND | -- | ND | -- |
| Heptachlor | ND | ND | ND | ND | **3.3/3.8 J** | ND | **4.5/5.1 J** | ND | **4.5/5.1 J** | ND | **4.4/5.0 J** | ND |
| Heptachlor Epoxide | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Hexachlorobenzene | **6/8.8** | **4.1/6.0 J** | ND | **2.1/3.1 J** | ND | **25.4/37.2 J** | ND | **6.5/9.5 J** | ND | **5.2/7.6 J** | **21.9/32.1** | ND |
| Cis-Chlordane | **0.1/0.1 J** | **6.6/8** | **0.5/0.6 J** | ND | **2.5/3.0 J** | **18.6/22.6** | **0.7/0.9 J** | ND | **0.8/1.0 J** | ND | **1.4/1.7 J** | **8.1/9.9** |
| Cis-Nonachlor | ND | ND | ND | ND | **3.5/8.5 J** | ND | ND | ND | ND | ND | ND | ND |
| Trans-Chlordane | **0.1/0.1 J** | ND | **0.7/0.9 J** | ND | **1.5/1.8 J** | ND | **1.1/1.3 J** | ND | **0.6/0.7 J** | ND | **1.3/1.6 J** | ND |
| Trans-Nonachlor | ND | ND | ND | ND | ND | **19.9/60.2** | ND | ND | ND | ND | ND | ND |
| Oxychlordane | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Methoxychlor | ND | ND | ND | ND | **23.2/24.1 J** | ND | ND | ND | ND | ND | ND | ND |
| Endrin | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | **5.0/5.2 J** | ND |
| Endosulfan Sulfate | ND | **2064/2072** | **439/441 J** | **5557/5579** | ND | **1111/1115** | **635/638 J** | **1799/1806** | **582/584 J** | **1429/1435** | ND | **519/521** |
| Endosulfan I | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Endosulfan II | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Mirex | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Chlorpyriphos | **15.6/16.7 J** | **530/568** | **41.7/44.7** | ND | **22.4/24.0** | **736/789** | **204/219** | **2891/3099** | **134/144** | ND | **86/92** | **286/307** |
| 2,4'-DDE | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 2,4'-DDD | ND | ND | **2.9/6.1 J** | ND | **13/27.1** | ND | ND | ND | ND | ND | ND | ND |
| 2,4'-DDT | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 4,4'-DDE | **3.1/7.0 J** | ND | **15.5/34.8** | ND | **27.5/61.8** | ND | **7.1/16.0 J** | ND | **6.3/14.2 J** | ND | **12.2/27.4** | ND |
| 4,4'-DDD | ND | ND | ND | ND | **19.9/30.0 J** | ND | ND | ND | ND | ND | **6.9/10.4 J** | ND |
| 4,4'-DDT | ND | **0.6/0.8 J** | **3.8/4.8 J** | ND | **8.8/11.1** | **134/170** | **3.4/4.3 J** | ND | **5.7/7.2 J** | ND | **3.5/4.4 J** | **10/12.7** |

* = Dissolved water concentrations were calculated using raw SPMD data (ng/3 membranes) and the USGS SPMD Water Calculator Spreadsheet Version 5 (1/10/07) and were calculated after blank correction. Total water concentrations were calculated by using the equation Cw-tot = Cw (1 + TOC (Koc/Mw)) where Cw is the dissolved concentration, Koc is the organic carbon-water equilibrium partition coefficient, and Mw is the mass of water (Meadows et al., 1998).
**Bolded** values indicate that the chemical was detected.
(--) = not analyzed for.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
ND = not detected. REJ = The result was rejected by the laboratory for failing quality control measures.

