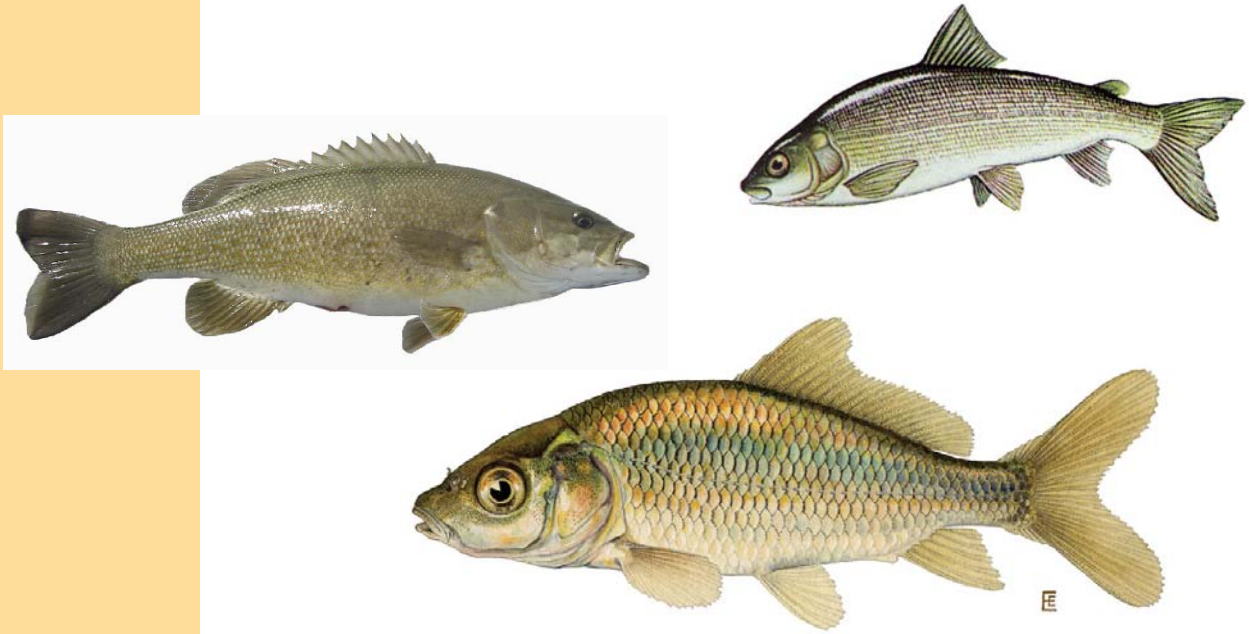

Quality Assurance Project Plan

Okanogan River DDT and PCB Total Maximum Daily Load Effectiveness Monitoring

DEPARTMENT OF ECOLOGY
State of Washington

April 2009

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303(d) Listings Addressed in this Study: Okanogan River Segment ID YN58LL for 4,4'-DDD, 4,4'-DDE, PCB-1254, and PCB-1260 in fish tissue.

Waterbody Number: WA-49-1010. Additional waterbodies were addressed by the TMDL, but only the mainstem Okanogan River was monitored during this Effectiveness Monitoring project.

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Okanogan River DDT and PCBs Total Maximum Daily Load Effectiveness Monitoring

April 2009

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Table of Contents

List of Figures and Tables

Page

Figures

Tables

Abstract

In 2003, the Washington State Department of Ecology (Ecology) published a Total Maximum Daily Load (TMDL) report for DDT and PCBs in the lower Okanogan River basin. The 2001-2002 sampling for the TMDL examined DDT and PCB concentrations in the water column of the mainstem Okanogan River and its tributary streams, in sewage treatment plant (STP) effluent and sludge, and in stream and lake bottom sediments. Composite samples of three fish species – carp (*Cyprinus carpio*), mountain whitefish (*Prosopium williamsoni*), and smallmouth bass (*Micropterus dolomieui*) – were also analyzed for DDT and PCBs. Data from these samples and historical data were used to develop the TMDLs.

Sampling results suggested that only small loads of DDT and PCBs are delivered to the lower Okanogan River[1] through tributaries and STPs. No other specific sources of these pollutants were identified during the TMDL investigation. However, the small loads found in the water entering the lower Okanogan River contrast sharply with the actual measured loads found in fish from several reaches of the lower river. The TMDL loading analysis indicated that the bulk of pollutant loading was internal, presumably isolated in the bottom sediments of the river and Osoyoos Lake and eventually processed up through the food chain by smaller organisms to fish.

Since all reasonable implementation activities to prevent the entry of these two legacy pollutants into the river system were already in place, the TMDL recommended continued monitoring of fish tissue for concentrations of DDT and PCBs. The concentrations in fish tissue will serve as a surrogate indicator of pollutant concentrations in the river and provide information to track trends over time.

This document is a plan of how the monitoring of total DDT and PCBs in fish tissue from the lower Okanogan River was to be carried out in the summer of 2008.

[1] The lower Okanogan River is that section of the Okanogan River south of the Canadian border.

What is TMDL Effectiveness Monitoring?

TMDL Process

The Total Maximum Daily Load (TMDL) process typically includes the following steps:

1. Scientific study to (1) characterize the pollution parameters identified in the Section 303(d) list of impaired waterbodies and (2) identify pollutant sources.
2. Modeling of pollutant impacts on the environment, and quantifying the extent of impairment.
3. Estimating the loading capacity of the receiving water to assimilate pollutants and still meet Washington State water quality standards.
4. Determining the TMDL of pollutants by allocating the loading capacity to (1) wasteload allocations for point sources (discrete sources that receive an NPDES permit) and (2) load allocations for nonpoint sources (diffuse sources).
5. Developing a Summary Implementation Strategy (SIS) describing the approach for meeting pollutant allocations and complying with water quality standards.
6. Submitting the TMDL and SIS to the U.S. Environmental Assessment Program (EPA) for approval.

Based on the approved TMDL, an implementation plan is developed to correct pollution problems identified in the TMDL. Community involvement is encouraged during this period, as pollution control strategies are reviewed and converted into feasible solutions and activities that are economically feasible and capable of early implementation. These implementation activities are continued, as necessary, to meet and maintain compliance with state water quality standards. Periodic monitoring, *effectiveness monitoring*, is used to determine the progress of the TMDL implementation activities.

TMDL Effectiveness Monitoring

TMDL effectiveness monitoring is a fundamental component of any TMDL implementation activity. It measures to what extent the waterbody has improved and whether it has been brought into compliance with Washington State water quality standards. Effectiveness monitoring takes a holistic look at TMDL implementation, watershed management plan implementation, and other watershed-based cleanup efforts. Success may be measured against TMDL load allocations or target correlated with baseline conditions, or desired future conditions.

The benefits of TMDL effectiveness evaluation include:

- A measure of progress toward implementation of recommendations (i.e., how much watershed restoration has been achieved, how much more effort is required.

- More efficient allocation of funding and optimization in planning and decision-making (i.e., identifying recommendations or restoration activities that worked and which restoration activity achieved the most success for the money spent).
- Technical feedback to refine the initial TMDL model, best management practices, nonpoint source plans, and permits.

Project Background

Study Area

The Okanogan River flows from its headwaters in British Columbia (B.C.), Canada through north-central Washington where it discharges into the Columbia River near the town of Brewster. The Okanogan basin drains approximately 8,900 mi^2, mostly of forest and rangeland in the uplands, while the fertile valley bottom provides one of the most productive orchard regions in B.C. and Washington (Figure 1).

Most of the Okanogan River basin lies north of the Canadian border, where its flow is regulated by four lakes along the river's mainstem. All of the lakes are located north of the U.S.-Canada border except the 14,150-acre Osoyoos Lake, which straddles the border. The lower Okanogan River flows out of Osoyoos Lake (elevation 915') at the city of Oroville and flows 79 miles southward to its confluence with the Columbia River (779'). The Similkameen River discharges to the Okanogan River just downstream of Oroville, increasing the flow in the Okanogan River by an average of 400 percent. About 20 small tributary streams also drain the 2,600 mi^2 of the Washington portion of the basin (Figure 2). Most of the tributaries are small or intermittent, contributing little to the overall flow of the lower Okanogan River.

