Addendum 2 to Quality Assurance Project Plan

Freshwater Fish Contaminant Monitoring Program

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Addendum

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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 FFCMP14.

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Addendum 2 to Quality Assurance Project Plan

Freshwater Fish Contaminant Monitoring Program

October 2014

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EAP: Environmental Assessment Program
TSU: Toxics Studies Unit

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3.0 Background

This document describes the 2014 sampling effort for Ecology's Freshwater Fish Contaminant Monitoring Program (FFCMP) and is an addendum to the Quality Assurance Project Plan (Seiders, 2013). The 2014 sampling effort will focus on the Yakima River basin. The main goals are to characterize current contaminant levels in fish and determine changes over time by comparing results with historical data.

Numerous fish tissue monitoring efforts in the Yakima River basin have been conducted since the 1980s. These efforts were primarily focused on characterizing levels of chlorinated pesticides that were associated with the agricultural land use of the basin. Table 1 shows the general locations, timeframes, and analytes that these studies targeted.

Resident species most commonly sampled in the mainstem Yakima River were: common carp, largescale and bridgelip sucker, mountain whitefish, northern pikeminnow, and smallmouth bass. In Keechelus Lake and other lakes, species sampled were cutthroat trout, kokanee, largescale sucker, mountain whitefish, northern pikeminnow, and rainbow trout. While some historical studies included anadromous species, the current collection does not include them, because of their status under the Endangered Species Act.

Table 1. Summary of past sampling efforts for the Yakima River and Keechelus Lake.

Study:	Ecology BWMP [1]	USGS Yakima SWQA [2]	Ecology WSPMP [3]	Ecology WSPMP [4] and Douglas Cr [5]	EPA CRITFC [6]	Ecology Upper Yakima [7]	EPA Lakes [8]	Ecology PBDE [9]	Ecology Yakima Fish [10]	Ecology CP/CEC [11]
Sample Year:	1984	1989-91	1992	1995	1996-98	1999	2001	2005	2006	2011
General Location										
Mouth					x					
Horn Rapids **	x	x	x		x			x	x	x
Grandview		x		x						
Prosser **					x				x	
Granger	x	x			c					
Wapato-Toppenish **									x	
Union Gap	x	x								
Canyon (near Wymer) **		x			x	x			x	
Thorp									x	
Cle Elum		x				x				
Keechelus L **							x		x	
Target Analytes										
CP	x	x	x	x	x	x			x	x
Hg	x				x					
PBDE				x	x			x	x	x
PCB	x	x	x	x	x				x	
PCDD/F					x				x	
other		x			x					x

**- 2014 Sample Locations.

1 - Hopkins et al., 1985; 2 - Rinella, et al., 1992; 3 - Davis and Johnson, 1994; 4 - Davis et al., 1998;
5 - Johnson and Olsen, 2001; 6 - EPA, 2002; 7 - Rogowski, D., 2000; 8 - EPA, 2009; 9 - Johnson et al., 2006;
10 - Johnson et al., 2007; 11 - Johnson and Friese, 2013.
Target Analytes: CP: Chlorinated pesticides; Hg: mercury; PBDE: polybrominated diphenyl ethers;
PCB: polychlorinated biphenyls; PCDD/F: poly-chlorinated dibenzo-p-dioxins and –furans.

These past monitoring efforts provided information that supported key actions by state and local jurisdictions. These actions included:

- Fish Consumption Advisory in 1993 for DDT compounds (Health, 2009)
- Clean Water Act Section 303d listings for chlorinated pesticides beginning in 1996
- TMDL efforts to address turbidity (which was associated with DDT compounds) in the lower and upper basins in 1998 and 2002 (Joy and Patterson, 1997; Joy, 2002).

Not shown in Table 1 is Ecology's sampling of bass at Horn Rapids for mercury. This site is part of a statewide effort to determine temporal trends in mercury in bass (Mathieu and Friese, 2011).

More recent sampling has also supported TMDL efforts. In 2006, Yakima River fish were sampled in order to compare findings to water quality standards and inform TMDL work (Johnson et al., 2007). A more comprehensive TMDL study in 2007-08 directly addressed 303(d) listings for chlorinated pesticides, PCBs, turbidity, and suspended solids (Johnson et al., 2010). The sampling included waters from the river and tributaries, wastewater treatment plant effluents, irrigation returns, and stormwater. Table 2 summarizes fish tissue-based water quality impairments from Ecology's 2012 Water Quality Assessment (http://www.ecy.wa.gov/programs/wq/303d/index.html).

