Quality Assurance Project Plan

Verification of 303(d) Listed Sites in Northwest, Central, and Eastern Regions of Washington State

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303(d) listings addressed in this study:

Lake Washington Ship Canal/Shilshole Bay (043HCN) – Dieldrin
Springbrook/Mill Creek (TS53NN) – Sediment Bioassay
Icicle Creek (KN36FW) – Total PCBs
Wenatchee River (HM20EV) – Total PCBs, 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and Alpha-BHC
Spokane River (QZ45UE) – Sediment Bioassay

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December 2003

Approvals

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Abstract

Five waterbodies located among three regions of Washington State (northwest, central, and eastern) are listed on the federal Clean Water Act, Section 303(d) list for violations of water quality standards. By request of the Washington State Department of Ecology's Water Quality Program, these waterbodies will be assessed to determine whether or not they should remain on the 303(d) list.

The water quality violations include:

1. Dieldrin in fish from Shilshole Bay, and sediment bioassay toxicity in Springbrook/ Mill Creek (northwest region).
2. Total PCBs, 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and Alpha BHC in Wenatchee River fish, and total PCBs in Icicle Creek fish (central region).
3. Sediment bioassay toxicity in the Spokane River (eastern region).

The waterbodies will be assessed by analyzing contaminant concentrations in fish tissue and toxicity of sediments, and comparing results to the criteria specified by Ecology's Water Quality 303(d) Listing Policy.

Background and Problem Statement

The Washington State Department of Ecology (Ecology) Water Quality (WQ) Program has requested that five waterbodies located among three of its management regions (northwest, central, and eastern) be re-assessed for violations of water quality standards. The five waterbodies are listed on the federal Clean Water Act, Section 303(d) list because of these violations. The WQ Program is currently in the process of preparing the 2002/2004 303(d) list and needs more information in order to determine the appropriateness of these listings. Ecology's Environmental Assessment Program will investigate each waterbody and make recommendations on listing status to the WQ Program. The 303(d) waterbody listings are shown in Appendix A.

1. Shilshole Bay and Springbrook/Mill Creek (northwest region)

Shilshole Bay is located in Puget Sound at the terminus of the Lake Washington Ship Canal, near the city of Seattle (Figures 1 and 2). It is located within Water Resource Inventory Area (WRIA) 8. Muscle tissue from English Sole (*Parophrys vetulus*) from Shilshole Bay were found to have concentrations of dieldrin above the National Toxics Rule (NTR) Human Health Criterion of 0.65 ng/g, parts per billion (ppb) wet weight (1.0 ng/g vs. 0.65 ng/g). These concentrations were found in 1988, as part of an environmental conditions survey conducted by the U.S. Environmental Protection Agency (EPA) (Crecelius et al., 1989). Dieldrin is an insecticide that was phased out of commercial use starting in 1974 and banned completely by 1987 (EPA, 1992). Dieldrin is considered by EPA to be a probable human carcinogen.

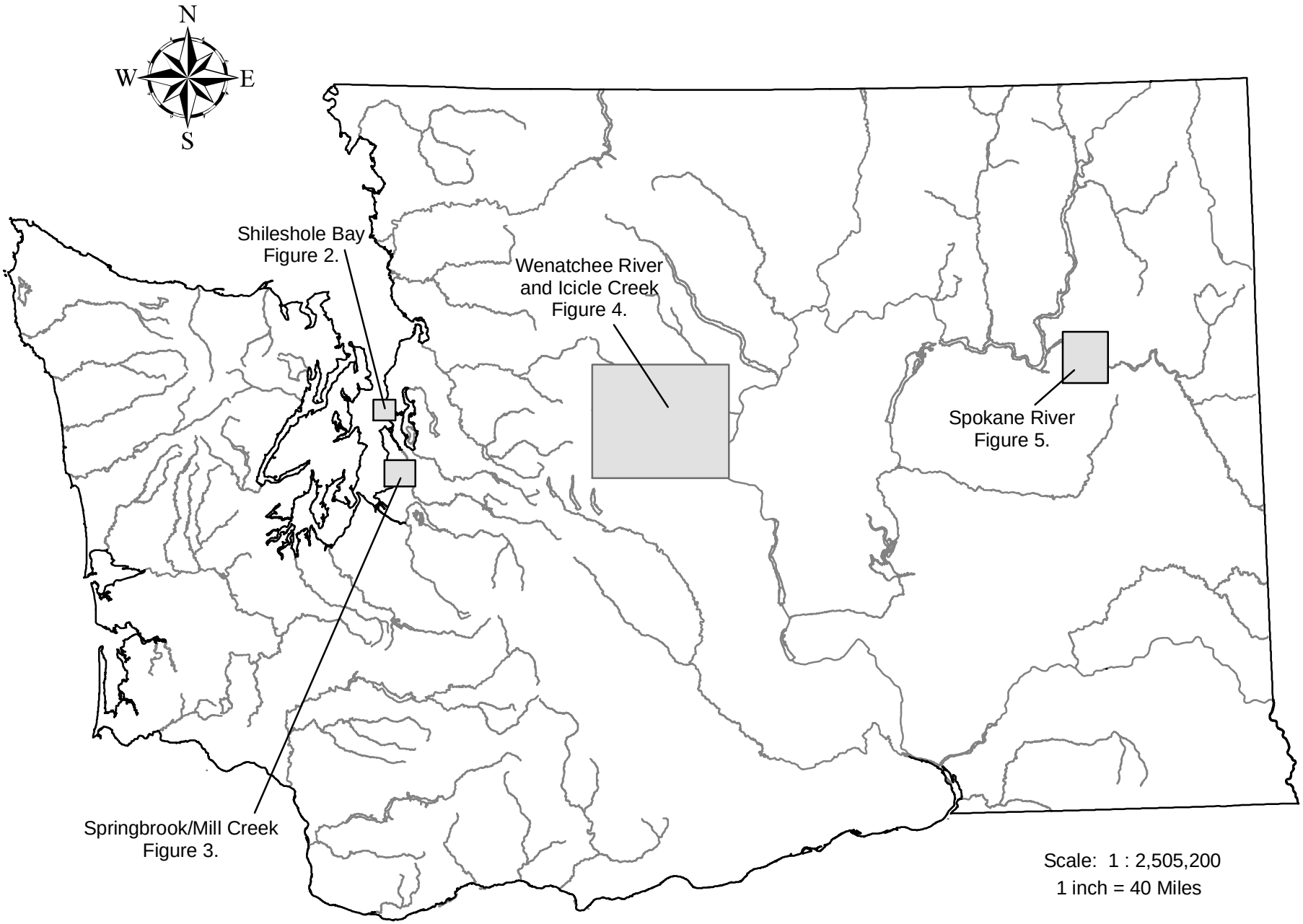

Figure 1. Map of Washington State Showing Major Rivers and the Sampling Areas for the 2003 303(d) List Verification Study

