Quality Assurance Project Plan

Yakima River Chlorinated Pesticides, PCBs, Suspended Sediment, and Turbidity Total Maximum Daily Load Study

by
Art Johnson

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

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303(d) Listings Addressed in this Study

Multiple toxics listings for mainstem and tributaries (see text)

Waterbody Number: Yakima River
(37-1010, 37-1020, 37-1040, 39-1010, 39-1030, 39-1060, 39-1070) and tributaries

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Approvals

Approved by:	June 2007
Ryan Anderson, Total Maximum Daily Load Lead, Central Regional Office	Date
Approved by:	June 2007
Denise Mills, Water Quality Program Section Manager, Central Regional Office	Date
Approved by:	July 2007
John Merz, Water Quality Watershed Unit Supervisor, Central Regional Office	Date
Approved by:	June 2007
Art Johnson, Project Manager, Environmental Assessment Program	Date
Approved by:	July 2007
Kristin Kinney, EIM Data Engineer, Environmental Assessment Program	Date
Approved by:	June 2007
Dale Norton, Unit Supervisor, Environmental Assessment Program	Date
Approved by:	June 2007
Gary Arnold, Section Manager, Environmental Assessment Program	Date
Approved by:	June 2007
Stuart Magoon, Director, Manchester Environmental Laboratory	Date
Approved by:	June 2007
Bill Kammin, Ecology Quality Assurance Officer	Date

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Abstract

A Quality Assurance Project Plan is provided for a one-year monitoring program to evaluate chlorinated pesticide, polychlorinated biphenyl (PCB), total suspended solids (TSS), and turbidity concentrations in the Yakima River. This is the next step in an ongoing cleanup initiated through the Total Maximum Daily Load (TMDL) process required by the Clean Water Act for waterbodies that do not meet standards. The results will be used to: 1) assess the effectiveness of the 1997 lower Yakima River Suspended Sediment and DDT TMDL; 2) identify sources and quantify loadings of chlorinated pesticides, PCBs, TSS, and turbidity; 3) recommend numerical targets that will result in the river and its tributaries meeting water quality standards; and 4) propose wasteload and load allocations for sources, as appropriate.

Acknowledgements

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Problem Statement

The Washington State Department of Ecology (Ecology) is conducting this study to determine what loadings of chlorinated pesticides, polychlorinated biphenyl (PCBs), total suspended solids (TSS), and turbidity will bring the Yakima River into compliance with water quality standards. This is the next step in an ongoing cleanup initiated through the Total Maximum Daily Load (TMDL) process required by the Clean Water Act for waterbodies that do not meet standards. Previous Yakima River TMDLs set water quality targets for suspended sediment to meet less stringent aquatic life criteria for chlorinated pesticides and the turbidity standard. Chlorinated pesticides and PCBs are persistent, legacy chemicals no longer produced or used in the United States. Currently-used pesticides and other agricultural chemicals are not the subject of this TMDL evaluation.

Background

The TMDL Process

Under the Clean Water Act, states have their own water quality standards designed to protect, restore, and preserve water quality. The standards consist of designated uses (such as fish migration, rearing, spawning, and harvesting) and numeric standards to achieve those uses. When a waterbody fails to meet standards after application of best management practices (BMPs) and required technology-based controls, Section 303(d) of the Clean Water Act requires that the state place the waterbody on a list of impaired waters. The U.S. Environmental Protection Agency (EPA) requires states to update the 303(d) list every two-to-four years.

States must prepare a TMDL analysis for each waterbody and pollutant on the 303(d) list. A TMDL determines the maximum pollutant load a waterbody can assimilate without violating standards. A TMDL must identify the total allowed pollutant amount and its components: appropriate wasteload allocations (WLA) for point sources and load allocations (LA) for non-point sources and natural background. The goal of a TMDL is to ensure that standards are attained within a reasonable period of time.

Yakima River Basin

Basin Description

The Yakima River flows 215 miles out of Keechelus Lake in the Central Washington Cascades to the Columbia River, draining an area of 6,155 square miles (Figure 1). The major population centers are, in downstream order, Ellensburg (16,542), Yakima (79,480), Toppenish (9,000), Sunnyside (14,710), and West Richland (10,210). Much of the land that lies to the south of the lower Yakima River is within the Yakama Nation Reservation and under the sovereign jurisdiction of the Yakama Nation. The reservation occupies about 15 % of the basin.

The Yakima basin is in the Cascade rain shadow. Mean annual precipitation ranges from 140 inches in the mountains to less than 10 inches in the eastern regions. The western basin is mostly forested, while the eastern uplands are dominated by sagebrush and grass. The lowlands are farmed and intensively irrigated.

The upper Yakima basin includes the Kittitas Valley, an area around Ellensburg devoted primarily to hay, cereal crops, and irrigated pasture. The lower Yakima basin is downstream of the Naches River confluence at river mile (r.m.) 116.3. The lower Yakima Valley produces fruit, vegetables, grapes, other specialty crops such as hops and mint, dairy products, and beef. The upper and lower Yakima basins are separated by the Yakima River Canyon, an arid 20-mile reach between the Kittitas and Yakima Valleys. The canyon is generally considered to be part of the upper river.

Approximately one-half million acres are irrigated in the drainage. Most of the water is managed by the U.S. Bureau of Reclamation (USBR). Snowmelt and precipitation are held in six reservoirs on the upper Yakima and Naches Rivers and delivered to growers via rivers, creeks, and man-made canals. Diversions to the canals begin in April and end in October. Water distribution from canals to farms is primarily managed by irrigation districts.

Irrigation is by one of three methods: furrow, sprinkler, or drip[1]. Of these methods, furrow typically results in the most runoff from agricultural lands. Excess water is collected at the lower ends of fields and flows into drains that ultimately reach the Yakima River. In the last several decades, much of the irrigated land has been converted to sprinkler or drip irrigation, but because of cultural practices, economics, and convenience, rill and furrow is still used by some as the method of choice for many crops.

[1] Elaine Brouillard of the Sunnyside Valley Irrigation District, gives the following percentages for this district: 36% portable sprinkler, 32% furrow, 29% permanent sprinkler, and 3% drip (personal communication)

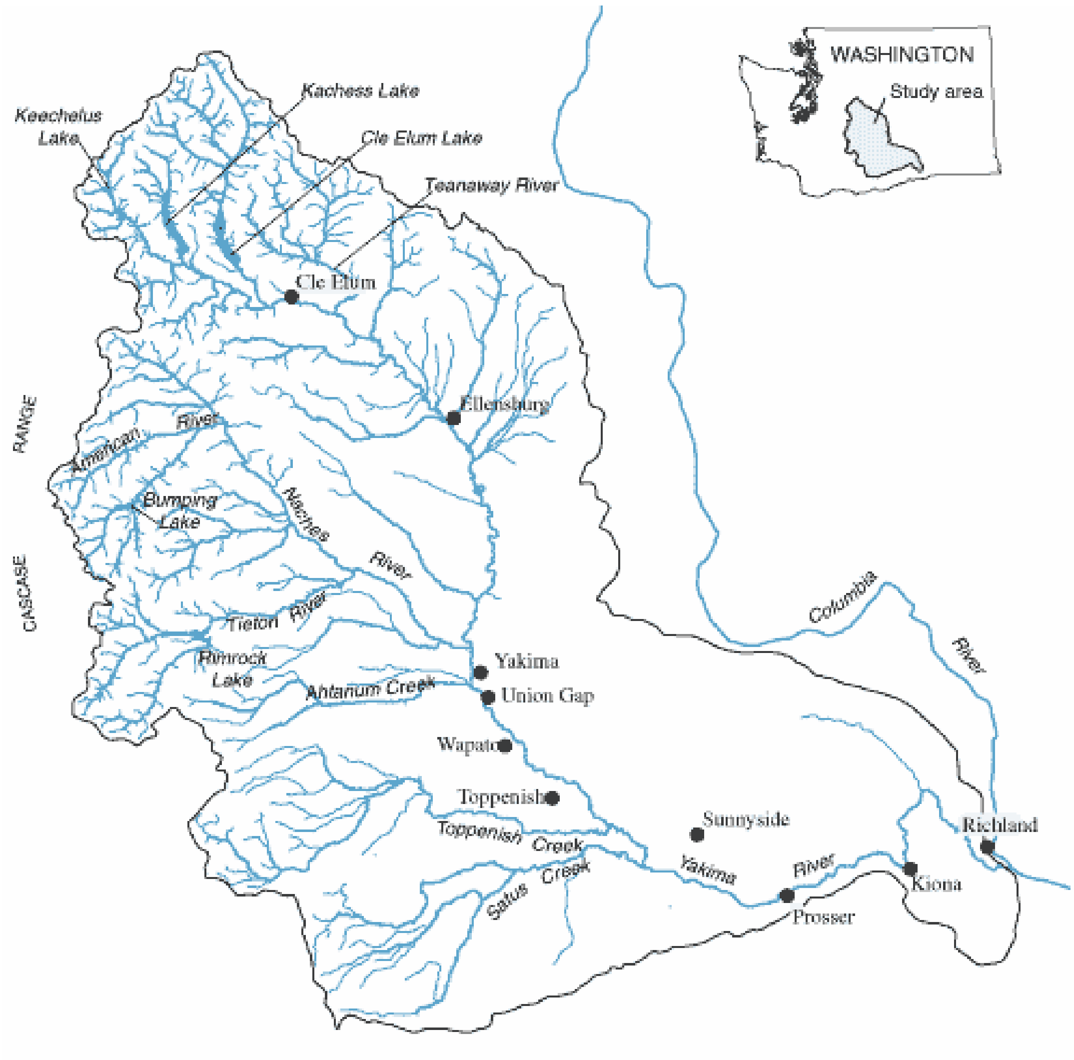

Figure 1. Yakima River Basin (http://wa.water.usgs.gov/projects/yakimawarsmp/maps.htm)

Hydrology

Peak runoff in the Yakima River occurs during snowmelt in April and May (Figure 2). Because of diversions, flow regulation in the headwaters, and dry summers, some reaches of the Yakima have a low-flow period during late summer. Most tributaries of the Yakima River are dominated by irrigation returns and have their low-flow periods in the winter.

Streamflows in the basin vary from year to year depending on snowfall. When water is plentiful, there are more operational spills which dilute the sediment and chemicals washed off fields into waterways. Water availability and dilution effects must be considered when comparing water quality between years or examining findings from a particular year (Fuhrer et al., 2004).

During the summer, return flows downstream from the city of Yakima account for 50 to 70% of the flow in the Yakima River (Fuhrer et al., 2004). Thus, for many water quality parameters, the quality of irrigation returns largely determines the quality of water in the lower Yakima River. While most of the drinking water in the Yakima basin comes from wells, surface water also provides drinking water for some cities like Yakima (Naches River) and Cle Elum (Yakima River).

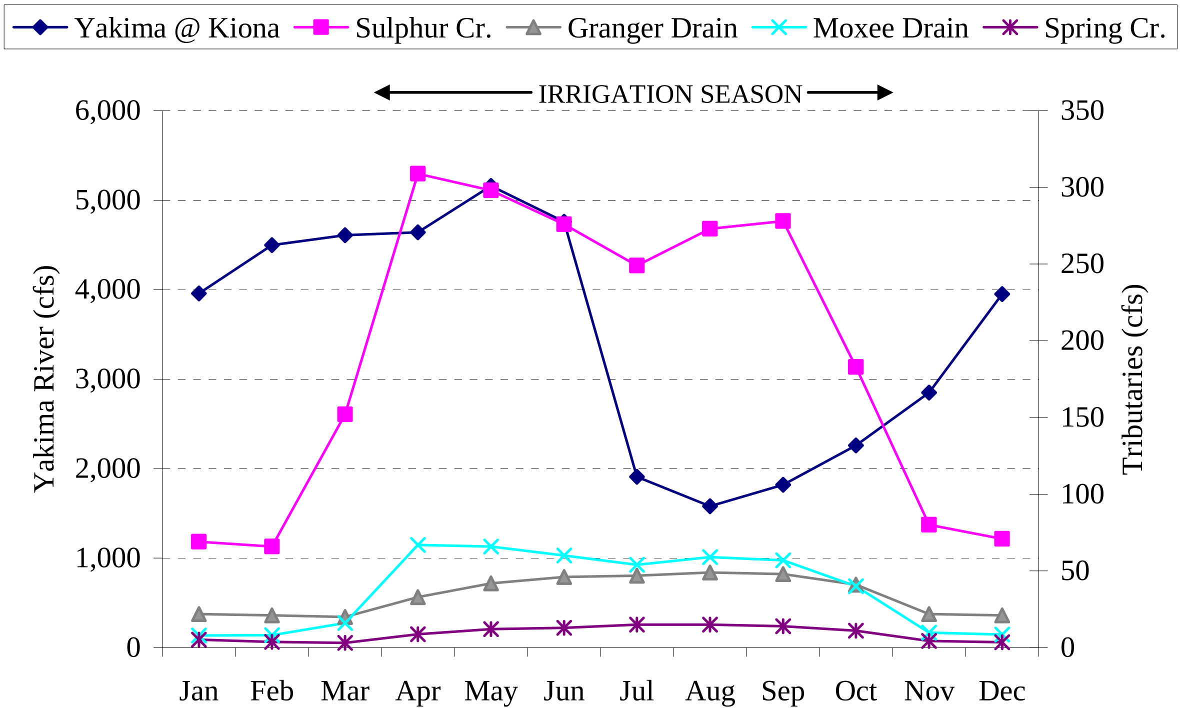

Figure 2. Monthly Average Flow in the Lower Yakima River and Selected Tributaries (USGS data: Yakima 1905-2006, Sulphur 1976-90; Granger 1991-2003, Moxee 1999-2000, Spring 1996-98)

Previous Water Quality Studies

Yakima River water quality was investigated in the 1970s, with several studies evaluating sediment loading (CH2M Hill, 1975; Boucher, 1975; Soil Conservation Service (SCS), 1978; Corps of Engineers, 1978; Ecology, 1979; Nelson, 1979; Boucher and Fretwell, 1982; and Molenaar, 1985). This work showed irrigation practices directly affected suspended sediment concentrations in the river. Peak concentrations occurred in April through June when streamflows were high and freshly tilled fields were being irrigated. Suspended sediment loads began to increase rapidly below the confluence of Moxee Drain (r.m. 107), a major irrigation return near Yakima.

In 1986, the Yakima River basin was selected as one of four surface-water pilot studies for the U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program. Data collected from 1987-1991 provide a baseline characterization of suspended solids, pesticides, nutrients, trace elements, and aquatic life in Yakima River streams. A special NAWQA study was conducted in the Yakima during 1999-2000 to monitor water quality trends and evaluate transport of agricultural chemicals and their effects on stream ecosystems. NAWQA results are reported by Rinella et al. (1999), Ebbert and Embrey (2002), Fuhrer et al. (2004), and others.

NAWQA studies showed that the highest detection frequencies and concentrations of pesticides generally occur during irrigation season. Pesticides that persist in soil, such as (DDT) dichlorodiphenyltrichloroethane, continue to be transported in streams and drains throughout the year, especially during storm runoff or snowmelt.

Groundwater inputs are also potential pesticide sources, including those normally associated with suspended sediment. DDT compounds, for example, have been detected in wells in the Toppenish and Sulphur subbasins of the lower Yakima River (Rinella et al., 1999). A recent Ecology study found the highest dieldrin levels in Wide Hollow Creek near Union Gap occurred after the irrigation season. Dieldrin was inversely correlated with discharge, suggesting subsurface flow is a major source in this area (Johnson and Burke, 2006).

The U.S. Fish and Wildlife Service began routine monitoring of bioaccumulative pesticides in Yakima River fish in the 1970s (Schmitt et al., 1990). They found high concentrations of several chlorinated compounds including DDT and dieldrin. Ecology followed up on these findings in 1985 (Johnson et al., 1986). A number of creeks and irrigation returns were identified as pesticide sources, including Wilson Creek in the upper Yakima basin and Moxee Drain, Granger Drain, Sulphur Creek Wasteway, and Spring Creek in the lower Yakima basin.

NAWQA confirmed continued high concentrations of total DDT[2] in resident lower Yakima River fish (Rinella et al., 1993). As a result, the Washington State Department of Health (WDOH) issued an advisory in 1993 that recommended limiting the consumption of bottom fish from the lower river (WDOH, 1993; www.doh.wa.gov/ehp/oehas/fish.) Because of the NAWQA studies and the WDOH advisory, the correlation between pesticides and sediment eroded from farmland came into the public focus.

[2] Total DDT is the sum of DDT and its breakdown products (DDE) dichlorodiphenyldichloroethylene and (DDD) dichlorodiphenyldichloroethane.

Existing Yakima River TMDLs

A number of TMDLs have been approved or are underway in the Yakima River basin including TMDLs for fecal coliform bacteria, temperature, ammonia, chlorine, and suspended sediment and chlorinated pesticides www.ecy.wa.gov/programs/wq/tmdl/watershed/index.html. The present study builds on results achieved through the suspended sediment/chlorinated pesticide TMDLs, described below.