The lower Okanogan River bisects the ancestral homelands of the people of the Colville Confederated Tribes (CCT), and now, from its mouth to river mile 38.6 near Omak, forms the western boundary of the CCT reservation.

The basin in Washington is sparingly populated, with 39,564 people in Okanogan County according to the 2000 census. The cities of Omak and Okanogan have a combined population of approximately 7,000. Other population centers include the cities of Oroville (≈ 1,600), and Tonasket (≈ 1,000).

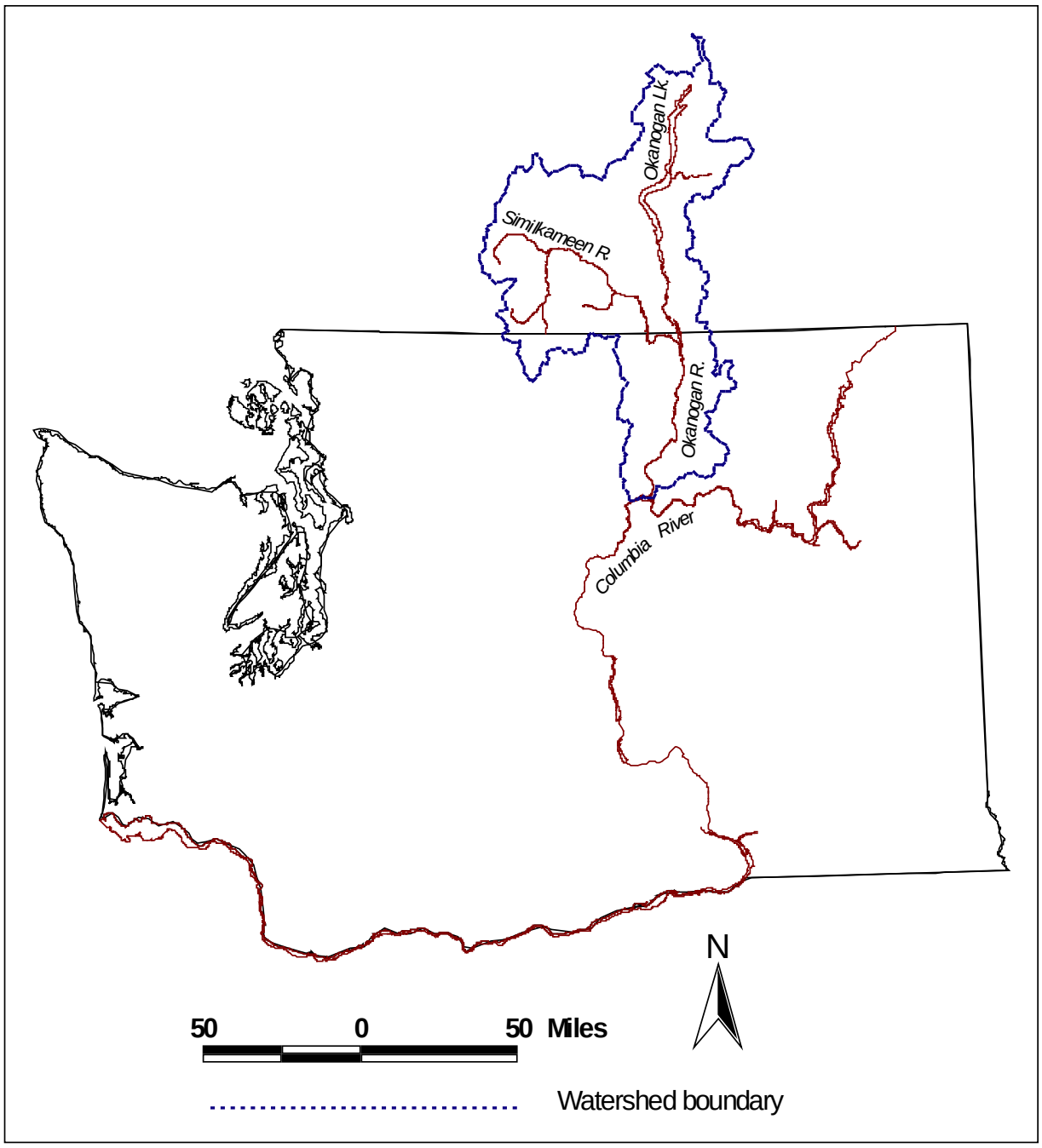

Figure 1. Okanogan River watershed.

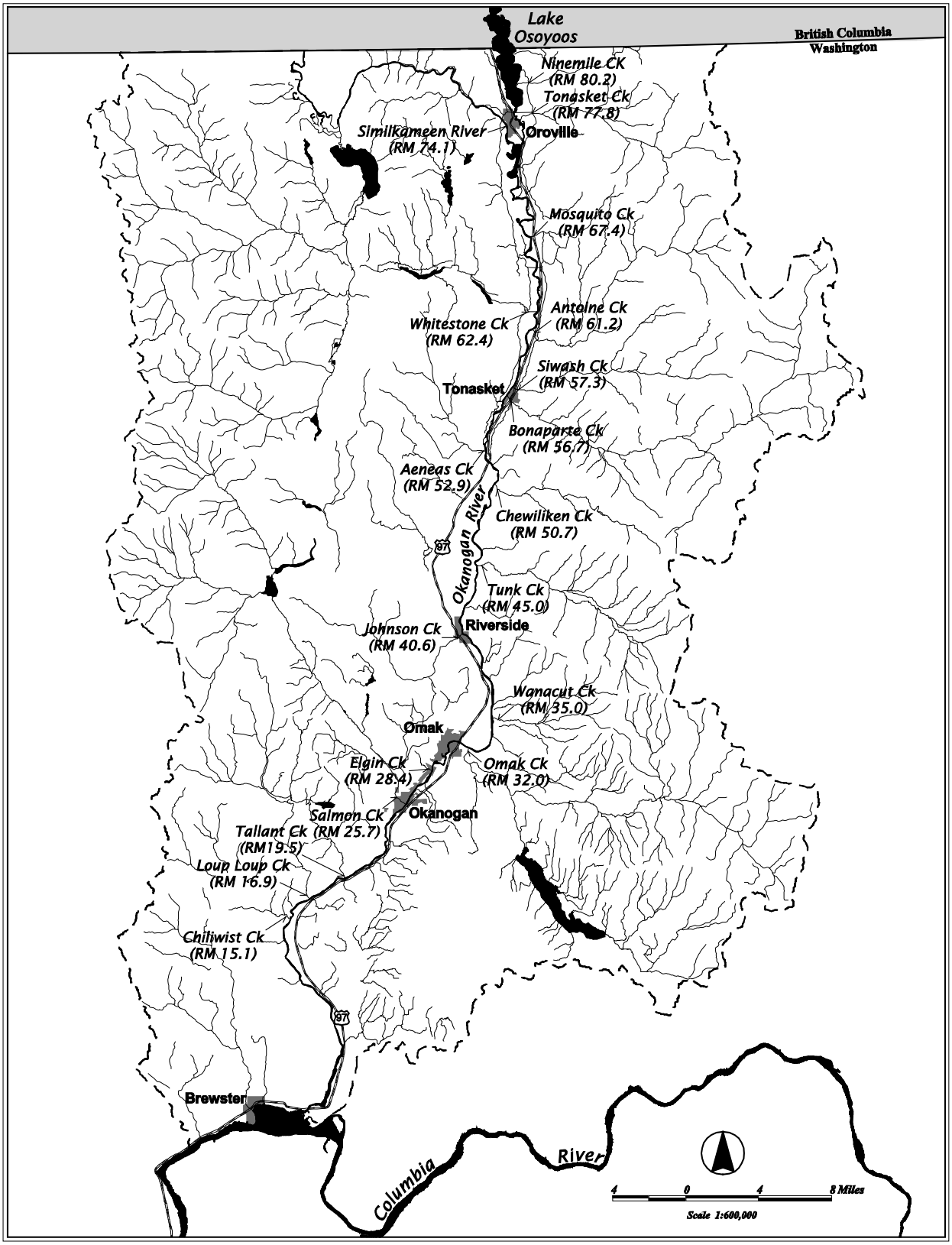

Figure 2. Mainstem and tributaries of the lower Okanogan River.