Table D-5. Applicable Water Quality Criteria (ng/L, part per trillion).

| Parameter | Washington State Criteria for Protection of Aquatic Life | | National Toxics Rule Criteria for Protection of Human Health | | 2006 EPA National Recommend Water Quality Criteria | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Protection of Aquatic Life | | Protection of Human Health | |
| | Freshwater Acute | Freshwater Chronic | Water + Fish Consumption | Fish Consumption | Freshwater Acute | Freshwater Chronic | Water + Fish Consumption | Fish Consumption |
| Dieldrin | 2,500 | 1.9 | 0.14 | 0.14 | 240 | 56 | 0.052 | 0.054 |
| Alpha-BHC | -- | -- | 3.9 | 13 | -- | -- | 2.6 | 4.9 |
| Beta-BHC | -- | -- | 14 | 46 | -- | -- | 9.1 | 17 |
| Gamma-BHC (Lindane) | 2,000 | 80 | 19 | 63 | 950 | -- | 980 | 1,800 |
| Delta-BHC | -- | -- | -- | -- | -- | -- | -- | -- |
| Pentachloroanisole | -- | -- | -- | -- | -- | -- | -- | -- |
| Heptachlor | 520 | 3.8 | 0.21 | 0.21 | 520 | 3.8 | 0.079 | 0.079 |
| Heptachlor Epoxide | -- | -- | 0.10 | 0.11 | 520 | 3.8 | 0.039 | 0.039 |
| Hexachlorobenzene | -- | -- | 0.75 | 0.77 | -- | -- | 0.28 | 0.29 |
| Cis-Chlordane | -- | -- | -- | -- | -- | -- | -- | -- |
| Cis-Nonachlor | -- | -- | -- | -- | -- | -- | -- | -- |
| Trans-Chlordane | -- | -- | -- | -- | -- | -- | -- | -- |
| Trans-Nonachlor | -- | -- | -- | -- | -- | -- | -- | -- |
| Oxychlordane | -- | -- | -- | -- | -- | -- | -- | -- |
| Total Chlordane | 2,400 | 4.3 | 0.57 | 0.59 | 2,400 | 4.3 | 0.8 | 0.81 |
| Methoxychlor | -- | -- | -- | -- | -- | -- | -- | -- |
| Endrin | 180 | 2.3 | 760 | 810 | 86 | 36 | 59 | 60 |
| Endosulfan Sulfate | 220 | 56 | 930 | 2000 | -- | -- | 62,000 | 89,000 |
| Endosulfan I | 220 | 56 | 930 | 2000 | 220 | 56 | 62,000 | 89,000 |
| Endosulfan II | 220 | 56 | 930 | 2000 | 220 | 56 | 62,000 | 89,000 |
| Mirex | -- | -- | -- | -- | -- | 1.0 | -- | -- |
| Chlorpyriphos | 83 | 41 | -- | -- | 83 | 41 | -- | -- |

| Parameter | Washington State Criteria for Protection of Aquatic Life | | National Toxics Rule Criteria for Protection of Human Health | | 2006 EPA National Recommend Water Quality Criteria | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Protection of Aquatic Life | | Protection of Human Health | |
| | Freshwater Acute | Freshwater Chronic | Water + Fish Consumption | Fish Consumption | Freshwater Acute | Freshwater Chronic | Water + Fish Consumption | Fish Consumption |
| 2,4'-DDE | -- | -- | -- | -- | -- | -- | -- | -- |
| 2,4'-DDD | -- | -- | -- | -- | -- | -- | -- | -- |
| 2,4'-DDT | -- | -- | -- | -- | -- | -- | -- | -- |
| 4,4'-DDE | 1,100 | 1.0 | 0.59 | 0.59 | -- | -- | 0.22 | 0.22 |
| 4,4'-DDD | 1,100 | 1.0 | 0.83 | 0.84 | -- | -- | 0.31 | 0.31 |
| 4,4'-DDT | 1,100 | 1.0 | 0.59 | 0.59 | 1,100 | 1.0 | 0.22 | 0.22 |

Table D-6. Water Quality Data for the Potholes Reservoir and Wasteways.