Lower Yakima River Suspended Sediment and DDT TMDL

In 1997, a TMDL was established for suspended sediment in the lower Yakima River to bring it into compliance with Washington State aquatic life criteria for DDT and the turbidity standard. The basic premise behind the lower Yakima River TMDL was that suspended sediment from erosion of farm soils was the primary vehicle by which DDT and other chlorinated pesticides were being introduced to the river at levels that adversely affected aquatic life and caused an increased health risk to people consuming fish. Suspended sediments—measured as total suspended solids (TSS) – also caused excessive turbidity in the Yakima and its tributaries. The combined effects of high TSS, turbidity, and chlorinated pesticides degraded fish and wildlife habitat. Threatened and endangered salmonids were a particular concern.

The field study for the lower Yakima River Suspended Sediment and DDT TMDL was conducted by Ecology during 1994-1995 (Joy and Patterson, 1997). The schedule adopted for meeting water quality targets developed through the TMDL is shown in Table 1.

Table 1. Lower Yakima River TMDL Schedule

Year	Target	Applies To
2002	$\leq$ 5 NTU increase above background	Mainstem
2002	25 NTU	Mouths of all tributaries and drains
2007	25 NTU	All points within tributaries and drains
2007	Develop strategy to meet DDT human health criteria	All tributaries, drains, and the mainstem
2012	7 mg/L TSS	All tributaries, drains, and the mainstem
2015	DDT human health criteria to be met in fish and water	All tributaries, drains, and the mainstem

According to the schedule, tributaries to the lower Yakima River are expected to meet a turbidity target of 25 NTU[3] by 2007. A strategy to further reduce DDT levels in the river and meet human health criteria is to be developed this same year. By 2012, the mainstem and tributaries are to comply with a 7 mg/L target for TSS and by 2015 the human health criteria for DDT are to be achieved in fish and water.

[3] NTU = nephelometric turbidity units

Many farmers adopted contemporary soil erosion BMPs to meet the 5- and 10-year targets for the lower Yakima River. TMDL effectiveness monitoring conducted by Ecology in 2003 showed turbidity has been reduced dramatically (Figure 3). USGS has reported a corresponding decrease in total DDT levels in water samples from 1992 compared to 2000 (Fuhrer et al., 2004).

Figure 3. Turbidity Improvements in the Mainstem Lower Yakima River, 1995 - 2003. [data source: Coffin et al., 2006; graphic by Ryan Anderson, Ecology Central Regional Office]

Upper Yakima River Suspended Sediment and Chlorinated Pesticide TMDL

Ecology conducted a similar TMDL for the upper Yakima River in 1999 (Joy, 2002; Creech and Joy, 2002). Suspended sediment and chlorinated pesticide inputs from Wilson Creek, which drains the Kittitas Valley, were the focus of the study. The TMDL schedule for the upper river (Table 2) calls for effectiveness monitoring in 2006. Ecology, the Kittitas County Water Purveyors (KCWP), and the Kittitas County Conservation District (KCCD) conducted the required TSS and turbidity monitoring in 2006 (data not yet analyzed), but postponed the pesticide monitoring to 2007. Cleanup should be nearly complete by 2011, if the current rate of irrigation improvements continues.

Table 2. Upper Yakima River TMDL Schedule

Year	Target	Applies To
2006	DDT compounds and dieldrin to meet aquatic life criteria	Cherry Creek and Wipple Wasteway
2006	DDT compounds to meet human health criteria in fish fillets	Mainstem
2006	Monitor dieldrin in fish fillets to gauge progress toward meeting human health criteria	Mainstem
2006	90^{th} percentile turbidity $\leq$ 10 NTU over background	Mainstem (r.m. 121.7 – 139.8) and mouths of selected tributaries
2011	DDT compounds and dieldrin to meet human health criteria in water	Mouths of Cherry Creek and Wipple Wasteway
2011	Substantial progress made toward meeting human health target for dieldrin in fish fillets	Upper Yakima Basin
2011	90^{th} percentile turbidity $\leq$ 5 NTU over background	Mainstem (r.m. 121.7 – 139.8) and mouths of selected tributaries

303(d) Toxics Listings for Yakima River

Washington's current 303(d) list (www.ecy.wa.gov/programs/wq/303d/index.html) has Yakima River Category 5 listings for a number of chlorinated pesticides and breakdown products, an organophosphorus insecticide (chlorpyrifos), total polychlorinated biphenyls (PCBs), and dioxin (2,3,7,8-TCDD). Waterbodies in Category 5 require a TMDL.

The individual Category 5 listings for chemicals that have exceeded human health criteria in edible fish tissue samples from the Yakima River are in Appendix A. The listings for exceeding aquatic life or human health criteria in the water column are in Appendix B. Both sets of listings are summarized in Table 3.

The lower river has Category 5 listings for DDT compounds because, while EPA approved the 1997 TMDL for meeting aquatic life criteria, it was not approved for achieving compliance with human health criteria. The upper river TMDL was approved for meeting human health criteria and the pesticide listings were subsequently moved to Category 4a (waterbodies that have an approved TMDL). More than 90% of the Category 5 listings are now for the lower Yakima River.

Table 3. Summary of 303(d) Toxics Listings for the Yakima River (2002/2004 List)

Reach	Number of Listings	Parameter	Sample Type
		Upper Yakima River (WRIA* 39/38)	
Keechelus Lake	2	PCBs, Dioxin	Fish tissue
Yakima R. Canyon	3	Chlordane, PCBs, Dioxin	Fish tissue
Cowiche Creek	1	DDE	Fish tissue
		Lower Yakima River (WRIA 37)	
Yakima R. near Union Gap	4	DDE, DDD, BHC, PCBs	Fish tissue
"	2	DDE, DDT	Water
Yakima R. near Zillah	3	DDT, DDD, Dieldrin	Fish tissue
Yakima R. near Granger	4	DDE, PCBs	Fish tissue
"	2	DDT, Dieldrin	Water
Yakima R. near Grandview	2	DDE, DDD	Water
Yakima R. near Prosser	3	DDE, Chlordane, Dioxin	Fish tissue
"	1	DDT	Water
Yakima R. near Benton City	7	DDT, DDE, DDD, BHC, PCBs	Fish tissue
"	5	DDT, DDE, DDD, Dieldrin, Endosulfan	Water
Yakima R. near Horn Rapids	6	DDT, DDE, DDD, Dieldrin, BHC, PCBs	Fish tissue
Yakima R. near Mouth	2	DDT, DDE	Fish tissue
Yakima Tributaries (6)	34	DDT, DDE, DDD, Dieldrin, Endosulfan, Chlorpyrifos	Water
		Total Fish Tissue Listings	35
		Total Water Column Listings	46
		Total Listings	81

*Water Resources Inventory Area

All of these chemicals bioaccumulate in fish, wildlife, and humans. DDT compounds, PCBs, and dioxin, in particular, are highly bioaccumulative due to their stability and solubility in lipids (fat). Concentrations in fish tissues, for example, can be tens of thousands of times higher than in the surrounding water.

Chlorinated pesticides and PCBs are legacy pollutants no longer produced or used in the United States. They were banned by EPA in the 1970s and 1980s for ecological and human health concerns, but persist in soil, lakes, rivers, and streams.

Endosulfan, a chlorinated insecticide, is an exception in that it is currently approved for a variety of crops and ornamentals. More recent data show endosulfan levels have declined in the Yakima River as a result of BMPs; it may no longer qualify for 303(d) listing (Johnson, 2005; Johnson and Burke, 2006).

Chlorpyrifos is a currently-used organophosphorus insecticide. Moxee Drain is the only waterbody listed for this compound. Recent data collected by Ecology show that Marion Drain, Sulphur Creek Wasteway, and Spring Creek may also qualify for a 303(d) listing for chlorpyrifos (Burke et al., 2006 and unpublished Ecology data). These are all lower Yakima River tributaries.

PCBs were widely used in industrial applications as insulating fluids, plasticizers, in inks and carbonless paper, and as heat transfer and hydraulic fluids. Dioxin is an unintended by-product of combustion and certain industrial processes. These chemicals are routinely detected in Washington rivers and streams and are the cause of many 303(d) listings.

Detailed profiles including use, regulations, environmental occurrence, and health effects of chlorinated pesticides, chlorpyrifos, PCBs, and dioxin have been prepared by the Agency for Toxic Substances & Disease Registry and are available at www.atsdr.cdc.gov/toxpro2.html.

Water Quality Criteria

Use Designation

Under the Water Quality Standards for Surface Waters of the State of Washington, Amended November 20, 2006 (Chapter 173-201A WAC), all surface waters of the state are protected for the designated uses of salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values. This designation includes water quality criteria for fecal coliform bacteria, temperature, pH, dissolved oxygen, total dissolved gas, turbidity, and aesthetic values.

The turbidity criteria are a focus of the current Yakima River suspended sediment TMDLs: *Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 % increase in turbidity when the background is more than 50 NTU.* The criteria do not set a maximum acceptable turbidity level based on beneficial use considerations, but they do limit the effect of an identified source on raising the turbidity in the receiving water. Background conditions are defined as … *the biological, chemical, and physical conditions of the water body, outside the area of influence of the discharge under consideration.*

The adverse effects of elevated TSS are addressed indirectly through the turbidity criteria. EPA and a number of other authorities have established levels of TSS that are considered protective of aquatic life. Drawing on these recommendations, the lower Yakima River Suspended Sediment and DDT TMDL set a TSS target of 56 mg/L (equivalent to 25 NTU) to support Yakima River fisheries resources (Joy and Patterson, 1997).

Toxic Substances

Washington State's aquatic life and human health criteria for 303(d) listed chemicals in the Yakima River are shown in Table 4.

Table 4. Washington State Water Quality Criteria* for 303(d) Listed Pesticides, PCBs, and Dioxin in the Yakima River Basin (ng/L; parts per trillion)

Chemical	Criteria for Protection of Aquatic Life		Criteria for Protection of Human Health	
	Freshwater Chronic	Freshwater Acute	Fish Consumption	Water & Fish Consumption
4,4'-DDT	- -	- -	0.59	0.59
4,4'-DDE	- -	- -	0.59	0.59
4,4'-DDD	- -	- -	0.84	0.83
DDT (and metabolites)	1.0	1,100	- -	- -
Dieldrin	1.9	2,500	0.14	0.14
alpha-BHC	- -	- -	13	3.9
Chlordane	4.3	2,400	0.59	0.57
Endosulfan	220	56	2,000	930
Chlorpyrifos	41	83	- -	- -
Toxaphene[†]	0.2	730	0.75	0.73
PCBs	14	2,000	0.17	0.17
2,3,7,8-TCDD (dioxin)	- -	- -	0.000014	0.000013

*Chapter 173-201A Water Quality Standards for Surface Waters of the State of Washington

[†]Toxaphene may qualify for 303(d) listing, based on Ecology's 2006 fish tissue study (see text)

Aquatic Life

The aquatic life criteria are designed to protect for both short term (acute) and long term (chronic) effects of chemical exposure. The criteria are primarily intended to avoid direct lethality to fish and other aquatic life within the specified exposure periods. The chronic criteria for PCBs and many of the chlorinated pesticides are to protect fish-eating wildlife from adverse effects due to bioaccumulation.

The exposure periods assigned to the acute criteria are expressed as: 1) an instantaneous concentration not to be exceeded at any time or 2) a 1-hour average concentration not to be exceeded more than once every three years on the average. The exposure periods for the chronic criteria are either: 1) a 24-hour average not to be exceeded at any time or 2) a 4-day average concentration not to be exceeded more than once every three years on the average.

Human Health

Criteria for the protection of human health are applied to the state through the EPA National Toxics Rule (NTR) (40 CFR 131.36(14). In freshwater, the criteria take into account the combined exposure of drinking the water and eating fish that live in the water. In marine waters, human health criteria only consider the effect of eating fish. The criteria protect against non-carcinogenic illness and keep the risk of developing cancer to a pre-specified level.

In Washington, the cancer risk is set such that no more than 1 in 1,000,000 people with full exposure would be likely to develop cancer in response to that exposure. Full exposure is defined by a set of assumptions on body size, fish and water consumption, and the number of years exposed. The risk is correlated to an average-size man consuming 6.5 grams per day of fish (approximately 5 pounds per year), drinking 2 liters of water (if freshwater), and continuing this pattern for 70 years. For the chemicals of concern in the Yakima River, almost all of the cancer risk is from fish consumption. People with higher or lower body weight and exposure patterns would face higher or lower risks. This basic exposure pattern is the same for both cancer-causing and non-cancer-causing chemicals.

EPA has classed all the 303(d) listed chemicals for the Yakima River as probable human carcinogens, except for endosulfan and chlorpyrifos. The human health criteria for endosulfan are based on a reference dose that is unlikely to have appreciable health risk. There are no human health criteria for chlorpyrifos; the 303(d) listing is for exceeding aquatic life criteria.

The edible fish tissue criteria that Ecology used to place the Yakima River on the 303(d) list are shown in Table 5. These values are derived from the human health criteria in Table 4 and EPA bioconcentration factors (BCFs). BCF= C_t/C_w, where C_t is the contaminant concentration in fish or shellfish tissue (wet weight) and C_w is the concentration in water. The BCFs are taken from the EPA 1980 Ambient Water Quality Criteria documents (www.epa.gov/waterscience/criteria/1980docs.htm). The BCF predicts the chemical concentration in fish tissue that would be expected to result for a given concentration in the water column. In essence, the 303(d) fish tissue criteria are the NTR water quality criteria expressed in tissue form.

Table 5. Edible Fish Tissue Criteria for 303(d) Listed Pesticides, PCBs, and Dioxin in Yakima River Fish (ug/Kg wet weight; parts per billion)

Chemical	Fish Tissue Criteria
4,4'-DDT	32
4,4'-DDE	32
4,4'-DDD	45
Dieldrin	0.65
Total Chlordane	8.3
alpha-BHC	1.7
Toxaphene*	9.8
Total PCBs	5.3
Dioxin (2,3,7,8-TCDD)	0.00007

*Toxaphene may qualify for 303(d) listing, based on Ecology's 2006 fish tissue study (see text)

Yakama Nation Jurisdiction

Land within the Yakama Reservation is under the sovereign jurisdiction of the Yakama Nation. The Yakamas are developing their own set of tribal water quality standards but have not yet formally adopted them.

The Yakima River is the boundary of the Yakama Reservation (from Ahtanum Creek at r.m. 106.9 to the Mabton-Sunnyside Bridge at r.m. 59.8). EPA has not taken a position on whether that section of river may be subject to state or tribal jurisdiction.

Since the Yakima was on the 303(d) list of threatened or impaired waterbodies, the state acted to improve and protect water quality by developing the existing TMDLs. Water quality scientists, technicians, and educators from both the Yakama Nation and Ecology have maintained a cooperative partnership to monitor conditions and promote appropriate water management practices. The approval and cooperation of the Yakama Nation is important to the success of continuing cleanup efforts for the river.

2006 Fish Tissue Survey

In light of the 303(d) listings and TMDL schedules, Ecology surveyed chlorinated pesticide, PCB, and dioxin levels in resident fish species throughout the Yakima River in 2006 (Johnson, 2006). The objective was to verify the listings, assess progress toward the TMDL targets, and determine the need for and appropriate scope of additional TMDL field work. Preliminary data for the chemicals of primary concern are summarized in Table 6 and compared to the 303(d) criteria for fish consumption. Concentrations that exceed criteria are highlighted in bold font. DDT and DDD are also 303(d) listed chemicals, but most of the DDT residues have broken down to DDE.