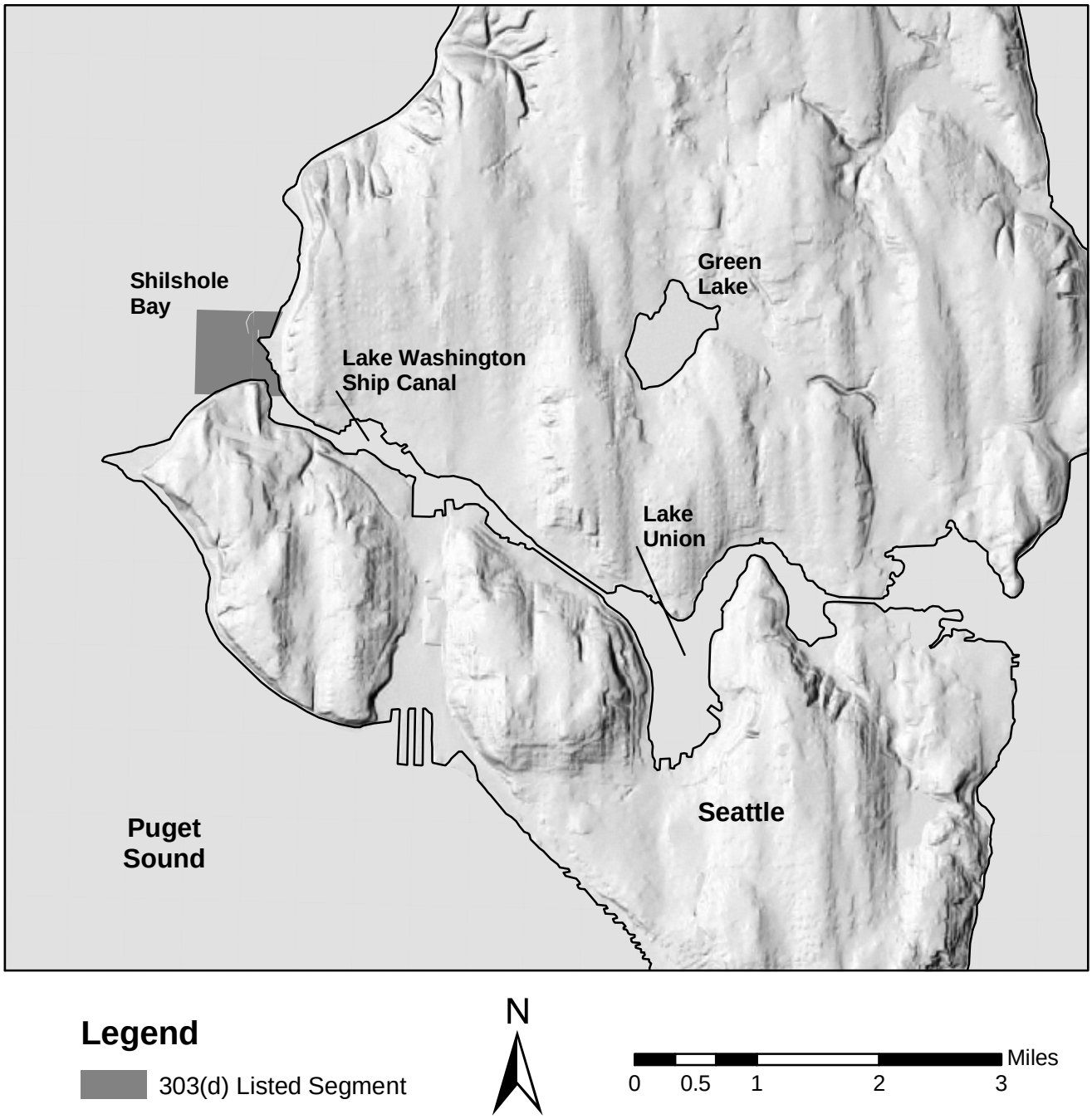

Figure 2. Shilshole Bay Study Area

Springbrook/Mill Creek is a tributary of the Green River and is located in the city of Kent, within WRIA 9 (Figure 3). Mill Creek is a headwater tributary of Springbrook Creek, and therefore is often referred to as Springbrook/Mill Creek. The 303(d) listing is located on Mill Creek. Toxicity was found in the bed sediments of Mill Creek, as a result of a study conducted by Landau and Associates in 1993. Toxicity was measured through the use of bioassay tests. The sediment toxicity study was a part of the larger clean-up effort at the Western Processing Superfund Site, initiated in 1983. The Western Processing company operated a chemical waste processing and recycling facility on its 13 acre site from 1961 to 1983. Some of the chemicals that were cleaned up from soil and water at the site include metals, polychlorinated biphenyls (PCBs), phenols, and volatile organic compounds (EPA, 2000a).

2. Wenatchee River and Icicle Creek (central region)

The Wenatchee River and its tributary, Icicle Creek, are shown in Figure 4. They are both located in WRIA 45. There is a well documented history of the presence of chlorinated chemicals in the Wenatchee River Basin (see Appendix B for data on fish tissue).

- One of the first studies to identify the presence of chlorinated chemicals in the Wenatchee River was conducted by Ecology in 1984 (Hopkins et al., 1985). In a Mountain Whitefish (*Prosopium williamsoni*) muscle tissue composite, they found that several chlorinated compounds (Total PCBs, Alpha-BHC, and DDT) exceeded the NTR Human Health Criteria. These data are the basis for the 303(d) listings in the Wenatchee River.
- In 1993, Ecology found elevated DDT and PCB levels in whole Largescale Sucker (*Catostomus macrocheilus*) composites from the Wenatchee River (Davis et al., 1995). In 1997, The United States Geological Survey (USGS) found high concentrations of total PCBs in the water column. Water column concentrations were estimated through the use of Semipermeable Membrane Devices (SPMDs) and were found to be between four to 200 times the concentrations found in seven other Columbia River mainstem and tributary sites (USGS, 1999). Also in 1997, as part of the Columbia River Basin Fish Contaminant Survey conducted by EPA, several muscle tissue composites of Spring Chinook (*Oncorhynchus tshawytscha*) from Icicle Creek (a major tributary of the Wenatchee River), were found to have total PCB concentrations exceeding the NTR Human Health Criteria (EPA, 2002). These data were the basis for the 303(d) listings in Icicle Creek.

DDT (breakdown chemicals include DDD and DDE) and Alpha-BHC (sometimes called Lindane) are both insecticides that were historically used in agricultural applications. Although EPA banned the use of DDT in 1972 and the use of Alpha-BHC in 1977, these chemicals persist in the environment (EPA, 1992). They are considered by EPA to be probable human carcinogens. The presence of these chemicals in the Wenatchee River are likely due to the numerous orchards and other agriculture in the basin.

Sources of PCBs in the Wenatchee River basin are more obscure than the insecticide sources. PCBs were historically used as insulating fluids, plasticizers, in inks and carbonless paper, and as heat transfer and hydraulic fluids (EPA, 1992). Other research has indicated that DDT can be chemically converted to PCBs via exposure to ultraviolet sunlight (Maugh, 1973). PCBs were also spread by way of recycled waste oil used for dust control and in home and industrial