Problem Description

Historical Use of DDT and PCBs

In the Okanogan watershed, the history of land use for forestry, agriculture, and mining – and the accompanying use of pesticides and PCBs – are very similar on both sides of the international boundary. Land cover in the Okanogan watershed is primarily forest and rangeland, especially in the uplands. Near the valley bottom, orchards and pasture/hay are the primary agricultural uses. Fruit orchards have a long history in the Okanogan valley, with the first planted in 1857. By 1916, there were approximately 12,000 acres of irrigated orchards in the lower Okanogan River valley. Fruit orchards presently comprise about 2% or approximately 37,000 acres of the land area. The upper Okanogan River basin (north of the Canadian border) has a similar composition of orchard lands, providing over 99% of the tree fruit grown in British Columbia (Sinclair and Elliott, 1993).

Historical DDT[2] use in the Okanogan basin, primarily on orchard and other agricultural lands, has resulted in contamination of the aquatic environment. Although banned in the U.S. as a pesticide in 1972, DDT and its breakdown products have persisted. They have accumulated at high concentrations in lower Okanogan River and Osoyoos Lake fish as shown in the TMDL assessment study and other investigations (e.g., Johnson and Norton, 1990; Davis and Serdar, 1996; Serdar et al., 1998; Serdar, 2003).

PCBs, like DDT, have a similar history in the U.S. and Canada. Beginning in 1929, PCBs were used in many industrial applications where their flame resistance and thermal stability were particularly useful. The most common usage of PCBs was in electrical equipment, though they were put to a wide variety of uses including in some consumer goods. The U.S. and Canada banned the manufacture and most non-electrical uses of PCBs by 1979, with the last uses of PCBs scheduled to be phased out through equipment maintenance and replacement. PCBs are now a ubiquitous environmental contaminant. PCBs persist in the aquatic environment and continue to accumulate in fish tissue even though production of PCBs ended more than 25 years ago.

Documentation of DDT and PCBs in the Environment

Beginning in the early 1970s, Canadian investigators began documenting high DDT levels in fish collected from B.C. lakes along the mainstem Okanogan River (Northcote et al., 1972). In 1983, Ecology collected data which revealed DDT and PCB contamination in fish from the lower Okanogan River below the Canada border (Hopkins et al., 1985). Since then, a number of Ecology surveys have verified DDT and PCB contamination in the basin (Johnson and Norton, 1990; Davis and Serdar, 1996; Johnson et al., 1997; Serdar et al., 1998). These past studies led to a technical assessment in 2001-02 (Serdar, 2003) for the preparation of a TMDL for DDT and PCBs in the lower Okanogan basin (Peterschmidt, 2004).

[2] Unless stated otherwise, DDT refers to DDT and its breakdown products, DDE and DDD. The sum of these compounds is total DDT (t-DDT).

The Okanogan River basin, in both Canada and the United States, is traditional hunting and fishing grounds for the Native American people of the Colville Confederated Tribes (CCT). Many members of the CCT live near and along the river and regularly consume fish taken from its waters. The CCT is concerned about the presence and concentrations of PCBs and DDT found in the river and the affect that these pollutants may be having on the biology in the river and, especially, on the health of people using the river's resources as a food source.

The Washington State Department of Health reviewed data from Ecology's 2000-01 technical assessment for the Okanogan DDT and PCBs TMDL and determined that, based on the 2000-01 study and accepted consumption models, a fish consumption advisory for the river was not warranted. EPA is planning to perform a food consumption survey in the near future to determine if current consumption models are appropriate for the CCT (Stiffelman, 2008).

Findings from the 2001-02 TMDL study (Serdar, 2003) indicate DDT concentrations in edible fish tissues from the Okanogan River appear to be much lower than in the 1980s and 1990s (Hopkins et al., 1985; Davis and Serdar, 1996). In 2001-02 the maximum concentrations observed were 600 µg/Kg t-DDT compared with 3,200 µg/Kg reported in earlier studies. However, even with the reductions in concentrations noted during the 2001-02 TMDL assessment, 4, 4'-DDE still did not meet (exceeded) the criterion in 23 of the 24 samples collected and analyzed. Only one sample exceeded the 4, 4'-DDD criterion, and none of the samples exceeded the 4, 4'-DDT criterion. (Table 1.)

Data from 1984 and 1994 (Hopkins et al., 1985; Davis and Serdar, 1996)) had shown total DDT (t-DDT)* concentrations in several fish species from the lower Okanogan River among the highest ever recorded in Washington State (1,700 – 3,200 µg/Kg). Concentrations in Osoyoos Lake fish, collected primarily during a 1995 survey, showed more moderate levels (40 – 1,200 µg/Kg t-DDT), but concentrations were generally elevated above the National Toxics Rule criterion and Washington State's water quality standard for DDT (32 µg/Kg for 4,4-DDT and 4,4'-DDE, 45 µg/Kg for 4,4'-DDD).

A study by Johnson et al. (1997) also found DDT in several tributaries to the Okanogan River and Osoyoos Lake. Three streams had t-DDT concentrations above the Washington State water quality standard to protect aquatic life from chronic exposure to DDT (0.001 µg/L) (WAC 173-201A). Tallant Creek, flowing into the lower Okanogan River, had t-DDT concentrations up to 500 times the standard. However, while these concentrations were relatively high, the daily loads of DDT to the Okanogan River from all of the sources combined was low, approximately 0.3 grams/day (Johnson et al., 1997).

PCBs have also been found in some Okanogan River and Osoyoos Lake fish (Hopkins et al., 1985; Davis and Serdar, 1996; Serdar et al., 1998). Concentrations of total PCBs (t-PCBs, sum of Aroclors) in muscle tissues were relatively low (20 – 40 µg/Kg) in fish from the lower reaches of the mainstem Okanogan River. Osoyoos Lake fish had no detectable PCBs in muscle tissues, but detectable concentrations in whole fish indicate that PCBs are present in the lake. During sampling in 2001-2002 the maximum PCB concentrations in fish tissue from the Okanogan River appeared to be similar to earlier findings, with a maximum concentration of 42 µg/Kg compared to 45 µg/Kg in a previous study Serdar, 2003). The criterion for PCBs was exceeded in 17 of the 24 samples analyzed during the 2001-2002 TMDL investigation (Serdar, 2003). (Table 1.)

A complete data set for previous Ecology studies for DDT and PCBs in the Okanogan basin can be found in Appendix F in the *TMDL Technical Assessment of DDT and PCBs in the Okanogan Basin* (Serdar, 2003). The report is available on the Department of Ecology website at. www.ecy.wa.gov/pubs/0303013.pdf .

Since external sources account for only a small fraction of the contaminant levels in Osoyoos Lake and lower Okanogan River fish tissue, it is assumed that the major source of DDT and PCB is from internal loading, particularly from bottom sediments already in the river and lake.

An element of the original TMDL assessment of DDT contamination in the watershed included sediment core sampling in the southern end of Osoyoos Lake and investigating layers of sediments to determine the historic deposition of DDT in the lake (Serdar, 2003). A large spike in DDT concentrations was seen in sediments deposited around late 1998 or early 1999 (Figure 3). Concentrations of DDT were triple those seen during the 1980s and 1990s. The anomalous concentration suggests the source of the spike was a spill, dumping, or other introduction of concentrated DDT into the aquatic environment during the late 1990s (Peterschmidt, 2006).

It appears that the Okanogan River continues to be dosed with contaminated Osoyoos Lake sediments which are re-suspended and transported downstream, especially during high flows. This effectiveness monitoring project will not be examining the bottom sediments in Osoyoos Lake but that activity may be appropriate during periodic monitoring projects in the future.