Table 6. Mean Concentrations of 303(d) Listed Compounds and Toxaphene in Composite Samples* of Yakima River Fish Fillets Collected in 2006 (ug/Kg wet weight, parts per billion; except ng/Kg, parts per trillion, for TCDD)

Reach	Species	N =	DDE	Dieldrin	Total Chlordane	Alpha-BHC	Total PCBs	Toxaphene	TCDD
				UPPER YAKIMA RIVER					
Kachess Lake	Sucker	3	0.83	0.40 U	0.40 U	0.40 U	2.0 U	NA	0.030 UJ
"	Pike Minnow	3	3.7	0.40 U	0.40 U	0.40 U	**16** J	NA	0.030 UJ
Keechelus Lake	Sucker	3	2.2	0.38 U	0.38 U	0.40 U	**13** J	NA	0.030
"	Pike Minnow	2	2.6	0.40 U	0.40 U	0.40 U	**17** J	NA	0.030 UJ
"	Kokanee	3	2.2	0.40 UJ	0.70 J	0.40 U	**15** J	NA	0.030 UJ
"	Cutthroat	3	0.61	0.39 U	0.23 J	0.40 U	**5.6** J	2.0 U	0.030 UJ
"	Whitefish	2	0.73	0.39 U	0.39 U	0.40 U	**9.6** J	NA	0.030 UJ
Cle Elum	Sucker	2	7.1	0.39 U	0.41 J	0.40 U	**9.5** J	5.0 U	0.030 UJ
"	Pike Minnow	3	11	0.39 U	0.57 J	0.40 U	4.9 J	5.0 U	0.030 UJ
"	Whitefish	3	10	0.40 UJ	2.0 J	0.40 U	**16**	2.0 U	**0.15**
Yakima Canyon	Sucker	3	12	**0.93**	1.1 J	0.40 U	**9.4** J	5.0 U	0.030 UJ
"	Pike Minnow	3	31	**0.77**	2.3 J	0.40 U	**24**	2.0 U	0.030 UJ
"	Whitefish	3	**34**	0.35 J	2.9 J	0.40 U	**24**	2.0 U	0.030 UJ
				LOWER YAKIMA RIVER					
Wapato	Sucker	3	**63**	**0.99** J	0.59 J	0.40 U	**13**	5.0 U	0.03 UJ
"	Pike Minnow	3	**113**	**0.81**	0.74 J	0.40 U	**16**	7.0	0.03 UJ
"	Whitefish	3	**100**	**1.3** J	2.0 J	0.40 U	**28**	**11**	**0.24**
Prosser	Sucker	3	**100**	**2.3** J	0.68 J	0.39 U	**16** J	**14** J	0.03 J
"	Smallmouth Bass	2	**38**	**0.74** J	0.39 U	0.39 U	4.0 J	8.4 J	0.03 UJ
"	Carp	3	**500**	0.59 J	**10**	0.39 U	**170**	2.0 U	0.03 UJ
Horn Rapids	Sucker	3	**82**	**0.95**	1.8 J	0.40 U	**34**	2.0 U	0.03 UJ
"	Pike Minnow	3	**78**	**2.7** J	0.56 U	0.40 U	**7.9** J	**17** J	**0.10** J
"	Smallmouth Bass	3	**54**	**0.79**	0.99 U	0.39 U	**18**	1.9 U	0.03 UJ
"	Carp	3	**520**	**1.3** J	5.3 J	0.40 U	**96**	**55** J	0.03 UJ
303(d) Human Health Criteria			32	0.65	8.3	1.7	5.3	9.8	0.07

Bold values exceed criteria
*4-5 individuals per composite, except 8-15 for TCDD
U = not detected
UJ = not detected; detection limit is an estimate
J = estimated value
NA = not analyzed

A detailed report on the 2006 fish study is currently being prepared (Johnson et al., 2007 draft). Overall, the preliminary results indicate that:

- Levels of chlorinated pesticides in Yakima River fish have decreased since the suspended sediment TMDLs were initiated.
- Upper Yakima River fish are currently meeting, or very close to meeting, human health criteria for DDT, DDE, DDD, dieldrin, total chlordane, alpha-BHC (Benzehexuchloride), toxaphene, and dioxin.
- PCBs exceed human health criteria throughout the river, with slightly to substantially higher levels in the lower river.
- Most lower river fish species currently exceed human health criteria by factors of 2–4 for DDE and dieldrin and 2–6 for PCBs. Carp are more contaminated than other lower river species, partly due to their greater fat content.
- Chlordane and alpha-BHC meet human criteria in lower river fish, except for carp which marginally exceed the chlordane criterion in the Prosser area.
- Dioxin levels are low throughout the Yakima River, slightly exceeding human health criteria in a few cases.
- Some lower river species exceed the human health criteria for toxaphene. Toxaphene, a chlorinated insecticide, is difficult to analyze and has been under-reported in the past.

2007-2008 TMDL Evaluation

Based on findings from the 2006 fish samples, Ecology has decided to focus the field study for the 2007-2008 TMDL on the lower Yakima River and limit the chemical contaminants to chlorinated pesticides and PCBs. Dioxin will not be analyzed at this time because the levels are low. In view of the PCB criteria being exceeded throughout the mainstem, the study will include limited sampling to identify PCB sources to the upper Yakima River.

Effectiveness monitoring will also be conducted to assess progress toward meeting the 2007 TMDL targets for TSS and turbidity in the lower river, and chlorinated pesticides in the upper river (Tables 1 and 2). Effectiveness monitoring for the upper river is focused on Cherry Creek and Wipple Wasteway, and is the subject of an addendum to this Quality Assurance Project Plan (Coffin and Johnson, 2007 draft).

Chlorpyrifos

The chlorpyrifos listing for Moxee Drain and other potential new listings for this currently-used insecticide raise a different set of issues and call for different remedies than chlorinated pesticides and PCBs. Chlorpyrifos and associated organophosphorus insecticides have a faster breakdown rate, lower affinity for sorption and bioaccumulation, and greater solubility. Unlike legacy chemicals, water quality exceedances for chlorpyrifos in the Yakima drainage are restricted to periods when it is applied. Additionally, aquatic life criteria are the primary concern with chlorpyrifos, rather than the human health criteria concerns with legacy pollutants.

The most successful reductions of off-site pesticide transport are achieved through careful use, application practices, and land BMPs. The EPA Office of Pesticide Programs (OPP) has authority to regulate pesticide use under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). In view of the aquatic life exceedances that have been observed for chlorpyrifos, use and application restrictions will likely occur in the lower Yakima watershed under the EPA-OPP- Endangered Species Protection Program (www.epa.gov/espp/usa-map.htm). The Endangered Species Protection Bulletin is a legal modification to the pesticide label and is enforceable www.epa.gov/oppfead1/endanger/.

Similarly, the Washington State Department of Agriculture (WSDA) has legal authority to impose any of these restrictions. WSDA and Ecology are currently engaging growers in the lower Yakima watershed for help in determining less toxic and less mobile pesticides through a series of presentations. Application methods, integrated pest management, and meteorological planning are included to help prevent off-site transport. (Chris Burke, Ecology, personal communication)

While chlorpyrifos data will be collected during the present study, this study will not propose wasteload or load allocations for this pesticide. Depending on study findings and future actions taken by EPA and WSDA regarding its use, an alternate approach may be appropriate for chlorpyrifos at a later date.

Project Description

The goals of this study are to:

1. Assess the effectiveness of the 1997 lower Yakima River Suspended Sediment and DDT TMDL in reducing TSS and turbidity levels in the mainstem and priority tributaries.
2. Identify current sources and quantify loadings of chlorinated pesticides, PCBs, TSS, and turbidity to the lower Yakima River and of PCBs to the upper Yakima River.
3. Recommend numerical water quality targets that will result in the Yakima River meeting Washington State human health for chlorinated pesticides and PCBs, and the turbidity standard.
4. Propose wasteload and load allocations to meet the targets, as appropriate.
5. Provide data to the WDOH to update the Yakima River fish consumption advisory

The project area for the study will include the Yakima River mainstem and tributaries from Roza Dam (r.m. 127.9) to the Columbia River confluence. Pesticide sampling will focus on selected mainstem stations and priority tributaries. Reconnaissance-level pesticide sampling will be conducted for minor tributaries and returns. Facilities with permits to discharge wastewater to the Yakima River or its tributaries will be screened for chlorinated pesticides and PCBs. Stormwater runoff from the Yakima urban area will be characterized for chlorinated pesticides and PCBs. Limited PCB sampling will also be done to identify PCB sources in the upper Yakima River. All samples will be analyzed for TSS and turbidity.

Field work will be conducted from April 2007 through March 2008. The analyses will include all chlorinated pesticides and PCBs that have been reported in fish or water samples from the Yakima River drainage.

Specific objectives of the study are to:

1. Monitor chlorinated pesticides, PCBs, TSS, and turbidity in the lower Yakima River mainstem and priority tributaries.
2. Obtain reconnaissance-level pesticide and ancillary water quality data for minor lower Yakima River tributaries.
3. Investigate wastewater treatment plant (WWTP) effluent as a potential source of chlorinated pesticides and PCBs.
4. Determine if process water from fruit packers and vegetable processors is a source of chlorinated pesticides.
5. Identify PCB source areas in the upper Yakima River.

6. Characterize chlorinated pesticide, PCB, TSS, and turbidity levels in representative samples of urban stormwater runoff.
7. Evaluate the correlation between chlorinated pesticides, TSS, and turbidity in the lower Yakima River and revise existing TMDL water quality targets as appropriate.
8. Determine the Yakima River's loading capacity for chlorinated pesticides, PCBs, TSS, and turbidity.
9. Propose wasteload and load allocations for point sources, nonpoint sources, and background to meet state water quality standards.
10. Incorporate the above data and analysis into a report that addresses the TMDL elements required by EPA Region 10 (i.e., scope of the TMDL; applicable water quality standards; numerical targets; loading capacity, wasteload and load allocations; margin of safety; seasonal variation; and monitoring plan).

The TMDL study will be conducted by the Ecology Environmental Assessment (EA) Program and the Ecology Central Regional Office (CRO) Yakima River TMDL Team. Samples will be analyzed by the Ecology Manchester Environmental Laboratory.

This Quality Assurance Project Plan (QAPP) was prepared following the Ecology guidance in Lombard and Kirchmer (2004).

Organization and Schedule

Responsibilities

- Central Regional Office (CRO) Yakima River TMDL project team – Ryan Anderson (509-575-2642), Jane Creech (509-454-7860), Mark Peterschmidt (509-454-7843), and Gregory Bohn (509-454-4074).
- EPA contact – To be determined
- EA Program Statewide Assessments Unit (SAU) Project Manager – Art Johnson (360-407-6766) will have overall responsibility for implementing the study, analyzing the data, and preparing the study report.
- EA Program field leads:

Effectiveness Monitoring – Chris Coffin, Freshwater Monitoring Unit, Eastern Operations Section (EOS) (509-454-4257), will be responsible for all aspects of the field work associated with effectiveness monitoring for TSS, TNVS, turbidity, and conductivity. EOS will be responsible for writing the effectiveness monitoring report.

Surface Water Pesticides – Kristin Kinney, Directed Studies Unit, Eastern Operations Section (509-454-4243), will be responsible for all aspects of the field work associated with collecting pesticide samples for the routine and reconnaissance tasks, including obtaining flow data for sampling sites and coordination with CRO and the Yakama Nation for sampling on the Yakama Reservation.

Semipermeable Membrane Devices (SPMDs) – Art Johnson, Statewide Assessments Unit, Statewide Coordination Section (360-407-6766), will be responsible for the SPMD deployments, including coordination with Environmental Sampling Technologies (EST) laboratory.

WWTPs – Steve Golding, Directed Studies Unit, Western Operations Section (360-407-6701), will be responsible for collecting all WWTP effluent samples, including coordination with CRO permit managers and WWTP operators.

Fruit Packers/Vegetable Processors – Brandee Era-Miller, Statewide Assessments Unit, Statewide Coordination Section (360-407-6771), will be responsible for collecting all process water samples from fruit packers and vegetable processors, including coordination with CRO permit managers and plant managers.

Stormwater – Brandi Lubliner, Directed Studies Unit, Western Operations Section (360-407-7140), will be responsible for identifying drains for stormwater sampling, including coordination with city and county public works officials, and will be responsible for using the data to estimate stormwater loads. Kristin Kinney, Directed Studies Unit (509-454-4243), will be the field lead for stormwater.

EA Program Statewide Assessments Supervisor – Dale Norton (360-407-6765).

- Manchester Environmental Laboratory Director – Stuart Magoon (360-871-8813).
- Manchester Laboratory Chemistry Units Supervisor – Dean Momohara (360-871-8808).
- Manchester Laboratory Organics Unit Supervisor – John Weakland (360-871-8820).
- Manchester Laboratory QC & Sample Management – Karin Feddersen (360-871-8829).
- Environmental Sampling Technologies (SPMDs) – Terri Spencer (816-232-8860).
- Ecology Quality Assurance Officer – Bill Kammin (360-407-6964).
- Ecology Environmental Information Management System (EIM) data entry – Kristin Kinney (509-454-4243).

Schedule*

Environmental Information System (EIM) Data Set	
EIM Data Engineer	Kristin Kinney
EIM User Study ID	AJOH0055
EIM Study Name	Yakima River Chlorinated Pesticide and PCB Evaluation
EIM Completion Due	June 2008
Final Report	
Author Lead	Art Johnson
Schedule	
Draft Due to Supervisor	December 2008
Draft Due to Client/Peer Reviewer	February 2009
Draft Due to External Reviewer	April 2009
Final Report Due	December 2009

*see Table 14 for the field work schedule

Sampling Design

Surface Water

Effectiveness Monitoring

As previously mentioned, effectiveness monitoring for the lower Yakima River Suspended Sediment and DDT TMDL was conducted in 2003 (Coffin et al., 2006). TSS and turbidity samples were collected at five mainstem stations and four priority tributaries twice a month from April 2003 through October 2003. The monitoring stations for 2003 are listed in Table 7.

The basis for evaluating turbidity improvements in the lower Yakima mainstem was comparison to upstream *background* conditions. Background was determined by measuring turbidity at the Yakima River at Terrace Heights Bridge (r.m. 113.2). This site is downstream from the Naches River confluence (r.m. 116.3) and upstream of agricultural returns in the Yakima area. Data from Terrace Heights Bridge were compared to results from four downstream stations at Parker Bridge (r.m. 104.6), Mabton/Sunnyside Bridge (r.m. 59.8), Euclid Bridge (r.m. 55.0), and Benton City-Kiona Bridge (r.m. 29.8).

Table 7. Lower Yakima River Mainstem Stations and Tributaries Where Effectiveness Monitoring was conducted in 2003 and is proposed for 2007

Name and Location	River Mile	Bank*	2003	2007
Yakima River at Harrison Bridge	121.7	- -		x
Naches River near mouth	116.3	RB		x
Yakima River at Terrace Heights Bridge	113.2	- -	x	
Moxee Drain at Birchfield Road	107.3	LB	x	x
Yakima River at Parker Bridge	104.6	- -	x	x
Granger Drain at sheep barns in Granger	82.8	LB	x	x
Sulphur Creek Wasteway at Holaday Road	61.0	LB	x	x
Yakima River at Mabton/Sunnyside Bridge	59.8	- -	x	
Yakima River at Euclid Bridge	55.0	--	x	x
Spring Creek near mouth	41.8	LB	x	x
Yakima River at Benton City-Kiona Bridge	29.8	--	x	x

*signifies a right or left bank tributary, as seen facing downstream

The four tributaries included in effectiveness monitoring were Moxee Drain, Granger Drain, Sulphur Creek Wasteway, and Spring Creek. These were selected as being representative of irrigation return water that enters the Yakima River and were specifically named as priority tributaries in the TMDL five-year targets.

Data from these nine sites were compared with results from the TMDL field study in 1994-1995. The TMDL established irrigation season as the *critical period* (approximately mid-April through mid-October, depending on water supply). Therefore, effectiveness monitoring was also limited to the irrigation season. Similar methods employing depth- and width-integrated sampling techniques were used in both 1994-1995 and 2003.

A similar set of samples will be collected during the 2007 irrigation season as part of the present study. The same stations will be sampled, with the exception of Terrace Heights and Mabton/Sunnyside Bridge. The Terrace Heights station will be replaced with two stations farther upstream—Yakima River at Harrison Bridge and the Naches River— where pesticides are being monitored, as described below. Background for the lower river will be calculated as the flow-weighted average of these two sites. Mabton/Sunnyside Bridge is only a few miles above the Euclid Bridge station and had similar levels of TSS and turbidity in the previous round of effectiveness monitoring.

The effectiveness monitoring stations proposed for 2007 are indicated in Table 7 and their locations shown in Figure 4. The 2007 results will be compared to 1994-1995 and 2003.

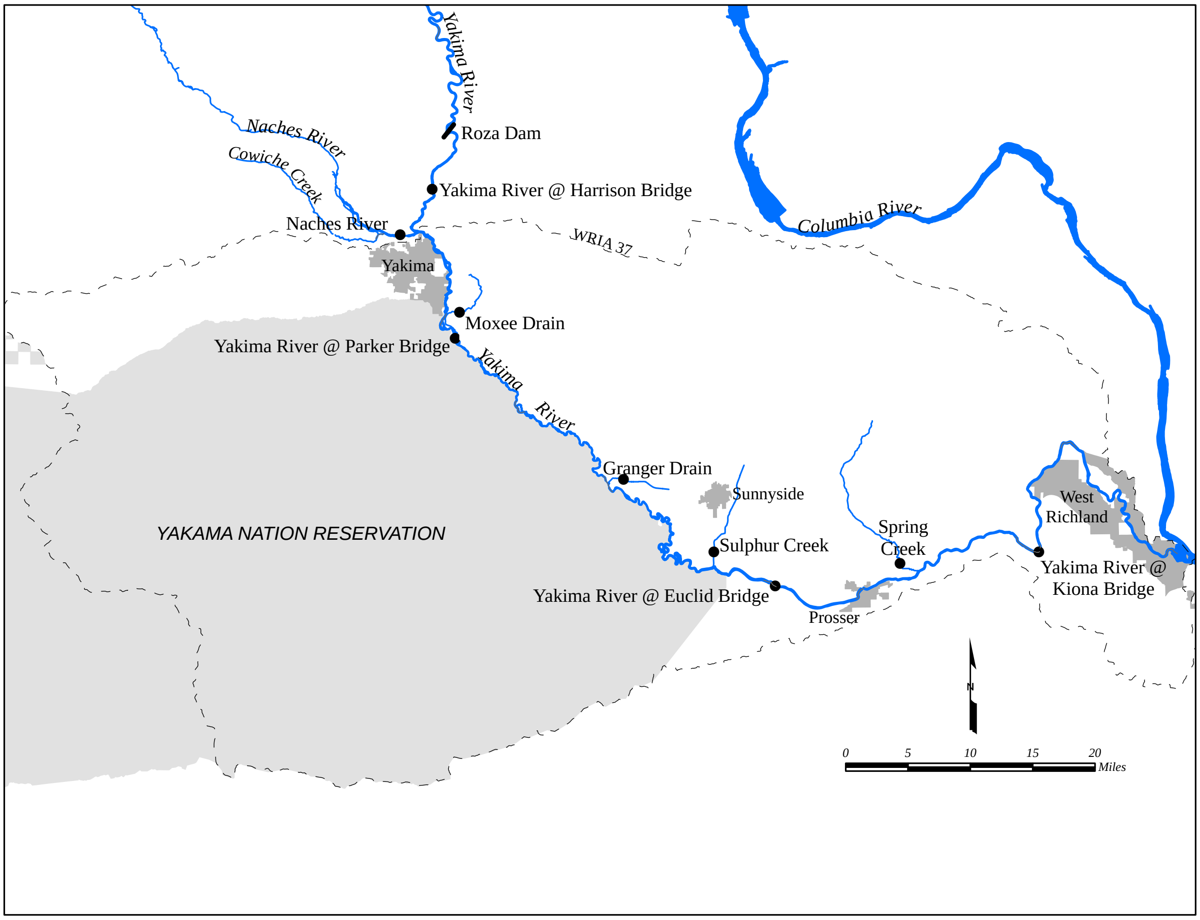

Figure 4. Sites Proposed for Effectiveness and Routine Pesticide Monitoring in the Lower Yakima River During 2007-08. (R. Coots, EA Program)

With improved water clarity, there was a substantial amount of plant growth in 2004 and 2005 in portions of the lower Yakima River. To differentiate between suspended matter derived from plant material vs. other sources, a total non-volatile suspended solids (TNVSS) analysis will be included for all mainstem stations.