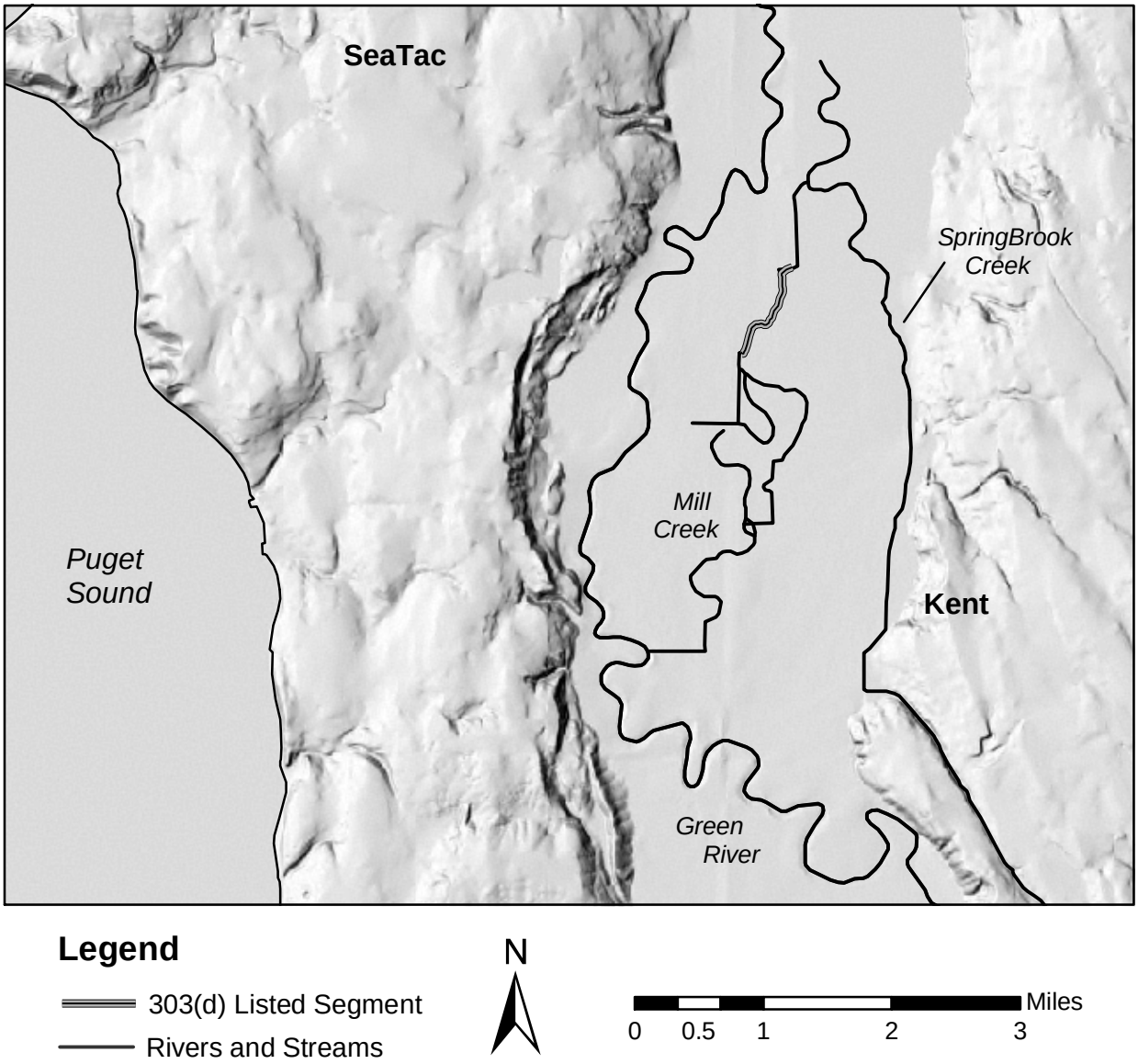

Figure 3. Springbrook/Mill Creek Study Area

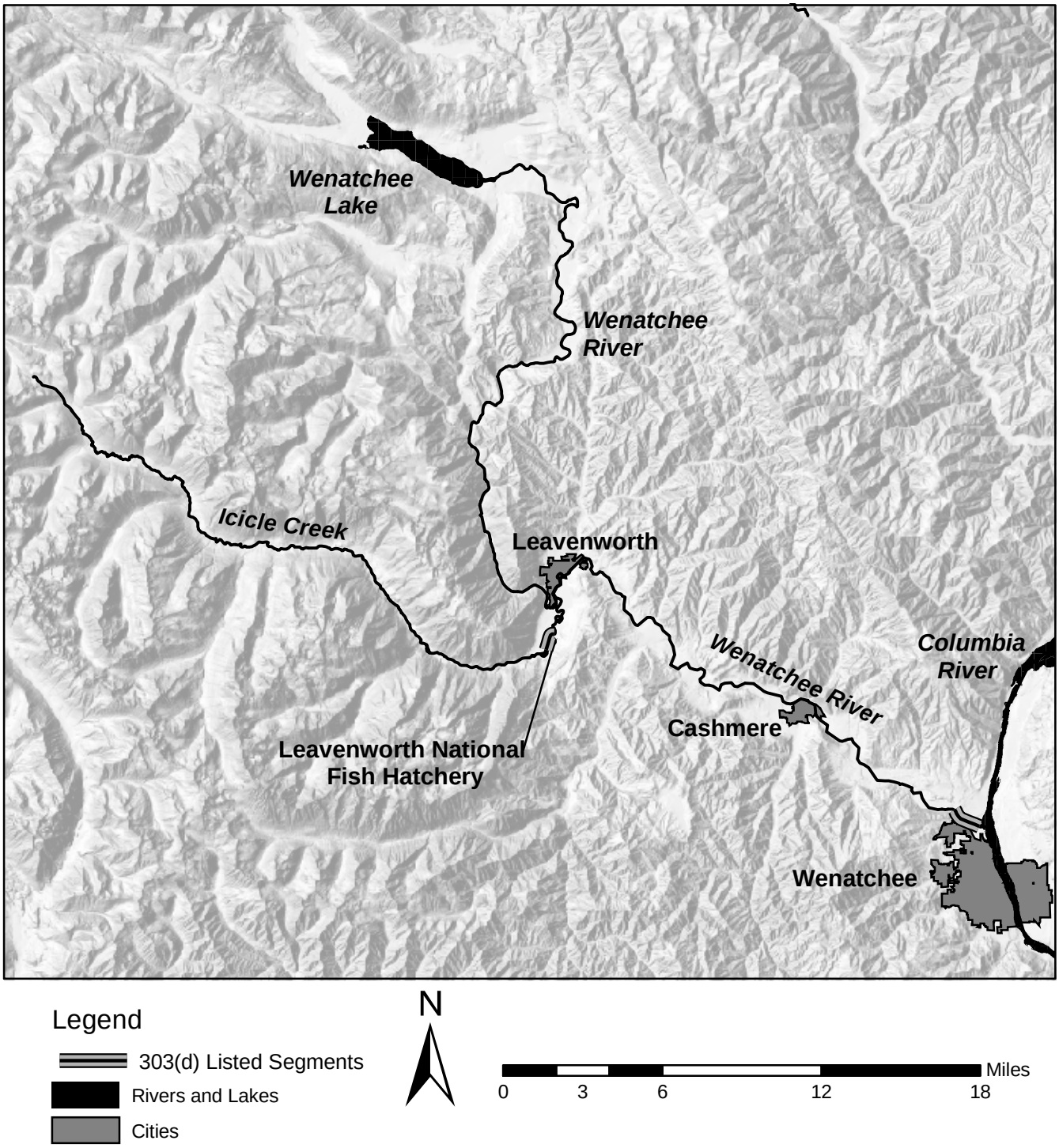

Figure 4. Wenatchee River and Icicle Creek Study Areas

furnaces in some areas of the United States (Chemical Week, 1978). EPA phased out the use and manufacture of PCBs between 1977 and 1985 (EPA, 1992). PCBs are also considered by EPA to be probable human carcinogens.

3. Spokane River (eastern region)

Bioassay toxicity was documented by Ecology in sediments from sections of the Spokane River both above and below Long Lake Dam in 1994 (Batts and Johnson, 1995). Toxicity in the above-dam sections were addressed in a study conducted by Ecology in 2000 (Johnson and Norton, 2001). Ecology found toxicity at several of the above-dam sections and has proposed several more listings for the draft 2002/2004 303(d) list.

