West Medical Lake
Total PCBs and Dioxin (2,3,7,8-TCDD)
Total Maximum Daily Load

Water Quality Study Design
(Quality Assurance Project Plan)

by
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Study Codes

Data for this project are available at Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search User Study ID is RCOO0008.

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2004 303(d) Listings Addressed in this Study

West Medical Lake, 630CWH (Total PCBs and 2,3,7,8-TCDD)

Waterbody Number: WA- 43-9160

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List of Acronyms

Following is a list of acronyms and abbreviations used frequently in this report.

EAP	Environmental Assessment Program
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management system
EPA	U.S. Environmental Protection Agency
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
PCBs	polychlorinated biphenyls
QA	quality assurance
QC	quality control
SOP	standard operating procedure
TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalence factor
TEQ	toxic equivalency
TMDL	Total Maximum Daily Load (water cleanup plan)
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington State Department of Health

Abstract

During 2002 the Department of Ecology's Washington State Toxic Monitoring Program conducted sampling in West Medical Lake near Spokane. The study found levels of total polychlorinated biphenyls (PCBs) and dioxins in rainbow trout tissue above National Toxic Rule human health criteria. This led to listing the lake under section 303(d) of the federal Clean Water Act, for non-attainment of beneficial uses. The Clean Water Act requires states to submit to the U.S. Environmental Protection Agency a Total Maximum Daily Load (TMDL) priority list of waters that do not meet applicable criteria.

To address 303(d) listings, the Department of Ecology's Eastern Regional Office requested a TMDL assessment of West Medical Lake to (1) evaluate current levels of Total PCBs and dioxin in fish tissue, sediment, and effluent, and (2) allocate loads to sources.

The TMDL assessment will include collection and analysis of six fish composites of rainbow trout and one other sport species, sediment sampling at seven sites, and four seasonal effluent samples from the West Medical Lake Wastewater Treatment Plant.

What is a Total Maximum Daily Load (TMDL)?

Federal Clean Water Act Requirements

The Clean Water Act established a process to identify and clean up polluted waters. Under the Clean Water Act, each state is required to have its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses for protection, such as cold water biota and drinking water supply, as well as criteria, usually numeric criteria, to achieve those uses.

Every two years, states are required to prepare a list of waterbodies – lakes, rivers, streams, or marine waters – that do not meet water quality standards. This list is called the 303(d) list (Ecology, 2005). To develop the list, Ecology compiles its own water quality data along with data submitted by local, state, and federal governments, tribes, industries, and citizen monitoring groups. All data are reviewed to ensure that they were collected using appropriate scientific methods before the data are used to develop the 303(d) list. The 303(d) list is part of the larger Water Quality Assessment.

The Water Quality Assessment is a list that tells a more complete story about the condition of Washington's water. This list divides waterbodies into five categories:

Category 1 – Meets standards for parameter(s) for which it has been tested

Category 2 – Waters of concern

Category 3 – Waters with no data available

Category 4 – Polluted waters that do not require a TMDL because:

- 4a. – Has a TMDL approved and it is being implemented
- 4b. – Has a pollution control plan in place that should solve the problem
- 4c. – Is impaired by a non-pollutant such as low water flow, dams, culverts

Category 5 – Polluted waters that require a TMDL – on the 303d list (Ecology, 2005).

TMDL Process Overview

The Clean Water Act requires that a TMDL be developed for each of the waterbodies on the 303(d) list. The TMDL identifies pollution problems in the watershed and specifies how much pollution needs to be reduced or eliminated to achieve clean water. Then Ecology works with the local community to develop an overall approach to control the pollution, called the Implementation Strategy, and a monitoring plan to assess effectiveness of the water quality improvement activities. Once the TMDL has been approved by the U.S. Environmental Protection Agency (EPA), a *Water Quality Implementation Plan* must be developed within one year. This Plan identifies specific tasks, responsible parties, and timelines for achieving clean water.

Elements Required in a TMDL

The goal of a TMDL is to ensure the impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of water quality problems and of the pollutant sources that cause the problem. The TMDL determines the amount of a given pollutant that can be discharged to the waterbody and still meet standards (the loading capacity) and allocates that load among the various sources.

If the pollutant comes from a discrete (point) source such as a municipal or industrial facility's discharge pipe, that facility's share of the loading capacity is called a *wasteload allocation*. If the pollutant comes from a set of diffuse (nonpoint) sources such as general urban, residential, or farm runoff, the cumulative share is called a *load allocation*.

The TMDL must also consider seasonal variations and include a margin of safety that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. A reserve capacity for future loads from growth pressures is sometimes included as well. The sum of the wasteload and load allocations, the margin of safety, and any reserve capacity must be equal to or less than the loading capacity.

Identification of the contaminant loading capacity for a waterbody is an important step in developing a TMDL. EPA defines the loading capacity as "the greatest amount of loading that a waterbody can receive without violating water quality standards" (EPA, 1999). The loading capacity provides a reference for calculating the amount of pollution reduction needed to bring a waterbody into compliance with standards. The portion of the receiving water's loading capacity assigned to a particular source is a load or wasteload allocation. By definition, a TMDL is the sum of the allocations, which must not exceed the loading capacity.

TMDL = Loading Capacity = sum of all wasteload allocations + sum of all load allocations + margin of safety

What Part of the Process Are We In?

The TMDL process is a stepwise approach to achieving water quality standards in waterbodies currently not meeting standards. Overall, the process can take five or more years from start to finish. This project would fall under year two of the process where a water quality study is designed and conducted, and problems are clearly defined in a written report. Below is the TMDL process described by year.

Year 1

Within the watershed planning process, TMDL studies are identified and prioritized by regional watershed and TMDL coordinators for 303(d) listed parameters.

Years 2 and 3

The Washington State Department of Ecology (Ecology) Environmental Assessments Program designs and conducts a water quality study where problems are defined and a technical report is written describing the situation. Ecology's Water Quality Program staff put together a TMDL team, including local tribes, to (1) guide TMDL activities and (2) develop an implementation strategy to guide management activities to a clear, concise concept of how water quality standards will be achieved.

Year 4

The TMDL is prepared in 3 steps:

- In Step 1, a *Water Quality Improvement Report*, including the technical study report and Implementation Strategy, is developed and sent to the EPA for approval.
- Step 2 is implementation. On-the-ground management activities identified in the Implementation Strategy are put in place.
- Step 3 is the evaluation of effectiveness. An evaluation of water quality following implementation of management activities determines if water quality has improved or standards are met.

Year 5

Year 5 cover monitoring and adaptive management. Monitoring will be required because improvement from some management activities may not be measurable for some time. Management activities may be implemented to point source, nonpoint source, or some combination of both. If management activities have not improved water quality and water quality is not meeting water quality standards, adaptive management may be required by revision of the implementation strategies.

Why is Ecology Conducting a TMDL Study in This Watershed?

Overview

Ecology is conducting a West Medical Lake TMDL study because fish tissue samples have shown that beneficial uses, such as recreational fishing, are being affected. The lake is currently included on Ecology's 2004 303(d) list of impaired waters for total polychlorinated biphenyls (PCBs) and dioxin in edible fish tissue (Table 1). A 2002 study by Ecology's Washington State Toxics Monitoring Program showed that Total PCBs and dioxin concentrations in rainbow trout fillets were higher than (exceeded) National Toxics Rule (NTR) human health criteria (Seiders and Kinney, 2004).