Pesticide Monitoring

A two-tiered approach will be used for monitoring chlorinated pesticides in surface water in the lower Yakima River drainage. Routine sampling will be conducted at mainstem stations and major tributaries and drains that were the focus of monitoring efforts for the previous TMDL. Reconnaissance-level sampling will be conducted for minor tributaries and returns deemed to have the greatest potential for contamination. PCB concentrations will not be measured in these samples due to the high cost of analyzing a whole water sample (see Passive Sampling).

Routine Sampling

The four mainstem stations and five tributaries shown in Table 8 will be sampled intensively for chlorinated pesticides twice a month during the irrigation season (April - September 2007 samples) and monthly during the fall and winter (October 2007 - March 2008 samples). The sampling stations are the same as for effectiveness monitoring (Figure 4).

Table 8. Lower Yakima River Mainstem Stations and Tributaries Proposed for Routine Monitoring for Chlorinated Pesticides during 2007-2008.

Name and Location	River Mile	Bank*
Yakima River at Harrison Bridge	121.7	- -
Naches River near mouth	116.3	RB
Moxee Drain at Birchfield Road	107.3	LB
Yakima River at Parker Bridge	104.6	- -
Granger Drain at sheep barns in Granger	82.8	LB
Sulphur Creek Wasteway at Holaday Road	61.0	LB
Yakima River at Euclid Bridge	55.0	--
Spring Creek near mouth	41.8	LB
Yakima River at Benton City-Kiona Bridge	29.8	--

*signifies a right or left bank tributary, as seen facing downstream

This effort will provide twelve pesticide results each for the irrigation season and six results each for the non-irrigation season. Extra weight is being given to the irrigation season because pesticides are most frequently detected during this period and to better establish the correlation between chlorinated pesticides, TSS, and turbidity. The TSS and turbidity targets from the previous TMDL were derived by pooling data from the entire study area. This may not be appropriate under current conditions, in which case the larger sample size may allow site-specific targets to be developed.

The Yakima River at Harrison Bridge and the Naches River stations represent pesticide background for the lower Yakima River. Both stations were monitored for the previous TMDL. The Naches River supplies fairly high-quality water to the irrigation system and has few point sources. The Naches is the larger source of water to the lower Yakima during the September - October *flip-flop* when upper river flows are reduced to prevent de-watering of salmon redds. The Yakima River stations at the Parker, Euclid, and Benton City-Kiona bridges bracket the major irrigation returns and urban areas.

Reconnaissance Sampling

Many smaller tributaries to the Yakima River have either never been sampled for chlorinated pesticides or the samples have not been analyzed down to human health criteria levels. Table 9 lists an additional 23 tributaries that will be sampled on a quarterly basis starting in May 2007. Figure 5 shows their location. This reconnaissance effort will provide two sets of results each for the irrigation and non-irrigation season.

Table 9. Lower Yakima River Tributaries Proposed for Reconnaissance Sampling for Chlorinated Pesticides during 2007-08.

Name and Location	River Mile	Bank*
Selah Creek near mouth	123.7	LB
Wenas Creek near mouth	122.4	RB
Selah Ditch @ mouth	117.1	RB
Cowiche Creek (Naches tributary)	- -	- -
Wide Hollow Creek @ Main Street	107.4	RB
Ahtanum Creek near mouth†	106.9	RB
Joint Drain 14.6 @ Zillah	~89	LB
East Toppenish Drain @ Toppenish Road East†	86.0	RB
Subdrain 35 near Mouth†	83.2	RB
Marion Drain @ Indian Church Road†	82.6	RB
Toppenish Creek @ Indian Church Road†	80.4	RB
Coulee Drain @ Satus Road†	77.0	RB
Satus Creek @ North Satus Road†	60.2	RB
South Drain @ South Satus Road†	69.3	RB
DID #7 nr. mouth	65.1	LB
Satus Drain #302 near mouth†	60.2	RB
Satus Drain #303 near mouth†	~60	RB
Drain #31 @ Sunnyside-Mabton Highway	58.0	LB
Grandview Drain @ mouth	55.8	LB
Wauna Ditch @ Wamba Road	47.2	LB
Corral Canyon Creek @ Old Inland Empire Highway	33.5	LB
Cold Creek @ Horn Road	18.8	LB
Amon Creek Wasteway near mouth	2.1	RB

*signifies a right or left bank tributary, as seen facing downstream

†Yakama Nation Reservation

An attempt was made to be comprehensive in selecting tributaries for reconnaissance sampling, to avoid overlooking significant sources of contamination. These tributaries were recommended by Joe Joy (Ecology's lead investigator for the 1997 TMDL); the CRO Yakima River TMDL Team; and Marie Zuroske of the South Yakima Conservation District. It may not be possible to get quarterly samples from all tributaries because some flow intermittently during the irrigation season or may be dry during the winter. Ecology will request permission to collect samples from tributaries on the Yakama Reservation.

Sample Collection and Analysis

The depth-integrating samplers used for effectiveness monitoring are not designed for low-level organics work, are difficult to clean, and have an increased chance of introducing contamination in an agricultural setting. The routine and reconnaissance pesticide samples will be composites from quarter-point transects collected directly into appropriately cleaned glass bottles. The bottles will be raised and lowered through the water column to approximate the width-depth integrated method. This technique is being used by Ecology to monitor current-use pesticides in lower Yakima River tributaries (Burke et al., 2006).

Hallock (2005) compared TSS, turbidity, and other water quality data obtained for the Yakima River at Kiona using Ecology collected single point surface grabs vs. U.S. Geological Survey (USGS) width-depth integrated samples. Only sediment measures were significantly different overall and even for this constituent the difference was small. Hallock pointed out that some of the difference in sediment results was attributable to the analytical method. The SSC method used by USGS yields significantly higher results than the TSS method used by Ecology, even when collection methods are the same.

A similar comparison was conducted for a range of sites sampled during the Yakima River Suspended Sediment and DDT TMDL. There were no significant differences between TSS or other results from simple grabs and integrated samples (Joy and Patterson, 1997).

The routine samples will be analyzed for chlorinated pesticides. TSS, turbidity, and conductivity will be analyzed at routine stations when these parameters are not being covered by effectiveness monitoring. All reconnaissance samples will be analyzed for chlorinated pesticides, TSS, turbidity, and conductivity. Stream flow will be gauged where required.

Pesticides will be analyzed by gas chromatography/electron capture detection (GC/ECD). A large volume injection (LVI) technique will be used to achieve detection limits in the sub-parts per trillion range for comparison with human health criteria. Target compounds for the pesticide analysis are listed in Appendix C.

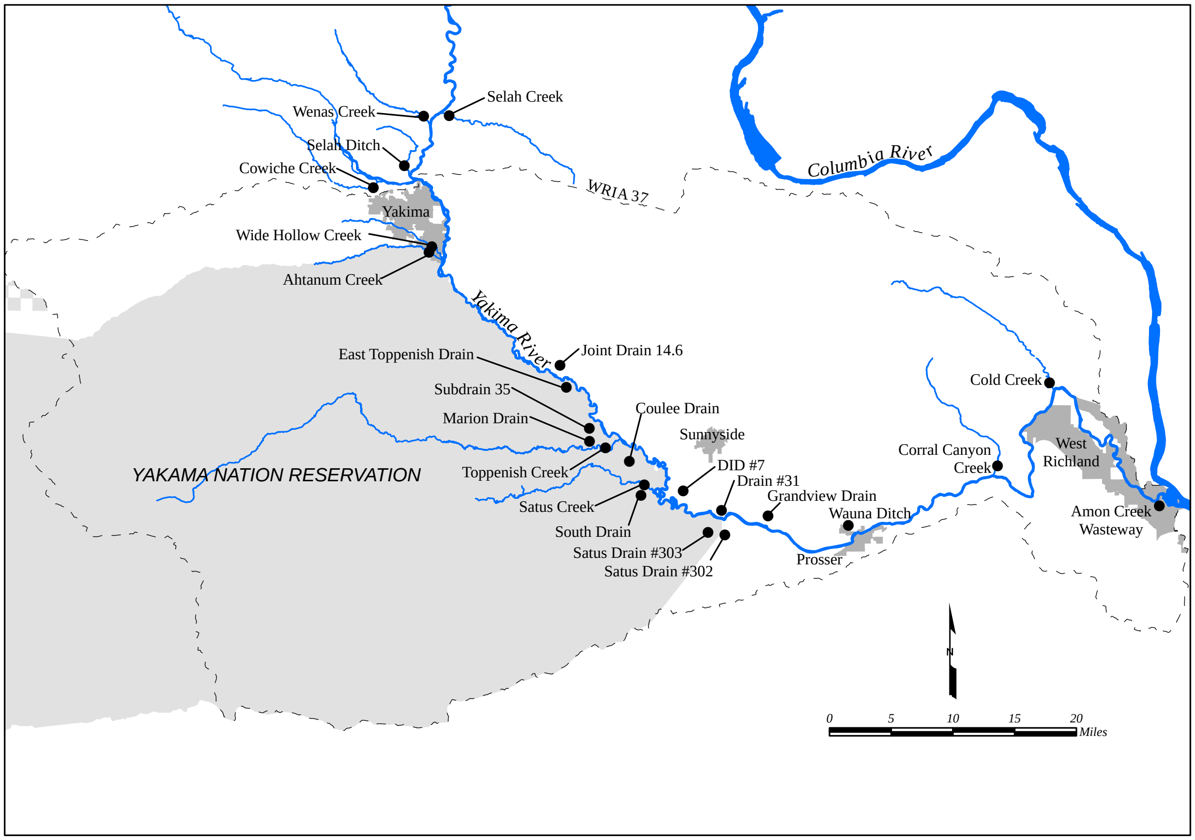

Figure 5. Tributaries Proposed for Reconnaissance Pesticide Sampling in the Lower Yakima River During 2007-2008. (R. Coots, EA Program)

DDT/TSS Correlation

The National Research Council (2001) suggests using statistical regression of a water quality indicator on one or more predictor variables as a simple and potentially useful model for developing TMDLs. This was the approach used to establish TSS and turbidity targets in the 1997 lower Yakima River TMDL. The TMDL was able to correlate total DDT with TSS and set targets for TSS reduction to meet the DDT aquatic life criteria; TSS was, in turn, linked to the state turbidity standard and to fish habitat requirements. Setting water quality targets based on TSS and turbidity has the advantage of translating more directly into land-use practices and habitat requirements, and being quicker and less expensive to monitor than targets based on trace chemical concentrations.

The lower Yakima River correlation for total DDT and TSS in 1994-1995 is shown in Figure 6. The TMDL's interim and final water quality targets of 25 NTU (56 mg/L TSS) and 7 mg/L TSS were based on this relationship (Table 1).

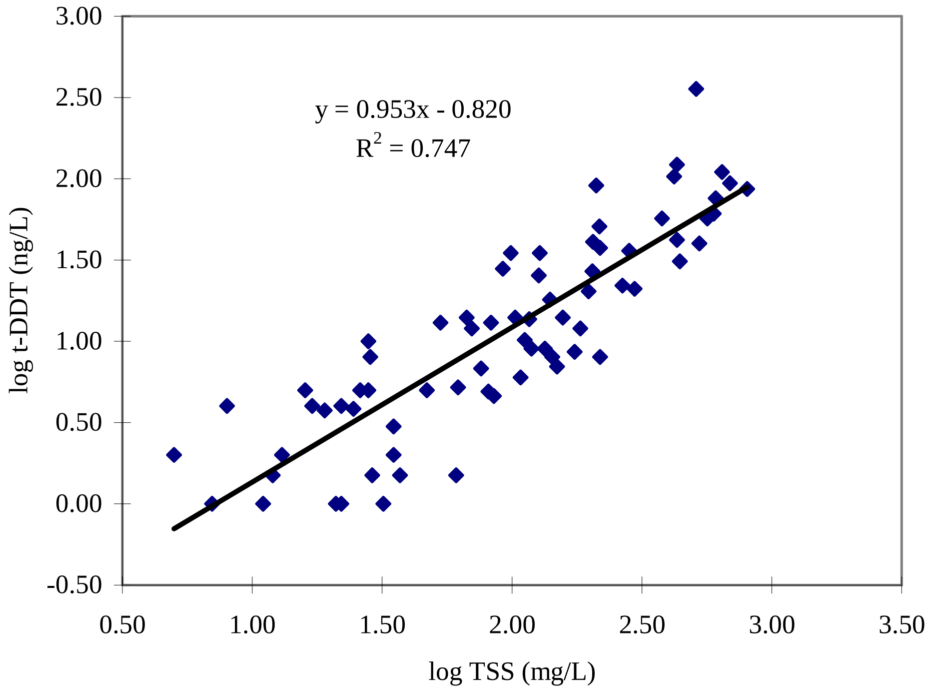

Figure 6. DDT:TSS Correlation for the Lower Yakima River in 1994-1995 (from Joy and Patterson, 1997)

The DDT, TSS, and turbidity data being collected during 2007-2008 will be examined for correlations, focusing on data from the irrigation season. USGS has reported that the total DDT concentration associated with suspended sediment in the lower Yakima River showed a marked decrease in 1999-2000 compared to the pre-TMDL period (Fuhrer et al., 2004). The correlation has apparently changed since 1995. Fuhrer (2004) lists several possible reasons for the decrease: 1) degradation of total DDT in soils and bed sediments, 2) dilution of suspended sediment with uncontaminated eroded soils, or 3) use of PAM (polyacrylamide) in the flocculation and sedimentation of fine-grained, organically enriched soil particles that tend to sorb total DDT. The DDT:TSS correlation may, therefore, be more difficult to establish now than in 1994-1995 when concentrations were higher.

Passive Sampling for PCBs and Toxaphene

PCBs and toxaphene are complex mixtures of hundreds of compounds which are difficult to analyze. Analyzing enough whole water samples to obtain representative data would be prohibitively expensive. Therefore, a passive sampling technique using a semipermeable membrane device (SPMD) will be used to estimate PCB and toxaphene concentrations during selected time periods in the Yakima mainstem and major tributaries.

A SPMD is composed of a thin-walled, layflat polyethylene tube filled with a neutral lipid material, triolein, (Figure 7). When placed in water, dissolved lipophilic compounds like chlorinated pesticides and PCBs diffuse through the membrane and are concentrated over time. A SPMD will effectively sample up to 10 liters of water per day, depending on the chemical in question. The typical deployment period is about 28 days, after which the membranes are retrieved, extracted, and analyzed for the chemicals of interest. The large chemical residues accumulated in a SPMD give a strong analyte signal, which translates into parts per trillion detection limits or lower. Because SPMDs measure the long-term average concentration of a chemical, random fluctuations are smoothed and representativeness of the data improved.

Figure 7. Standard SPMD Membrane Mounted on a Spider Carrier

SPMDs were developed by the USGS Columbia Environmental Research Center, Columbia, Missouri and are now of standardized design, patented, and commercially available through Environmental Sampling Technologies (EST), St. Joseph, Missouri, (www.est-lab.com/index.php). Details of SPMD theory, construction, and applications can be found at wwwaux.cerc.cr.usgs.gov/spmd/index.htm and in Huckins et al. (2006). The use and practicality of SPMDs for environmental monitoring is now well established. There are more than 180 peer reviewed publications in the open scientific literature where SPMDs have been used for detecting chemical contaminants in the environment (Huckins et al., 2006).