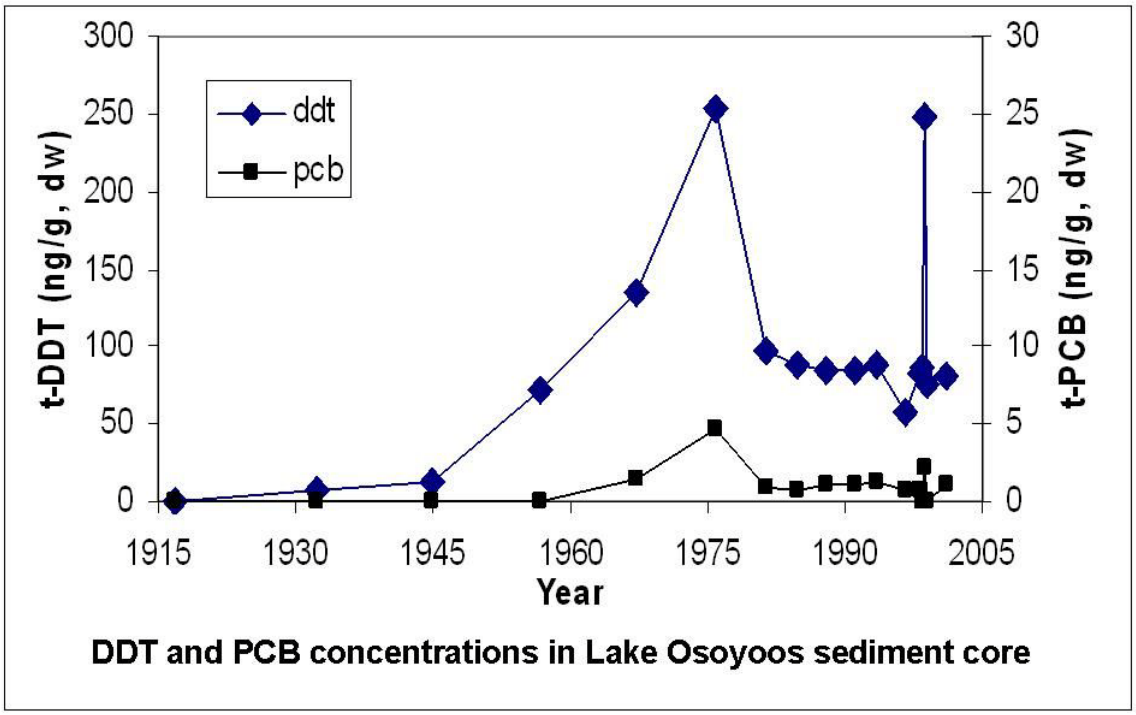

Figure 3. DDT and PCB concentrations in Lake Osoyoos sediment core.

Downstream of Oroville, DDT concentrations in sediments appear to be diluted by relatively clean Similkameen River sediments. In this same area, there are also lower DDT concentrations in fish tissue. Even here, however, it does appear that major reductions in sediment DDT and PCB concentrations will be needed to bring concentrations in fish tissue down to criteria levels.

There are few realistic options for reducing DDT and PCB loading to Osoyoos Lake and the lower Okanogan River. Most loading to fish occurs internally through direct or indirect exposure to sediments. Natural attenuation will eventually reduce such levels through dilution and capping, especially downstream of the Similkameen River confluence. This project, as well as similar projects in the future, will document changes in the concentration of DDT and PCBs in fish tissue from the lower Okanogan River.

Contamination of fish tissue in the lower Okanogan River basin from DDT and PCBs is of the greatest concern. Even though little can be done to actively remove existing DDT or PCB contamination in the Okanogan River, it is important to measure concentrations in fish. This is because fish provide the exposure link to consumers potentially at risk (i.e., humans, piscivorous birds, and mammals) and fish can serve as an indicator to assess whether river concentrations are changing.

Impairment and Historical Data Review

DDT and PCB Concentrations in Fish Tissue

Ecology collected carp, mountain whitefish, and smallmouth bass from three locations on the lower Okanogan River during 2001, except for carp which were not found in the lower (Monse) reach. Samples were analyzed for DDT, PCBs, and lipid content in fillet. Table 1 shows the results.

Concentrations of t-DDT ranged from 30 to 600 µg/Kg, while t-PCB concentrations were much lower, ranging from 2 µg/Kg or less to 40 µg/Kg. Mountain whitefish and carp generally had much higher DDT and PCB concentrations than smallmouth bass.

4,4'-DDE was the primary DDT component, exceeding the National Toxics Rule (NTR) criterion of 32 µg/Kg in all samples except smallmouth bass from the Riverside-Omak location. 4,4'-DDD concentrations were much lower with only one sample, Riverside-Omak carp, exceeding the NTR criterion of 45 µg/Kg. None of the samples exceeded the 4,4'-DDT criterion.

PCB-1254 made up the highest proportion of t-PCB in most samples, followed by PCB-1260 and PCB-1248. PCB-1242 was not detected aside from a low concentration (4.0 µg/Kg) in one Riverside-Omak carp sample. All carp and mountain whitefish equaled or exceeded the NTR criterion for PCBs (5.3 µg/Kg). In contrast, only one of the nine smallmouth bass samples had t-PCB greater than the criterion.

Lipid content, fish size, and sampling location all appear to be factors in DDT and PCB concentrations for each species. Figures 6 and 7 show lipid-normalized t-DDT and t-PCB concentrations grouped by species for each location. Carp and mountain whitefish collected from the Oroville location clearly had higher lipid-normalized t-DDT concentrations than from other sites. Smallmouth bass from the Monse reach had lipid-normalized t-DDT concentrations slightly higher than those collected from the Oroville and Riverside-Omak locations.

Lipid-normalized t-PCB concentrations generally followed the same location pattern as with lipid-normalized t-DDT; the highest concentrations were at Oroville, followed in decreasing order by Riverside Omak and Monse. However, carp from Oroville and Riverside-Omak had similar concentrations, and the lipid-normalized t-PCB concentrations in the large-sized smallmouth bass from Monse were much higher than those from other locations.

Table 1. DDT and PCB concentrations in fillet of fish from the lower Okanogan River, 2001 (µg/Kg, wet weight) (Serdar, 2003).

Sample No. (02-)	Location	number per comp.	mean length (mm)	mean weight (g)	mean age (yr)	Lipid (%)	4,4'-DDE	4,4'-DDD	4,4'-DDT	t-DDT	PCB-1248	PCB-1254	PCB-1260	t-PCB[a]
Carp														
128230	Oroville	8	552±25	2,135±432	nc	1.04	**290**	**37**	u(1.6)	**327**	**2.7**	**5.1**	**4.7**	**13**
128231	"	8	514±7	1,749±93	nc	0.84	**410**	**24**	u(1.5)	**434**	**1.7**	**3.9**	**3.1**	**9**
128232	"	7	463±37	1,348±354	nc	1.55	**210**	**38**	**0.6**	**249**	**3.6**	**4.2**	**2.2**	**10**
128233	Riv. - Omak	8	619±20	3,345±385	nc	3.43	**270**	**41**	u(1.5)	**311**	**6.8**	**9.2**	**10**	**26**
128234/35	"	8	584±12	2,740±481	nc	3.00	**220**	**29**	u(1.6)	**249**	**13**	**10**	**13**	**36**
128236	"	8	550±13	2,393±320	nc	3.09	**210**	**26**	u(1.6)	**236**	u(18)	**9.9**	**8.4**	**22**[b]
Mountain whitefish														
128237	Oroville	8	363±21	315±76	5	0.79	**460**	**38**	**17**	**515**	**3.0**	**12**	**8.7**	**24**
128238	"	8	330±7	229±54	4	1.31	**330**	**21**	**9.8**	**361**	**2.9**	**9.8**	**7.3**	**20**
128245	"	8	290±14	167±21	2	1.17	**150**	**19**	**5.1**	**174**	**2.4**	**6.1**	**3.2**	**12**
128239/40	Riv. - Omak	10	365±19	453±87	6	4.26	**520**	**62**	**17**	**599**	**5.2**	**19**	**18**	**42**
128241	"	10	334±13	331±69	5	4.70	**330**	**39**	**13**	**382**	**3.0**	**10**	**7.3**	**20**
128249	"	10	284±20	209±48	3	4.58	**160**	**19**	**6.0**	**185**	**5.0**	**18**	**7.0**	**30**
128242	Monse	9	326±48	301±134	4	2.96	**110**	**14**	**3.2**	**127**	**3.5**	**9.8**	**6.2**	**20**
128243	"	9	246±7	127±18	2	3.07	**120**	**16**	**3.7**	**140**	**2.5**	**6.4**	**2.3**	**11**
128244	"	8	220±15	81±14	2	1.55	**73**	**4.9**	**2.8**	**81**	u(2.8)	**2.9**	**2.1**	**5**
Smallmouth bass														
128246	Oroville	1	424	1,111	5	3.21	**230**	**44**	**14**	**288**	**3.9**	**8.1**	**2.6**	**15**
128247	"	4	316±28	472±138	nc	1.39	**64**	**11**	**2.3**	**77**	u(2.7)	**2.4**	u(2.7)	**2**
128248	"	1	248	206	1	1.60	**100**	**3.5**	**0.8**	**104**	u(2.8)	**2.2**	u(2.8)	**2**
128250	Riv. - Omak	7	350±56	685±377	4	1.17	**78**	**6.5**	**3.1**	**88**	u(2.7)	**2.7**	u(2.7)	**3**
128251	"	7	287±11	320±47	3	1.42	**55**	**2.9**	**1.6**	**60**	**5.6**	**2.1**	u(2.7)	**8**
128252	"	7	213±28	133±50	1	0.95	**25**	**1.7**	**0.8**	**28**	u(2.8)	u(2.8)	u(2.8)	nd
128253	Monse	5	327±12	496±41	3	1.35	**150**	**14**	**3.0**	**167**	**2.9**	**9.5**	**1.9**	**14**
128254	"	5	276±32	276±98	3	1.12	**89**	**11**	**1.6**	**102**	u(2.7)	**2.2**	u(2.7)	**2**
128255	"	5	200±10	98±18	1	0.70	**59**	**3.4**	**0.8**	**63**	u(2.8)	u(2.8)	u(2.8)	nd