Study Area

The TMDL study area consists of West Medical Lake and its surrounding watershed of 1.8 $miles^2$. Currently, there is one National Pollutant Discharge Elimination System (NPDES) permitted discharger to the lake, the Medical Lake Wastewater Treatment Plant. This plant handles wastewater from the city of Medical Lake, Eastern State Hospital, and Lakeland Village (Figure 1).

Figure 1. Study area for the West Medical Lake PCB and dioxin (TCDD) Total Maximum Daily Load study.

Pollutants Addressed by This TMDL

This TMDL addresses Total PCBs and 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD; dioxin).

Impaired Beneficial Uses and Waterbodies on Ecology's 303(d) List of Impaired Waters

Recreation is the main beneficial use to be protected by this TMDL. West Medical Lake is a popular fishing destination for the greater Spokane area. It is threatened by concentrations of Total PCBs and TCDD in fish tissue that exceed NTR human health criteria. This lake is not typically used for primary contact recreation due to excessive plant growth from high nutrient levels.

Sources of the target pollutants (PCBs and dioxin) are not well understood but could be associated with air deposition, surface runoff, past handling practices as well as the wastewater treatment plant and two historical discharges to the lake from Eastern State Hospital and Lakeland Village.

Table 1 shows the parameters currently on the 303(d) list being addressed by this study.

Table 1. West Medical Lake 2004 303(d) listings for Total PCBs and dioxin in fish tissue.

Waterbody	Parameter	Listing ID	Township	Range	Section
West Medical Lake	Total PCBs	42173	T24N	R40E	13
	Dioxin	42381	T24N	R40E	13

This watershed has other water quality issues that will not be addressed in this TMDL. In particular, the following additional 303(d) listings, shown in Table 2, for parameters other than Total PCBs and TCDD that occur in the study area.

Table 2. Additional 303(d) listings not addressed by this study.

Waterbody	Parameter	Medium	Listing ID	Township	Range	Section
West Medical Lake	Ammonia-N	Water	8957	T24N	R40E	13
	Fecal Coliform	Water	6723	T24N	R40E	13

Why Are We Doing This TMDL Now?

A more thorough investigation of the PCB issue in West Medical Lake was requested by Ecology's regional water quality managers in 2005 to respond to the potential for public health impacts from trout consumption and the 303(d) listing for water quality impairment. Ecology's Water Quality Program funded the TMDL study for 2007-08.

How Will the Results of This Study be Used?

A TMDL study identifies how much pollution needs to be reduced or eliminated to achieve clean water. This is done by assessing the situation and then recommending practices to reduce pollution, and by establishing limits for facilities that have permits. Since the study may also identify the main sources or source areas of pollution, Ecology and local partners will use the results to figure out where to focus water quality improvement activities. Or, sometimes the study suggests areas for follow-up sampling to further pinpoint sources for cleanup actions.

The current NPDES permit for the Medical Lake Wastewater Treatment Plant does not have permit limits for Total PCBs or TCDD. The permit requires monitoring for priority pollutants, which include PCBs and dioxins, twice during the permits life. In addition, acute and chronic bioassay testing is also required twice. Bioassay does not identify specific pollutants in effluent but determines the overall toxicity from the combined effect of all contaminants.

Water Quality Standards and Beneficial Uses

PCBs are a mixture of compounds widely used in industrial applications as insulating fluids, plasticizers, in inks and carbonless paper, heat transfer and hydraulic fluids, and a variety of other uses. PCBs were developed and sold as mixtures under the trade name Aroclors. PCBs enter the environment during manufacture, use, disposal, spills, or burning of materials containing PCBs.

Being resistant to breakdown, PCBs persist in the environment for long periods of time. Binding strongly to soil particles, PCBs can travel by air over long distances from where they were used and are routinely detected in environmental samples.

The EPA started restrictions on the manufacture of PCBs in 1977, and by 1985 phased out use of PCBs through regulation.

There are 209 different PCB compounds. Some PCBs have similar structure and properties of dioxins and are referred to as dioxin-like compounds.

Dioxins are a group of 75 compounds of which seven are considered highly toxic. Washington State water quality criteria currently address only TCDD – considered the most toxic of the dioxin compounds.

Dioxins are unintended byproducts of incomplete combustion or industrial processes where chlorine is available in the burning process. Ubiquitous in the environment, dioxins are resistant to metabolism and have a high affinity to lipids. Like PCBs, dioxins are a concern because of persistence, ability to bioaccumulate in the food chain, and potential health effects in the environment and in animals (including humans).

Table 3 lists the applicable water quality standards for the parameters being addressed in this TMDL assessment (WAC 173-201A).

Table 3. Washington State water quality criteria for Total PCBs and TCDD.

Chemical	Criteria for Protection of Aquatic Life		Criteria for Protection of Human Health		
	Freshwater Acute (ng/L)	Freshwater Chronic (ng/L)	Water and Fish Consumption (ng/L)	Fish Consumption (ng/L)	Fish Tissue
Total PCBs	2,000	14	0.17	0.17	5.3 *ug*/Kg
TCDD (dioxin)	-	-	0.000013	0.000014	0.07 ng/Kg

Toxics Criteria

Washington State applies toxics criteria to waters of the state to protect aquatic life and human health. In some cases, the state designates criteria to protect wildlife that are drinking water and eating fish contaminated with toxins.

Washington State has not formally adopted freshwater sediment quality standards. Instead recommended numerical Freshwater Sediment Quality Values (FSQVs) are used as guidelines. The recommended guidelines are intended for the protection of sediment-dwelling organisms from toxic effects of chemical contaminants. Until formal adoption as standards, Ecology evaluates freshwater sediments on a case-by-case basis through use of biological testing (bioassays or benthic community analysis) or comparison to available FSQVs.

Aquatic life

Criteria in 173-201A WAC are designed to protect aquatic life from both short-term (acute) and long-term (chronic) effects. The state designs aquatic life criteria primarily to avoid direct lethality to fish and other aquatic life within the exposure periods specified for the specific criteria.

The exposure periods assigned to the acute criteria are expressed as (1) instantaneous concentrations 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 assigned to the chronic criteria are expressed as 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. The chronic criteria for PCBs and many of the chlorinated pesticides are to protect fish-eating wildlife from adverse effects from bioaccumulation.

Currently, Washington State has no aquatic life criteria for TCDD as Table 3 shows.

Human health

In 1992, EPA established water quality criteria for the protection of human health from priority pollutants referred to as the National Toxics Rule (NTR) [40 CFR 131.36(14)]. The federal Clean Water Act required states without sufficient human health criteria for priority pollutants to adopt the NTR. Washington State has adopted these criteria and applied them to surface waters of the state.

In fresh waters, human health criteria take into account the combined exposure of both drinking the water and eating fish that lived in the water. In marine waters, human health criteria only consider the effect of eating fish that lived in the water.

The state established criteria to protect against non-carcinogenic illness and to 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 set assumptions on body size, fish, and water consumption, and the number of years exposed. For example, in Washington the risk is correlated to an average-sized man consuming 6.5 grams per day of fish (approximately 5 pounds per year), drinking 2 liters of water (if a fresh waterbody), and continuing this pattern for 70 years. People with higher or lower exposure patterns would face higher or lower risks. This basic exposure pattern is the same for both cancer-causing and non-cancer-causing chemicals.

Watershed Description

West Medical Lake is located in eastern Washington about 15 miles southwest of Spokane. It forms the western city boundary of Medical Lake, within the Upper Crab Creek watershed. The shoreline surrounding West Medical Lake is largely natural with a picnic area on the east shore and a large public access, boat rental, and docks on the south shore. A pump house is on the lake's north shore. The land surrounding the lake is owned by the state with no near shore residential development. The drainage area to West Medical Lake is largely agriculture with wheat fields the major land use.