The amount of chemical absorbed by a SPMD is proportional to the local water column concentration. Therefore, contaminant levels among sites can be assessed by directly comparing absorbed amounts over the monitoring period. SPMDs also provide an estimate of the time-weighted average concentration for the chemicals of interest. Water column concentrations are obtained using Permeability/Performance Reference Compounds (PRCs) spiked into deployed SPMDs. PRC loss rates are used to calibrate for the effects of water velocity, temperature, and biofouling. Studies have shown that chemical concentrations derived from SPMDs are comparable to other low-level sampling methods such as solid-phase and liquid-liquid extraction, generally agreeing within a factor of two (Ellis et al., 1995; Rantalainen et al., 1998; Hyne et al., 2004).

The locations proposed for deploying SPMDs in the Yakima River are shown in Table 10 and Figures 8 and 9. For the lower river, these are the same as the routine pesticide monitoring stations except for Roza Dam, Sunnyside Diversion Dam, and Prosser Diversion Dam. SPMDs are being deployed at these dams because the bridges used for routine monitoring do not offer a secure location.

Table 10. Yakima River Mainstem Sites and Tributaries Where SPMDs will be Deployed During 2007.

Name and Location	River Mile	Bank*
Yakima River below Kachess Lake†	202.5	- -
Yakima River ab. Ellensburg**	161.3	- -
Wilson Creek near Mouth	147.0	LB
Yakima River at Roza Dam	127.9	- -
Naches River near mouth	116.3	RB
Moxee Drain at Birchfield Road	107.3	LB
Yakima River at Sunnyside Diversion	103.8	- -
Granger Drain at sheep barns in Granger	82.8	LB
Sulphur Creek Wasteway at Holaday Road	61.0	LB
Yakima River at Prosser Diversion	47.2	--
Spring Creek near mouth	41.8	LB
Yakima River at Benton City-Kiona Bridge	29.8	--

*signifies a right or left bank tributary, as seen facing downstream

† at Lake Easton dam

** at Ellensburg Power Co. diversion (Towne Ditch)

Because the human health criteria for PCBs are exceeded throughout the river, SPMDs will also be located at three additional upper river sites (Table 10, Figure 9). The site below Kachess Lake outlet is intended to provide background data for the upper mainstem. Other upper river SPMDs will be located in the mainstem above Ellensburg and in the mouth of Wilson Creek. The SPMD effort in the upper river is being focused on this region because it is the most developed urban/agricultural area and, on this basis, has the greatest potential to be a source of PCBs and toxaphene.

The SPMDs will be deployed during the early irrigation and again after the end of the irrigation season (Figure 10). The deployment period will be approximately one month each time.

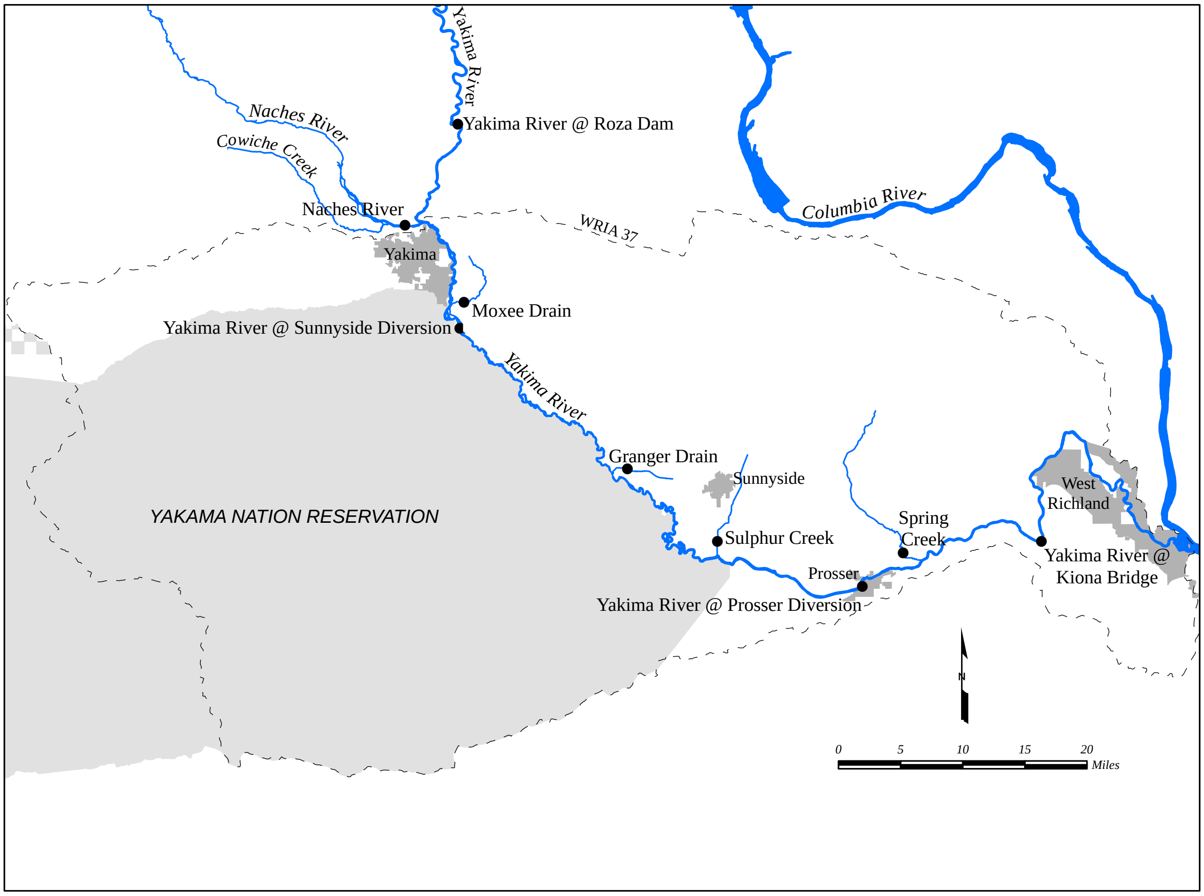

Figure 8. Sites where SPMDs will be Deployed for Chlorinated Pesticides and PCBs in the Lower Yakima River During 2007. (R. Coots, EA Program)

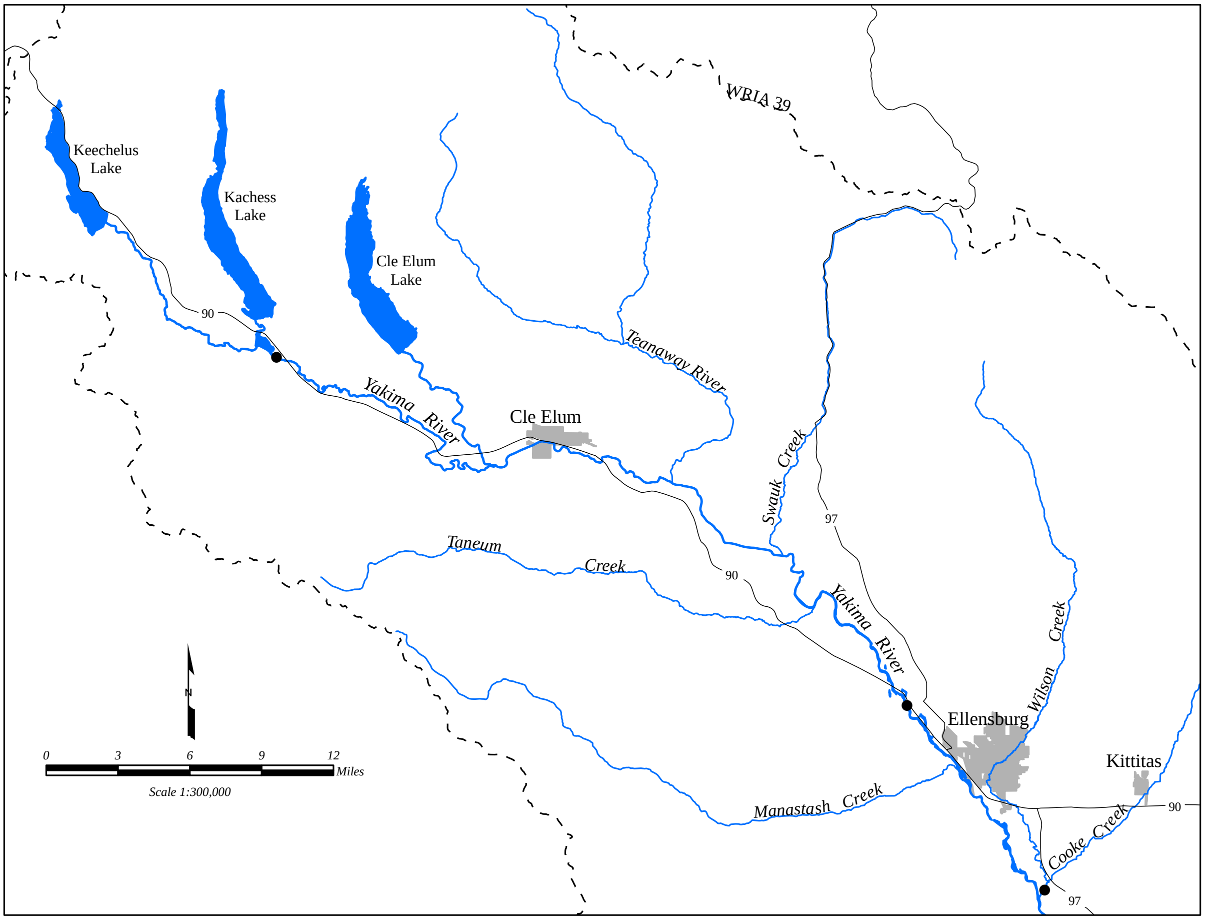

Figure 9. Sites where SPMDs will be Deployed for Chlorinated Pesticides and PCBs in the Upper Yakima River During 2007. (R. Coots, EA Program)

The SPMD extracts will be analyzed for chlorinated pesticides and PCBs. The target list, shown in Appendix D, includes some additional pesticides/breakdown products compared to the water samples. PCBs will be analyzed as individual congeners[4], using high resolution gas chromatography/mass spectrometry (HRGC/MS) to achieve low detection limits. Water samples will be taken at the beginning and end of each deployment and analyzed for total organic carbon (TOC). TOC can be used to estimate total chemical concentrations from the dissolved data obtained with SPMDs. TSS, turbidity, and conductivity will be analyzed for the upper river SPMD stations, since these data are not being collected in other parts of the study.

[4] In the United States, PCBs were primarily manufactured and sold under the trade name Aroclor. PCBs are typically analyzed as equivalent concentrations of commercial Aroclor mixtures (e.g., PCB-1254) or as individual compounds, referred to as PCB congeners. A congener analysis affords much lower detection limits than an Aroclor analysis, but is much more expensive.

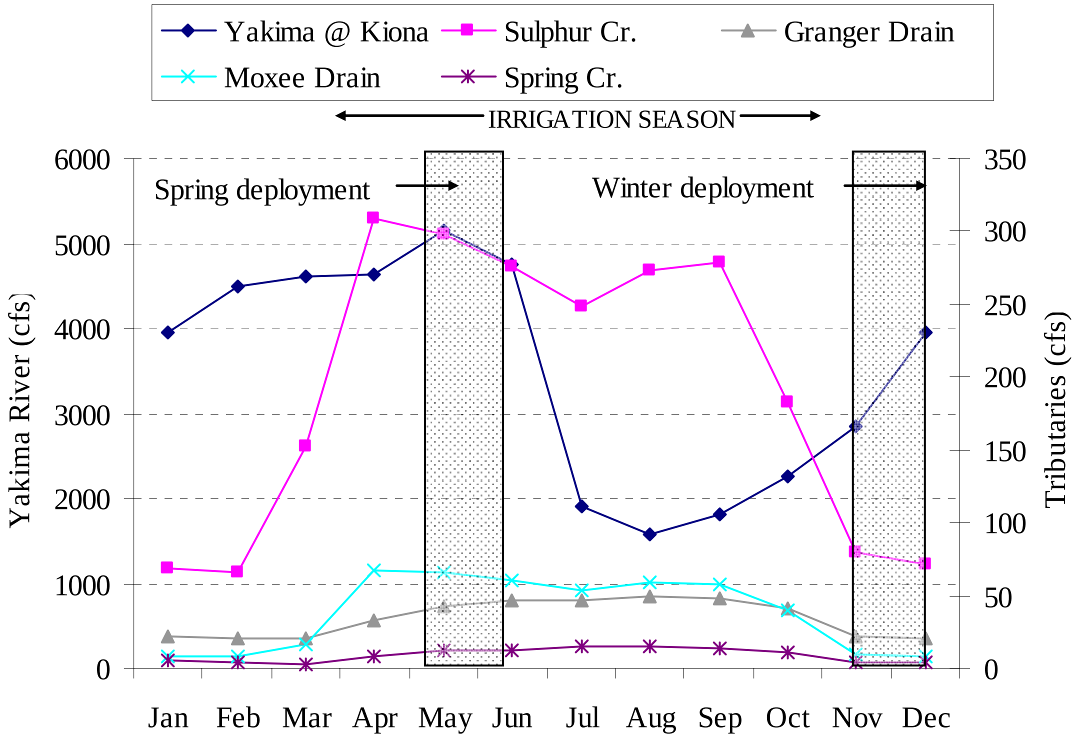

Figure 10. Monthly Average Flow at Selected Sites in the Yakima River Showing Periods When SPMDs will be Deployed (USGS data)

Flow Data

For surface water, the TMDL analysis will use flow data obtained from USGS, USBR, Kittitas Reclamation District, Selah-Moxee Irrigation District, Yakima-Tieton Irrigation District, Roza Irrigation District, Union Gap Irrigation District, Sunnyside Valley Irrigation District, Roza-Sunnyside Joint Board of Control, the Wapato Irrigation Project, Yakama Nation Water Resources Program, Yakima Nation Fisheries Program, Ecology Stream Hydrology Unit, Kittitas County Water Purveyors, and the Kittitas County Conservation District. Flow data will be downloaded from USGS, USBR, and Ecology websites or collected through personal communications with these entities. For some sites, instantaneous flow will be obtained through nearby staff gauges, estimated using upstream and downstream gauges, or measured directly.

Wastewater Discharges

One of the mechanisms for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES), which is administered by EPA. EPA has authorized Washington State to administer the NPDES permit program in Washington. Chapter 90.48 RCW defines Ecology's authority and obligations in issuing wastewater discharge permits. A NPDES permit must be issued before discharge of wastewater to waters of the state is allowed. The permits establish effluent limits, monitoring schedules, and other requirements.

Three types of municipal/industrial wastewater discharges that come under NPDES are potential sources of chlorinated pesticides or PCBs to the Yakima River: wastewater treatment plants, fruit packers, and vegetable processors.

Wastewater Treatment Plants

Wastewater treatment plant (WWTP) effluent is rarely analyzed for pesticides or PCBs at levels approaching human health criteria. In the few instances where this has been done, some of these chemicals have exceeded the criteria. Table 11, for example, shows selected results from a low-level pesticide/PCB analysis of WWTP effluents from seven Eastern Washington cities, as compared to human health criteria.

Table 11. Results from Analyzing DDT Compounds, Dieldrin, and PCBs in WWTP Effluent from Several Eastern Washington Cities (ng/L, parts per trillion)

WWTP	N =	Total DDT	Dieldrin	Total PCBs*	Reference
Okanogan	2	ND-0.4 est.	NA	ND-0.39	Serdar (2003)
Oroville	2	0.7-1.1 est.	NA	ND	"
Omak	2	ND	NA	ND	"
Spokane	2	NA	NA	1.77-1.81	Golding (2001)
Liberty Lake	2	NA	NA	1.54-1.92	"
Walla Walla	4	ND-0.90 est.	ND-0.25 est.	0.65-0.88	Johnson et al. (2004)
College Place	4	ND-0.10 est.	ND-0.21 est.	0.53-2.5	"
Human Health WQ Criteria for Fish Consumption		0.59	0.14	0.17	

NA = not analyzed
ND = not detected
*PCBs analyzed as congeners, except Aroclors were analyzed for Okanogan area WWTPs

Twenty-one WWTPs discharge to the Yakima River or its tributaries (Table 12, Figure 9 and 11). Effluent flows range from 0.055 to 21.5 million gallons per day.

Three of these WWTPs— Wapato, Harah, and Toppenish— are on the Yakama Nation Reservation and under EPA jurisdiction. These facilities will not be sampled because Ecology lacks regulatory authority to impose waste load allocations and NDPES discharge limitations (on Yakama Nation lands). Depending on study findings for the other WWTPs, Wasteload Allocations (WLAs) may be recommended for these facilities. If so, then EPA would be requested to do monitoring to assess compliance.

Final effluents from the remaining WWTPs will be sampled on a quarterly basis during 2007-2008. This will include the Cle Elum, Kittitas, and Ellensburg WWTPs to more thoroughly address the PCB issue in the upper river. Upper river WWTP effluent will be analyzed for PCBs only, since a TMDL has already been established for chlorinated pesticides in this reach.

