DEPARTMENT OF ECOLOGY
State of Washington

Addendum 4 to Quality Assurance Project Plan

Freshwater Fish Contaminant Monitoring Program: 2015

October 2015

Publication No. 15-03-126

Publication Information

Addendum

This addendum is on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/1503126.html

This addendum is an addition to an original Quality Assurance Project Plan. It is not a correction (errata) to the original plan.

Data for this project will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search Study ID FFCMP15.

Activity Tracker code

Ecology's Activity Tracker code for this addendum is 02-500.

Original Publication

Quality Assurance Project Plan: Freshwater Fish Contaminant Monitoring Program.
Publication No. 13-03-111.
https://fortress.wa.gov/ecy/publications/SummaryPages/1303111.html

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Addendum 4 to
Quality Assurance Project Plan

Freshwater Fish Contaminant Monitoring Program: 2015

October 2015

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Signatures are not available on the Internet version.
EAP: Environmental Assessment Program
TSU: Toxics Studies Unit

Table of Contents

List of Figures and Tables

Figures

Tables

3.0 Background

This document describes the 2015 sampling effort for the Washington State Department of Ecology (Ecology) Freshwater Fish Contaminant Monitoring Program (FFCMP) and is an addendum to the Quality Assurance Project Plan (Seiders, 2013). The 2015 sampling effort will focus on several lakes in Washington. The main goals are to characterize current contaminant levels in fish and determine changes over time by comparing results with historical data.

The statewide drought required that the FFCMP 2015 effort abandon its original focus on the Walla Walla River because sample collection became uncertain. The main factors were decreasing river flows, increasingly high water temperatures, and the likelihood that permitting agencies would not allow fish collection due to such conditions. An alternate sampling plan was developed with target sites that include Lake Washington, Green Lake, Lake Sammamish, Ross Lake, and the Wenatchee River (Figure 1). Lake Washington and Green Lake were original target sites for long term monitoring because of high contaminant levels and the presence of fish consumption advisories. Sampling at the other sites will help support other studies addressing contaminants in fish.