West Medical Lake is one of the few lakes in Washington State that receives a NPDES permitted discharge. Nutrient levels in the lake are high. The lake is classified as highly eutrophic and may be one of the most enriched lakes in the state (Smith et al, 2000). Aquatic plants are thick in most places, and zooplankton is supportive of a productive sport fishery. The Washington Department of Fish and Wildlife (WDFW) has operated aerators in the past to maintain reasonable dissolved oxygen levels and prevent fish kills. West Medical Lake is not normally used for primary contact recreation.

Draining a relatively small basin of about 1.8 $miles^2$, West Medical Lake has approximately 4 miles of shoreline, a surface area of 220 acres, and an average depth of 22 feet. With no natural inflows or outflows, the hydraulic residence time of this seepage lake is very long, and estimated at about 29 years (Willms and Pelletier, 1992).

The arid eastern Washington climate in the study area averages about 80 degrees from June through August, and an average high from December through February of about 35 degrees. Annual precipitation is slightly more than 16 inches per year. Elevation of West Medical Lake is 2,420 feet above sea level.

Potential Sources of Contamination

Historically, Eastern State Hospital and Lakeland Village, two facilities run by the Washington State Department of Social and Health Services (DSHS), directly discharged treated wastewater to West Medical Lake. The discharges from the DSHS facilities were rerouted in October 2000 and connected to the new city of Medical Lake's wastewater treatment plant, providing tertiary treatment by activated sludge, coagulation, and filtration.

Recently, fish food used at some WDFW hatcheries has been suspected of containing significant levels of PCBs and other persistent organic pollutants. An Ecology study (Serdar et al., 2006) reported some hatchery and planted fish contained concentrations of PCBs and dioxins that may be above regulatory criteria. It is possible some West Medical Lake fish may have been contaminated prior to planting. West Medical Lake was not a part of the study, and it is not known if fish planted in West Medical Lake were affected by contaminated food at WDFW hatcheries (Donley, 2008).

Permit holders

The City of Medical Lake is authorized under the NPDES Waste Discharge Permit and Reclaimed Water Permit No. WA-0021148 to discharge reclaimed water to West Medical Lake. The effective date of the permit was June 1, 2005, and the permits expire on April 27, 2010.

Currently, the NPDES permit does not have discharge limits for PCBs or TCDD. This study will establish discharge limits for those pollutants.

Design flow is for an average maximum discharge per month of 1.85 million gallons per day (mgd). Following tertiary treatment, the effluent is discharged from a manifold coming from the eastern shoreline at the historical wastewater treatment plant to almost the center of West Medical Lake as reclaimed water for augmentation and maintenance of the lake's water level. During the dry season, treatment plant discharge to West Medical Lake averages between 0.4 and 0.5 mgd, and during the wet season between 0.7 and 1.0 mgd (Cooper, 2007).

Nonpoint sources

There are a number of possible nonpoint (diffuse) sources of PCBs and dioxins to West Medical Lake. Air deposition is a likely contributor. Entering the air during manufacture, use, and disposal, airborne contaminants such as PCBs and dioxin can travel long distances from their source.

Waste burning of materials containing PCBs and dioxin contributes to the airborne pool of contaminants available as fallout to land and water surfaces. Uncontrolled combustion is thought to be a major source of PCBs and dioxin today. Anything from backyard trash burning to industrial incinerators can be considered a potential source. Agricultural burning and forest fires are also thought to be contributors of dioxin.

Because of the persistent nature of PCBs, contaminant levels found in the lake today could be partly a result of past improper or illegal handling and disposal of transformers and other electrical equipment containing PCBs.

Stormwater runoff from Eastern State Hospital, Lakeland Village, and agricultural lands may also be playing a role as a source of PCBs and dioxin to the lake. PCBs and dioxin bind to soils and are washed off to waterbodies during storm events.

The lake sediments are also a likely internal source of pollutants to the food chain. Historical discharges to the lake from the two state facilities, in addition to other ambient sources, have likely contributed to sediment contamination.

Historical Data Review

Only limited data are available for evaluating concentrations of toxic chemicals in West Medical Lake. In 2002, Ecology included West Medical Lake in the Washington State Toxics Monitoring Program investigating concentrations of toxic contaminants in freshwater fish tissue. The program analyzed fish tissue for PCBs, chlorinated pesticides, PCDDs/PCDFs (polychlorinated dibenzodioxins/polychlorinated dibenzofurans), PBDEs (polybrominated diphenyl ethers), and mercury in 106 fish fillet samples from eight lakes across the state.

The rainbow trout collected from West Medical Lake in 2002 had the highest levels of Total PCBs among eight study lakes (Seiders and Kinney, 2004). Concentrations ranged from 3.7 to 36 *u*g/Kg (parts per billion). The National Toxic Rule (NTR) criterion for Total PCBs in edible fish tissue is 5.3 *u*g/Kg, leading to the 2004 303(d) listing.

In addition to the 303(d) listing for Total PCBs, West Medical Lake is listed for dioxin. The World Health Organization and EPA have adopted a toxic equivalency (TEQ) system to estimate the toxicity of the 17 dioxin/furan congeners[5] of concern, compared to TCDD. Each of the 17 dioxin/furan congeners has been assigned a toxicity equivalence factor (TEF). The TCDD is considered most toxic and has a value of one. A congener 1,000 times less toxic than TCDD would have a TEF of 0.001. The TEFs from detected dioxin/furan compounds in a sample are summed for a toxic equivalent quotient (TEQ), which can be compared to available criteria on TCDD.

Prior to the 2004 303(d) list, Ecology used dioxin TEQ values for including a waterbody on the list. Current 303(d) listing policy is to use only the reported value of the 2,3,7,8-TCDD (referred to in this report as TCDD) congener. The NTR criterion for TCDD in edible fish tissue is 0.07 ng/Kg. The West Medical Lake rainbow trout that led to the 303(d) listing did not have TCDD reported above the 0.52 ng/Kg detection limit. The 303(d) listing was based on the concentration of 2,3,7,8-tetrachlorodibenzofuran (TCDF) reported at 0.84 ng/Kg (parts per trillion). TCDF has a toxic equivalent factor of 0.1; therefore, the TEQ was 0.084 ng/Kg, slightly exceeding the NTR standard.

[5] Congeners are one of many variants or configurations of a compound related to the number and placement of chlorine atoms around the molecule.

Project Goal and Study Objectives

Goal

The overall goal of the TMDL project is to ensure that West Medical Lake will attain water quality standards for Total PCBs and TCDD.

Objectives

The objectives of the proposed study are as follows:

- Evaluate current levels of Total PCBs and TCDD in fish tissue, sediment, and effluent.
- Establish Total PCBs and TCDD wasteload allocations for point sources and load allocations for nonpoint sources to meet water quality standards and protect beneficial uses.
- Provide data to the Washington State Department of Health (WDOH) to evaluate if a fish consumption advisory for the lake is needed.

Sampling Process Design

Overview

The study objectives will be met through characterizing the current levels of PCBs and TCDD in edible fish tissue and sediments from West Medical Lake. Seasonal loads of these target parameters will also be monitored at point sources and any significant discharges to the lake. When possible, flow will be measured at sites at the time of sampling.

Rainbow trout will be targeted for collection as the basis of the 303(d) listing for PCBs and dioxins in West Medical Lake. The WDFW stock the lake with 150,000 to 300,000 rainbow trout per year (Donley, 2008). Every effort will be made to collect carry-over fish two or more years of age.