Table 12. Yakima River Wastewater Treatment Plants and Discharge Locations

Permit No.	Facility Name	NPDES Expiration Date	Receiving Water	Average Flow Maximum Month (mgd)
Upper Yakima River				
WA002193-8	Cle Elum	31-Aug-11	Yakima River @ ~ r.m. 183	3.6
WA-002125-3	Kittitas	29-Feb-12	Cooke Creek to Wilson Creek	0.45
WA-002434-1	Ellensburg	30-Nov-10	Yakima River @ r.m. 151.6	8.0
Lower Yakima River				
WA0021032C	Selah	31-Aug-06	Selah Ditch to Yakima River @ r.m. 117.1	2.0
WA0022586C	Naches	31-May-07	Naches River	0.17
WA0052396A	Cowiche	31-Oct-07	N. Fork Cowiche Creek	0.44
WA0024023C	Yakima	31-May-08	Yakima River @ r.m. 110.1	21.5
WA0022501C	Moxee	31-Oct-07	DID #11 to Moxee Drain	0.15
WA0050229	Wapato*	31-Mar-10	Drainage Way #2 to Yakima River	NA
WA0052132C	Buena	31-Jan-06	Unnamed trib to Yakima River @ r.m. 91.7	0.12
WA0022705	Harah*	30-Sep-11	Harah Drain to Yakima River	0.055
WA0020168C	Zillah	28-Feb-07	Yakima River @ r.m. 89.5	0.49
WA0026123	Toppenish*	25-Nov-08	Toppenish Drain to Yakima River	1.9
WA0022691C	Granger	31-Jul-07	Yakima River @ r.m. 82.8	0.32
WA0020991C	Sunnyside	31-Jul-07	Sulphur Cr. via Tributary	3.0
WA0052426A	Port of Sunnyside	28-Feb-10	Joint Control Drain 33.4 to Sulphur Cr.	0.55†
WA0020648C	Mabton	31-Dec-06	Yakima River @ r.m. 59.7	0.19
WA0052205B	Grandview	30-Nov-08	Yakima River @ r.m. 55.2	5.0
WA0020800D	Prosser	28-Feb-07	Yakima River @ r.m. 46.5	1.8
WA0051349C	Benton City	31-May-08	Yakima River ~r.m. 19	0.32
WA0051063C	West Richland	30-Jun-07	Yakima River ~r.m. 9	0.75

*Yakima Nation Reservation, EPA has permitting authority

†discharges October - June

PCBs have been the major water quality issue for TMDL wasteload allocations at some other Washington WWTPs. The data in Table 11 show only minor variations in PCB levels, indicating quarterly effluent sampling should give representative results. The PCB analysis for the Okanogan area facilities was by the less sensitive Aroclor method, resulting in mostly non-detects.

Effluent samples will be collected as composites taken over a two-day period. Effluent data obtained by Ecology at other WWTPs has shown little variation in PCB concentrations over two days (Golding, 2001). Each composite will consist of four grabs: two in the morning and two in the afternoon. Effluent flow is greater in the morning, but the effluent is more concentrated in the afternoon. The grabs will be hand collected to avoid contamination that could occur with an auto-sampler and adversely affect the analyses.

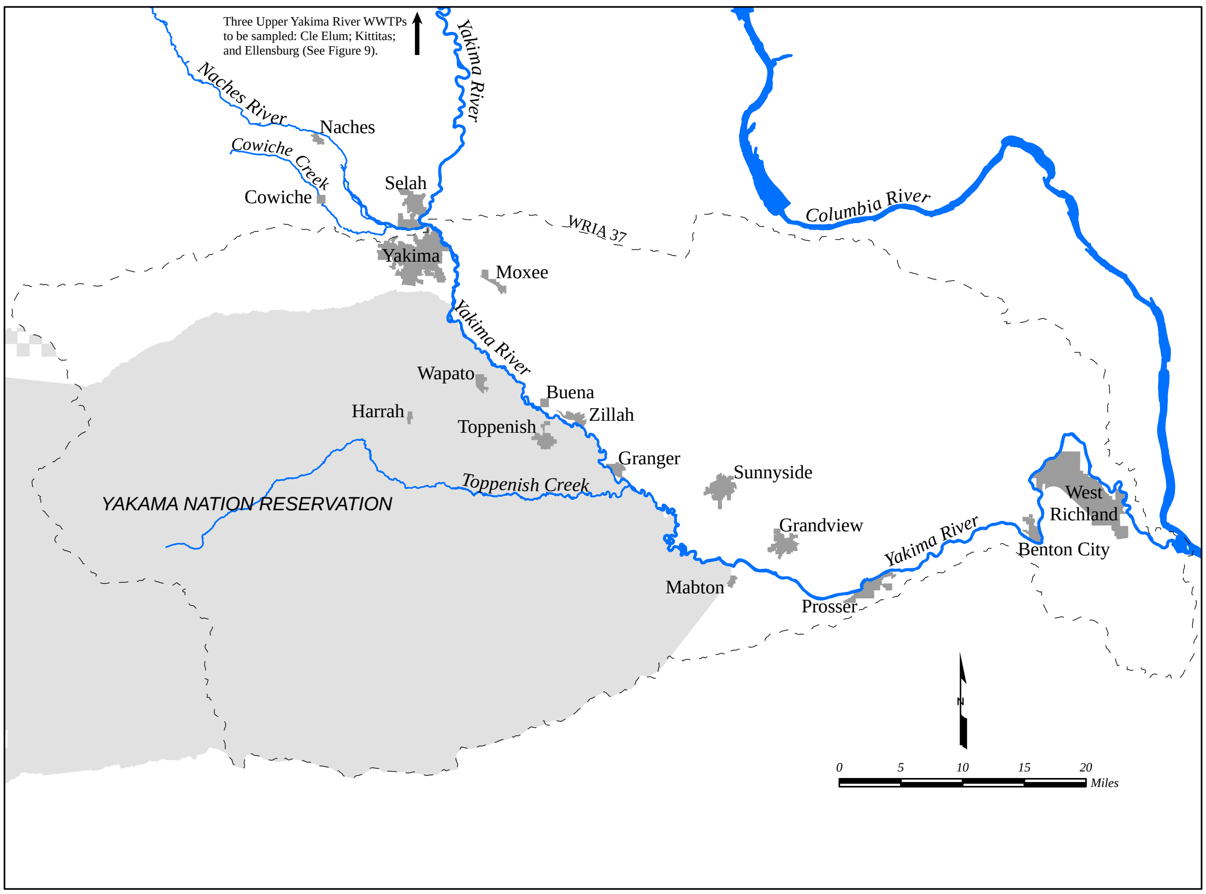

Figure 11. Wastewater Treatment Plants (WWTPs) in the Lower Yakima River Basin. (R. Coots, EA Program)

LVI does not work well on WWTP effluent due to the presence of numerous interfering substances (the Table 11 pesticide data were heavily qualified). Chlorinated pesticides will be analyzed using solid phase extraction (SPE), a less sensitive method. The anticipated reporting limits are 2-10 ng/L, somewhat higher than most of the human health criteria. This effort will constitute a screening-level assessment of chlorinated pesticides in WWTP discharges to the Yakima River. PCBs will be analyzed by the low-level HRGC/MS method, as in other types of samples. Target compounds for the pesticide and PCB analyses are listed in Appendix C. Ancillary parameters will include TSS, turbidity, and conductivity. Flow data will be obtained from WWTP records.

Fruit Packers and Vegetable Processors

Process water discharged from fruit packers and vegetable processors is a potential link between the agricultural lands that harbor persistent pesticide residues and the Yakima River. Dust and soils that may contain pesticides are washed or otherwise removed from fruits, vegetables, and transport containers during processing and washed into wastewater systems that discharge to the Yakima River drainage. DDT compounds have been detected at fruit processing facilities in the Okanogan area (Garry Struthers Associates, 2005)

Of the many fruit packers and vegetable processors in the lower Yakima Valley, six discharge process water directly to surface waters (Table 13). The others route it to WWTPs or land apply.

Table 13. Fruit Packers and Vegetable Processors Where Process Water will be Analyzed for Chlorinated Pesticides

Permit No.	Company/Facility Name	Location	Receiving Water
WAG 43-5126	Zirkle Fruit/Harrison Plant	Selah	Ditch to Taylor Ditch to Yakima River
WAG 43-5160	Apple King LLC/Apple King Facility	Yakima	Gleed Ditch to Naches River
WAG 43-5074	Gilbert Orchard	Yakima	Ditch to Bachelor Cr. to Ahtanum Cr.
WA-000056-6	Snokist Growers/Terrace Heights Cannery	Yakima	Yakima River at r.m. 113.0
WAG 43-5054	Andrus & Roberts Produce	Sunnyside	SVID Ditch to Yakima River
WA-002175-0	Twin City Foods, Inc.	Prosser	Yakima River at r.m. 47.0

Process water from the six facilities listed in Table 13 will be collected using the same techniques as for WWTPs. The samples will consist of quarterly, two-day, grab composites. The samples will be analyzed for chlorinated pesticides (Appendix C), TSS, turbidity, and conductivity. Pesticides will be analyzed using LVI for low detection limits. These types of facilities are not known to be PCB sources, so these compounds will not be analyzed. Flow data will be obtained from each facility.

Stormwater

In 2006, Ecology issued a draft version of the Phase II Municipal Stormwater Permit for Eastern Washington for public comment. The final permit became effective February 16, 2007. By EPA mandate in November 2002, a TMDL must address the pollutant loads from NPDES permitted stormwater discharge. Stormwater runoff can accumulate and transport pollutants such as pesticides, PCBs, and sediment via the stormwater conveyance system to receiving waters and degrade water quality.

Phase II communities are identified under the rule as jurisdictions that: 1) own and operate a municipal separate storm sewer system (MS4), 2) discharge to surface waters, 3) are located in urbanized areas, and 4) have a population of greater than 10,000 and less than 100,000. Yakima basin cities that come under Phase II are Ellensburg, Yakima, Union Gap, urbanized portions of Yakima County, Sunnyside, and West Richland.

Within the one-year period of the TMDL field study, it is impractical to obtain stormwater samples from all these cities. Eastern Washington storms usually have very little onset rainfall and a short duration single peak. The storms are also geographically sporadic. Low rainfall in Sunnyside and West Richland make it difficult to catch storms. Therefore, stormwater sampling for the TMDL will focus on characterizing chlorinated pesticide and PCB levels in runoff from the Yakima urban area. A similar effort will be made for Ellensburg to more thoroughly address the PCB issue in the upper river.

EPA recognizes that establishing numeric limits for municipal stormwater discharges is rarely feasible because of the variability of storm events (EPA, 2002). EPA therefore recommends that TMDL waste load allocations for NPDES-regulated municipal stormwater discharges should be expressed as BMPs rather than as numerical limits (EPA, 2002).

Because BMPs, rather than wasteload allocations, would result from identifying stormwater as a source of pesticides or PCBs to the Yakima River, it is not necessary to measure the total mass loading of these chemicals from stormwater. The TMDL will, however, use the stormwater data, available Geographic Information System coverages, and other information, to estimate loadings and put municipal stormwater runoff in perspective with other sources of contamination (Lubliner, 2007).

For purposes of this plan, it is anticipated that up to three storm events will be captured during the winter of 2007-2008 and that three storm drains will be sampled each time in Yakima and Ellensburg. To the extent possible, the drains will represent typical urban, commercial, and residential land uses. Whether the same or different drains will be sampled for each event remains to be determined. The drains will be selected in consultation with the public works departments of Yakima and Kittitas Counties and the cities of Yakima and Ellensburg. The Yakima Area Creeks Fecal Coliform TMDL study has already identified a number of potential sampling sites around Yakima (Joy, 2005). The trigger for mobilizing to sample will be a storm front with 60% or higher chance of predicted rain from a National Oceanic and Atmospheric Administration and local website, and strong evidence of a local precipitation having actually materialized at the sites.

Storm duration and intensity are likely the greatest factors in pollutant generation. Logistical restrictions, however, often effectively reduced most sampling efforts to grabs or manual composites at any given period during a storm. The stormwater samples for the TMDL will consist of grab composites collected during actual stormwater runoff. The samples will be analyzed for chlorinated pesticides (Appendix C), PCBs, TSS, turbidity, and conductivity, except Ellensburg stormwater will not be analyzed for pesticides. Chlorinated pesticides and PCBs will be analyzed using the same methods as for the WWTPs. Stormwater discharge will be measured at the sample collection site where feasible.

Stormwater comes under NPDES regulation in three additional areas: Washington Department of Transportation (WSDOT), construction projects, and industrial facilities.

WSDOT highways and facilities are required to be covered under a MS4 permit. WSDOT controls the major roads and highways through the urbanized areas, (e.g., U.S. Highways 97 and 12, Interstate 82, and State Route 24). Road surfaces are significant contributors to stormwater runoff volume, but are not known to be current sources of chlorinated pesticides or PCBs.

The NPDES Construction Stormwater General Permit covers soil disturbance for projects of one acre or more. These types of activities are potential sources of chlorinated pesticides or PCBs when building on farm land or ground that has been otherwise contaminated. While no specific sampling is planned for construction sites, the stormwater sampling being conducted for the TMDL will include contributions from ongoing construction within the urban areas being monitored.

Fifteen industries in the basin fall under the NPDES Industrial General Stormwater Permit. These include fruit packers, manufacturing companies, industrial parks, log yards, air carriers, and transit. As previously described, fruit packers are potential sources of chlorinated pesticides. If the process water samples being collected for the TMDL contain significant pesticide residues, stormwater sampling at fruit packing facilities may be recommended.

Other Sources of Contamination

A variety of other potential sources of chlorinated pesticides and PCBs exist within the lower Yakima basin. These include, but are not limited to, landfills, illegal dumpsites, hazardous waste sites, toxic cleanup sites, and pesticide handling facilities. It is beyond the scope of this study to investigate these types of sources. For purposes of the TMDL they will be considered part of the nonpoint load. Depending on findings from the field study, follow-up sampling may be recommended to investigate some of these areas.

Representativeness, Comparability, and Completeness

The intent of this sampling design is to obtain representative data on chlorinated pesticides, PCBs, and ancillary parameters in the Yakima River and sources discharging to it. Steps being taken to ensure representativeness include sampling at the appropriate time (e.g., intensive surface water sampling during the irrigation season), use of appropriate sampling and sample handling procedures, use of composite samples, and comprehensive sampling of known and potential sources.

The field and laboratory methods being used are standardized and comparable to the previous TMDLs and similar Ecology studies in other watersheds.

The completeness goal for this project is to have valid, defensible data for 95% of the samples collected.

Sampling Design Summary

Table 14 summarizes the type, number, and frequency of samples to be collected during the field study for the 2007-2008 Yakima River Chlorinated Pesticide and PCB Evaluation.

Table 14. Summary of Sampling Design for 2007-08 Yakima River TMDL Evaluation

Task	Location (Sites)	Frequency	Analyses: Chlor. Pest.	PCBs	TSS	Turbidity	Conductivity	TOC	Number of Samples per Month (4/07-3/08): April	May	June	July	August	September	October	November	December	January	February	March	Total
Effectiveness Monitoring	Mainstem (4) Major Tributaries (5)	Bimonthly			✓	✓	✓		18	18	18	18	18	18	18						126
Routine Pesticide Monitoring	Mainstem (4) Major Tributaries (5)	Bimonthly/ Monthly	✓		✓†	✓†	✓†		18	18	18	18	18	18	9	9	9	9	9	9	162
Recon. Pesticide Sampling	Minor Tributaries (22)	Quarterly	✓		✓	✓	✓			22			22			22			22		88
SPMD Samples	Mainstem (6) Major Tributaries (6)	Twice	✓	✓	✓†	✓†	✓†	✓		12						12					24
Effluent Sampling	WWTPs (18)	Quarterly	✓*	✓	✓	✓	✓		18			18			18			18			72
Process Water Sampling	Fruit Packers/Vegetable Processors (6)	Quarterly	✓		✓	✓	✓			6			6			6			6		24
Stormwater Sampling	Yakima and Ellensburg (3 each)	Three Events	✓*	✓	✓	✓	✓								------------ 18----------------- (October–March)						18

†October through March only

*Not analyzed in upper river samples

Quality Objectives

The goal of this project is to obtain data of sufficient quality so that uncertainties are minimized and results are comparable to water quality standards and existing data from previous studies. These objectives will be achieved through careful attention to the sampling, measurement, and quality control (QC) procedures described in this plan.

Measurement Quality Objectives

The samples will be analyzed by the Ecology Manchester Environmental Laboratory (MEL) and their contractors. MEL and their contractors are expected to meet all QC requirements of the analytical methods being used for this project. Measurement quality objectives (MQOs) are shown in Table 15.

Table 15. Measurement Quality Objectives for the 2007-08 Yakima River TMDL Evaluation

Analysis	Check Stds./ Lab Control Samples (% recov.)	Duplicate Samples (RPD)	Surrogates (% recov.)	Matrix Spikes (% recov.)	Labeled Congeners (% recov.)	Lowest Concentration of Interest
Water Samples						
Chlorinated pesticides	50-150%	NA*	50-150%	50-150%	NA	0.07 ng/L
PCB congeners	50-150%	NA*	NA	NA	25-150%	10 pg/L
TSS	80-120%	±20%	NA	NA	NA	1 mg/L
TNVSS	80-120%	±20%	NA	NA	NA	1 mg/L
Turbidity	80-120%	±20%	NA	NA	NA	0.5 NTU
Conductivity	80-120%	±20%	NA	NA	NA	1 umhos/cm
Total Organic Carbon	80-120%	±20%	NA	75-125%	NA	1 mg/L
SPMD Extracts						
Chlorinated pesticides	50-150%	NA*	50-150%†	50-150%†	NA	10 ng/SPMD
PCB congeners	50-150%	NA*	50-150%†	50-150%†	25-150%	0.1 ng/SPMD

NA = not analzyed

*Field replicate samples will be analyzed, see text

†To be spiked at EST laboratory

The MQOs for precision and bias correspond to MEL's Action Limits. The MQO for recovery of labeled congeners in the PCB analysis is the QC limit specified in the method. Data outside these limits will be evaluated for appropriate corrective action.