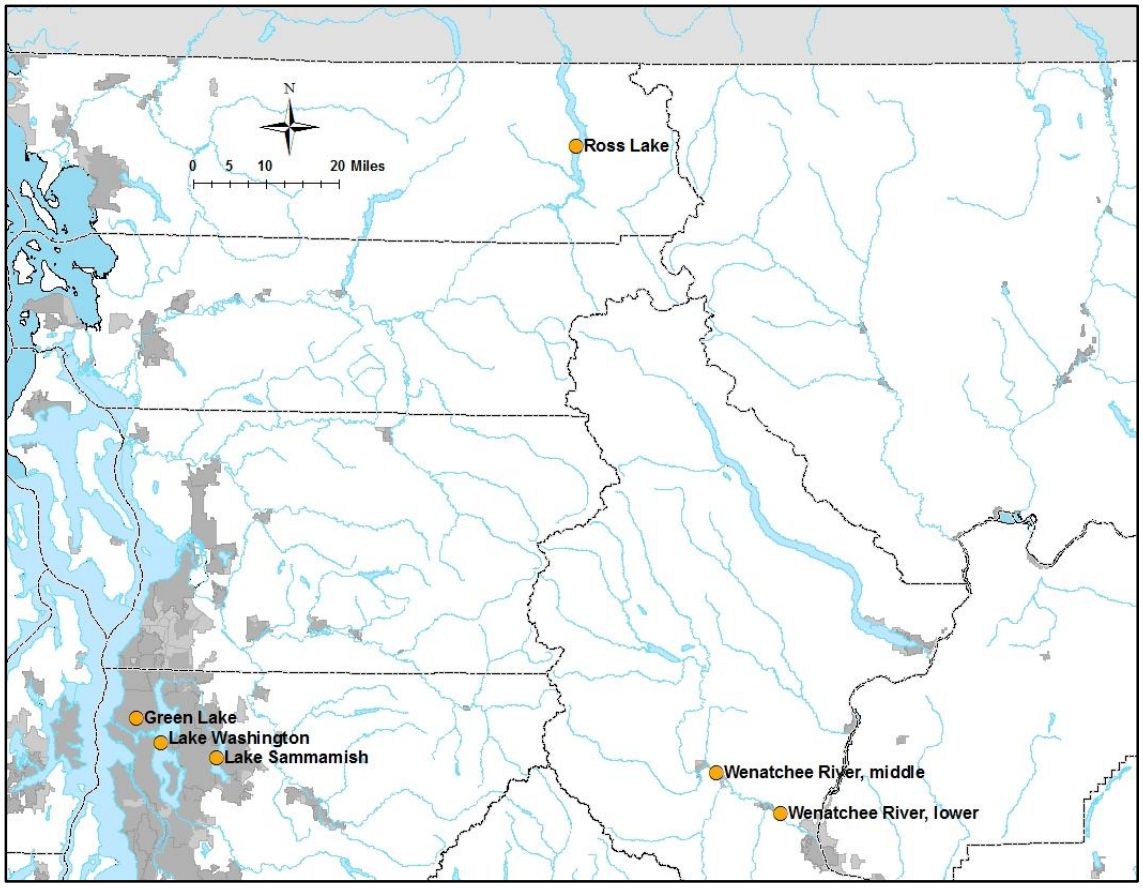

Figure 1. Target sample sites for the 2015 FFCMP effort.

Much of the fish collection in 2015 will be done during studies already planned by other entities: University of Washington, North Cascades National Park, and King County.

Previous studies and associated data were reviewed to guide development of objectives and sampling plans specific to each site. Contaminants assessed in previous studies included chlorinated pesticides, PBDEs, PCBs, and PCDD/Fs. These chemicals were often found at elevated levels from which a decrease could likely be detected over time, assuming inputs decrease. Reductions in contaminant levels might also approach levels seen in similar species from areas not directly impacted by human activities.

Collectively, data from the historical sampling efforts comprise a mix of sites, species, tissue types, collection seasons, and analytical methods. Monitoring efforts or data analyses to measure statistically significant temporal changes have not been pursued in any of these areas until recently. Challenges to such efforts have been small sample sizes, high variability associated with fish tissue, and high costs associated with laboratory analyses for organic contaminants.

Information about previous work on contaminants in fish from the 2015 target locations is summarized below.

Lake Washington

Several fish tissue monitoring efforts in Lake Washington have been conducted since 2003. These efforts were primarily focused on characterizing the nature and extent of contaminants in various species of fish. While many studies had some common goals, a consequence of different objectives and levels of effort has resulted in a historical data set that is a mix of species, tissue types, target analytes, and collection seasons. Table 1 summarizes the timeframe, species, and target analytes for these studies. The larger efforts are described below.

Contaminants of concern include various organic compounds. Concentrations of PCBs (10-1339 ug/kg) and PCDD/Fs (4.6-11.9 ng/kg) in fillet tissue from common carp, cutthroat trout, and northern pikeminnow are among the highest found in Washington. Other compounds showing relatively high levels among different species include PBDEs, DDTs, chlordanes, and mercury.

Figure 2 shows boxplots of PCB concentrations in fillet tissue from various species. PCBs in most species do not meet Washington's Fish Tissue Equivalent Concentration (FTEC) of 5.3 ug/kg. The FTEC is the concentration of a contaminant in edible fish tissue that translates to Washington's water quality criterion for the protection of human health from that contaminant. Fish tissue sample concentrations that are higher than the FTEC are deemed to not meet the water quality standard which may lead to that waterbody being placed on the 303(d) list during Ecology's statewide Water Quality Assessment.

Table 1. Summary of fish contaminant studies for Lake Washington.

Study:	UW [1], Health [2]	Ecology WSTMP [3]	Health [4]	Ecology WSTMP [5]	Ecology Statewide PBDE [6]	King County [7]	King County [8]
Sample Year:	2001-2003	2003	2005	2005	2005	2010	2014
Species - number and type of samples analyzed							
BC			3-f				
CCP			4-f	1-f*	1-f*		
CTT***	20-w,i		14-f*	2-f*			1-f,i
LMB		1-f					
LSS			7-f		2-f		
NPM***	20-w,i		7-f*	1-f*		5-w, 5-w,i	
PEA						9-w	
PMP			7-f				
RBT			1-f				
SCU						3-w	
SMB***	3-w,i					5-f, 5-w	6-f, 8-w
YP***	29-w,i		10-f			5-f	11-f, 10-w
Target analytes							
CP	x	x	x	x			x
Hg	x	x	x	x			x
PBDE		x	x	x	x		x
PCB	x	x	x	x		x	x
PCDD/F				x			

All samples are composites of fillets from multiple fish except those indicated by "i"; *** - 1 to 3 size classes analyzed in some studies.

* These cases shared homogenized tissue for lab analyses of the same or different target analytes; i = individual fish; f = fillet tissue; w = whole fish.