Table 2. Summary of Yakima River basin fish tissue-based impaired waters by category.

WRIA	General Location	2012 Water Quality Assessment Category							
		4,4'-DDD	4,4'-DDE	4,4'-DDT	Alpha-BHC	Chlor-dane	Dieldrin	Dioxin	PCB
39: Upper Yakima	Keechelus Lake							5	5
	Easton-Cle Elum						4A		
	Cle Elum		4A						
	Canyon		4A	4A		5	4A	5	5
38: Naches	Cowiche Cr		5						5
37: Lower Yakima	Union Gap	5	5		5				5
	Wapato		5				5		2
	Granger		5	5				5	5
	Grandview	5							
	Prosser		5	5		5		5	2
	Benton City	5	5	5	5				5
	Horn Rapids		5	5		5	5		5
	Mouth		5	5		2			2

WRIA: Water Resource Inventory Area
Category 5 - Segment is impaired and is on the 303(d) list. Segment will need a TMDL or pollution control plan.
Category 4A - Segment is impaired yet has a TMDL approved by EPA to address the impairments.
Category 2 - Segment is a "Water of Concern": data are insufficient to classify segment as Category 5.

Collectively, data from the historical sampling efforts comprise a mix of sites, species, tissue types, collection seasons, and analytical methods. While Ecology has reported general impressions about changes in contaminant levels over time, we have not measured for statistically significant temporal changes. 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.

Summary of Historical Results

Contaminants assessed in previous studies included chlorinated pesticides, PBDEs, PCBs, and PCDD/Fs. These chemicals were often found at elevated levels, which could decrease over time, if inputs decrease. Decreased contaminant levels might also approach levels seen in similar species from less contaminated areas such as Keechelus Lake.

Figures 1 and 2 show that chlorinated pesticides 4,4'-DDE and dieldrin are elevated in fillets of many species from the lower part of the river compared to levels seen in the upper basin. The TMDL effort is expected to lower fish tissue contaminant levels below Washington's water quality standards. Washington uses Fish Tissue Equivalent Concentrations (FTEC) of contaminants to determine whether water quality standards for toxic chemicals are being met. The FTEC is the concentration of a contaminant in edible fish tissue that equates to Washington's water quality criterion for the protection of human health from that contaminant. Fish tissue sample concentrations lower than the FTEC indicate that water quality standards are met for that specific contaminant.

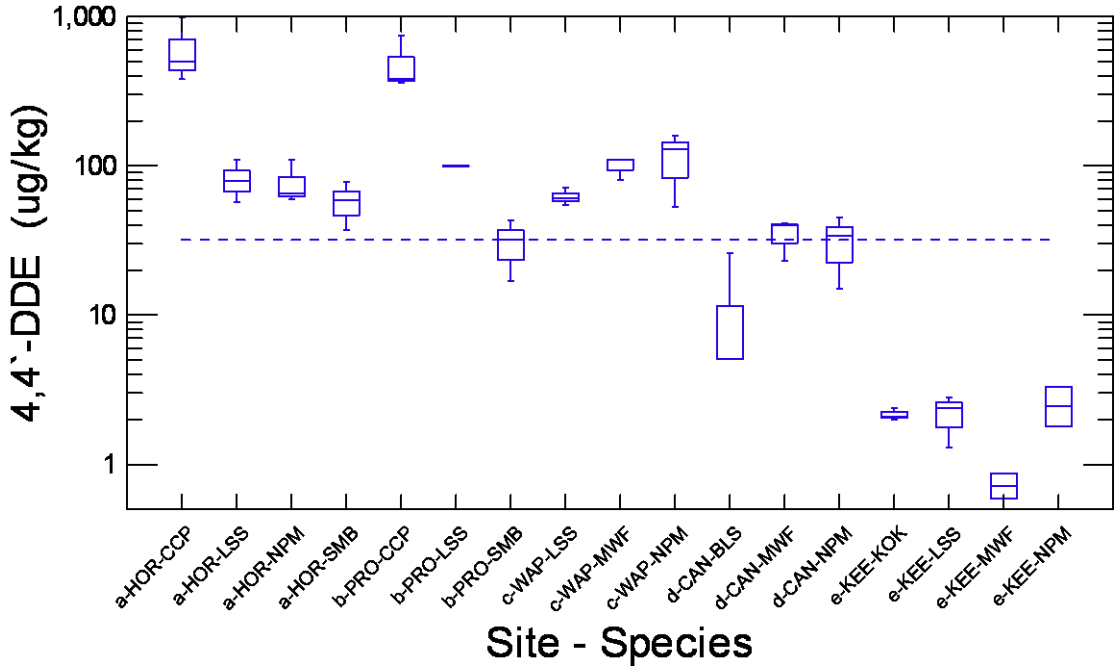

Figure 1. Levels of 4,4'-DDE in fish sampled in 2006 from the Yakima River with Washington's FTEC of 32 ug/kg (dotted line).