In addition to rainbow trout, one other sport fish species will be collected. The other species will be based on availability. Efforts will be made to collect enough fish to satisfy the requirements of WDOH for evaluating if a consumption advisory is needed.

TMDL wasteload allocations will be set based on results from effluent samples and flows from the treatment facility. Load allocations will be based on results from discharge samples and flow at the time of sampling.

Details

Fish

Two general areas of fish collection are proposed for the West Medical Lake PCB and TCDD study. Rainbow trout (*Oncorhynchus mykiss*) and one other popular sport fish species will be collected from each area for comparison of Total PCBs and TCDD.

A total of six composite fish tissue samples, made up of five individual fish each, will be collected from West Medical Lake. Each of the two areas will target enough fish to make up three, five-fish composites. If fish numbers are low in one area, additional fish will be collected from another to make up the six composites.

Composite fish tissue samples will be made from equal weight portions of individual fish. Individual aliquots and composite samples will be homogenized to a uniform color and consistency. The composites will be divided into the appropriate sample containers for PCB aroclor equivalents, dioxins/furans, and lipid analysis.

The WDFW routinely collect fish from West Medical Lake. Ecology will coordinate fish collection for the study with the WDFW. Sample collection will be conducted in late March or early April 2008. The two areas proposed for fish collection are shown on Figure 2. The lake was divided into two areas based on the general configuration of the lake and the location of the

NPDES discharge. Results from fish tissue analysis will be compared to NTR criteria and the fish tissue results which led to the 303(d) listing.

Sediment

A screening survey of surface sediments in West Medical Lake will be conducted to establish a baseline for Total PCBs and dioxins. Currently, the spatial extent and levels of these pollutants in sediment are unknown. A total of seven sediment samples will be collected from West Medical Lake during March 2008. If ice cover precludes sediment collection, collection would commence as soon as the lake surface clears. Two sediment samples will bracket the wastewater treatment plant outfall, and the remainder will be collected as transect samples from the outfall (Figure 2).

Composite samples will be made from three separate grabs. The top 2-cm of each grab will be collected. The composites will be divided into the appropriate sample containers for PCB aroclor equivalents, dioxins/furans, total organic carbon, and grain size. Results of the sediment analysis will be compared to other similar studies, between study sites, to regulatory screening levels, and to recommended guidelines.

Effluent/Water

Treatment plant samples will be composites of the final effluent. Samples will be collected on four occasions: once in January, April, July, and October of 2008. Location of sample collection will be the same as NPDES requirements, just prior to discharge.

Composites will be made up of four grabs, two collected in the morning and two collected in the afternoon, during two consecutive days. Grab samples will be hand composited to avoid contamination by automatic samplers. The composite samples will be analyzed for PCB congeners, dioxins/furans, total organic carbon, and total suspended solids.

Sites may be added or removed from the sampling plan depending on access and new information provided during the Quality Assurance Project Plan review, field observations, and preliminary data analysis.

Representativeness, Comparability, and Completeness

The sampling design was developed to obtain representative data on PCBs and dioxins in fish tissue, sediments, and treatment plant effluent associated with West Medical Lake. Representativeness will be ensured by sampling at appropriate times and locations, using proper sample handling procedures, using composite sampling, and sampling all known potential sources.

All field and laboratory methods being used are standardized and comparable with previous studies and similar Ecology TMDLs in other areas of the state.

The project goal for completeness is to have 95% of all sample results be valid and defensible.

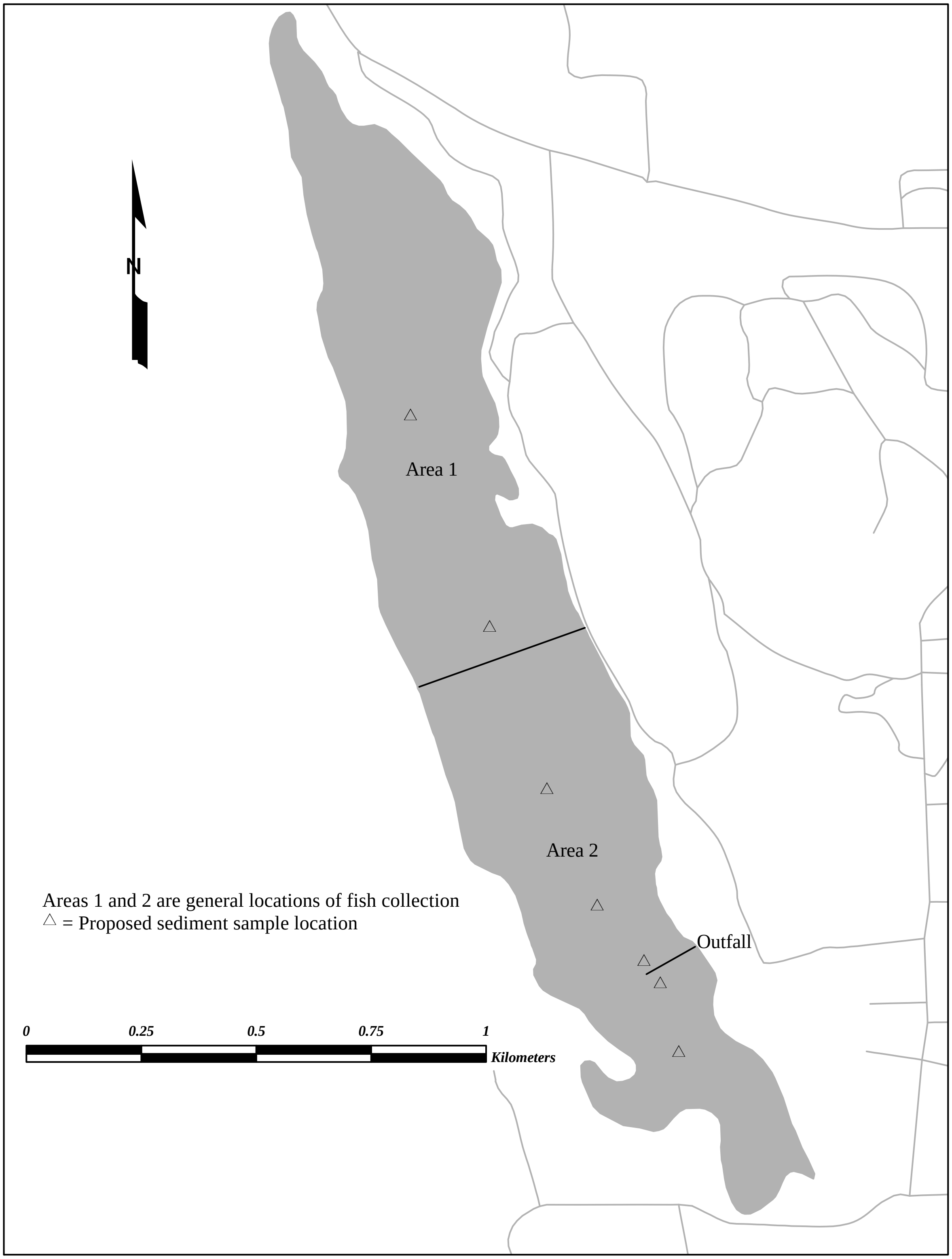

Figure 2. Proposed fish and sediment sampling locations for the West Medical Lake PCB and dioxin (TCDD) Total Daily Maximum Load study.