Since sediment toxicity has not been addressed since 1994 in the section of the Spokane River below Long Lake Dam, current conditions need to be evaluated. The listed section of the Spokane River is located near Porcupine Bay (Figure 5) in WRIA 54, an area influenced by the backwater of Franklin D. Roosevelt Lake. Suspected causes of toxicity in this area include zinc and lead (Batts and Johnson, 1995).

Project Description

Segments from the five waterbodies will be assessed using the NTR Human Health criteria (40 CFR Part 131) for fish tissue – or Ecology's Sediment Management Standards (WAC 173-204-340) for sediments and Ecology's 2002 303(d) listing policy (Ecology, 2002) – to evaluate if their continued listing on the 303(d) list is warranted. Individual listings that will be evaluated in this study are shown in Table 1.

Table 1. Individual 303(d) Listings Addressed by the Verification Study.

Waterbody Name	Matrix	303(d) Listed Parameter	New (1998) Waterbody ID	Old (1996) Waterbody ID
1. Northwest Region				
Shilshole Bay	Fish Tissue	Dieldrin	043HCN	Not listed in 1996
Springbrook/Mill Creek	Sediment	Bioassay Toxicity	TS53NN	WA-09-1026
2. Central Region				
Wenatchee River	Fish Tissue	Total PCBs	HM20EV	Not listed in 1996
Wenatchee River	Fish Tissue	4,4'-DDT	HM20EV	"
Wenatchee River	Fish Tissue	4,4'-DDE	HM20EV	"
Wenatchee River	Fish Tissue	4,4'-DDD	HM20EV	"
Wenatchee River	Fish Tissue	Alpha BHC	HM20EV	"
Icicle Creek	Fish Tissue	Total PCBs	KN36FW	"
3. Eastern Region				
Spokane River	Sediment	Bioassay Toxicity	QZ45UE	WA-54-1020

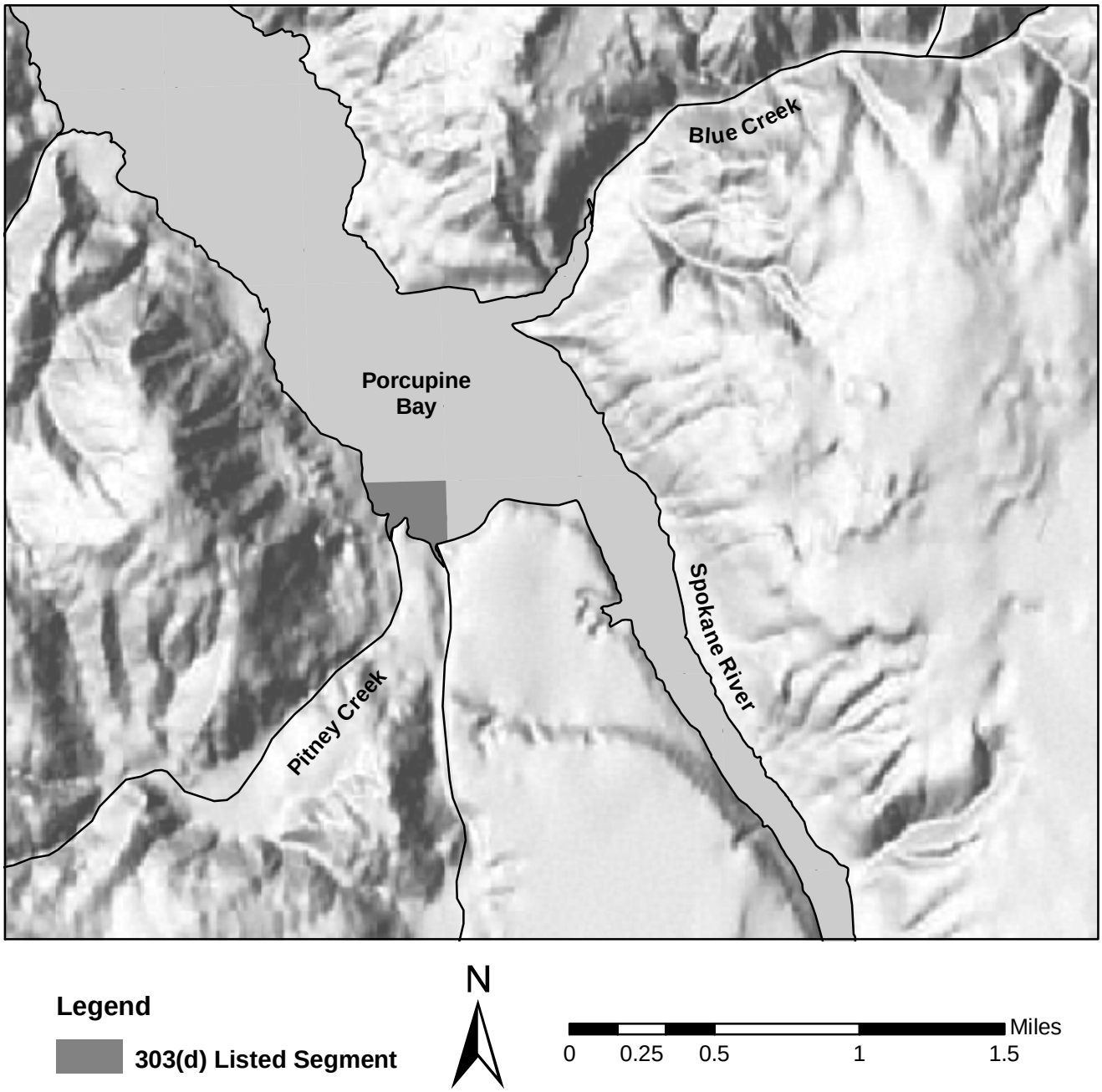

Figure 5. Spokane River Study Area

Responsibilities

Lisa Olson (Ecology) – Client and staff contact for the Northwest Regional Office. Responsible for reviewing the Quality Assurance (QA) Project Plan and draft study report.

Dave Schneider (Ecology) – Client and staff contact for the Central Regional Office. Responsible for reviewing the QA Project Plan and draft study report.

Elaine Snouwaert (Ecology) – Client and staff contact for the Eastern Regional Office. Responsible for reviewing the QA Project Plan and draft study report.

Brandee Era-Miller (Ecology) – Toxics Studies Unit. Project Manager: responsible for study design and preparation of the QA Project Plan, field sampling, interpretation of results, and authoring the study report. Enters project data into EIM database.

Dave Serdar, Trevor Swanson, Mike LeMoine, Terry Wittmeier, James Kardouni, *Aspen Madrone, David Schneider, Joan LeTourneau* (Ecology) and *Art Viola* (Washington Department of Fish and Wildlife) will assist with field sampling.

Dale Norton (Ecology) – Unit Supervisor, Toxics Studies Unit. Responsible for review of QA Project Plan and draft study report.

Will Kendra (Ecology) – Section Manager, Watershed Ecology Section. Responsible for review of QA Project Plan and draft study report.

Cliff Kirchmer (Ecology) – Quality Assurance Officer. Responsible for review of QA Project Plan.

Stuart Magoon and Manchester Environmental Laboratory Personnel (Ecology) – Responsible for review of the QA Project Plan pertaining to laboratory analysis and the analysis and reporting of project data to the project manager.