[a]Aroclors 1268, 1262, 1242, 1232, 1221, and 1016 not detected at practical quantitation limits of 2.7 – 5.4 µg/Kg.
[b]Includes 4.0 µg/Kg PCB-1242.
MTWF = mountain whitefish.
SMBS = smallmouth bass.
comp. = composite.
nc = not calculated.
detected values in **bold.**
u = undetected at practical quantitation limit in parentheses.
nd = not detected.

TMDL Overview

In 2003, Ecology's Environmental Assessment Program prepared a TMDL assessment of DDT and PCBs in the lower Okanogan River basin, including Osoyoos Lake (Serdar, 2003). Sampling conducted during 2001-2002 examined DDT and PCB concentrations in the water column of the mainstem Okanogan River, water in tributary streams, sewage treatment plant (STP) effluent and sludge, and cores of bottom sediments. Composite samples of three species of fish – carp (*Cyprinus carpio*), mountain whitefish (*Prosopium williamsoni*), and smallmouth bass (*Micropterus dolomieui*) – also were analyzed for DDT and PCBs. Data from these samples were used in conjunction with historical data to develop the TMDL.

Results suggested that only small loads of DDT and PCBs were being delivered to Osoyoos Lake and the lower Okanogan River through tributary streams and STPs. Combined, measurable DDT and PCB loads from tributaries and STPs averaged approximately 200 mg t-DDT/day and 3 mg t-PCB/day, respectively. This contrasted sharply with measured loads in several reaches of the lower Okanogan River (1,500 – 4,300 mg t-DDT/day; no measurable PCBs), the assimilative capacities of the river (1,300 – 6,700 mg t-DDT/day; 230 – 1,100 mg t-PCB/day), and theoretical loads based on fish tissue concentrations (13,000 – 32,000 mg t-DDT/day; 0 – 6,500 mg t-PCB/day).

The loading analysis showed that the bulk of loading was internal, presumably through bottom sediments. Load allocations and wasteload allocations were developed for tributaries, STPs, and sediments.

Cleanup and TMDL Implementation

Prior to the implementation of the TMDL (Serdar, 2003), many actions and activities had already been undertaken that reduce the entry of DDT and PCB contamination to the environment:

- Banning the production and use of these materials was the beginning of environmental recovery.
- Collection and disposal programs that remove unused pesticides from storage and the waste stream have reduced, and continue to reduce, the threat of these persistent chemicals on the environment.
- Improving efficiency in the delivery and use of irrigation water, along with reduced soil erosion and improved management of riparian lands, have all contributed to the reduction of DDT in the Okanogan River.
- Regulatory restrictions and management of PCB-containing wastes has reduced the quantity of PCBs entering the environment.

It is the goal of the implementation plan to assure the continuation of these actions and support them as opportunities arise.

The Detailed Implementation Plan (Peterschmidt, 2006) calls on Ecology to track progress in the improvement of water quality by monitoring the concentrations of DDT and PCBs in fish from the Okanogan River. As the amounts of DDT and PCBs continuing to reach the river diminish, the contaminants existing in the river will diminish. However, the persistent nature of these contaminants will result a slow reduction of the contamination already existing in the river system.

The persistent natures of DDT and PCBs in the environment truly make them a legacy of past practices. While these toxic compounds continue to persist in the environment, their effective levels are reduced over time through degradation and by natural attenuation through dilution and capping. The natural processes resulting in the lower exposure of aquatic life to the contaminants will play a major role in the success of this TMDL, particularly for addressing the contaminants already contained in the river. Activities in the implementation plan have the goal of minimizing the addition of contaminants to the river from the uplands.

Actions taken pursuant to the TMDL implementation fall into three categories: voluntary stewardship actions, actions that are taken in accordance with a law or legal agreement, and monitoring activities (see next chapter).

Voluntary Activities

These are implementation actions that are undertaken by individual land owners or larger organizations, such as irrigation districts, and result in the reduced rate of contaminant movement from the uplands into the rivers, streams, or lakes. Examples include:

- Participation in the Washington State Department of Agriculture waste pesticide program.
- Protect soils from erosion by water or wind.
- Efficiently deliver and use irrigation water.

Actions Taken in Accordance with a Law or Legal Agreement

The TMDL addresses water quality impairment from legacy loading (Serdar, 2003). The primary actions for reducing DDT and PCB in the environment were the regulatory 1972 ban on DDT use and the 1979 ban on PCB production with the subsequent phase-out and control of PCB products.

The regulatory bans will only be successful through the observance of the following bulleted items.

- Compliance with the restrictions on DDT and PCBs
- Prevention of sediment entry into the river through implementation of stormwater regulations.
- Implementation of and compliance with NPDES permits.

Several organizations within the Okanogan watershed support programs that address the implementation activities of the TMDL (Table 2).

Table 2. Management roles, activities, and schedules.

Entity	Responsibilities to be met	Schedule
Washington State Department of Agriculture	Continue to bring Waste Pesticide Collection Program events to the Okanogan watershed.	ongoing
OCD, NRCS, and Ecology	Continue to fund agricultural BMP implementation to reduce soil losses from agricultural lands.	ongoing
Cities of Oroville, Tonasket, Omak, and Okanogan	Monitor DDT and PCB in wastewater treatment plant discharges in accordance with NPDES permit requirements.	ongoing
OCD, Irrigation Districts, and Ecology	Promote continuing improvements to the efficient and effective use of irrigation water to reduce the potential for agricultural runoff to carry sediment to the river system.	ongoing
Ecology	Periodically monitor Okanogan River fish tissues.	every five years
Land developers	Prevent sediments from reaching the river and streams by implementing BMPs described in the *Stormwater Management Manual for Eastern Washington* (Ecology, 2004).	ongoing

OCD – Okanogan Conservation District
NRCS – Natural Resources Conservation Service
BMP – best management practice

Project Goals and Study Objective

Goals

The goals of this effectiveness monitoring project are to (1) determine whether there is improvement in water quality as determined by a reduction in t-DDT and PCBs levels in fish tissue from the Okanogan River and (2) support the systematic review and improvement of water quality.

Objective

The objective of this project is to test the effectiveness of the Okanogan DDT and PCB TMDL implementation strategy (Peterschmidt, 2006). Implementation strategy developed for this TMDL was essentially to "wait and see" if the concentrations of the legacy pollutants DDT and PCB diminish over time.

Prior to establishment of this TMDL, both pollutants had been effectively banned from use, collection programs had been established to divert privately held and unused product into a controlled waste stream, clean-up programs had been (and are still) available to address spills or stock piles when discovered, and erosion control methods had been established and implemented to prevent dispersal of DDT from past-use agricultural areas.