Sampling Procedures

Fish

Collection of fish from West Medical Lake will be coordinated with the WDFW. If targeted species or sample numbers are not met using nets, a Smith-Root Model SR16 electrofishing boat may also be used. Only fish of legal size will be collected for analysis. For species with no size limit, only fish large enough to reasonably be expected to be consumed will be collected.

Collection, processing, and preservation of fish tissue samples will follow Ecology standard operating procedure (SOP) EAP009 guidance (Sandvik, 2006c). All fish collected for analysis will be given a unique identification number that corresponds to the data entered into field logs. Fish length and weight will be recorded in the field following collection. Fish will be double wrapped in aluminum foil, with the dull side contacting the fish, and sealed in zip-lock bags. All fish samples will be kept in coolers on ice until return from the field. Once back from the field, fish samples will be frozen to -18° C until processed.

Preparation of tissue samples will follow Ecology SOP EAP008 guidance (Sandvik, 2006b). Techniques will be employed to minimize the possibility of sample contamination. All persons processing tissue samples will wear non-talc gloves and aprons. Work surfaces will be covered with heavy grade aluminum foil. Gloves, aluminum foil, and dissection tools will be changed between composite samples.

Each composite will be made up from equal weight aliquots of fillet from five fish. Composites will be of similar-size fish (i.e., the smallest fish in a composite will be at least 75% as long as the largest). Composites will be formed randomly, after sorting for similar-size groups. Fillets will be prepared by scaling and removal of one whole side per fish from the gill arch to the caudal peduncle. Fillets will include dark tissue along the lateral line and fat from the belly flap. Sex will be determined for each fish, and structures like scales, otoliths, opercles, and dorsal spines will be collected for determination of age following Ecology SOP EAP007 guidance (Sandvik, 2006a).

Fillets will be placed in a Kitchen Aid or Hobart commercial blender and homogenized individually to a uniform color and consistency. Samples will be thoroughly mixed by hand following each of three passes through the blender. Homogenates will be stored frozen (-18°C) in two 8-oz. glass jars with Teflon liners, cleaned to EPA (1990) QA/QC specifications, and certified for trace organic analyses. One container will be submitted to the laboratory for analysis and the other will be archived at Ecology headquarters.

All equipment used in the preparation of tissue samples will be washed thoroughly with tap water and Liquinox detergent, followed by sequential rinses of hot tap water, de-ionized water, and pesticide-grade acetone. All equipment will then be air dried on aluminum foil under a fume hood prior to use. The full decontamination procedure will be repeated between subsequent composite samples.

Requirements for containers, preservation, and holding times are listed in Table 4. Chain-of-custody will be maintained throughout the sampling and analysis processes.

Sediment

To the extent possible, sediment sampling methods will follow PSEP (1996) protocols. All persons processing samples will also be familiar with standardized procedures for field and sampling protocols as outlined in Ecology SOPs (Ecology, 1993). Surface sediment samples will be collected from a Wooldridge 16-foot aluminum jet sled using a 0.05 m^2 stainless steel Ponar grab. The latitude and longitude of sediment stations will be located by a global positioning system (GPS) and recorded in field logs. Station position relative to significant on-shore structures will also be recorded.

Following collection of each sediment grab, an evaluation of acceptability will be made. Information about each sediment grab will be recorded in the field log. A grab will be considered acceptable if it is not overfilled, overlying water is present but not overly turbid, the sediment surface appears intact, and the grab reached the desired sediment depth.

Overlying water will be siphoned off prior to sub-sampling. Equal volumes of the top 2-cm of sediment will be removed from three separate grabs per site. Dedicated stainless steel spoons and bowls will be used for sub-sampling and to homogenize sediments from each station to a uniform consistency and color. Debris on the sediment surface or materials contacting the sides of the Ponar grab will not be retained for analysis.

Homogenized sediments from each station will be placed in 4-oz. glass jars with Teflon-lined lids for analysis of PCBs and dioxins. Sample containers will be cleaned to EPA (1990) QA/QC specifications and certified for trace organic analyses. Additionally, 2-oz. glass jars will be filled with homogenate for total organic carbon analysis, while 8-oz. plastic jars will be filled for determination of grain size.

All equipment used to collect sediment samples will be washed thoroughly with tap water and Liquinox detergent, followed by sequential rinses of hot tap water, de-ionized water, and pesticide-grade acetone. Sampling equipment will then be air dried and wrapped in aluminum foil until used in the field. The same cleaning procedure will be used on the grab prior to going into the field. To avoid cross-contamination between sample stations, the grab will be thoroughly brushed down with on-site water at the next sample location.

Immediately following collection, sediment samples will be placed in coolers on ice at 4°C and transported to the Manchester Environmental Laboratory (MEL) within 72 hours. Requirements for containers, preservation, and holding times are listed in Table 4. Chain-of-custody procedures will be maintained throughout the sampling and analysis processes.

Effluent/Water

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

Sample grabs will be taken with 1-liter glass amber bottles, cleaned to EPA (1990) QA/QC specifications, and split into appropriate sample containers (Table 4). A new 1-liter bottle will be used for each sample. Samples will be analyzed for PCB congeners, dioxins/furans, total suspended solids (TSS), and total organic carbon (TOC). All persons collecting samples for the project will be familiar with standardized procedures for field and sampling protocols as outlined in Ecology SOPs (Ecology, 1993).

The latitude and longitude of the treatment plant sampling location or other sources sampled for the study will be located by GPS and recorded in field logs. Flow data will be obtained from treatment plant records or measured by wading for surface discharges. Water samples will be returned to Ecology headquarters and held in a secure cooler for later transportation with a chain-of-custody record to MEL.

Table 4. Containers, preservation, and holding times for study samples.

<table>
<tr><th>Parameter</th><th>Matrix</th><th>Container[1]</th><th>Preservation</th><th>Holding Time</th></tr>
<tr><td>PCB Aroclors</td><td>Tissue</td><td>Certified 8-oz Glass
w/ Teflon Lid Liner</td><td>Cool to 4°C</td><td rowspan="3">1 Year Extraction
1 Year Analysis</td></tr>
<tr><td>PCB Aroclors</td><td>Sediment</td><td>Certified 4-oz Glass
w/ Teflon Lid Liner</td><td>Cool to 4°C</td></tr>
<tr><td>PCB Congeners</td><td>Effluent/Water</td><td>1 L Glass
w/ Teflon Lid Liner</td><td>Cool to 4°C</td></tr>
<tr><td rowspan="3">Dioxins/Furans</td><td>Tissue</td><td>Certified 8-oz Amber Glass
w/ Teflon Lid Liner</td><td rowspan="2">Store: Freeze, -18°C
Transport (protect from light):
Cool to 4°C</td><td rowspan="3">1 Year Extraction
1 Year Analysis</td></tr>
<tr><td>Sediment</td><td>Certified 4-oz Amber Glass
w/ Teflon Lid Liner</td></tr>
<tr><td>Effluent/Water</td><td>Certified 1 L Amber</td><td>Transport (protect from light):
Cool to 4°C</td></tr>
<tr><td>Lipids</td><td>Tissue</td><td>Certified 4-oz Glass
w/ Teflon Lid Liner</td><td>Freeze, -18°C</td><td>1 Year Extraction
14 Days Analysis</td></tr>
<tr><td rowspan="2">TOC[2]</td><td>Sediment</td><td>Certified 2-oz Glass
w/ Teflon Lid Liner</td><td>Cool to 4°C</td><td>14 Days;
6 months frozen</td></tr>
<tr><td>Effluent/Water</td><td>60 mL Poly</td><td>1:1 HCl/
Cool to 4°C</td><td>28 Days</td></tr>
<tr><td>Grain Size</td><td>Sediment</td><td>8-oz Glass or Poly</td><td>Cool to 4°C</td><td>6 Months</td></tr>
<tr><td>TSS[3]</td><td>Effluent/Water</td><td>1 L Poly</td><td>Cool to 4°C</td><td>7 Days</td></tr>
</table>

1 = Sample containers provided by Manchester Environmental Laboratory (MEL) or their contract laboratory.
2 = Total organic carbon
3 = Total suspended solids

Measurement Procedures

Laboratory

All project samples will be analyzed at MEL or through a contractor selected by MEL. MEL and contract laboratories may use other appropriate methods following consultation with the project lead.