Contract Laboratories – Contract laboratories performing the contract data analysis are responsible for following the methods specified in this QA Project Plan. The contract laboratories will be given a copy of the QA Project Plan.

Schedule and Budget

Field Work	
Fish Collection	October – November 2003
Sediment Collection	October – November 2003
Fish Tissue Processing	December 2003
Data Reporting	
Laboratory Data Completed	December 2003 – January 2004
EIM Data Entry	January 2004
Draft Report for Client Review	March 2004
Final Report	April 2004

Laboratory Budget, FY04	
Sediment Bioassays and Chemistry	$ 26,739
Fish Tissue Analysis	$ 4,770
Total Cost	**$ 31,214**

Data Quality Objectives

In order to limit potential sources of bias prior to laboratory analysis, sediment sampling will follow the Puget Sound Estuary Program (PSEP) procedures, and fish tissue processing will follow EPA guidance (PSEP, 1996; EPA, 2000b). These protocols are explained in further detail in the Field Quality Control section and the Field Procedures and Sample Preparation section of this QA Project Plan.

The laboratories conducting the analysis for this study are expected to meet all of the quality control (QC) requirements of the analytical methods selected for this project. Measurement quality objectives (MQOs) for the laboratory analysis methods and required reporting limits are shown in Table 2 and include target values for data accuracy, precision, and bias. The laboratory reporting limits are adequate to meet the data quality objectives for this study; therefore, the required reporting limits are the laboratory reporting limits.

Laboratory surrogate recoveries will be used to measure accuracy for chlorinated pesticides and PCB Aroclors. The MQOs for these surrogate recoveries are 50 to 150% surrogate recovery.

Determining the quantitative accuracy of sediment bioassays is difficult due to the unknown variables that affect organism response, overlying water quality, and the experience of laboratory personnel. There are also no accepted reference materials suitable for determining the accuracy of sediment bioassays (EPA, 2000c). It is therefore critical that field sampling procedures and laboratory protocols for the sediment bioassay tests are followed closely.

Table 2. Measurement Quality Objectives and Required Reporting Limits for Laboratory Analysis Methods.

Target Parameter	Accuracy (% deviation from true value)	Precision (RSD)	Bias (% of true value)	Required Reporting Limits
Sediment				
TOC	n/a	7	n/a	0.1 %
Grain Size[1]	n/a	10	n/a	0.1 %
Cd, Cu, & Pb	20	7.5	5	0.1 mg/Kg, dry
Hg	20	7.5	5	0.005 mg/Kg, dry
Zn	20	7.5	5	5.0 mg/Kg, dry
Fish Tissue				
Chlorinated Pesticides[2]	50	15	20	10-100 ug/Kg, wet
PCB Aroclors	50	15	20	50-5000 ug/Kg, wet
Percent Lipids	n/a	20	n/a	0.1 %

[1] = Gravel, sand, silt, and clay fractions
[2] = 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Alpha BHC, and dieldrin
RSD = Relative Standard Deviation

Representativeness

Composite samples for both sediments and fish tissue will help to obtain data representative of each sampling site. Three separate composite sediment samples will be analyzed for bioassay toxicity at each 303(d) listed site, and the results will be used to determine overall site toxicity. Fifty total fish will be analyzed for the contaminants of concern. This number of fish should be more than sufficient to account for natural variability in contaminant concentrations in fish tissue.

Completeness

The amount of useable data obtained from this study will be maximized by careful planning of field work and by using standardized protocols for collection, packaging, and transport of samples. Excess sample will be retained from each sample and stored in the event that additional chemical analysis is required to meet data quality objectives.

Comparability

The analytical methods used for both sediment and fish tissue analysis in this study are standard methods used in numerous other Ecology studies and should be comparable to many other data sets.

Decision Criteria

In order to make recommendations on whether waterbodies should be de-listed or continue to be listed on the 303(d) list, data must meet the listing criteria of Ecology's Water Quality 303(d) Listing Policy (Ecology, 2002). Listing recommendations for this study will be based on the following:

- For biological assessment of freshwater sediment, the 303(d) listing policy states that potential listings will be based on biological tests done in accordance with adopted narrative standards, on a case-by-case basis, in concurrence with the Sediment Management Standards WAC 173-204-340 (Ecology, 2002). Standard Ecology practice for freshwater biological assessment has been the use of a suite of bioassay tests that include two acute tests and one chronic test. Bioassay tests for this study will be chosen from the Sediment Sampling and Analysis Plan Appendix, a guidance document for the Sediment Management Standards (Ecology, 2003). For each listed waterbody, three separate sites will be tested and compared for significant statistical difference to both reference and control sediments. Statistical difference, as defined by the Sediment Management Standards, is determined using a t-test with a significance of 0.05.
- The listing criteria for contaminants in fish include fin fish muscle tissue from at least three single-fish samples or a single composite sample made up of at least five separate fish of the same species. If the average of the three single-fish samples with the highest contaminant concentration or the contaminant concentration of composite fish sample exceeds criteria for human health impacts based on EPA's bio-concentration factors and water column criteria established under the NTR, then the waterbody should be listed (Ecology, 2002).

Sampling Design

1. Shilshole Bay and Springbrook/Mill Creek (northwest region)

Two composite samples, each consisting of five English Sole (*Parophrys vetulus),* will be collected from the 303(d) listed section of Shilshole Bay. The fish will be caught by trawling from Ecology's 26-foot Almar research vessel or from a Washington Department of Fish and Wildlife (WDFW) trawling vessel.

Sediments from Springbrook/Mill Creek will be collected by carefully wading into the stream and using a 0.02 m^2 petite ponar grab or a 0.05 m^2 large ponar grab by hand. Composite grabs from three locations within the 303(d) listed section of the creek will be collected. A reference site from the Green River watershed that contains sediments similar to those of Mill Creek will also be sampled.

2. Wenatchee River and Icicle Creek (central region)

Six composite samples of five fish each will be collected from the Wenatchee River, and two composite samples will be collected from Icicle Creek. The 303(d) listed section of the

Wenatchee River is located at the mouth of the river; however, fish will collected in a way that represents a majority of the river's length. Two composite fish samples will be collected from the following three sections of the Wenatchee River (see Figure 4):

- Upper Wenatchee River (from the outlet of Lake Wenatchee to Leavenworth)
- Middle Wenatchee River (from Leavenworth to Cashmere)
- Lower Wenatchee River (Cashmere to the confluence with the Columbia River)

All fish from Icicle Creek (two composites) will be caught near the 303(d) listed section of the creek, downstream of the Wenatchee National Fish Hatchery.

Target species for both the three sections of the Wenatchee River and Icicle Creek include one composite of mountain whitefish (*Prosopium williamsoni*) and one composite of bridgelip suckers (*Catostomus Columbianus*). These two species were selected for several reasons. First, in order to represent the contaminant conditions unique to the Wenatchee River, resident species were needed. Second, mountain whitefish represent fish that humans are likely consuming. Mountain whitefish are one of the only legal fisheries in the Wenatchee River Basin (Viola, 2003). Third, EPA recommends analyzing both bottom-feeding species and predator species when screening for contaminants in fish tissue (EPA, 2000b). Bridgelip suckers are considered bottom-feeders and mountain whitefish predators. In addition, both species are known to have low-ranging migratory patterns (Hildebrand, 1991; Viola, 2003). Both species have also shown a tendency to accumulate certain persistent organo-chlorine compounds (Davis et al., 1995).

Several methods of fish collection may be used to obtain fish. Fishing methods (in preferred order of use) include angling, back-pack electrofishing, and netting.