To successively reach the objective we will:

- Measure the concentration of t-DDT and PCBs in fish tissue from the lower Okanogan River.
- Compare new data to data from past studies, especially the 2003 Okanogan River DDT and PCBs TMDL (Serdar, 2003).
- Determine if there are observable changes in the pollutant concentrations in fish tissue.
- Compare results to water quality standards and determine if removal from the 303(d) list is warranted.
- Continued monitoring.

The project is designed so that sampling and analysis methods, sampling sites, sample size, and fish species are similar and comparable to the 2001-02 TMDL study (Serdar, 2003).

Study Design

Overview

Fish Collection

The fish species analyzed for both the TMDL (Serdar, 2003) and this study will be common carp (*Cyprinus carpio*), mountain whitefish (*Prosopium williamsoni*), and smallmouth bass (*Micropterus dolomieui*). These are the three most common resident game species in the Okanogan River and represent different feeding behaviors and habitat uses.

Carp feed throughout the water column generally found in slow-moving shallow waters, although they are adaptable to a variety of habitat types. Carp are known to accumulate high concentrations of DDT, PCBs, and other chlorinated organic chemicals (e.g., Davis and Serdar, 1996; Serdar et al., 1998).

Mountain whitefish are more pelagic, preferring riffle areas and feeding primarily on zooplankton and insects. Mountain whitefish also can accumulate high concentrations of chlorinated organic chemicals due largely to their high lipid content (e.g., Johnson et al., 1988; Ecology, 1995).

Smallmouth bass prefer gravelly substrates along gradually sloped littoral areas. Initially planktivorous or insectivorous as juveniles, they become predators (piscivorous) and are a prized game fish. Due to their lean muscle, their tendency to accumulate DDT and PCBs is less than either carp or mountain whitefish.

Fish collection will be a shared effort with participation of staff from Ecology and the Fish and Wildlife Program of the Colville Confederated Tribes (CCT). Depending on access to the river at the scheduled time of sampling, fish collection will either employ an electrofishing boat owned and operated by Ecology or by the CCT. If the river is not accessible by boat, nets will be deployed to collect the appropriate species and sample size.

Sample collection and fish tissue preparation will employ the methods described in two Ecology Standard Operating Procedures: (1) EAP009, Collection, Processing and Preservation of Finfish Samples at the time of Collection in the Field (Sandvik, 2006a) and (2) EAP007, Resecting Finfish Whole Body, Body Parts or Tissue Samples (Sandvik, 2006b).

Fieldwork

We have set a sampling and analysis goal of 100% completeness. However, there are many reasons for missing samples in a monitoring program. These include inclement weather or flooding, hazardous driving or monitoring conditions, and illness or unavailability of monitoring staff. Routinely missed samples could impart bias in expressions generated from final data. Sampling events will be rescheduled when missed in order to maintain integrity of the

characterization effort. Field monitoring data loss due to equipment failure may occur; backup equipment will be available to minimize this problem.

Apart from weather, unforeseen occurrences are random relative to water quality conditions. These occurrences will not affect long-term data analyses, except for effects from potential reduction in sample size.

Sampling Locations

To assess the geographical distribution of contaminants in fish, the 2001-02 TMDL assessment examined samples from the Okanogan River, upper (Oroville reach), middle (Riverside-Omak reach), and lower (Monse reach) to be analyzed for DDT and PCBs in edible muscle tissue (Serdar, 2003). These three reaches also encompass the population centers and public boat launches along the river. This current effectiveness monitoring project will target the same areas as in the 2001-02 TMDL.

Table 3 lists the general locations of the reaches to be sampled. The following launch sites will be used.

- Access to the upper river (Oroville reach) will be by a boat launch at the Highway 97 Okanogan River crossing at the south end of the town of Oroville.
- Access to the middle river (Riverside-Omak reach) will be by two boat launches: at the town of Riverside and at the fairgrounds in the city of Omak.
- Access to the lower river (Monse reach) will be by a boat launch at the Monse Bridge. Sampling will be upstream from this point to avoid the backwater from the Columbia River.

Table 3. Sampling site geographical locations.

Station	Description	Latitude	Longitude
Upper	Oroville Reach	48.917932N	119.423348W
Middle	Riverside-Omak Reach	48.421622N	119.470749W
Lower	Monse Reach	48.162399N	119.670653W

Monitoring Partnerships

The CCT is particularly interested in measuring fish tissue concentrations of DDT and PCBs and determining whether these levels are changing because many tribal members consume fish from the Okanogan River. This project will be conducted as a joint effort by Ecology and the CCT. The data may be used by the CCT as they develop risk assessments.

Experimental Design

At each of the three river reaches, we will attempt to collect at least three composite samples (5 to 8 fish) for each of the three target species: common carp, mountain whitefish, and smallmouth bass. The number of fish may be reduced if river access, available fish, personnel, or time is limited.

Samples will be processed in the field and at the Ecology headquarters building in Lacey, WA, using established SOPs. Processed samples will be frozen and shipped to Manchester Environmental Laboratory for analysis.

All fish collection will be carried out using SOP EAP009 (Sandvik, 2006a). Fish will be collected using an Ecology or CCT electrofishing boat or by setting nets by hand from the bank. Measurements of weight and length of the sampled fish will be collected in the field. Individual fish will be assigned a sample number with corresponding identification in a field log, double-wrapped in aluminum foil (dull side in), then sealed in a zip-lock bag. Whole fish samples will be kept on ice until return from the field where they will be frozen at -20°C at the Ecology headquarters building. Established sample holding times will be maintained.

Following SOP EAP007 (Sandvik, 2006b), composite fillet homogenates of mountain whitefish and smallmouth bass will be prepared by removing the scales then removing the entire fillet from the left side of each fish. The resulting sample will contain the skin and some of the belly flap and dorsal fat. Common carp will be processed similarly, except the skin will be removed and not included in the homogenate.

Three composite samples of each species (carp, mountain whitefish, and smallmouth bass) will be analyzed from each of the three collection locations (upper, middle, and lower Okanogan River). Each composite sample will consist of five to eight fish of a single species, depending on availability.

Fish tissue will be homogenized using three passes through a Kitchen-Aid® or similar food processor. Ground tissue will be thoroughly mixed following each pass through the processor.

All equipment used for tissue preparation will be thoroughly washed with Liquinox® detergent, then rinsed in hot water, de-ionized water, pesticide-grade acetone, and finally, pesticide-grade hexane. This decontamination procedure will be repeated between processing of each composite sample. Fully homogenized tissues will be stored frozen (-20°C) in two 8-oz. glass jars with Teflon lid liners certified for trace organics analysis: one container submitted for analysis and the other archived at -20 °C. (Table 4)

Table 4. Sample containers, preservation, and holding times for processed tissue.

Analysis	Container	Preservation	Holding Time
DDT, PCBs, percent lipids in fish	8-oz glass jar with certificate of analysis, Teflon lid liner	Hold for analysis @ 0 to 6°C or freeze @ -20°C.	14 days @ 0 to 6°C and 1 year if sample is frozen

Project Schedule

Table 5 lists the proposed schedule for completing field and laboratory work, data entry into EIM, and reports.

Table 5. Project schedule.

Field and laboratory work	
Field work	July-September 2008
Laboratory analyses completed	December - January 2009
Environmental Information System (EIM) system	
EIM data engineer	Evan Newell
EIM user study ID	ccof0003
EIM study name	Okanogan River DDT and PCBs TMDL Effectiveness Monitoring
Data due in EIM	March 2009
Final report	
Author lead	Chris Coffin
Schedule	
Draft due to supervisor	May 2009
Draft due to client/peer reviewer	June 2009
Draft due to external reviewer	July 2009
Final report due on web	September 2009

Project Costs

Project costs for analytical and travel expenses are listed in Table 6. This estimate does not include staff time.

Table 6. Manchester Environmental Laboratory, sample analysis costs.

Analysis	No. Field Samples	No. QA Samples	Total Samples	Unit Price	Total Price
DDT analogues, PCBs (Aroclors)	27	7	34	$350	$11,900
Percent lipids	27	6	33	$31	$1,023

Costs include 50% discount from MEL.

Costs for staff travel will be approximately $1,000.

Total project costs ($12,923 + $1,000) are approximately $14,000.