References: 1- McIntyre, 2004, McIntyre and Beauchamp, 2007; 2- Hardy and McBride, 2004; 3- Seiders et al., 2006; 4- McBride, 2005; 5- Seiders et al., 2007; 6- Johnson et al., 2006; 7- King County, 2013; 8- King County, 2010 and 2014.

UW: University of Washington
Health: Washington State Department of Health
WSTMP: Washington State Toxics Monitoring Program

Species Codes: BC: Black crappie; CCP: Common carp; CTT: Cutthroat trout; LMB: Largemouth bass; NPM: Northern pikeminnow; PMP: Pumpkinseed; RBT: Rainbow trout; SCU: Sculpin; SMB: Smallmouth bass; YP: Yellow perch.

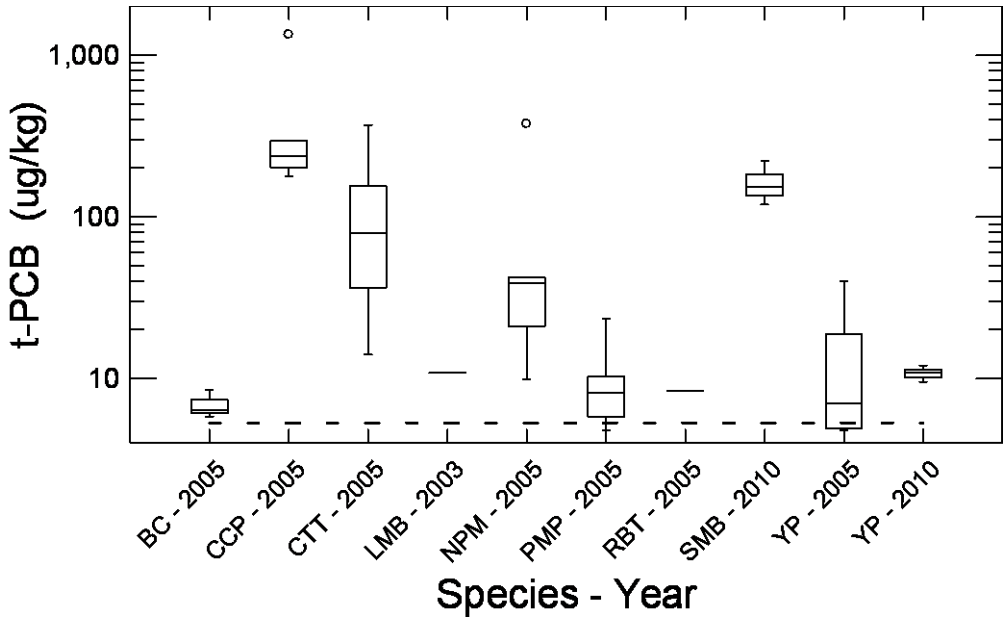

Figure 2. Boxplots of PCBs in Lake Washington fish from multiple species and years with Washington's FTEC of 5.3 ug/kg (dotted line).

Species Codes: BC: Black crappie; CCP: Common carp; CTT: Cutthroat trout; NPM: Northern pikeminnow; PMP: Pumpkinseed; SMB: Smallmouth bass; YP: Yellow perch

Table 2 summarizes results for key analytes from previous studies. Most values are means from multiple composites of fillet tissue.

Table 2. Summary of results for fillet tissue and physical data from previous studies of fish in Lake Washington.

Species and Sample Year	t-PCBa (ug/kg)	t-DDT (ug/kg)	t-Chlordane (ug/kg)	Dieldrin (ug/kg)	TCDD-TEQ (ng/kg)	2,3,7,8-TCDD (ng/kg)	t-PBDE (ug/kg)	Hg (ug/kg)	Lipids (%)	Mean Total Length (mm)	Mean Weight (g)	Mean Age (yrs)
BC-2005	6.9	5.1	0.9				1.7	98	0.9	194	150	2.2
CCP-2005	451	160	41		11.1	1.93	12	91	4.8	552	2695	8.1
CTT-2005	113	74	34	2.2	4.81	0.809	53	220	2.8	333	540	3.0
LMB-2003	10.8	2.1	0.4				0.6	62	0.8	280	399	1.0
NPM-2005	97.4	90	18	1.3	5.80	0.684	60	394	3.6	330	566	4.5
PMP-2005	9.8	3.3	0.9				2.2	60	0.4	125	47	2.1
RBT-2005	8.4	5.6	1.0	0.7			0.9	17	2.1	266	213	1.0
SMB-2010	164								1.4	397	1130	
YP-2005	12.1	4.8	1.3	0.6			2.5	154	0.5	221	156	3.4
YP-2010	10.8								0.4	264	251	

Species Codes: BC: Black crappie; CCP: Common carp; CTT: Cutthroat trout; LMB: Largemouth bass; NPM: Northern pikeminnow; PMP: Pumpkinseed; RBT: Rainbow trout; SCU: Sculpin; SMB: Smallmouth bass; YP: Yellow perch.