Analytical methods were selected to achieve reporting limits equal to or better than the lowest concentration of interest. The PCB congener analysis for the treatment plant effluent will use low-level detection of individual congeners by using high-resolution gas chromatography/mass spectrometry (HRGC/MS). PCB congener analysis will be contracted out by MEL.

MEL will analyze fish tissue and sediments for PCB Aroclors. Quantification will be by gas chromatography (GC/ECD) Method EPA 8082.

Dioxin/furan analysis for fish tissue, sediment, and effluent will be contracted out by MEL. The samples will be analyzed by HRGC/HRMS following EPA 1613B methods.

Table 5 shows the number of project samples, expected range of results, reporting limits, and sample preparation and analysis methods.

Table 5. Analytical methods for fish tissue, sediment, and effluent samples.

Analysis	Number of Samples[1]	Expected Range of Results	Reporting Limit	Sample Preparation Method	Analytical Method
Fish Tissue					
PCB Aroclor	8	5-500 *ug*/Kg, wet	5 *ug*/Kg, wet	EPA 3541	EPA 8082
Dioxins/Furans[2]	8	0.01-10.0 ng/Kg, wet	0.07 ng/Kg, wet	Silica-gel if needed	EPA 1613B
Percent Lipids	8	0.1-10%	0.1%	Extraction	EPA 1613B
Sediment					
PCB Aroclors	8	5-500 *ug*/Kg, dry	5 *ug*/Kg, dry	EPA 3541	EPA 8082
Dioxins/Furans	8	0.01- 50 ng/Kg, dry	0.05 ng/Kg, dry	Silica-gel if needed	EPA 1613B
Total Organic Carbon	8	1.0-20.0%	0.1%	Combustion/NDIR	PSEP-TOC
Grain Size	8	NA	0.1%	Sieve and pipette	PSEP, 1986
Effluent/Water					
PCB Congeners	8	0.1 – 100 ng/L	10 pg/L	EPA Method 1668A	EPA Method 1668A
Dioxins/Furans	5	0.01-1000 pg/L	4.4 pg/L	EPA 1613B	EPA 1613B
Total Organic Carbon	10	1.0-20.0%	1 mg/L	NA	EPA Method 415.1 or SM 5310B
Total Suspended Solids	10	0.1 – 10 mg/L	1 mg/L	NA	EPA Method 160.3 or SM 2540

1 = includes quality control (QC) samples.
2 = More than the standard tissue volume may be extracted for dioxin/furan analysis to meet detection limits.
NA = Not applicable.

Data Quality Objectives

Data quality objectives are normally specified at two levels. Level one data are intended to be used for critical decision making, while level two data are where data decision making is not the primary purpose of data collection. Data generated for this project will be level one.

MEL and their contracted laboratories are expected to attempt to meet quality control (QC) requirements of methods selected for the project. QC procedures used during field sampling and laboratory analysis will provide estimates for determining accuracy of the monitoring data. Table 6 shows the measurement quality objectives (MQOs) for the analytical methods selected. Reporting limits are expected to be concentrations low enough to meet applicable criteria within budget limits and allow comparisons to 303(d) listing criteria (Ecology, 2002), www.ecy.wa.gov/programs/wq/303d/2002/303d_policy_final.pdf

Bias can be defined as systematic error due to contamination, sample preparation, calibration, or the analytical process. Most sources of bias can be minimized by adherence to established protocols for collection, preservation, transportation, storage, and analysis of study samples. Surrogate compound recovery will be used as the primary means of estimating the accuracy or bias of the PCB and dioxin/furan analyses.

Precision is a measure of the ability to consistently reproduce results. Precision will be evaluated by analysis of check standards, duplicates/replicates, spikes, and blanks. Results of multiple analyses will be used as a means to estimate precision. Field replicates will be analyzed to estimate *overall precision* of the entire sampling and analysis process. Analysis of laboratory duplicates, which consist of aliquots from one sample container, will estimate *laboratory precision*. The difference between the precision estimate of the laboratory duplicates and the precision estimate of field replicates is an estimate of *field precision*.

MQOs may be difficult to achieve for concentrations near the limits of detection. Relative accuracy will decrease when concentrations are near reporting limits. These data will be reviewed by MEL using SOPs for data qualification. In addition to the MQOs in Table 6, the NTR criteria for edible fish tissue and water used to evaluate study results are provided.

Table 6. Measurement quality objectives (MQOs) for analysis of fish tissue, sediment, and effluent.

Analysis	Laboratory Duplicates (RPD)	Surrogate Recovery (%)	National Toxics Rule (NTR) Criteria
Fish Tissue			
PCB Aroclors	≤50	25-150	5.3 *u*g/Kg, ww
Dioxins/Furans	≤50	25-150 Labeled Congeners	0.07 ng/Kg, ww
Lipids	≤20	NA	NA
Sediment			
PCB Aroclors	≤50	25-150	NA
Dioxins/Furans	≤50	25-150 Labeled Congeners	NA
Total Organic Carbon	≤20	NA	NA
Grain Size	≤20	NA	NA
Effluent/Water			
PCB Congeners	≤50	25-150 Labeled Congeners	0.17 ng/L
Dioxins/Furans	≤50	25-150 Labeled Congeners	0.014 pg/L
Total Organic Carbon	≤50	NA	NA
Total Suspended Solids	≤20	NA	NA

NA = Not applicable.

Quality Control

Field

Field quality control (QC) samples provide an estimate of the total variability of the data, field plus laboratory. Field QC will consist of collection and analysis of replicate samples and transfer blanks. Sediment and effluent replicates will consist of two samples collected one after the other close to the same time and location. Transfer blanks will consist of reagent grade water prepared by MEL and placed in a sample container, taken to the field during sample collection, transferred to a second sample container in the field, and returned as other samples for analysis. Table 7 lists the QC samples to be analyzed for the project.

Table 7. Field quality control samples.

Matrix/Analysis	Replicates[1]
Effluent/Water	
PCB Congeners	2/project
Total Organic Carbon	2/project
Total Suspended Solids	2/project
Sediments	
PCB Aroclors	2/project
Dioxins/Furans	2/project
Total Organic Carbon	2/project
Grain Size	2/project
Matrix/Analysis	Transfer Blanks[2]
Effluent/Water	
Dioxins/Furans	1/project
PCB Congeners	1/project

1 = Two independent samples collected as close to the same time and location as possible.
2 = Reagent grade water placed in a sample container at MEL carried to the field and transferred to another sample container. Transfer blanks will be analyzed as other collected samples.

Sampling will be conducted to avoid cross-contamination. Samplers will wear non-talc nitrile gloves during collection. Immediately following collection, samples will be stored in iced coolers, until delivered to MEL.