| Site Name | Date | Time | Sample ID | Temperature degrees C | Conductivity umhos/cm | TSS mg/L | TOC mg/L | Nitrite-Nitrate mg/L |
|---|---|---|---|---|---|---|---|---|
| Lind Coulee | 11/14/07 | 13:15 | 07-469000 | 8.1 | 529 | 1 | 1.6 | 4.46 |
| | 12/14/07 | 11:40 | 07-509000 | 6.9 | 545 | 3 | 1.8 | 4.73 |
| | 4/22/08 | 15:40 | 08-178922 | 12.0 | 190 | 97 | 1.6 | 0.48 |
| | 5/21/08 | 18:30 | 08-218922 | 15.2 | 230 | 128 | 2.0 | 0.93 |
| Lake Surface | 11/15/07 | 13:30 | 07-469002 | 9.2 | 344 | 16 | 3.9 | 0.67 |
| | 12/13/07 | 14:45 | 07-509002 | 3.1 | 364 | 6 | 3.7 | 0.82 |
| | 4/23/08 | 12:55 | 08-178924 | 11.8 | 363 | 4 | 3.4 | 0.95 |
| | 5/22/08 | 15:10 | 08-218924 | 20.2 | 315 | 1 | 2.9 | 0.51 |
| Lake Bottom | 11/15/07 | 12:50 | 07-469003 | 8.7 | 372 | 14 | 3.5 | 1.11 |
| | 12/13/07 | 15:00 | 07-509003 | 2.1 | 395 | 8 | 3.4 | 1.49 |
| | 4/23/08 | 11:45 | 08-178925 | 9.3 | 370 | 7 | 3.7 | 0.95 |
| | 5/22/08 | 11:20 | 08-218925 | 14.2 | 360 | 4 | 3.1 | 0.55 |
| Frenchman Hills Wasteway | 11/14/07 | 14:05 | 07-468999 | -- | 524 | 2 | 2.1 | 5.52 |
| | 12/13/07 | 12:10 | 07-508999 | 3.1 | 595 | 3 | 2.0 | 7.27 |
| | 12/27/07 | 14:10 | 07-528998 | 2.8 | 594 | 4 | 2.1 | 6.40 |
| | 1/11/08 | 12:42 | 08-028140 | 3.9 | 601 | 4 | 2.5 | 6.23 |
| | 4/22/08 | 18:15 | 08-178921 | 12.5 | 292 | 8 | 2.1 | 1.43 |
| | 5/21/08 | 20:20 | 08-218921 | 16.2 | 309 | 19 | 2.5 | 1.21 |
| Winchester Wasteway | 11/14/07 | 15:15 | 07-468998 | 4.8 | 445 | 1 | 2.1 | 2.14 |
| | 12/13/07 | 11:40 | 07-508998 | 0.5 | 532 | 2 | 2.0 | 3.46 |
| | 4/22/08 | 17:15 | 08-178920 | 12.2 | 382 | 12 | 3.4 | 1.34 |
| | 5/21/08 | 19:40 | 08-218920 | 17.8 | 349 | 7 | 2.9 | 0.23 |
| Crab Creek | 11/15/07 | 15:05 | 07-469001 | 8.3 | 284 | 4 | 3.1 | 1.13 |
| | 12/27/07 | 12:00 | 07-528999 | 1.5 | 354 | 3 | 3.2 | 0.34 |
| | 4/23/08 | 13:45 | 08-178923 | 11.4 | 281 | 5 | 2.4 | 0.09 |
| | 5/22/08 | 11:40 | 08-218923 | 17.4 | 224 | 4 | 2.1 | 0.01 U |

-- = not analyzed for.
U = the analyte was not detected at or above the reported sample quantitation limit.

Table D-7. Chemical Data for Potholes Reservoir Sediments, Spring 2008 (ug/Kg, part per billion, dry weight).