Fish collected in 2001-2003 by the University of Washington were analyzed as whole fish by King County Environmental Lab, and the data were used for different purposes. McIntyre and Beauchamp (2004) evaluated the bioaccumulation of contaminants in the aquatic food web in the lake. High levels of PCBs in fish led Washington State Department of Health (Health) to develop a fish consumption advisory using the same data set (Hardy and McBride, 2006). These results from whole fish are not reflected in Table 2 above.

Health and Ecology obtained fish from Washington Department of Fish and Wildlife's 2005 fish community study and analyzed fillet tissues for various contaminants (McBride, 2005; Seiders et al., 2007). Results from these analyses showed high levels of PCBs and PCDD/Fs in fish and led to several 303(d) listings. Health used these data to confirm and supplement the risk assessment that was conducted using data from whole fish tissue previously collected.

In 2010, King County sampled fish as part of larger study on PCBs in Lake Washington (King County, 2013). A mix of fillet and whole tissues were analyzed for PCBs. King County sampled fish again in 2014 as part of a long-term program to track contaminant levels in fish from five waterbodies in the county (King County, 2010, 2014).

For the long term monitoring component of the FFCMP, results from the 2005 study by Health will be the primary data set for comparison to this project's 2015 results. Results from other studies may also be used, such as the data from 2010 and 2014 collected by King County. Fish will be collected in 2015 by the Washington Cooperative Fish and Wildlife Research Unit at the University of Washington during a predation study (Clark and Beauchamp, 2015).

Green Lake

Green Lake was sampled in 2001 by the WSTMP. Common carp was the only species analyzed for organic contaminants and results led to a Fish Consumption Advisory because of high levels of PCBs. Levels of other contaminants were also elevated (Table 3). The 2015 sampling will target multiple samples of multiple species in order to better characterize contaminant levels and inform risk assessment work by Health and the local health departments.

Table 3. Results for key parameters from the 2001 sampling effort in Green Lake.

Species and Sample Year	t-PCBa (ug/kg)	t-DDT (ug/kg)	t-Chlordane (ug/kg)	Dieldrin (ug/kg)	TCDD-TEQ (ng/kg)	2,3,7,8-TCDD (ng/kg)	t-PBDE (ug/kg)	Hg (ug/kg)	Lipids (%)	Mean Total Length (mm)	Mean Weight (g)	Mean Age (yrs)
CCP-2001	132	60.4	35.6	0.98U	1.197	0.3	2.1	57.9	3.6	549	2879	5.6
LMB-2001								41.56	1.0	311	603	1.6

Species Codes: CCP: Common carp; LMB: Largemouth bass.

U= Not detected at or above the reported value.

Ross Lake

Ross Lake lies in North Cascades National Park and is now a reservoir formed by Ross Dam. A large mining operation has been proposed in the upper North Fork Skagit River, which is the main tributary, in Canada, to Ross Lake. Concerns about future contamination prompted a request by Park staff to look at concentrations of metals in the trout population (Anthony, 2015). The 2015 FFCMP effort plans to provide additional data on levels of 13 metals in multiple composite samples of fillet tissue from trout. A list of target metals was developed after reviewing information from the proposed copper mining activity in Canada and other mining activities in Washington data. Park staff identified cadmium and chromium to be of particular concern. Other metals of concern include arsenic, copper, lead, mercury, silver, and zinc.

Trout collected from Ross Lake were previously analyzed by the FFCMP. In 2007, the Park provided a single composite sample each of bull trout and rainbow trout. The concentration of mercury in the bull trout sample (216 ug/kg) was among the highest found in Washington trout. Organic contaminants such as PCBs, 4,4'-DDE, PBDEs, and PCDD/Fs were found at low levels in bull and rainbow trout samples (Seiders and Deligeannis, 2009). In 2012, single composite samples each of bull trout, rainbow trout, and brook trout were analyzed for 13 metals (Seiders et al., 2014). Detected metals were chromium, copper, selenium, and zinc. Larger sample sizes are needed to better characterize concentrations of metals and organics prior to mining activities in the upper Skagit watershed.