To help minimize field variability from sample collection, field samplers will be familiar with and follow methods described in the PSEP (1996). All sampling equipment will be cleaned prior to going into the field according to protocols (see *Field Procedures*). Pre-cleaned sampling equipment will be wrapped in aluminum foil until use.

Laboratory

MEL routinely runs laboratory control samples for total organic carbon and percent lipids. MEL will follow SOPs as described in the *Manchester Environmental Laboratory Quality Assurance Manual* (MEL, 2006). Laboratory QC samples for this project are presented in Table 8.

Table 8. Laboratory quality control samples.

Matrix/Analysis	Laboratory Control Sample	Method Blank	Surrogate Spikes	Matrix Spikes	Duplicate Analysis
Fish					
PCB Aroclors	1/batch	1/batch	all samples	1/batch	--
Dioxins/Furans	1/batch	1/batch	all samples	--	--
Lipids	--	1/batch	--	--	1/batch
Effluent/Water					
PCB Congeners	1/batch	1/batch	all samples	--	1/batch
Dioxins/Furans	1/batch	1/batch	all samples	--	--
Total Organic Carbon	--	1/batch	--	--	1/batch
Total Suspended Sediments	--	--	--	--	1/batch
Sediment					
PCB Aroclors	1/batch	1/batch	all samples	1/batch	--
Dioxins/Furans	1/batch	1/batch	all samples	--	--
Total Organic Carbon	--	1/batch	--	--	1/batch
Grain Size	--	--	--	--	1/batch

Data Management Procedures

All field data and observations will be recorded in notebooks on waterproof paper. The information contained in field notebooks will be transferred to Excel spreadsheets after return from the field. Data entries will be independently verified for accuracy by another member of the project team.

Case narratives included in the data package from Manchester Environmental Laboratory (MEL) will discuss any problems encountered with the analyses, corrective action taken, changes to the requested analytical method, and a glossary for data qualifiers. Laboratory QC results will also be included in the data package. This will include results for surrogate recoveries, laboratory duplicates, matrix spikes, and laboratory blanks. The information will be used to evaluate data quality, determine if the MQOs were met, and act as acceptance criteria for project data.

Field and laboratory data for the project, including contract laboratory data, will be entered into Ecology's Information Management (EIM) system. Laboratory data will be downloaded directly into EIM from MEL's data management system (LIMS). Data reports from contract laboratories used for the project will be delivered in Excel spreadsheets formatted for input into the EIM system.

Audits and Reports

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

A draft report of the study findings will be completed by the project lead in January 2009 and a final report in February 2009. The report will include, at a minimum, the following:

- A map showing all sampling locations and any other pertinent features to the study area.
- Coordinates of each sample site.
- Description of field and laboratory methods.
- Discussion of data quality and the significance of any problems encountered.
- Summary tables of the chemical and physical data.
- Results of the PCBs and dioxins/furans related to recommended standards.
- A wasteload allocation for the Medical Lake treatment plant discharge.
- A recommendation for a TMDL which may include wasteload allocations, load allocations, required percent reductions, and a margin of safety.
- An evaluation of the significant findings, and comparisons of historical data to current conditions.
- Complete set of chemical and physical data and MEL QA review in the Appendix.

Following receipt and review of study data, the project lead will forward to the WDOH a fish tissue data package for the purpose of conducting a human health assessment. The data package will include all chemical and ancillary data (including biological data on fish), QC data, case narratives, and Manchester's data reviews. The WDOH is responsible for issuing fish consumption advisories if warranted.

Upon study completion, all project data will be entered into Ecology's EIM system. Public access to electronic data and the final report for the study will be available through Ecology's internet homepage (www.ecy.wa.gov).

Data Verification

Data verification is a process conducted by those producing data. Verification of laboratory data is normally performed by a MEL unit supervisor or an analyst experienced with the method. It involves a detailed examination of the data package using professional judgment to determine whether the measurement quality objectives (MQOs) have been met. Final acceptance of the project data is the responsibility of the project lead. The complete data package, along with MEL's written report, will be assessed for completeness and reasonableness. Based on these assessments, the data will either be accepted, accepted with qualifications, or rejected and re-analysis considered.

Data verification involves examining the data for errors, omissions, and compliance with quality control (QC) acceptance criteria. MEL's SOPs for data reduction, review, and reporting will meet the needs of the project. Data packages, including QC results for PCBs and dioxins/furans analysis conducted by MEL and contract laboratories, will be assessed by laboratory staff using the EPA Functional Guidelines for Organic Data Review. MEL staff will provide a written report of their data review which will include a discussion of whether (1) MQOs were met, (2) proper analytical methods and protocols were followed, (3) calibrations and controls were within limits, and (4) data were consistent, correct, and complete, without errors or omissions. All data generated from the project will be entered into the EIM database.

Data Quality Assessment (Usability)

After the project data has been reviewed and verified, the project lead will determine if the data are of sufficient quality to make decisions for which the study was conducted. The data from the laboratory's QC procedures, as well as results from field replicates and laboratory duplicates and surrogate recoveries, will provide information to determine if MQOs have been met. Laboratory and quality assurance staff familiar with assessment of data quality may be consulted. The project final report will discuss data quality and whether the project objectives were met. If limitations in the data are identified, they will be noted.

Some analytes will be reported near the detection capability of the selected methods. MQOs may be difficult to achieve for these results. MEL's SOP for data qualification and best professional judgment will be used in the final determination of whether to accept, reject, or accept the results with qualification. The assessment will be based on a review of field replicates, along with laboratory QC results, which include assessment of laboratory precision, contamination (blanks), accuracy, matrix interferences, and the success of laboratory QC samples meeting control limits.

Project Organization

The roles and responsibilities of Ecology staff are as follows:

- **Ken Merrill**, Overall TMDL Project Lead, Water Quality Program, Eastern Regional Office: Acts as point of contact between Ecology technical study staff and interested parties. Coordinates information exchange, technical advisory group formation, and organizes meetings. Supports, reviews, and comments on QA Project Plan, and technical report. Is responsible for implementation, planning, and preparation of TMDL document for submittal to EPA.

- **Dave Knight**, Unit Supervisor, Water Quality Program, Eastern Regional Office: Approves TMDL submittal to EPA. Reviews and approves QA Project Plan and final TMDL report.

- **Jim Bellatty**, Section Manager, Water Quality Program, Eastern Regional Office: Approves TMDL submittal to EPA. Reviews and approves QA Project Plan and final TMDL report.

- **Randy Coots,** Project Manager and Field Lead, Toxics Studies Unit, Statewide Coordination Section, Environmental Assessment Program: Responsible for overall project management. Defines project objectives, scope, and study design. Author of the project QA Project Plan. Manages the data collection program. Coordinates field surveys with the Eastern Regional Office and local staff members. Responsible for data collection and data quality review. Writes TMDL technical study report.

- **Casey Deligeannis**, Field Assistant, Toxics Studies Unit, Statewide Coordination Section, Environmental Assessment Program: Conducts fish collection and other field activities under the supervision of the project manager.

- **George Onwumere,** Unit Supervisor, Environmental Assessment Program: Reviews and approves QA Project Plan, the staffing plan, final TMDL report, and technical study budget.

- **Bob Cusimano,** Section Manager, Environmental Assessment Program: Reviews QA Project Plan and final TMDL report.

- **Gary Arnold,** Section Manager, Eastern Operations Section, Environmental Assessment Program: Approves QA Project Plan and final TMDL report.