3. Spokane River (eastern region)

Composite sediment samples from three locations within the 303(d) listed section of the Spokane River will be collected with a $0.1m^2$ stainless steel van Veen grab from Ecology's 26-foot Almar research vessel.

A reference site containing sediments similar to those from the sampling location will also be sampled. Reference sites recommended by Ecology staff include (1) Buffalo Lake on the Colville Reservation, northeast of Grand Coulee Dam, (2) Deep Creek, west of the city of Spokane, (3) Upstream on the Little Spokane River, north of Spokane, and/or (4) Hangman Creek, south of Spokane. Because boat access is limited at a few of the reference sites, sediments may be collected by carefully wading into the stream and using a $0.02\ m^2$ petite ponar grab or a $0.05\ m^2$ large ponar grab by hand.

Sediment samples will also be analyzed for cadmium, copper, lead, mercury, and zinc. Zinc and lead are the suspected causes of toxicity, and elevated levels of mercury have been found in nearby reaches of lower Lake Roosevelt (Batts and Johnson, 1995; Era and Serdar, 2001).

Field Procedures and Sample Preparation

Sediment

To the extent possible, sampling methods will follow PSEP protocols (PSEP, 1996). Sediments will be collected using either a 0.02 m^2, 0.05m^2 or a 0.1m^2 stainless steel grab sampler. At a minimum, each sample will consist of three individual grabs. A grab will be considered acceptable if it is not over-filled with sediment, overlying water is present but not turbid, the sediment surface is relatively flat, and the desired depth of penetration has been achieved. Sampling locations will be recorded from GPS, and a field log describing the quality of each grab will be maintained.

Fine-grained sediments (silt) will be targeted over large-grained sediments (sand) to represent depositional areas. Sediments grabs will be taken from the top 0-15 cm of sediment (the biologically active zone) and removed from each grab with a stainless steel spoon and placed in a large stainless steel bowl. Sediments touching the sidewalls of the grab will not be taken. Once all three replicate grabs have been collected, sediments will be homogenized by stirring.

Homogenized sediment will be placed in glass jars with Teflon lid liners, cleaned to EPA QA/QC specifications (EPA, 1990). Sample containers, preservation, and holding times are shown in Table 3. Excess sample retained from each sample will be stored frozen in the event that additional analysis is required by the laboratories.

Table 3. Recommended Containers, Preservations, and Holding Times for Sediment and Fish Tissue Analysis.[1]

Analyte	Container	Preservation	Holding Time
Sediment Bioassays			
Chironomus	1 liter glass jar	Refrigerate, 4° C	2 weeks
Hyalella	1 liter glass jar	Refrigerate, 4° C	2 weeks
Microtox	1 liter glass jar	Refrigerate, 4° C	2 weeks
Sediment Chemistry			
TOC	2 oz glass jar	Refrigerate, 4° C	28 days (1 year if frozen)
Grain Size [2]	8 oz glass or polyethylene jar	Refrigerate, 4° C	6 months
Cd, Cu, Pb and Zn	8 oz glass jar	Refrigerate, 4° C	6 months
Hg	4 oz glass jar	Refrigerate, 4° C	28 days
Fish Tissue Chemistry			
Chlorinated Pesticides PCB Aroclors Percent Lipids	Certified 4-oz glass Teflon lid liner	Refrigerate, 4° C Freeze, -18° C	7 day Extraction 14 day Analysis (1 year if frozen)

[1] = Information taken from the Manchester Laboratory Manual and PSEP Protocols (MEL, 2003; PSEP, 1996)
[2] = Gravel, sand, silt, and clay fractions

Stainless steel implements used to collect and manipulate the sediments will be cleaned by washing with Liquinox detergent, followed by sequential rinses with hot tap water, 10% nitric acid, and deionized water. The equipment will then be air-dried and wrapped in aluminum foil. Between-sample cleaning of the sediment grabs will consist of a thorough brushing with on-site water.

Sediment samples will be placed on ice immediately after collection and transported to Manchester Laboratory within two business days. Manchester will ship the bioassay samples to the contract laboratories. Chain-of-custody will be maintained.

Additional sampling equipment and sample containers will be brought during field sampling as preventive maintenance.

Fish Tissue

All necessary state and federal permits have been obtained for fish collection. Fish will be collected by trawling in Shilshole Bay and by angling, back-pack electrofishing, and/or netting in the Wenatchee River and Icicle Creek. Trawling tow locations and fishing locations will be recorded by GPS. Fish selected for analysis will be quickly killed with a sharp blow to the head, given an ID number, and the weight and length recorded. The fish will be individually wrapped in heavy aluminum foil and put in plastic bags, kept cold in coolers, and frozen immediately upon return from the field.

Preparation of fish tissue samples will follow EPA (2000b) guidance and will take place at Ecology's Headquarters building in Lacey, Washington. Precautions will be taken to minimize contamination during sample processing. Persons preparing samples will wear non-talc nitrile 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.

Samples for analysis will be prepared by partially thawing the fish to remove the foil wrapper and rinsing in deionized water to remove adhering debris. For English sole and mountain whitefish, the entire skin-on muscle fillet from one side of each fish will be removed with stainless steel knives and homogenized by several passes through a Kitchen-Aide food processor. For bridgelip suckers, the entire partially-frozen fish will be cut into rounds and passed several times through a Hobart commercial blender. Both muscle fillet and whole-fish composite samples will be made up of equal-portioned aliquots from five fish. Composite samples will be homogenized to uniform color and consistency and placed in jars, specifically-cleaned for chemical analysis, and sent to Manchester laboratory (see Table 3). Excess sample will be retained from each composite and stored frozen in the event that additional analysis is required by the laboratories.

All resecting instruments will be washed thoroughly with Liquinox detergent, followed by sequential rinses of hot tap water, de-ionized water, pesticide-grade acetone, and pesticide-grade hexane. The same decontamination procedure will be repeated between each composite sample.

The sex of each fish will be recorded during processing, and aging structures (scales, otoliths, opercles, and/or dorsal spines as appropriate for each species) will be saved for age determination.

Laboratory Procedures

Table 4 shows the target analytes, analytical methods, reporting limits, and laboratories conducting the analysis for both the sediment and fish tissue samples. Sediment bioassay tests and grain size will be conducted by Ecology-accredited contract laboratories selected by Manchester Laboratory in consultation with the project manager.

Table 4. Target Analytes, Analytical Methods, Reporting Limits, and Laboratories.

Target Analyte	Reporting Limits	Analytical Method & Method Reference	Laboratory
Sediment			
Microtox Bioassay	n/a	Ecology Protocol (Ecology, 2003)	Contract
Hyalella 10-day Bioassay	n/a	ASTM E-1706 and Method 100.1 (EPA, 2000c)	Contract
Chironomus 20-day Bioassay	n/a	Method 100.5 (EPA, 2000c)	Contract
Grain Size[1]	0.1 %	Sieve & Pipet (PSEP, 1996)	Contract
TOC	0.1 %	Combustion/CO2 - Measurement @ 70°C Method 9060	Manchester
Cd, Cu & Pb	0.1 mg/Kg, dry	ICP/MS - EPA 200.8	Manchester
Hg	0.005 mg/Kg, dry	CVAA - EPA 245.5	Manchester
Zn	5.0 mg/Kg, dry	ICP/MS - EPA 200.8	Manchester
Fish Tissue			
Chlorinated Pesticides[2]	10-100 ug/Kg, wet	EPA 3540/3620/3665 (prep) EPA 8081	Manchester
PCB Aroclors	50-5000 ug/Kg, wet	EPA 3540 (prep) EPA 8082	Manchester
Percent Lipids	0.1 %	Extraction - SW 608.5	Manchester

[1] = Gravel, sand, silt, and clay fractions
[2] = 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Alpha BHC, and dieldrin

Sediment Bioassay Methods

The Microtox® test measures light emitted by the bioluminescent marine bacteria *Vibrio fischeri* upon exposure to test sediment porewater for five and 15 minutes. Results are then compared for statistical significance against the results of control and reference sediment porewater. The method for this test is an Ecology modification of PSEP protocols (Ecology, 2003).