Wenatchee River and Lake Sammamish

As part of the cooperative nature of the FFCMP, the 2015 analytical plan will include tissue samples collected from other projects for specific contaminants. Several composite samples of Wenatchee River mountain whitefish will be analyzed for PCB congeners in order to supplement other work. These fish were collected as part of a PCB Source Identification study (Hobbs, 2014). Also, one composite sample each of Lake Sammamish northern pikeminnow and smallmouth bass will be analyzed for dioxins/furans. These results will complement a study of contaminants in fish (Lester, 2015; King County, 2010; Lester, 2015).

4.0 Project Description

The main goal of the 2015 monitoring effort is to develop a robust data set of contaminant levels in fish from Lake Washington and Green Lake to:

- Characterize temporal trends by comparisons to historical and future data.
- Compare results to human health water quality criteria (FTEC).
- Support fish consumption risk assessments by health jurisdictions.
- Inform future efforts such as TMDL development and effectiveness monitoring.

A secondary goal is to complement work by others in the Wenatchee River, Lake Sammamish, and Ross Lake by analyzing fish tissue for key parameters of interest.

Table 4 shows location information for the 2015 sites. Site selection was described in the original QAPP and is refined here for the 2015 effort. The key characteristics of sites selected for long term monitoring are:

- Concentrations of key contaminants are elevated in fish tissue.
- Likelihood of detecting change in contaminant levels over time.
- Presence of historical data that can be used for temporal comparisons.
  - Multiple samples taken during previous efforts.
  - Multiple sampling efforts at different times in the past.
  - Potential for pooling data to increase statistical sensitivity.
- Waters impaired: Category 5, 4A, or 2 from the 2012 Assessment.
- Ability to collect desired species: access, permits, species abundance.

Table 4. Sample location information, FFCMP 2015.

Site	Latitude North	Longitude West	Likely EIM Location ID	Likely EIM NHD Reach Code	WRIA
Ross Lake	48.8333	121.0417	ROSSLK-F	17110005001261	4
Green Lake	47.6783	122.3337	GREEN	17110012000401	8
Lake Sammamish	47.6031	122.0942	SAMMAMISHLK-F	17110012000406	8
Lake Washington	47.6305	122.2594	WA L-ENTIRE-F	17110012005962	8
Wenatchee River, lower	47.5018	120.4268	WENTMDL-W03	17020011016208	45
Wenatchee River, middle	47.5822	120.6152	45WR20.9	17020011000075	45

Datum for Coordinates: NAD83HARN.

Target analytes include chlorinated pesticides, mercury, polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), and polychlorinated dibenzo-p-dioxins and -furans (PCDD/Fs).

This project will use data collected through past monitoring efforts conducted by Ecology and other organizations. These data and associated documentation (e.g., project plans, project reports, and laboratory data reports) will be reviewed to assess their usability in this project.

For the long-term monitoring strategy at Lake Washington and Green Lake, multiple replicates of composite samples for each species at each site are anticipated to provide an adequately robust data set that will meet objectives. Review of field replicate data from the WSTMP showed that variance is inconsistent and can be high for organic contaminants, ranging up to 100% RPD for PCBs, DDTs, and PCDD/Fs. A sample size of five to seven composite samples should reduce the variability associated with the mean and median tissue concentrations and improve the ability to determine change among sample results over time.

Table 5 shows the sites, target species, and number of analyses of composite samples by analyte group. Actual numbers of samples may be adjusted depending on success of fish collection efforts. Fish collected from Lake Washington may be stratified spatially if adequate numbers are collected.

Table 5. Sample plan and estimated laboratory costs, FFCMP 2015.

Sites		Species Code	Number of Composite Samples for Each Analysis					
			Hg	Metals (12)	3 PCB Aroclors, 3 DDTs, lipid	Cl Pest, PCB Aroclor, PBDE, lipid	PCB congener	PCDD/F
Washington L		CCP	3		4	3	3	3
		CTT-XL	1			1		
		CTT-L	3		2	3	3	3
		CTT-S	3			3		
		NPM	3		4	3	3	3
		SMB-L	3		2	3	3	3
		SMB-S	3			3		
		LSSw	3		4	3		
		YP	3			3		
Green L		BNT	3			3		
		CCP	3		4	3	3	3
		CAT	3			3		
		RBT	3			3	3	3
		LMB	3			3		
		LSSw	3		4	3		
Ross Lk		BLT	5	5		3		
		RBT	5	5		3		
Sammamish L		NPM						1
		SMB						1
Wenatchee R	Lower, Spring	MWF			4		4	
	Upper, Spring				2		2	
	Lower, Fall				4		4	
	Upper, Fall				2		2	
Total # field samples			53	10	36	49	30	20
Total # lab QC analyses			6	2	6	6	3	3
Total # analyses			59	12	42	55	33	23
Cost per analysis			$ 50	$ 150	$ 264	$ 620	$ 713	$ 531
Subtotal costs			$ 2,950	$ 1,800	$11,088	$ 34,100	$ 23,513	$12,219
Grand Total			**$**	**85,669**				