- **Stuart Magoon, Leon Weiks, Karin Feddersen, and Nancy Rosenbower,** Manchester Laboratory, Environmental Assessment Program: Provides laboratory staff and resources, sample processing, analytical results, laboratory contract services, and QA/QC data. Reviews sections of the QA Project Plan relating to laboratory analysis.

- **Bill Kammin,** Ecology Quality Assurance Officer: Reviews and approves QA Project Plan. Provides technical assistance on QA/QC issues during the implementation and assessment of projects.

Project Schedule

Table 9 provides the schedule for EIM system management and completing the draft and final TMDL reports.

Table 9. Proposed schedule.

Environmental Information System (EIM) Data Set	
EIM Data Engineer	Brandee Era-Miller
EIM User Study ID	RCOO0008
EIM Study Name	West Medical Lake PCB and Dioxin TMDL
EIM Completion Due	March 2009
Final Report	
Author Lead	Randy Coots
Schedule	
Draft Due to Supervisor	December 2008
Draft Due to Client/Peer Reviewer	January 2009
Final Report Due	February 2009

Laboratory Budget

The total laboratory cost for the project is estimated at $34,652 (Table 10). All analyses will be conducted by MEL except for PCB congeners, dioxins/furans, and grain size. Analysis of these samples will be conducted by a laboratory contracted by MEL. The cost estimates reflect MEL's 25% surcharge for contracting services and a 50% discount for analyses conducted by MEL.

Table 10. Summary of laboratory costs[1].

Analysis	Matrix	Sample No.	QA No.	Sample Total	Cost per Sample	Subtotal
PCB Aroclors	Fish Tissue	6	2	8	$100	$800
Dioxins/Furans		6	2	8	$850	$6,800[2]
Lipids		6	2	8	$31	$248
PCB Aroclors	Sediment	6	2	8	$100	$800
Dioxins/Furans		6	2	8	$850	$6,800[2]
Total Organic Carbon		6	2	8	$40	$320
Grain Size		6	2	8	$85	$680[2]
PCB Congeners	Effluent	6	2	8	$900	$7,200[2]
Dioxins/Furans		4	1	5	$850	$4,250[2]
Total Organic Carbon		6	2	8	$30	$240
Total Suspended Solids		6	2	8	$10	$80
					Total Laboratory Cost	$28,218
					Manchester 25% Surcharge	$6,433
					Laboratory Cost Grand Total	$34,652

1 = Estimate includes 50% discount rate for analyses conducted by MEL.
2 = Additional 25% surcharge is added for contracting services provided by MEL.

Table 11 shows the breakdown of the individual analyses, timing of sample submittal, and monthly and total cost estimates for the project.

The greatest uncertainty in the laboratory load and cost estimate is with water samples. One additonal sample is allowed for in the sample estimate. If one or more significant inputs to the lake, other than the treatment plant discharge, is found, the water sample numbers could be different. Efforts will be made to keep the submitted number of samples within this estimate, however, because all possible discharges to the lake have not been evaluated. This is an estimate only.

Table 11. Number of monthly sample submittals for each analysis, estimate of monthly analytical costs, and total analytical cost estimate[1] for project.

Month	PCBs (Aroclors)	PCBs (Congeners)	Dioxins/ Furans	Lipids	TOC	TSS	Grain Size	Cost
January		2	1		2	2		$3,393
February								--
March	8		8		8		8	$10,470
April	8	2	9	8	2	2		$12,941
May								--
June								--
July		2	2		2	2		$4,455
August								--
September								--
October		2	1		2	2		$3,393
Totals	16	8	21	8	16	8	8	$34,652

1 = Estimate includes 50% discount for MEL analysis and a 25% surcharge for contract services.
TOC = Total organic carbon.
TSS = Total suspended solids.

References

Cooper, Steve, 2007. Personal communication. Plant Operator. City of Medical Lake Wastewater Treatment Plant. September 12, 2007.

Donley, Chris, 2008. Personal communication. Biologist. Washington Department of Fish and Wildlife. January 14, 2008.

Ecology, 1993. Field Sampling and Measurement Protocols for the Watershed Assessments Section. Washington State Department of Ecology, Olympia, WA. Publication No. 93-e04. www.ecy.wa.gov/biblio/93e04.html

Ecology, 2002. Water Quality Program Policy 1-11, Assessment of Water Quality for the Section 303(d) List. Washington State Department of Ecology, Olympia, WA. 33 pages. www.ecy.wa.gov/programs/wq/303d/2002/303d_policy_final.pdf

Ecology, 2005. 2004 Water Quality Assessment (Final) – Category 5 Listings. Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/programs/wq/303d/2002/2004_documents/list_by_category-cat5.html

EPA, 1990. Specifications and Guidance for Obtaining Contaminant-Free Sample Containers. U.S. Environmental Protection Agency. OSWER Directive #93240.0-05.

EPA, 1999. Draft Guidance for Water Quality Based Decisions: The TMDL Process (Second Edition). U.S. Environmental Protection Agency, Office of Water, EPA/841/D-99/001.

MEL, 2006. Manchester Environmental Laboratory Quality Assurance Manual. Manchester Environmental Laboratory, Washington State Department of Ecology, Manchester, WA.

PSEP, 1996. Puget Sound Estuary Program (PSEP): Recommended Protocols for Measuring Selected Variables in Puget Sound. U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle.

Sandvik, P., 2006a. Standard Operating Procedures for Resecting Finfish Whole Body, Body Parts or Tissue Samples, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP Number EAP007. www.ecy.wa.gov/programs/eap/qa/docs/ECY_EAP_SOP_FishTissueProcessing_v1_0.pdf

Sandvik, P., 2006b. Standard Operating Procedures for Resecting DNA Samples and Aging for Finfish, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP Number EAP008. www.ecy.wa.gov/programs/eap/qa/docs/ECY_EAP_SOP_FishDNAAgingStructuresProcessing_v1_0.pdf

Sandvik, P., 2006c. Standard Operating Procedure for Field Collection, Processing and Preservation of Finfish Samples at the Time of Collection in the Field, Version 1.0. Washington State Department of Ecology, Olympia, WA. SOP Number EAP009. www.ecy.wa.gov/programs/eap/qa/docs/ECY_EAP_SOP_FishFieldCollectionProcessing_v1_0.pdf

Seiders, Keith and Kristin Kinney, 2004. Washington State Toxic Monitoring Program – Toxic Contaminants in Fish and Surface Water in Freshwater Environments, 2002. Washington State Department of Ecology, Olympia, WA. September 2004. Publication No. 04-03-040. www.ecy.wa.gov/biblio/0403040.html

Serdar, Dave, Kristin Kinney, Myrna Mandjikov, and Dolores Montgomery, 2006. Persistent Organic Pollutants in Feed and Rainbow Trout from Selected Hatcheries. Washington State Department of Ecology, Olympia, WA. April 2006. Publication No. 06-03-017. www.ecy.wa.gov/biblio/0603017.html

Smith, Kirk, Dave Hallock, and Sara O'Neil, 2000. Water Quality Assessment of Selected Lakes Within Washington State, 1998. Washington State Department of Ecology, Olympia, WA. December 2000. Publication No. 00-03-039. www.ecy.wa.gov/pubs/0003039.pdf

WAC 173-201A. Water Quality Standards for Surface Waters in the State of Washington Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/laws-rules/ecywac.html

Willms, Roger and Greg Pelletier, 1992. Impacts of Eastern State Hospital and Lakeland Village Wastewater Discharges on the Quality of West Medical Lake. Washington State Department of Ecology, Olympia, WA. Publication No. 92-e63. www.ecy.wa.gov/biblio/92e63.html