Quality Objectives

Quality objectives are statements of the precision, bias, and lower reporting limits necessary to address project objectives. Precision and bias together express data accuracy. Other considerations of quality objectives include representativeness and completeness.

Measurement Quality Objectives

Precision is a measure of data consistency. It is expressed as the relative standard deviation (RSD) and derived from replicate sample analyses. It is subject to random error. RSD is determined by dividing the standard deviation of a sample by the mean for the same sample and then multiplying by 100%. For this project, each sample for which an RSD will be calculated will consist of paired duplicates.

Bias is a measure of the systematic error between an estimated value for a parameter and the true value. Systemic errors can occur through poor technique in sampling, sample handling, or analysis. Although we will not evaluate bias, we will minimize the bias through strict adherence to standard operating protocols (SOPs). Field staff will follow the SOPs listed in this plan.

Measurement quality objectives are shown in Table 7. These numbers are based on discussions with personnel at Manchester Environmental Laboratory (Weakland, 2008) and results achieved during the 2001-02 TMDL study (Serdar, 2003).

Table 7. Measurement quality objectives.

Analysis	Matrix Spikes	Matrix Spike Duplicates	Surrogates	Lab Duplicates
DDT analogs	50%-150% recovery	≤40% RPD	30%-130% recovery	≤20% RPD
PCBs (Aroclors)	50%-150% recovery	≤40% RPD	30%-130% recovery	≤20% RPD
Percent lipids	NA	NA	NA	≤50% RPD

NA=Not Applicable.
RPD=Relative Percent Difference.

Manchester Environmental Laboratory's *Lab Users Manual* (MEL, 2008) indicates a reporting limit of 1-100 µg/Kg for DDT analogs and 10-1000 µg/Kg for PCB Aroclors, depending on the matrix and analyte. A high lipid content in the sample matrix, as is expected with common carp and mountain whitefish, can interfere with the analyses and increase the reporting limit. However, during the 2001-02 TMDL study, Manchester Laboratory was able to achieve reporting limits considerably lower for PCB Aroclors (total PCB detected in that study varied from approximately 2 to 42 µg/Kg). If achievable, the required reporting limit for the constituents listed in Table 8 is sufficiently low to allow comparison of new data from this study with data from the 2001-02 TMDL study and with applicable toxics criteria.

The objective for sampling *completeness* is 100%. Completeness will be assessed by examining (1) the number of samples collected compared to the sampling plan; (2) number of samples shipped and received at Manchester Laboratory in good condition; (3) the laboratory's ability to produce usable results for each sample; and (4) sample results accepted by the project manager.

Quality Objectives for Modeling or Other Analysis

The data collected during this project will be compared with that collected during the 2001-2002 TMDL evaluation. In that earlier study, all analyses of lab duplicates, spiked samples, laboratory control samples, and standard reference material were within the established quality control (QC) limits. One of the three surrogates used for surrogate spike analysis of DDT samples did not meet QC limits. The analyses for this effectiveness monitoring project needs be at least as good as the 2001-02 data to be readily comparable. Preferably, *all* established QC limits will be met.

Sampling Procedures

All fish collection, preparation, and preservation will be carried out using the appropriate Standard Operating Procedure (SOP) (Sandvik, 2006a,b) or similar methods employed by CCT Fish and Wildlife Program. Fish will be collected using an Ecology or CCT electrofishing boat or by setting nets by hand from the bank. Measurements of weight and length of the sampled fish will be collected in the field. Individual fish will be assigned a sample number with corresponding identification in a field log, double-wrapped in aluminum foil (dull side in), then sealed in a zip-lock bag. Samples will be kept on ice until return from the field where they will be frozen at –20°C at the Ecology headquarters building. Established sample holding times will be maintained (Table 4).

Following SOP EAP007, composite fillet homogenates will be prepared by removing the scales then removing the entire fillet from the left side of each fish. The resulting sample will contain the skin and some of the belly flap and dorsal fat. Three composite samples of each species (carp, mountain whitefish, and smallmouth bass) will be prepared from each of the three collection locations (upper, middle, and lower Okanogan River. Each composite sample will consist of five to eight fish of a single species, depending on availability.

Tissues will be homogenized using three passes through a Kitchen-Aid® or similar food processor. Ground tissue will be thoroughly mixed following each pass through the grinder.

All equipment used for tissue preparation will be thoroughly washed with Liquinox® detergent, rinsed in hot water, de-ionized water, pesticide-grade acetone, and finally, pesticide-grade hexane. This decontamination procedure will be repeated between processing of each composite sample. Fully homogenized tissues will be stored frozen (–20°C) in two 8-oz. glass jars with Teflon lid liners certified for trace organics analysis; one container submitted for analysis and the other archived at -20 °C.

Laboratory Measurement Procedures

Laboratory analyses will be performed in accordance with the *Manchester Environmental Laboratory Users Manual* (MEL, 2008). This manual indicates that the reporting limits can be achieved by using analytical methods as listed in Table 8. The laboratory staff will consult the project manager if there are any changes in procedures over the course of the project, or if other difficulties arise.

Table 8. Analytical methods, reporting limits, and laboratories.

Analysis	Required Reporting Limit	Sample Preparation Methods	Sample Analysis Method	Laboratory
DDT analogs	5 µg/Kg	EPA 3540/3620/3665	EPA 8081/8082	MEL
PCBs (Aroclors; 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262 & 1268.)	3 µg/Kg	EPA 3540/3620/3665	EPA 8081/8082	MEL
Percent lipids	0.1%	MEL SOP 730072	MEL SOP 730009	MEL

The field crew will communicate with the laboratory to ensure that laboratory resources are available. The project team will follow normal Manchester Laboratory procedures for sample notification and scheduling. With adequate communication, sample quantities and processing procedures should not overwhelm the laboratory capacity. When laboratory-sample load capacities are heavy, rescheduling of individual surveys may be necessary.

Quality Control Procedures

Quality control (QC) procedures used during field sampling and laboratory analysis will provide estimates toward understanding accuracy of the monitoring data. Field work will follow established SOPs, EAP007 and EAP009 (Sandvik, 2006a,b). All samples will be analyzed at Manchester Laboratory following standard QC procedures outlined in the *Lab Users Manual* and the *Laboratory Quality Assurance Manual* (MEL, 2008 and 2006). The laboratory's data quality objectives are documented in MEL (2006).

The results of the laboratory QC sample analyses should be used in determining compliance with measurement quality objectives (Table 7). Variation will be described for field and laboratory results by examining replicate samples and comparing to measurement quality objectives. Laboratory QC data for duplicate samples will be compared to the measurement quality objectives for precision.

Table 9 lists the number and type of QC samples that will be requested during processing and analysis of the tissue samples.

Table 9. Frequency of quality control procedures.

Analysis	Processing Splits	Lab Method Blank	Lab Duplicate	Matrix Spike	Matrix Spike Duplicate
DDT analogs	5	1/batch	2/batch	2/batch	1/batch
PCB (Aroclors)	5	1/batch	2/batch	2/batch	1/batch
Percent lipids	5	NA	2/batch	NA	NA

Data Management Procedures

Laboratory Data

Procedures for laboratory data reduction, review, and reporting are outlined in the Manchester Laboratory *Lab Users Manual* (MEL, 2008). Laboratory staff will be responsible for the following functions:

- MEL-generated data verification.
- Proper transfer of MEL-generated data to the Laboratory Information Management System (LIMS).
- Reporting data to the project manager.

The Environmental Information Management (EIM) data engineer will subsequently enter data into Ecology's EIM system.

The project manager will perform the following functions:

- Review data for errors (quarterly) and make procedural adjustments as necessary.
- Apply corrective measures to minimize errors and validate the quality of the data.

Major changes will require notification of those who have signed this Quality Assurance (QA) Project Plan. The project manager may approve data that do not meet measurement quality objectives (Table 7), but only after consultation with these signatories, and only with appropriate data qualification.

Laboratory Reports

MEL's SOP for reduction, review, and reporting of the chemical data will meet the needs of this project. Each laboratory unit assembles data packages consisting of raw data from the analyses of the samples, copies of the pertinent logbook sheets, QA/QC data, and final reports of data entered into LIMS. These data packages are subjected to a data verification and quality assurance review by another analyst familiar with the procedure.