Notes for Table 5:
Species codes: BLT: Bull trout; BNT: Brown trout; CAT: Channel catfish; CCP: Common carp; CTT: Cutthroat trout; LMB: Largemouth bass; LSSw: Largescale sucker (as whole fish); MWF: Mountain whitefish; NPM: Northern pikeminnow; RBT: Rainbow trout; SMB: Smallmouth bass; YP: Yellow perch;
-L and -S: L: large size, -S: small size.

5.0 Organization and Schedule

Table 6 lists the people involved in this project. All are employees of the Washington State Department of Ecology. Table 7 is the proposed schedule for this project.

Table 6. Organization of project staff and responsibilities, FFCMP 2015.

EAP Staff (except TMDL Leads)	Title	Responsibilities
Will Kendra SCS 360-407-6698	Client	Provides internal review of the QAPP, addendums, and reports. Approves the final QAPP and addendums.
Keith Seiders Toxics Studies Unit SCS 360-407-6689	Project Manager and Principal Investigator	Writes the QAPP, addendums, and reports. Reviews historical data and develops sample strategy for different sites on annual basis. Works with laboratories to obtain analytical services. Reviews, analyzes, and interprets data. Guides field assistants in various roles and tasks.
Casey Deligeannis Toxics Studies Unit SCS 360-407-7395	Field and EIM Lead, Project Assistant	Leads efforts for sample collection, processing, and transportation of samples to the laboratory. Ensures that field and processing information is recorded. Enters field and laboratory data into EIM. Compiles and summarizes historical and current-year data. Assists report effort.
Dale Norton Toxics Studies Unit SCS 360-407-6765	Unit Supervisor for the Project Manager	Provides internal review of the QAPP, addendums, and reports. Approves the final QAPP and addendums. Manages budget and staffing needs.
Joel Bird Manchester Environmental Lab. 360-871-8801	Laboratory Director	Approves the final QAPP. Oversees all operations at MEL regarding in-house analyses and processes for contracting analyses to commercial labs.
William R. Kammin EAP 360-407-6964	Ecology Quality Assurance Officer	Reviews the draft QAPP and addendums. Approves the final QAPP and addendums.
Jessica Archer Western Ops 360-407-6701	Supervisor, EAP – Western Operations	Helps coordinate SWRO and NWRO inter-program and inter-office efforts as needed, especially public communications.
Tom Mackie EAP-Eastern Ops 509-454-4244	Supervisor, EAP - Eastern Operations	Helps coordinate CRO and ERO inter-program and inter-office efforts as needed, especially public communications.

** TMDL Contacts listed at: www.ecy.wa.gov/programs/wq/tmdl/contacts.html
CRO: Central Regional Office
EAP: Environmental Assessment Program
EIM: Environmental Information Management database
ERO: Eastern Regional Office
NWRO: Northwest Regional Office
SWRO: Southwest Regional Office
QAPP: Quality Assurance Project Plan
SCS: Statewide Coordination Section

Table 7. Schedule for completing field, laboratory, and report tasks, FFCMP 2015.

Field and laboratory work	Due date	Lead staff
Field work completed	November 2015	Casey Deligeannis
Sample processing completed	January 2016	Casey Deligeannis
Ecology Lab analyses completed	July 2016	MEL, Joel Bird
Contract Lab analyses completed	August 2016	MEL, Karin Feddersen
Environmental Information System (EIM) database		
EIM user study ID	FFCMP15	
Product	Due date	Lead staff
EIM data loaded	September 2016	Casey Deligeannis
EIM data verification	October 2016	To be determined
EIM complete	November 2016	Casey Deligeannis
Final report		
Author lead / Support staff	Keith Seiders / Casey Deligeannis	
Schedule		
Draft due to supervisor	September 2016	
Draft due to client/peer reviewer	October 2016	
Draft due to external reviewer(s)	October 2016	
Final (all reviews done) due to publications coordinator	November 2016	
Final report due on web	December 2016	

6.0 Quality Objectives

Table 8 shows measurement quality objectives (MQOs).