Check standards and laboratory control samples contain known amounts of analyte and indicate bias due to sample preparation and calibration. Results on duplicate (split) samples provide estimates of analytical precision. The precision of the organics data for the present study will be assessed with field replicates to estimate the total variability in the data (i.e., field + laboratory). As a cost savings measure, additional laboratory duplicates will not be requested for organic compounds.

Surrogates are compounds with characteristics similar to target compounds and are added to all organics' samples prior to extraction. Recovery of surrogate spikes is used to estimate recovery of target compounds in the sample. Matrix spikes may indicate bias due to matrix effects and provide an estimate of precision.

For the SPMD samples, surrogates will be spiked into all membranes at EST laboratory, prior to extraction. EST will also do matrix spikes of field quality SPMD membranes with target compounds.

The PCB analysis for this study is being done by an isotopic dilution method using labeled congeners. The 12 PCBs designated as toxic by the World Health Organization (also known as dioxin-like PCBs) and the earliest and latest eluted congener at each level of chlorination are determined by isotope dilution quantitation. The remaining congeners are determined by an internal standard quantitation technique.

Surrogates and matrix spikes are not part of this PCB method and it is not practical to add the labeled compounds at EST prior to extracting the SPMDs. Therefore, recovery of PCBs through the entire procedure (dialysis, cleanup, and analysis) will be assessed using selected PCB congeners as surrogates. Bias will similarly be assessed with a matrix spike of an SPMD with selected PCB congeners.

The lowest concentrations of interest shown in Table 15 are based on reporting limits MEL or their contractors have achieved in surface water (chlorinated pesticides) or wastewater (PCBs) samples in the recent past. These have been adequate to quantify chlorinated pesticides and PCBs in samples with low levels of contamination. Higher reporting limits of 2-10 ng/L are anticipated for chlorinated pesticides in the WWTP and stormwater samples due to interferences.

Sampling Procedures

Sample containers, preservation, and holding times for the water samples being collected in this project are shown in Table 16. A detailed description of procedures for collecting each type of sample follows.

Table 16. Field Procedures for Water Samples

Parameter	Min. Sample Size	Container*	Preservation	Holding Time
Chlor. Pesticides (LVI)	1 gallon	1 gal. glass; Teflon lid	Cool to $4^{o}C$	7 days
Chlor. Pesticides (SPE)	1 liter	1 L amber glass; Teflon lid	Cool to $4^{o}C$	7 days
PCBs	1 liter	1 L amber glass; Teflon lid	Cool to $4^{o}C$	1 year
TSS/TNVSS	1,000 mL	1 L poly bottle	Cool to $4^{o}C$	7 days
Turbidity	100 mL	500 mL poly bottle	Cool to $4^{o}C$	48 hours
Conductivity	300 mL	500 mL poly bottle	Cool to $4^{o}C$	28 days
Total Organic Carbon	50 mL	60 mL poly bottle	HCl to pH<2, $4^{o}C$	28 days

*Sample containers to be obtained from Manchester Laboratory, except PCB sample containers from contract laboratory.

Surface Water

Sampling techniques for effectiveness monitoring will follow the depth- and width-integrating procedures similar to those used by Coffin et al. (2006) for the 2003 effectiveness monitoring program and by Joy et al. (1994-1995) for the lower Yakima River Suspended Sediment and DDT TMDL. Deepwater sites will be sampled with a US-DH-59 or a US-DH-76 attached to a rope. A US-DH-81 sampler will be used for wadeable streams. Sampling procedures will follow the USGS Equal-Width-Increment (EWI) method (Wilde et al., 1999). An effort will be made to sample three verticals representing equal widths of the stream cross-section at the same quarter-points used to collect samples for pesticide analysis.

Subsamples will be collected at each point along the transect and composited. Approximately 1000 mL will be collected at each station for TSS and 500 mL for turbidity and conductivity, according to the EWI method. Specific methods and equipment used to collect the samples will be recorded on field data sheets. The composites will be split by periodically stirring and pouring into appropriate sample containers for TSS, turbidity, and conductivity. Turbidity and conductivity samples will be combined into one 500 mL container. TNVSS is a progressive step in the analysis of TSS so both these analyses will come from the same sample.

Routine and reconnaissance pesticide samples will be collected by hand in one-liter, amber glass, narrow mouth bottles, cleaned to EPA (1990) Quality Assurance/Quality Control (QA/QC) specifications. Bridge samples will be taken by placing the bottle in a metal holder that orients the bottle opening upstream and lowering the sampler on a line. The samples will be taken as composites from a quarter-point transect across the stream. The sample bottle will be lowered and raised through the water column to obtain a depth integrated sample. Grabs from each transect will be composited into appropriate sample containers for chlorinated pesticides. A new bottle will be used for each sample.

Where required, stream flow will be measured using a Swoffer Model 2100 or Marsh-McBirney Model 201 meter and top-setting rod. The latitude and longitude of each sampling site will be recorded from a global positioning system (GPS) receiver.

All water samples will be placed on ice, returned to Ecology Headquarters (HQ) and held in a secure cooler for later transport with chain-of-custody record to MEL. Alternately, the samples may be shipped directly to MEL.

Semipermeable Membrane Devices (SPMDs)

Deployment and retrieval procedures for SPMDs will follow the EA Program SOP for SPMDs (Johnson, 2007). Standard SPMDs (91 x 2.5 cm membrane containing 1 mL triolein) and the stainless steel canisters (16.5 x 29 cm) and spindle devices that hold the membranes during deployment will be obtained from EST. The SPMDs are preloaded onto the spindles by EST in a clean room and shipped in solvent-rinsed metal cans under argon atmosphere. Five SPMDs will be used in each canister, with one canister per sampling site. The SPMDs will be kept frozen until deployed.

EST will spike each SPMD membrane with PRCs prior to their being deployed in the field, including the field trip blank and day-zero blank (see Quality Control). PCB-4, -29, and -50 will serve as PRCs for this project. These congeners are not present in significant amounts in the environment and have shown appropriate rates of loss (20-80%) in past Ecology studies. The spiking level will be 0.2 ug of each congener per SPMD membrane (1.0 ug per sample). The PCB contract laboratory will provide the PRC spiking solution to EST.

On arriving at the sampling site, the cans will be pried open, spindles slid into the canisters, and the device anchored and tethered in the stream. The SPMDs will be located out of strong currents, situated in such a way as to minimize the potential for vandalism, and placed deep enough to allow for anticipated fluctuations in water level. Because SPMDs are potent air samplers, this procedure should be done as quickly as possible. Field personnel will wear nitrile gloves and not touch the membranes.

TOC, TSS, turbidity, and conductivity samples will be collected in appropriate containers (Table 16) at the locations and frequencies described in the Sampling Design. The latitude and longitude of each sampling site will be recorded from a GPS.

The SPMDs will be deployed for approximately 28 days, as recommended by USGS and EST. The retrieval procedure is essentially the opposite of deployment. The cans holding the SPMDs must be carefully sealed and the SPMDs must be maintained at or near freezing until they arrive at EST for extraction.

The SPMDs will be shipped with a chain-of-custody record to EST by overnight Federal Express, in coolers with blue ice or ice in poly bottles.

Wastewater Treatment Plants (WWTPs)

The WWTP samples will be composites of the final effluent. Each composite will consist of two grabs per day (morning and afternoon) for two days. The samples will be collected manually to avoid the risk of contamination that could occur with automatic samplers.

The grabs will be taken with 1-liter amber glass bottles, cleaned to EPA (1990) QA/QC specifications, and split into appropriate sample containers (Table 16). A new 1-liter bottle will be used for each sample. The samples will be analyzed for chlorinated pesticides (using SPE), PCB congeners, TSS, turbidity, and conductivity. Upper Yakima River facilities will not be analyzed for pesticides.

The latitude and longitude of the effluent sampling sites will be recorded from a GPS. Flow data will be obtained from WWTP records. The effluent samples will be returned to Ecology HQ and held in a secure cooler for later transport with chain-of-custody record to MEL, or shipped directly to MEL.

Fruit Packers/Vegetable Processors

Sample collection and handling for fruit and vegetable process water will follow the same procedures being used for WWTP effluent. The samples will be analyzed for chlorinated pesticides (by LVI), TSS, turbidity, and conductivity.

Stormwater

For each storm event, an attempt will be made to subsample each stormdrain three times over a two-to-three hour rotation. Chlorinated pesticide (using SPE), PCB, TSS, turbidity, and conductivity samples will be collected as manual composites spanning the three rotations. Pesticide samples will not be collected at Ellensburg. A one-liter or one-gallon glass jar will be used to fill one- third of each sample container on each rotation. The composites will be kept on ice at all times. Sample containers will be as shown in Table 16. Instantaneous discharge measurements will be made using a portable Swoffer meter where feasible.

Measurement Procedures

Table 17 shows the types and numbers of samples to be analyzed, expected range of results, required reporting limits, and sample preparation and analysis methods. To the extent possible, methods were chosen to give reporting limits equal to or less than the lowest concentrations of interest. Other methods may by used by MEL and their contractor after consulting with the project lead.

Table 17. Laboratory Procedures

Analysis	Sample Matrix	Approx. Number of Samples*	Expected Range of Results	Reporting Limit	Sample Prep Method	Analytical Method
Chlor. Pesticides	Surface water	250	0.01 - 100 ng/L	0.07-0.2 ng/L	EPA 3510M	LVI†/EPA 8081
TSS	Surface water	270	1 - 1,000 mg/L	1 mg/L	N/A	EPA 160.2
TNVSS	Surface water	75	1 - 1,000 mg/L	1 mg/L	N/A	SM 2540E
Turbidity	Surface water	270	1-100 NTU	0.5 NTU	N/A	EPA180.1
Conductivity	Surface water	270	1-100 umhos/cm	1 umos/cm	N/A	EPA 120.1
TOC	Surface water	50	1-10 mg/L	1 mgL	N/A	EPA 415.1
Chlor. Pesticides	SPMD extract	24	1-1,00 ng	5-10 ng	dialysis/GPC†	EPA 8081
PCBs	SPMD extract	24	1-500 ng	0.1 ng	dialysis/GPC†	EPA 1668A
Chlor. Pesticides	WWTP effluent	72	0.01-10 ng/L	2-10 ng/L	EPA 3535M(SPE)	EPA 8081M
PCBs	WWTP effluent	84	0.1-5 ng/L	1-5 pg/L	EPA 1668A	EPA 1668A
TSS	WWTP effluent	84	1-100 mg/L	1 mg/L	N/A	EPA 160.2
Turbidity	WWTP effluent	84	1-50 NTU	0.5 NTU	N/A	EPA180.1
Conductivity	WWTP effluent	84	400-800 umhos/cm	1 umos/cm	N/A	EPA 120.1
Chlor. Pesticides	Fruit/vegetable proc. water	24	0.01 - 100 ng/L	0.07-0.2 ng/L	EPA 3510M	LVI†/EPA 8081
TSS	Fruit/vegetable proc. water	24	1-100 mg/L	1 mg/L	N/A	EPA 160.2
Turbidity	Fruit/vegetable proc. water	24	1-50 NTU	0.5 NTU	N/A	EPA180.1
Conductivity	Fruit/vegetable proc. water	24	400-800 umhos/cm	1 umos/cm	N/A	EPA 120.1
Chlor. Pesticides	Stormwater	9	0.1-10 ng/L	2-10 ng/L	EPA 3535M(SPE)	EPA 8081M
PCBs	Stormwater	18	1-100 ng/L	1-5 pg/L	EPA 1668A	EPA 1668A
TSS	Stormwater	18	5-500 mg/L	1 mg/L	N/A	EPA 160.2
Turbidity	Stormwater	18	5-300 NTU	0.5 NTU	N/A	EPA180.1
Conductivity	Stormwater	18	10-200 umhos/cm	1 umos/cm	N/A	EPA 120.1

*excluding field replicates and field blanks

†EST SOPs E14, E15, E19, E21, E33, E44, E48

Achieving low detection limits and minimizing the amount of qualified data are important to the success of this study. MEL and their contractors will conduct the chemical analyses in a manner consistent with the methods and MQOs.

MEL will analyze chlorinated pesticides in the surface water and fruit/vegetable processor samples using LVI. WWTP effluent and stormwater will be analyzed using SPE. The target list for these samples is in Appendix C. SPMD extracts will be analyzed for MEL's Pest2 target list in Appendix D.

Toxaphene will be quantified directly in the WWTP and stormwater pesticide analyses. For the LVI analyses, a low-level toxaphene standard will be analyzed with the control samples of each sample batch. If no toxaphene is detected above this standard, then the samples will be reported as non-detects. If samples exceed this standard, they will be re-analyzed with a standard 2 uL injection and toxaphene calibration curve. A reporting limit of approximately 3 ng/L is anticipated for toxaphene by LVI.

MEL will select a contract laboratory to analyze PCB congeners in the wastewater, stormwater, and SPMD samples and ship the water samples to the contractor. Method 1668A permits congener-specific determination of more than 150 PCB congeners by HRGC/MS.

EST laboratory will extract the SPMDs (referred to as dialysis), perform GPC cleanup on the extracts, split the extracts 50:50, and ship the ampulated extracts to MEL. The dialysis method used by EST is a patented procedure, described in Huckins et al. (2000). EST's dialysis and GPC methods are documented in SOPs, which are on file at Ecology.

The SPMD results will be reported as total ng in the entire extract (i.e., multiply by 2 due to the 50:50 split). The PRCs PCB-4, -29, and -50 will be quantified in the PCB analysis of the extracts. The PRCs and the PCB congeners (-14 or -36, -78, and -186) being spiked as surrogates will not be included in calculating homologs or total PCBs.

Excess sample extracts will be saved by MEL and the PCB laboratory for a period of 60 days after reporting the data. A turn-around time of 30-45 days is required for this project.

The total cost of analyzing project samples is estimated at $209,139 (Table 18). Given the size and complexity of the study, $10,000 has been budgeted for contingency samples.

It is anticipated that $40,000 - $60,000 of the laboratory budget would be spent before the end of this fiscal year (June 2007), depending on when EST submits the SPMD extracts to MEL. This cost estimate is based on MEL's 50% discounted price; true cost is 2X for those analyses conducted at MEL. The cost for contract lab analyses includes MEL's surcharge of 25%.

Table 18. Lab Cost Estimate for 2007-2008 Yakima River TMDL Evaluation

Task	Sampling Sites	Sampling Events	Number of Samples	Cost per Sample	Cost Subtotals*
Effectiveness Monitoring	9	14	126	34	$4,248
Routine Pesticide Monitoring	9	18	162	202	$33,912
Reconnaissance Pesticide Sampling	23	4	92	228	$20,976
SPMDs	12	2	24	1560	$37,440
WWTP Effluent Sampling	18	4	72	903	$62,616
Fruit/Vegetable Process Water Sampling	6	4	24	308	$7,392
Stormwater Sampling	6	3	18	903	$14,454
Contingency Samples	- -	- -	- -	- -	$10,000
			+10% QC Samples =		$19,104
			Total Lab Cost Estimate =		$210,142

Quality Control Procedures

Field

The field quality control (QC) samples to be analyzed for this project are shown in Table 19.

Field replicates will provide estimates of the total variability in the data (field + laboratory). For purposes of this study, replicates are defined as separate samples collected at the same location and approximately the same time. The replicates will be collected at the frequency shown in Table 19. Sites for replication will be rotated through the study area to cover a range of analytes and concentrations.

The potential for contamination arising from water sampling procedures, sample containers, preservation, or transport will be assessed with transfer blanks. Transfer blanks will be prepared in the field by pouring organic-free water, obtained from MEL or the PCB contract laboratory, from one sample bottle to another and the bottle re-sealed. This approximates the compositing procedure. The blanks will be prepared at the frequency shown in Table 19.

Table 19. Field Quality Control Samples

Task	Parameter	Replicates	Blanks
Effectiveness Monitoring	TSS, TNVSS, turbidity, conductivity	2/month	NA
Routine Pesticide Monitoring	TSS, turbidity, conductivity	1/month (fall-winter)	NA
	Chlorinated pesticides	1/month	4/project
Reconnaissance Pesticide Sampling	TSS, turbidity, conductivity	2/quarter	NA
	Chlorinated pesticides	2/quarter	none
SPMDs	TOC	2/deployment	NA
	Chlorinated pesticides, PCBs	2/deployment	2/deployment
WWTP Effluents	TSS, turbidity, conductivity	2/quarter	NA
	Chlorinated pesticides, PCBs	2/quarter	1/quarter
Fruit/Vegetable Process Water	TSS, turbidity, conductivity	1/quarter	NA
	Chlorinated pesticides, toxaphene	1/quarter	1/quarter
Stormwater	TSS, turbidity, conductivity	1/event	NA
	Chlorinated pesticides, PCBs	1/event	1/event

NA = not analyzed

Extra sample volumes will be collected when matrix spikes are scheduled to be analyzed.