On receipt of the chemistry data, the project lead will review the results for completeness, reasonableness, and usability. Data and case narratives will also be reviewed to assure that quality control procedures meet frequency requirements and control limits.

Field Data

Station data and field data will be written in field notebooks and then entered into EIM. After laboratory data are reviewed, they will also be entered into EIM. All data will be entered into EIM before the final report is complete.

Audits and Reports

Manchester Laboratory will submit laboratory reports, QA worksheets, and chain-of-custody records to Ecology's Environmental Assessment Program staff. Any problems and associated corrective actions will be reported by the laboratory to the project manager. The project manager is responsible for periodic audit updates to the project team and client as well as for the final report.

Documentation from the lab should include any quality control results associated with the data in order to evaluate the accuracy of the data and to verify that the quality objectives are met.

Manchester Laboratory participates in performance and system audits of their routine procedures. Results of these audits are available on request.

The project lead will provide a draft report of the study results to the client in June 2009. At a minimum, the final report will contain the following:

- A map of the study area showing sampling sites.
- Latitude/longitude and other location information for each sampling site.
- Descriptions of field and laboratory methods used in the study.
- A discussion of data quality and the significance of any problems encountered in the analyses.
- Summary tables of the chemistry data.
- An evaluation of contaminant concentrations and a comparison to past projects, including the 2001-02 TMDL.
- Recommendations for follow-up work.

A final report will be prepared after receiving comments from the Water Quality Program's Central Regional Office and any other reviewers they have selected. The goal is to complete the final report by September 2009.

Data Verification and Usability Assessment

Data Verification

Data verification involves examining the data for errors, omissions, and compliance with quality control (QC) acceptance criteria. Manchester Environmental Laboratory (MEL) is responsible for performing the following functions:

- Reviewing and reporting QC checks on instrument performance such as initial and continuing calibrations.
- Reviewing and reporting case narratives. This includes comparison of QC results with method acceptance criteria such as precision data, surrogate and spike recoveries, laboratory control sample analysis, and procedural blanks.
- Explaining flags or qualifiers assigned to sample results.
- Reviewing and assessing MEL's performance in meeting the conditions and requirements set forth in this sampling plan.
- Reporting the above information to the project manager or lead.

After measurement results have been recorded, the results are verified to ensure that:

- Data are consistent, correct, and complete, with no errors or omissions.
- Results of QC samples accompany the sample results.
- Established criteria for QC results were met.
- Data qualifiers are properly assigned where necessary.
- Data specified in the Sampling Process Design were obtained.
- Methods and protocols specified in the QA Project Plan were followed.

MEL is responsible for verifying all analytical results. Reports of results and case summaries provide adequate documentation of the verification process. MEL analytical data will be reviewed and verified by comparison with acceptance criteria according to the data review procedures outlined in the *Lab Users Manual* (MEL, 2008). Appropriate qualifiers will be used to label results that do not meet quality assurance requirements. An explanation for data qualifiers is provided.

Field results will also be verified by field staff before leaving the site after measurements are made. Detailed field notes will be kept to meet the requirements for documentation of field measurements. The field lead is responsible for checking that field data entries are complete and error free. The field lead should check for consistency within an expected range of values, verify measurements, ensure measurements are made within the acceptable instrumentation error limits, and record anomalous observations.

Data Usability Assessment

Data usability assessment follows verification. This involves a detailed examination of the data package using professional judgment to determine whether the measurement quality objectives (MQOs) have been met. The project manager examines the complete data package to determine compliance with procedures outlined in the QA Project Plan and standard operating procedures. The project manager is also responsible for the data usability assessment by ensuring that the MQOs for precision, bias, and sensitivity are met.

Part of this process is an evaluation of precision. Precision will be assessed by calculating relative standard deviations (RSDs) for field and laboratory duplicates. Laboratory duplicates will yield estimates of precision performance at the laboratory only. Field duplicates will indicate overall variability (environmental + sampling + laboratory). Acceptable precision performance is outlined in the MQOs (Table 7).

Completeness will be assessed by examining (1) number of samples collected compared to the sampling plan; (2) number of samples shipped and received at MEL in good condition; (3) MEL's ability to produce usable results for each sample; and (4) sample results accepted by the project manager.

To analyze data for its usability, the project lead will consider precision, completeness, and documentation of adherence to protocols. Data will also be examined for extremes (i.e., against historical records and against the distributions of these project data). Extreme values will require logical explanations.

The data will be used to determine whether TMDL targets and freshwater quality criteria have been met. The project manager will make this determination by examining the data and all of the associated quality control information.

Project Organization

Ecology employees involved in this project are listed in Table 10. All persons listed on the signature approval page are responsible for reviewing and approving the final Quality Assurance Project Plan.

Table 10. Organization of project staff and responsibilities.

Staff (all are EAP except client)	Title	Responsibilities
Chris Coffin Eastern Operations Section (509) 454-4257	Project Manager	Writes the QAPP, conducts QA review of data, analyzes and interprets data, and writes the draft report and final report.
Randy Coots Toxics Studies Unit Statewide Coordination Section (360) 407-6690	Principal Investigator	Ecology boat operator, oversees field sampling, processing, and transportation of samples to the laboratory.
Evan Newell Eastern Operations Section (509) 454-7865	EIM Specialist and Data Analyst	Enters data into EIM. Assists in data analysis.
Sheri Sears Fish and Wildlife Program Colville Confederated Tribes (509) 634-2118	CCT Liaison and Manager, Sampler, Field Technician	Coordinates tribal facilities, boats, netting crews, and fishing permits.
Monte Miller Fish and Wildlife Program Colville Confederated Tribes (509) 634-2119	Fish Biologist	Coordinates tribal facilities, boats, netting crews, and fishing permits. Operates CCT electrofishing boat.
Gary Arnold Eastern Operations Section (509) 454-4244	Section Manager for the Study Area	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Mark Peterschmidt Water Quality Program Central Regional Office (509) 454-7843	EAP Client	Clarifies scopes of the project, provides internal review of the QAPP, and approves the final QAPP.
Stuart Magoon Manchester Environmental Laboratory (360) 871-8801	Laboratory Director	Approves the final QAPP.
William R. Kammin (360) 407-6964	Ecology Quality Assurance Officer	Reviews the draft QAPP and approves the final QAPP.

CCT – Colville Confederated Tribes.
EAP – Environmental Assessment Program.
EIM – Environmental Information Management system.
QAPP – Quality Assurance Project Plan.

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Appendix. Glossary, Acronyms, and Abbreviations

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 designated 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.

Best management practices (BMPs): Physical, structural, and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges.

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.

Load allocation: The portion of a receiving waters' loading capacity attributed to one or more of its existing or future sources of nonpoint pollution or to natural background sources.

Loading capacity: The greatest amount of a substance that a waterbody can receive and still meet water quality standards.

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

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 National Pollutant Discharge Elimination System 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.

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 is 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.

Total Maximum Daily Load (TMDL): 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.

Wasteload allocation: The portion of a receiving water's loading capacity allocated to existing or future point sources of pollution. Wasteload allocations constitute one type of water quality-based effluent limitation.

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.

Acronyms and abbreviations

CCT	Colville Confederated Tribes
CFR	Code of Federal Regulations, usually preceded by chapter number and followed by a section number (i.e. 40CFR131.36)
DDD	1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethane (a.k.a. 4,4'-DDD)
DDE	1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene (a.k.a. 4,4'-DDE)
DDT	1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane (a.k.a. 4,4'-DDT and also used to refer to the DDD and DDE analogs)
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
g/day	grams per day
MEL	Manchester Environmental Laboratory
mg/day	milligrams per day
mg/l	milligrams per liter (parts per billion)
MQO	measurement quality objective
ng/g	nanograms per gram (parts per billion)
ng/l	nanograms per liter (parts per trillion)
NTR	National Toxics Rule (40CFR131.36)
OCD	Okanogan Conservation District
PCB	polychlorinated biphenyl

QA	quality assurance
QC	quality control
RCW	Revised Code of Washington
SOP	standard operating procedure
STP	sewage treatment plant
t-DDT	total DDT (sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT in this report)
TSCA	Toxic Substances Control Act, title 40 of the Code of Federal Regulations at Part 761 (40 CFR Part 761)
µg/l	microgram per liter (parts per billion)