Table 8. Measurement quality objective, FFCMP 2015.

Parameter	Analytical Method	Lab Duplicate (RPD)	Lab Control Sample (% recovery)	Surrogates (% recovery)	MS/MSD (% recovery)
Mercury	EPA 245.6 (CVAA)	0%-20% (for results > 5x RL)	85%-115%	NA	75%-125%; RPD limit 20%
Metals (As, Be, Cd, Ni, Ag, Pb, Ti, Sb, Se, Cr, Cu, Zn)	EPA 200.7 or 200.8	0%-20% (for results > 5x RL)	85%-115%	NA	75%-125%; RPD limit 20%
Chlorinated pesticides	EPA 8081 (GC/ECD); MEL SOP	0%-40%	50%-150%	20%-130% [a]	50%-150%; RPD limit 40%
PCB Aroclors	EPA 8082 (GC/ECD); MEL SOP	0%-40%	50%-150%	50%-150%	50%-150%; RPD limit 40%
PCB congeners	EPA 1668A (HiRes GC/MS)	0%-40%	per method for OPR, Internal Standards, and Labeled Compounds	NA	NA
PCDD/Fs	EPA 1613B (HiRes GC/MS)	0%-40%	per method for OPR, Internal Standards, and Labeled Compounds	NA	NA
PBDEs	EPA 8270 (SIM); SOP 730104	0%-40%	50%-150%	50%-150%	50%-150%; RPD limit 40%
Lipids	MEL SOP 730009	0%-20%	NS	NA	NA

[a] Surrogate recovery limits were recently revised by MEL and are specific to surrogates used: some limits are 20%-120%, others are 30%-130%.

8.0 Sampling Procedures

Samples will be collected and processed as described in the project plan for the FFCMP (Seiders, 2013). Fish collected by non-Ecology projects will use collection, preservation, and data collection practices acceptable to the FFCMP. Fish collection methods may include the use of gillnets, seines, electrofishing, and angling. Federal, tribal, and state scientific collection permits provide guidance for minimizing the disturbance of anadromous salmon and steelhead that may be present.

Table 9 shows sample containers, preservation, and holding times for fish tissue samples.

Table 9. Containers, preservation, and holding times for samples, FFCMP 2015.

Parameter	Sample Container	Minimum Amount Required *	Preservation	Holding Time
Mercury	2 oz. precleaned glass jar w/teflon lid	5g	freeze, -10° C	6 months to extraction, then 28 days to analysis
Metals (As, Be, Cd, Ni, Ag, Pb, Ti, Sb, Se, Cr, Cu, Zn)	2 oz. precleaned glass jar w/teflon lid	15g	freeze, -10° C	6 months to extraction, then 28 days to analysis
Chlorinated pesticides	4 oz. precleaned glass jar w/teflon lid	30g, 60g preferred	freeze, -10° C	1 year to extraction, then 40 days to analysis
PCB Aroclors	4 oz. precleaned glass jar w/teflon lid	30g, 60g preferred	freeze, -10° C	1 year to extraction, then 40 days to analysis
PCB congeners	4 oz. precleaned glass jar w/teflon lid	30g, 60g preferred	freeze, -10° C	1 year to extraction, then 40 days to analysis
PCDD/Fs	4 oz. precleaned glass jar w/teflon lid	30g, 60g preferred; 220g if base digestion used	freeze, -10° C	1 year to extraction, then 40 days to analysis
PBDEs	4 oz. precleaned glass jar w/teflon lid	30g, 60g preferred	freeze, -10° C	1 year to extraction, then 40 days to analysis
Lipids	4 oz. precleaned glass jar w/teflon lid	30 g	freeze, -10° C	1 year to extraction, then 40 days to analysis

8.3 Invasive species evaluation

Invasive or unwanted aquatic species may be encountered during fish collections for this project. Environmental ethics and Washington law prohibit the transportation of all aquatic plants, animals, and many noxious weeds. Sample collection efforts for this project will follow the Ecology Environmental Assessment Program's Standard Operating Procedure to Minimize the Spread of Invasive Species (Parsons et al., 2012) and Washington Department of Fish and Wildlife's Invasive Species Management Protocols (Tweit et al., 2011).

For this year's target sites, the New Zealand mudsnail is known to be present only in several tributaries to Lake Washington. The University of Washington is expected to provide all fish from Lake Washington. Yet if Ecology needs to collect additional fish from Lake Washington, the SOP described above will be followed.