The *Hyalella* test measures the survival of the amphipod *Hyalella azteca* after a 10-day exposure to test sediment and is considered to be an acute toxicity test (EPA, 2000c). Results are statistically compared to both control and reference sediments.

The *Chironomus* test measures the growth and survival of the midge *Chironomus tentans* after a 20-day exposure to test sediment and is considered to be a chronic toxicity test. The method is a modification of a 50 to 65-day lifecycle test developed by EPA (EPA, 2000c). Results are also statistically compared to both control and reference sediments.

Detailed Summary of Estimated Laboratory Cost

Total laboratory costs and number of samples for sediment and fish tissue are shown in Table 5.

Table 5. Estimated Laboratory Costs for the 303(d) List Verification Study.

Analysis	Matrix	No. of Samples (including reference sites)	No. of Quality Control Samples[1]	Total No. of samples	Cost per Analysis	Cost Subtotals
Microtox Bioassay	sediment	8	0	8	200	1,600
Hyalella 10-day Bioassay	sediment	8	0	8	725	5,800
Chironomus 20-day Bioassay	sediment	8	0	8	1500	12,000
					Bioassay Subtotal	$ 19,400
					25% Manchester surcharge	4,850
					Bioassay Total	$ 24,250
TOC	sediment	8	2	10	39	390
Grain Size	sediment	8	2	10	100	1,000
Cd, Cu, Pb, & Zn	sediment	4	2	6	104	624
Hg	sediment	4	2	6	30	180
					Sediment Analysis Total	**$ 26,444**
Percent Lipids	fish tissue	10	5	15	82	465
Chlorinated Pesticides[2] & PCB Aroclors	fish tissue	10	5	15	287	4,305
					Fish Tissue Analysis Total	**$ 4,770**
					Total Laboratory Cost	**$ 31,214 ***

[1] = Field duplicates, Standard Reference Material, and Matrix Spikes
[2] = 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Alpha BHC, and dieldrin

* Costs include 50% discount for Manchester Laboratory

Quality Control Procedures

Field

Field work will be conducted to avoid cross-contamination, and the field sampling procedures described in the Field Procedures and Sample Preparation section of this QA Project Plan will be carefully followed. A copy of the QA Project Plan will be taken into the field for reference.

Field duplicates will provide estimates of total variability in the data (field + laboratory). Sediment chemistry and fish tissue analysis for each waterbody will include one field duplicate as shown in Table 6. For the sediment bioassays, reference sites will be tested to help in determining sediment toxicity. Field duplicates for sediment and fish tissue will be composite sample splits.

Table 6. Field Duplicate Samples for Sediment and Fish Tissue.

Analysis	Springbrook/ Mill Creek	Spokane River	Shilshole Bay	Wenatchee River	Icicle Creek
Sediment					
TOC	1	1	-	-	-
Grain Size	1	1	-	-	-
Hg, Pb, and Zn	-	1	-	-	-
Fish Tissue					
Chlorinated Pesticides[1]	-	-	1	1	1
PCB Aroclors	-	-	1	1	1
Percent Lipids	-	-	1	1	1

[1] = 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Alpha BHC, and dieldrin

Laboratory

Laboratory QC protocols for the *Chironomus*, *Hyalella*, and Microtox® bioassay test methods are described in the Sediment Sampling and Analysis Plan Appendix, a guidance document for the Sediment Management Standards (Ecology 2003, table 15 and appendix C; and EPA, 2000c). The contract laboratory performing the bioassay tests are expected to closely follow these QC protocols.

As part of their standard operating procedures (SOPs), Manchester Laboratory routinely runs laboratory control samples for all analytical methods. These SOPs are described in the Quality Assurance Manual for the Washington State Department of Ecology Manchester Environmental Laboratory (MEL, 2002). Additional laboratory control samples are sometimes requested by the project manager. Laboratory control samples selected for this study are shown in Table 7.

Table 7. Laboratory Quality Control Samples for the 303(d) Verification Study.

Analysis	Method Blank	Lab Duplicate	Lab Control Standard	Surrogate Spikes	Std Ref Material	Matrix Spike
Sediment						
TOC	1	2	-	-	-	-
Grain Size	-	2	-	-	-	-
Hg, Pb, and Zn	1	1	1	-	-	1
Fish Tissue						
Chlorinated Pesticides[1]	1	2	1	all samples	1	1
PCB Aroclors	1	2	1	all samples	-	1
Percent Lipids	1	2	1	-	-	1

[1] = 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Alpha BHC, and dieldrin

A standard reference material (SRM) will be analyzed for determining accuracy of the DDT data for fish tissue. Manchester Laboratory will analyze National Institute of Standards & Technology (NIST) SRM 2978 – Mussel Tissue: Organic Contaminants – Raritan Bay, New Jersey.

Data Review and Validation

Upon receipt of the sediment bioassay data and chemical data for sediment and fish tissue, the project manager will review the results for completeness, reasonableness, and usability. The bioassay data will be closely reviewed to ensure that the laboratory methods and hypothesis testing were followed correctly.

The project manager will provide a draft report of the study results to clients in March 2004. At a minimum, the final report will contain the following:

- A map of the study areas that shows sampling sites
- Latitude/longitude and other location information for each sampling site
- Descriptions of field and laboratory methods
- A discussion of data quality and the significance of any problems encountered during sampling and analysis
- Summary tables of biological and chemical data
- A summary of significant findings
- Recommendations for continued listing or de-listing on the 303(d) list and potential follow-up work

A final report will be prepared after receiving review comments from (1) clients from the Water Quality Program – Northwest Regional Office, Central Regional Office, and Eastern Regional Office, (2) the Toxics Cleanup Program – Eastern Regional Office, and (3) the Environmental Assessment Program. The final report is slated for completion in April 2004.

All chemistry data generated from the study will be entered into Ecology's Environmental Information Management (EIM) system, and sediment data will be made available for entry into the SEDQUAL database via SEDQUAL data templates.

Data Quality Assessment

Once the data have been reviewed, verified, and validated, the project manager will determine if the data are of usable quality to make decisions for which the study was designed. Data from the laboratory QC procedures, replicate field samples, and SRMs will provide information to determine if measurement quality objectives have been met.

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Appendix A

303(d) Listings

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: PUGET SOUND (CENTRAL)

Water Course ID: 390KRD

Parameter: Dieldrin

WRIA: 8

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: EA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township:

Range:

Section:

Listed 96?:

98?:

Upper Route:

Lower Route:

Segment Length:

Grid Cell: 47122G4H

Latitude: 47.675

Longitude: 122.415

Basis

Crecelius, et al. 1989 , excursions beyond the criterion in edible fish tissue.