| Site Name: | Frenchman Hills Wasteway | Lind Coulee | Reservoir 1 | Reservoir 2 | Reservoir 3 | Reservoir 2 (Replicate) |
|---|---|---|---|---|---|---|
| Sample No.: | 08168912 | 08168913 | 08168914 | 08168915 | 08168916 | 08168917 |
| TOC (%) | 5.2 | 1.3 J | 2.3 J | 4.3 | 3.5 | 4.5 |
| Fines (%) | 42 J | 88 | 59 | 55 J | 46 J | 56 J |
| Alpha-BHC | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Beta-BHC | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Delta-BHC | 2.4 UJ | 0.95 UJ | 2.2 UJ | 4.7 UJ | 3.7 U | 5.1 UJ |
| Lindane | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Heptachlor | 2.4 U | 0.95 U | 2.2 UJ | 4.7 U | 3.7 U | 5.1 U |
| Heptachlor Epoxide | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Hexachlorobenzene | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| 2,4'-DDT | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| 2,4'-DDE | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| 2,4'-DDD | 2.4 U | **0.31 J** | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| 4,4'-DDT | 2.4 U | **0.69 J** | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| 4,4'-DDE | **3.6** | **4.3** | **3.9** | **4.8** | **2.9 J** | **4.9 J** |
| 4,4'-DDD | 2.4 U | **0.51 J** | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Aldrin | 2.4 U | 0.95 U | 2.2 UJ | 4.7 U | 3.7 U | 5.1 U |
| Dieldrin | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Endrin | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Endrin Aldehyde | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Endrin Ketone | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Cis-Chlordane | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Trans-Chlordane | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Cis-Nonachlor | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Trans-Nonachlor | 2.4 U | **0.48 J** | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Oxychlordane | 2.4 U | 0.95 U | 2.2 UJ | 4.7 U | 3.7 U | 5.1 U |
| Endosulfan I | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Endosulfan II | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| Endosulfan Sulfate | 2.4 UJ | 0.95 UJ | 2.2 UJ | 4.7 UJ | 3.7 UJ | **2.4 J** |
| Methoxychlor | 2.4 UJ | 0.95 U | 2.2 UJ | 4.7 U | 3.7 UJ | 5.1 U |
| Toxaphene | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| Chlorpyriphos | **1.0 J** | 0.95 UJ | 2.2 UJ | 4.7 UJ | 3.7 UJ | 5.1 UJ |
| Mirex | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Dacthal (DCPA) | 2.4 U | 0.95 U | 2.2 U | 4.7 U | 3.7 U | 5.1 U |
| Tetradifon (Tedion) | 2.4 UJ | 0.95 U | 2.2 U | 4.7 U | 3.7 UJ | 5.1 U |
| PCB-aroclor 1016 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| PCB-aroclor 1221 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| PCB-aroclor 1232 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| PCB-aroclor 1242 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| PCB-aroclor 1248 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| PCB-aroclor 1254 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |
| PCB-aroclor 1260 | 12 U | 4.7 U | 11 U | 24 U | 19 U | 26 U |

(See next page for Notes for Table D-7.)

Notes for Table D-7:

**Bolded** values indicate analyte detections.
Fines = Silt fractions (0.0039 mm to 0.0625 mm) + clay fractions (<0.0039 mm).
U = the analyte was not detected at or above the reported sample quantitation limit.
J = the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte.
UJ = the analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte.

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# Appendix E. 303(d) Fish Tissue Listings

Table E-1. Category Five 303(d) Fish Tissue Listings in WRIA 41.

| 303(d) Listing No. | Waterbody | Parameter | Species | Sampling Date | Study Listing Basis |
|---|---|---|---|---|---|
| 8945 | Lind Coulee | Dieldrin | LMB | 1992 | Serdar et al., 1994 |
| 8946 | Potholes Reservoir | Dieldrin | LWF | | |
| 51572 | | 2,3,7,8 TCDD | | 2005 | Seiders et al., 2007 |
| 51748 | | 4,4'-DDE | | | |
| 52052 | | Dieldrin | SMB & WALL | | |
| 52684 | | Total PCBs | LWF | | |
| 8953 | Lower Crab Creek | Total PCBs | MWF | 1992 | Davis and Johnson, 1994 |
| 8955 | | 4,4'-DDE | | | |
| 17217 | Royal Lake | 4,4'-DDE | SMB | 1995 | Davis et al., 1998 |
| 17218 | | Dieldrin | | | |
| 17230 | Red Rock Lake | 4,4'-DDE | LMB | | |
| 17231 | | Dieldrin | | | |
| 42171 | Moses Lake | Total PCBs | LMB & RBT | 2002 | Seiders and Kinney, 2004 |
| 42434 | | 2,3,7,8 TCDD | RBT | | |
| 43265 | Frenchman Hills Lake | Dieldrin | LMB | 1999 | EPA, 2005 |
| 51588 | Stan Coffin Lake | 2,3,7,8 TCDD | CC | 2005 | Seiders et al., 2007 |
| 52034 | Long Lake | Dieldrin | SMB & WALL | | |

MWF = mountain whitefish; LMB = largemouth bass; SMB = smallmouth bass; LSS = largescale sucker;
CC = channel catfish; WALL = walleye; RBT = rainbow trout.