9.0 Measurement Methods

The analytical methods are consistent with the most recent FFCMP monitoring events. Laboratory analyses of most samples will be conducted by the Ecology Manchester Environmental Laboratory (MEL). Analyses for PCB congeners and PCDD/Fs will be done by an accredited laboratory through a contract managed by MEL. Both MEL and the contract laboratories are expected to meet the QC requirements of the analytical methods being used and any other requirements specified by MEL or the Project Officer.

Table 10 shows the parameters to be analyzed, analytical methods, desired reporting limits, and ranges of expected results.

Table 10. Laboratory measurement methods for fish tissue samples, FFCMP 2015.

Parameter	Methods, RLs, Sample n			
	Number of Samples & Arrival Date [a]	Expected Range of Results [b]	Reporting Limits [c]	Analytical Method
Mercury	53, January 2016	10 - 1000 ug/kg	17 ug/kg	EPA 245.6 (CVAA)
Metals (As, Be, Cd, Ni, Ag, Pb, Ti, Sb, Se, Cr, Cu, Zn)	10, January 2016	most 0.1-1.0 ug/kg; Cr-Cu-Zn 0.5 - 10 ug/kg	Varies by metal; all 0.1 ug/kg except: Sb 0.2; Se 0.5; Cr 0.5; Zn 5.0	EPA 200.7 or 200.8
Chlorinated pesticides	49-full suite, 36-3 DDTs only January 2016	0.1 - 1000 ug/kg for DDTs; 0.1 - 50 ug/kg for others	most 0.5 - 3.0 ug/kg	EPA 8081 (GC/ECD); MEL SOP
PCB Aroclors	49-full suite, 36-3 PCBs only January 2016	0.5 - 100 ug/kg, depending on Aroclor	1.1 - 5 ug/kg	EPA 8082 (GC/ECD); MEL SOP
PCB congeners	30, January 2016	0.005 - 10 ug/kg, depending on congener	0.003-0.01 ug/kg	EPA 1668A (HiRes GC/MS)
PCDD/Fs	20, January 2016	0.005 - 5.0 ng/kg, depending on congener and extraction method	EQL 0.017 - 0.5 ng/kg	EPA 1613B (HiRes GC/MS)
PBDEs	59 January 2016	0.1 - 100 ug/kg	0.10 - 2.6 ug/kg; PBDE 209 1.9 - 4.3 ug/kg	EPA 8270 (SIM); MEL SOP 730104
Lipids	85 (36+49), January 2016	0.1 - 20%	0.10%	MEL SOP 730009

[a] MEL will be informed of numbers and arrival dates when the sampling effort concludes.

[b] Values reflect historical data from the study area.

[c] Value reflects typical range.

10.0 Quality Control

Table 11 shows laboratory quality control procedures.

Table 11. Laboratory quality control sample types and frequencies, FFCMP 2015.

Parameter	Analytical Method	Lab Duplicates	Lab Control Standards	Surrogates	MS/MSD	Method Blanks
Mercury	EPA 245.6 (CVAA)	1/ batch [a]	1/batch	NA	1/batch	1/batch
Metals (As, Be, Cd, Ni, Ag, Pb, Ti, Sb, Se, Cr, Cu, Zn)	EPA 200.7 or 200.8	1/ batch [a]	1/batch	NA	1/batch	1/batch
Chlorinated pesticides	EPA 8081 (GC/ECD); MEL SOP	1/batch	1/batch	each sample	1/batch	1/batch
PCB Aroclors	EPA 8082 (GC/ECD); MEL SOP	1/batch	1/batch	each sample	1/batch	1/batch
PCB congeners [b]	EPA 1668A (HiRes GC/MS)	1/batch	each sample & 1/batch [c]	NA	NA	1/batch
PCDD/Fs [b]	EPA 1613B (HiRes GC/MS)	1/batch	each sample & 1/batch [c]	NA	NA	1/batch
PBDEs	EPA 8270 (SIM); SOP 730104	1/batch	1/batch	each sample	1/batch	1/batch
Lipids	MEL SOP 730009	1/batch	1/batch	NA	NA	1/batch

[a] "Batch" is defined as up to 20 samples analyzed together.

[b] Includes one analysis of Certified Reference Material for the project (WMF-01 preferred; CARP-2 acceptable)

[c] Labeled compounds in each sample and Ongoing Precision and Recovery standards in each batch.

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