Remarks

Print | Close | Help

Water Name	SOOS CREEK SYSTEM				
Parameter	Temperature			**Mediu**	Water
Place on 1998 List?	No	**Listed in 1996**	Yes	**Action Needed**	None
New Segment ID #	HH34YJ	**Old Segment ID #**	WA-09-1026		
Stream Route #	0	**Water Resource Inventory Area**	9		
Township	21N	**Waterbody Grid #**			
Range	05E	**Grid Latitude**			
Section	10	**Grid Longitude**			
Basis for Consideration of Listing	1 excursion beyond the criterion out of 12 samples (8%) at Ecology ambient monitoring station 09B090 (RM 1.6) on 8/17/94;				
Remarks	A single excursion beyond the criterion does not meet the Water Quality Program policy for listing.				

Water Name	SPRINGBROOK (MILL) CREEK				
Parameter	Sediment Bioassay			**Mediu**	Sediment
Place on 1998 List?	Yes	**Listed in 1996**	Yes	**Action Needed**	Other Control
New Segment ID #	TS53NN	**Old Segment ID #**	WA-09-1015		
Stream Route #	1.188	**Water Resource Inventory Area**	9		
Township	22N	**Waterbody Grid #**			
Range	04E	**Grid Latitude**			
Section	01	**Grid Longitude**			
Basis for Consideration of Listing	Landau and Associates, 1993b.				
Remarks					

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: ICICLE CREEK

Water Course ID: KN36FW

Parameter: Total PCBs

WRIA: 45

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: RA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township: 24 N

Range: 17 E

Section: 23

Listed 96?:

98?:

Upper Route: 5.26

Lower Route: 4.318

Segment Length: 0.942

Grid Cell:

Latitude:

Longitude:

Basis

EVS Environmental Consultants (2000) show an excursion beyond the National Toxic Rule criterion from Spring Chinook composite of 5 fillet with skin collected in 1997 at station 51-0 (River Mile 2.8) sample #97250814.

Remarks

Print | Close | Help

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: WENATCHEE RIVER

Water Course ID: HM20EV

Parameter: Total PCBs

WRIA: 45

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: RA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township: 23 N

Range: 20 E

Section: 28

Listed 96?:

98?:

Upper Route: 2.616

Lower Route: 0.6

Segment Length: 2.016

Grid Cell:

Latitude:

Longitude:

Basis

Hopkins et al. 1985. show excursions beyond the National Toxic Rule criterion in a multiple fish composite of edible tissue of Mountain whitefish samples collected in 1984.

Remarks

Print | Close | Help

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: WENATCHEE RIVER

Water Course ID: HM20EV

Parameter: 4,4'-DDT

WRIA: 45

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: RA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township: 23 N

Range: 20 E

Section: 28

Listed 96?:

98?:

Upper Route: 2.616

Lower Route: 0.6

Segment Length: 2.016

Grid Cell:

Latitude:

Longitude:

Basis

Hopkins et al. 1985. show excursions beyond the National Toxic Rule criterion in a multiple fish composite of edible tissue of Mountain whitefish samples collected in 1984.

Remarks

Print | Close | Help

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: WENATCHEE RIVER

Water Course ID: HM20EV

Parameter: 4,4'-DDD

WRIA: 45

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: RA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township: 23 N

Range: 20 E

Section: 28

Listed 96?:

98?:

Upper Route: 2.616

Lower Route: 0.6

Segment Length: 2.016

Grid Cell:

Latitude:

Longitude:

Basis

Hopkins et al. 1985. show excursions beyond the National Toxic Rule criterion in a multiple fish composite of edible tissue of Mountain whitefish samples collected in 1984.

Remarks

Print | Close | Help

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: WENATCHEE RIVER

Water Course ID: HM20EV

Parameter: 4,4'-DDE

WRIA: 45

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: RA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township: 23 N

Range: 20 E

Section: 28

Listed 96?:

98?:

Upper Route: 2.616

Lower Route: 0.6

Segment Length: 2.016

Grid Cell:

Latitude:

Longitude:

Basis

Hopkins et al. 1985. show excursions beyond the National Toxic Rule criterion in a multiple fish composite of edible tissue of Mountain whitefish samples collected in 1984.

Remarks

Print | Close | Help

Water Quality Assessment for Washington

Main Page | ESA Information | TMDL Information

Water Body: WENATCHEE RIVER

Water Course ID: HM20EV

Parameter: ALPHA-BHC

WRIA: 45

Category: 5

Sample Medium: Tissue

Listing Cycle: 2002

Class: RA

Assessment Type: Physical/Chemical

Assessment Level: 4

Township: 23 N

Range: 20 E

Section: 28

Listed 96?:

98?:

Upper Route: 2.616

Lower Route: 0.6

Segment Length: 2.016

Grid Cell:

Latitude:

Longitude:

Basis

Hopkins et al. 1985. show excursions beyond the National Toxic Rule criterion in a multiple fish composite of edible tissue of Mountain whitefish samples collected in 1984.

Remarks

Print | Close | Help

Water Name	SPOKANE RIVER				
Parameter	Sediment Bioassay			**Mediu**	Sediment
Place on 1998 List?	Yes	**Listed in 1996**	Yes	**Action Needed**	Other Control
New Segment ID #	QZ45UE	**Old Segment ID #**	WA-54-1010		
Stream Route #	19.589	**Water Resource Inventory Area**	54		
Township	28N	**Waterbody Grid #**			
Range	37E	**Grid Latitude**			
Section	33	**Grid Longitude**			
Basis for Consideration of Listing	Batts and Johnson, 1995. , Microtox composite sample showed significant effect and Chironomus showed apparent effect in 1994.				
Remarks					

Water Name	SPOKANE RIVER				
Parameter	pH			**Mediu**	Water
Place on 1998 List?	No	**Listed in 1996**	Yes	**Action Needed**	None
New Segment ID #	QZ45UE	**Old Segment ID #**	WA-54-1020		
Stream Route #	106.23	**Water Resource Inventory Area**	54		
Township	25N	**Waterbody Grid #**			
Range	42E	**Grid Latitude**			
Section	04	**Grid Longitude**			
Basis for Consideration of Listing	2 excursions beyond the criterion out of 36 samples (6%) at Ecology ambient monitoring station 54A120 (RM 66.0) between 9/91 and 9/96..				
Remarks	The information does not meet the Water Quality Program policy for listing this segment for this parameter.				

Appendix B

Wenatchee River Fish Tissue Data

Table B-1. Chlorinated Chemical Data in Fish Tissue from Wenatchee River and Icicle Creek, ug/Kg (ppb) wet weight.

Location	Wenatchee River	Wenatchee River	Icicle Creek	National Toxics Rule Criteria*
Species	Mountain Whitefish	Largescale Sucker	Chinook Salmon	
Tissue	muscle tissue	muscle tissue	whole body	
N =	1 composite	2 composites	3 composites	
Date	1984[1]	1993[2]	1997[3]	
4,4'-DDT	250	32/26	--	32
4,4'-DDE	910	380/270	--	32
4,4'-DDD	120	68/47	--	45
Total DDT	1400	494/343	--	32
Alpha-BHC	23	--	--	1.7
PCB-1248	--	170/ --	--	5.3
PCB-1254	--	250/55	13/16/17	5.3
PCB-1260	46	48/49	--	5.3
Total PCBs	46	468/104	13/16/17	5.3

* Based on EPA bioconcentration factors and water column criteria established under the National Toxics Rule (40 CFR Part 131). Applies to edible fish tissue only.

-- Data either below detection limit or not reported in original report

[1] Hopkins et al., 1985

[2] Davis et al., 1995

[3] EPA, 2002