Because SPMDs sample vapors while being exposed to air, a field trip blank is needed to record potential chemical accumulation during deployment, retrieval, and transport. The field blank SPMD is opened to the air for the same amount of time it takes to open and place the SPMD array in the water, then the blank is resealed and refrigerated. The blank is stored frozen and taken back into the field and opened and closed again to mimic the retrieval process. The blank is processed and analyzed the same as deployed SPMDs. There will be two SPMD field blanks consisting of five membranes for each deployment period. The blanks will be exposed at the upper Yakima River station below Kachess Lake and at Granger Drain, as a means of assessing the potential range in chemical uptake from air through the study area.

Laboratory

Table 20 shows the laboratory QC samples to be analyzed for this project.

Table 20. Laboratory Quality Control Samples

Matrix	Analysis	Method Blanks*	Check Stnds/ LCS	Duplicates	Surrogate Spikes	MS & MSD	OPR Stds./ Labelled Cmpds.
Surface water	Chlorinated pesticides	2/batch	1/batch	NA	all samples	1/month	NA
"	TSS,TNVSS, turbidity	1/batch	1/batch	1/batch	NA	NA	NA
"	Conductivity	1/batch	1/batch	1/batch	NA	NA	NA
"	TOC	1/batch	1/batch	1/batch	NA	1/batch	NA
SPMD extracts	Chlorinated pesticides	2/batch	1/batch	NA	all samples†	1/batch**	NA
"	PCBs	1/batch	1/batch	NA	all samples†	1/batch**	each batch
WWTP effluent	Chlorinated pesticides	2/batch	1/batch	NA	all samples	1/quarter	NA
"	PCBs	1/batch	1/batch	NA	NA	NA	each batch
"	TSS, turbidity	1/batch	1/batch	1/batch	NA	NA	NA
"	Conductivity	1/batch	1/batch	1/batch	NA	NA	NA
Fruit/Vegetable	Chlorinated pesticides	2/batch	1/batch	NA	all samples	1/batch	NA
process water	Toxaphene	2/batch	1/batch	NA	all samples	1/batch	NA
"	TSS, turbidity	1/batch	1/batch	1/batch	NA	NA	NA
"	Conductivity	1/batch	1/batch	1/batch	NA	NA	NA
Stormwater	Chlorinated pesticides	2/batch	1/batch	NA	all samples	1/event	NA
"	PCBs	1/batch	1/batch	NA	NA	NA	each batch
"	TSS, turbidity	1/batch	1/batch	1/batch	NA	NA	NA
"	Conductivity	1/batch	1/batch	1/batch	NA	NA	NA

NA = not analyzed

*MEL and PCB contract laboratory blanks; see discussion for additional blanks prepared by EST

†To be spiked at EST

**To be spiked at EST; one matrix spike only

There are several departures from routine QC procedures:

1. Laboratory duplicates are not being requested for the organics analyses.
2. For surface water pesticide samples, matrix spikes are being analyzed at a lower than normal frequency to reduce cost. The number of matrix spike samples will be increased if early results show the MQOs for bias are being exceeded. Field personnel will collect extra sample volume for matrix spikes and will identify the matrix spike samples for the laboratory.
3. For the SPMD samples, surrogate and matrix spiking is being done at EST Laboratory, as described below.

SPMDs

EST will prepare the following method blanks for each SPMD deployment:

1. A spiking blank-SPMD exposed while spiking the SPMDs, to represent laboratory background. This blank is held frozen at EST and later dialyzed with project samples.
2. A day-zero SPMD blank to serve as a reference point for PRC loss.
3. A dialysis blank-SPMDs from the same lot as the project batch, to represent background during dialysis and cleanup.
4. A day-zero blank SPMD, prepared just prior to dialysis, to serve as a control.
5. A reagent blank to assess contamination independent of the SPMDs.

Blanks 2) and 3) will be analyzed. The other EST blanks will be saved, frozen at MEL and the PCB laboratory, and analyzed in the event there is evidence of significant contamination in the samples or other problems needing further investigation. MEL and the PCB contract laboratory will analyze their own method blanks with each batch of samples.

EST will add surrogate compounds to each SPMD membrane prior to dialysis. The surrogates for the chlorinated pesticide analysis will be tetrachloro-m-xylene, 4,4-dibromooctafluorobiphenyl, and dibutylchlorendate. The surrogates for the PCB analysis will be -14 or -36 on the low end, -78 for the middle, and -186 on the high end. The pesticide surrogates will be spiked at 80 ng each. The PCB surrogates will be spiked at 10-40 ng each. The analyzing laboratory will supply EST with the spiking solution for their respective surrogates.

For each dialysis batch, EST will do a matrix spike of field quality SPMD membranes using target compounds. The spiking level will be 80 ng for each of the pesticides, using MEL's standard matrix spike mix. The recommended compounds and spiking level for the PCB matrix spike remain to be worked out with the contractor. The pesticide matrix spikes and PCB matrix spikes will be on two separate membranes to avoid interferences. The analyzing laboratory will supply EST with the solutions for their respective matrix spikes. A duplicate matrix spike will not be prepared.

Data Management Procedures

Field data and observations will be recorded in a bound notebook of waterproof paper.

The data package from MEL will include a case narrative discussing any problems encountered in the analyses, corrective actions taken, changes to the referenced method, and an explanation of data qualifiers. The data package should also include all associated QC results. This information is needed to evaluate the accuracy of the data and to determine whether the MQOs were met. This should include results for all method blanks, check standards/laboratory control samples, surrogate compounds, matrix spikes, ongoing precision standards/labeled compounds included in the sample batch.

Project data will be downloaded from MEL's Laboratory Information Management System (LIMS) into Excel spreadsheets. For PCBs, the data is reported directly in Excel spreadsheet format. Field data will be transferred to Excel spreadsheets and verified for accuracy by another individual on the project team.

Water column concentrations of chlorinated pesticides and PCBs will be calculated by the project team using the most recent version of the SPMD Water Calculator spreadsheet developed by USGS. Currently, this is v5_10Jan07.xls, David Alvarez, Columbia Environmental Research Center. The spreadsheet calculates SPMD sampling rates from PRC-derived sampling rates, using an empirical uptake model described in Huckins et al. (2006). The spreadsheet can be found at Y:\Shared\SPMDs\SPMD Water Calculator v5_10Jan07 (Ecology access only).

The user will verify that the most current version of the calculator is being used and be certain to lock the spreadsheet to prevent accidental changes to underlying formulae. Before each use, the spreadsheet will be tested with a set of verified SPMD parameters and results to ensure that consistent and accurate data are being obtained throughout the project. Correcting for the field blank is at the discretion of the project lead; the data will be flagged accordingly. Total concentrations will be estimated using the relationship with TOC developed by Meadows et al. (1998).

All project data will be entered into Ecology's Environmental Information Management System (EIM). Data entered into EIM follow a formal data validation review procedure where data are reviewed by the project manager of the study, the person entering the data, and an independent reviewer.

Data Verification

MEL will conduct a review of all laboratory data and case narratives. MEL will verify that methods and protocols specified in the QA Project Plan were followed; that all calibrations, checks on quality control, and intermediate calculations were performed for all samples; and that the data are consistent, correct, and complete, with no errors or omissions. Evaluation criteria will include the acceptability of holding times, instrument calibration, procedural blanks, spike sample analyses, precision data, laboratory control sample analyses, and appropriateness of data qualifiers assigned. MEL will prepare written data verification reports based on the results of their data review. A case summary will meet the requirements for a data verification report.

To determine if project MQOs have been met, the project lead will compare results on field and laboratory QC samples to the MQOs. To evaluate whether the targets for reporting limits have been met, the results will be examined for non-detects and to determine if any values exceed the lowest concentration of interest.

The project lead will review the laboratory data packages and MEL's data verification report. Based on these assessments, the data will be either accepted, accepted with appropriate qualifications, or rejected and re-analysis considered.

Data Usability Assessment

Data usability will be assessed by the project manager. If the MQOs have been met, the quality of the data should be useable for meeting project objectives. If the MQOs have not been met, a determination will be made as to whether they are still useable. For example, data that are qualified as biased low may still be useful for establishing that a particular chemical exceeds water quality criteria. On the other hand, data that are qualified due to blank contamination may not be useful for documenting that criteria have been exceeded.

An assessment will be made of whether the requirements for representativeness and comparability have been met. The number of valid measurements completed will be compared to the completeness goal for the project.

Audits and Reports

Audits

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

The PCB analyses will be contracted out to a laboratory accredited by Ecology for Method 1668A. The Ecology Environmental Laboratory Accreditation Program evaluates a laboratory's quality system, staff, facilities and equipment, test methods, records, and reports, and establishes that the laboratory has the capability to provide accurate, defensible data. Results of on-site assessments and proficiency tests are available from Ecology on request.

Reports

A data transmittal report on results of the Ecology 2006 fish tissue study is currently being prepared (Johnson et al., 2007 draft) and will be reviewed by CRO, the EA Program, and EPA.

Following completion of the sampling and analysis described in this QA Project Plan, another technical report on results and analysis of TMDL data from this project will be prepared for review by CRO, the EA Program, and EPA. The tentative date for this report is February 2009. The report will address the TMDL elements required by EPA Region 10, (i.e., scope of the TMDL); applicable water quality standards; numerical targets; loading capacity, wasteload, and load allocations; margin of safety; seasonal variation; and monitoring plan. The report will also include selected information and conclusions from the fish tissue study. The responsible staff members are: Art Johnson, Brandee Era-Miller, and Kristin Kinney.

Based on review comments, a revised draft of the TMDL technical report will be prepared for external review. The tentative date for this report is April 2009.

A final TMDL technical report is anticipated on or about December 2009.

FMU will prepare a separate report on the results of effectiveness monitoring. The responsible staff members are: to be determined.

All project data will be entered into Ecology's Environmental Information Management System on or before December 2009. The responsible staff: Kristin Kinney.

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Appendices

Appendix A. 303(d) Category 5 Toxics Listings for Edible Fish Tissue in the Yakima River Drainage

Listing ID	WRIA*	Water Body	Parameter	Approximate Location
Upper Yakima River				
43146	39	Keechelus Lake	Total PCBs	Near inlet
43128	39	Keechelus Lake	Dioxin	Near inlet
20182	39	Yakima River	Chlordane	Umtanum
20219	39	Yakima River	Total PCBs	Umtanum
34889	39	Yakima River	Dioxin	Umtanum
Naches River				
17214	38	Cowiche Creek	4,4'-DDE	Near mouth
**	38	Cowiche Creek	Total PCBs	Near mouth
Lower Yakima River				
14253	37	Yakima River	4,4'-DDT	Union Gap
14257	37	Yakima River	4,4'-DDE	Union Gap
14255	37	Yakima River	4,4'-DDD	Union Gap
14259	37	Yakima River	Alpha-BHC	Union Gap
14261	37	Yakima River	Total PCBs	Union Gap
7351	37	Yakima River	4,4'-DDT	Zillah
8874	37	Yakima River	4,4'-DDE	Zillah
8875	37	Yakima River	Dieldrin	Zillah
19595	37	Yakima River	4,4'-DDE	Granger
19597	37	Yakima River	4,4'-DDE	Granger
19616	37	Yakima River	4,4'-DDT	Granger
19618	37	Yakima River	4,4'-DDT	Granger
20047	37	Yakima River	Total PCBs	Granger
20045	37	Yakima River	Total PCBs	Granger
16430	37	Yakima River	4,4'-DDD	Grandview
19598	37	Yakima River	4,4'-DDE	Prosser
19619	37	Yakima River	4,4'-DDT	Prosser
19705	37	Yakima River	Chlordane	Prosser
34887	37	Yakima River	Dioxin	Prosser
8897	37	Yakima River	4,4'-DDT	Benton City
14252	38	Yakima River	4,4'-DDT	Benton City
19602	37	Yakima River	4,4'-DDE	Benton City
14256	37	Yakima River	4,4'-DDE	Benton City

8893	37	Yakima River	4,4'-DDE	Benton City
14254	37	Yakima River	4,4'-DDD	Benton City
14258	37	Yakima River	Alpha-BHC	Benton City
7350	37	Yakima River	Total PCBs	Benton City
19622	37	Yakima River	4,4'-DDT	Horn Rapids
19601	37	Yakima River	4,4'-DDE	Horn Rapids
8861	37	Yakima River	4,4'-DDE	Horn Rapids
8902	37	Yakima River	Dieldrin	Horn Rapids
8864	37	Yakima River	Total PCBs	Horn Rapids
8863	37	Yakima River	Total PCBs	Horn Rapids
19614	37	Yakima River	4,4'-DDT	Near mouth
19592	37	Yakima River	4,4'-DDE	Near mouth

*Water Resource Inventory Area

**PCB exceedance overlooked for the 2002/2004 303(d) list

Appendix B. 303(d) Category 5 Toxics Listings for the Water Column in the Yakima River Drainage

Listing ID	WRIA*	Waterbody	Parameter
8876	37	Yakima River at Union Gap	DDT
8877	37	Yakima River at Union Gap	4,4'-DDE
8854	37	Yakima River bw. Granger	Dieldrin
8873	37	Yakima River bw. Granger	DDT
8889	37	Yakima River nr. Grandview	4,4'-DDD
8891	37	Yakima River nr. Grandview	4,4'-DDE
8896	37	Yakima River bw. Spring Cr.	DDT
8860	37	Yakima River at Kiona	DDT
8862	37	Yakima River at Kiona	4,4'-DDD
8865	37	Yakima River at Kiona	Endosulfan
8871	37	Yakima River at Kiona	Dieldrin
8890	37	Yakima River at Kiona	4,4'-DDE
8849	37	Wide Hollow Creek	4,4'-DDD
8848	37	Wide Hollow Creek	4,4'-DDE
8855	37	Wide Hollow Creek	DDT
8856	37	Wide Hollow Creek	Dieldrin
8857	37	Wide Hollow Creek	Endosulfan
7377	37	Moxee (Birchfield) Drain	4,4'-DDD
7376	37	Moxee (Birchfield) Drain	4,4'-DDE
7378	37	Moxee (Birchfield) Drain	Chlorpyrifos
7373	37	Moxee (Birchfield) Drain	DDT
7380	37	Moxee (Birchfield) Drain	DDT
7374	37	Moxee (Birchfield) Drain	Dieldrin
7383	37	Moxee (Birchfield) Drain	Endosulfan
7375	37	Moxee (Birchfield) Drain	Endosulfan
7362	37	Granger Drain	4,4'-DDD
7361	37	Granger Drain	4,4'-DDE
7360	37	Granger Drain	DDT
7363	37	Granger Drain	Dieldrin
7364	37	Granger Drain	Endosulfan
8906	37	Sulphur Creek Wasteway	4,4'-DDD
7385	37	Sulphur Creek Wasteway	4,4'-DDE
8909	37	Sulphur Creek Wasteway	DDT
7384	37	Sulphur Creek Wasteway	DDT
8911	37	Sulphur Creek Wasteway	Dieldrin

8908	37	Sulphur Creek Wasteway	Endosulfan
7369	37	Snipes Creek	4,4'-DDD
7367	37	Snipes Creek	4,4'-DDD
7370	37	Snipes Creek	4,4'-DDE
7366	37	Snipes Creek	4,4'-DDE
7365	37	Snipes Creek	DDT
7355	37	Spring Creek	4,4'-DDD
7357	37	Spring Creek	4,4'-DDD
7354	37	Spring Creek	4,4'-DDE
7358	37	Spring Creek	4,4'-DDE
7353	37	Spring Creek	DDT

*Water Resource Inventory Area

Appendix C. Chlorinated Pesticides and PCBs to be Analyzed in Water Samples for the 2007-2008 Yakima River TMDL Evaluation

(Manchester Laboratory large volume injection (LVI) target list, except as noted)

Chlorinated Pesticides

alpha-BHC
beta-BHC
gamma-BHC (Lindane)
delta- BHC
Heptachlor
Heptachlor epoxide
Aldrin
Dieldrin
Endrin
Endrin Ketone
Endrin Aldehyde
cis-Chlordane
trans-Chlordane
cis-Nonachlor
trans-Nonachlor
Oxychlordane
Endosulfan I
Endosulfan II
Endosulfan Sulfate
4,4'-DDE
4,4'-DDD
4,4'-DDT
Methoxychlor
Hexachlorobenzene
Toxaphene (SPE only; not analyzed in LVI samples)
Chlorpyrifos*

*Special analytical request, not part of the routine LVI target list.

Polychlorinated Biphenyls (method 1668A; see www.synectics.net/resources)

Approximately 150 individual PCB congeners

Appendix D. Chlorinated Pesticides and Polychlorinated Biphenyls to be Analyzed in SPMDs for the 2007-2008 Yakima River TMDL Evaluation

Chlorinated Pesticides (Manchester Laboratory PEST2 Target List)

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

Polychlorinated Biphenyls (method 1668A; see www.synectics.net/resources)

Approximately 150 individual PCB congeners