Sites are arrayed from downstream to upstream (left to right).

Site and Species Codes: HOR – Horn Rapids; PRO – Prosser; WAP – Wapato-Toppenish; CAN – Yakima canyon; KEE – Keechelus Lake. Species codes: BLS – Bridgelip sucker; CCP: Common carp; KOK: kokanee; LSS: Largescale sucker; MWF: Mountain whitefish; NPM: Northern pikeminnow; SMB: Smallmouth bass.

Other chemicals found at elevated levels include poly-brominated diphenyl ether (PBDE) flame retardants and dioxin/furans (PCDD/Fs). Limited sampling of PBDEs in Yakima River fish from 2005 to 2011 showed a range of 5-400 ug/kg, with many samples above the 80th percentile (about 11 ug/kg) of levels seen in Washington fish. Two of these samples are among the highest in Washington. Levels of PCDD/Fs in Yakima River fish range from 0.043 to 0.875 ng/kg, with most being above the FTEC of 0.065 ng/kg. This is the threshold that Ecology uses to designate a waterbody as a "Water of Concern" during Ecology's Water Quality Assessment process. Figure 3 shows levels of PCDD/Fs (expressed as TCDD-TEQ) in fish sampled from 1996 to 2006. Over a third of the samples were greater than the statewide 70th percentile value (0.030 ng/kg).

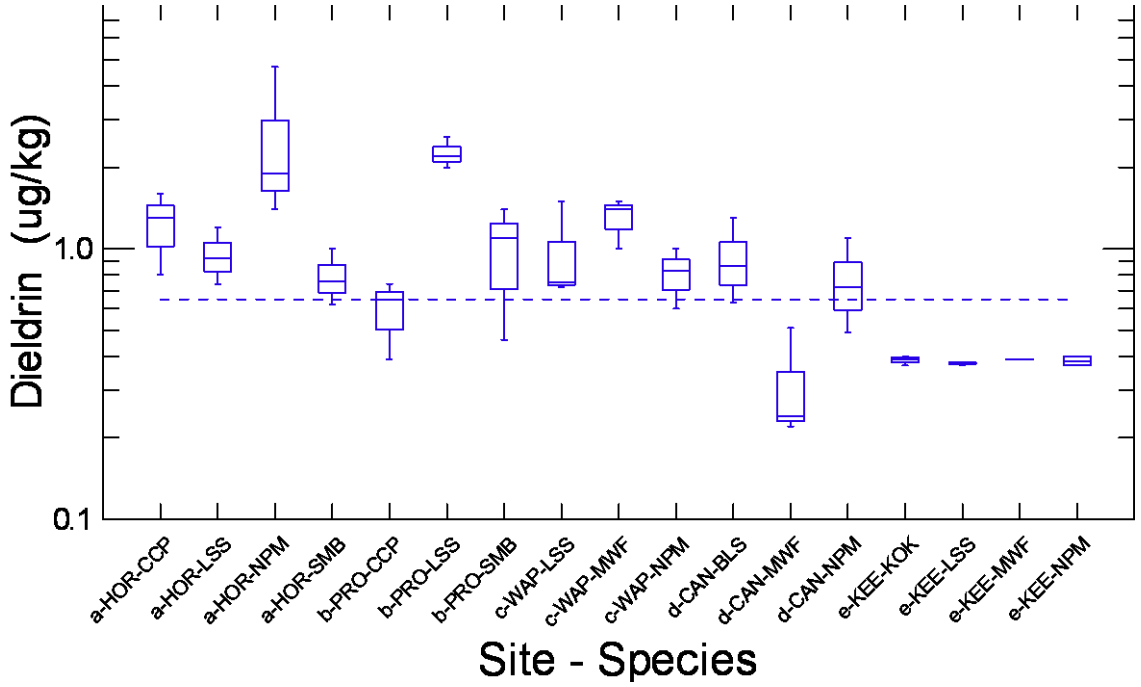

Figure 2. Levels of dieldrin in fish sampled in 2006 from the Yakima River with Washington's FTEC of 0.65 ug/kg (dotted line).

Sites are arrayed from downstream to upstream (left to right).
Site and Species Codes: see Figure 1.

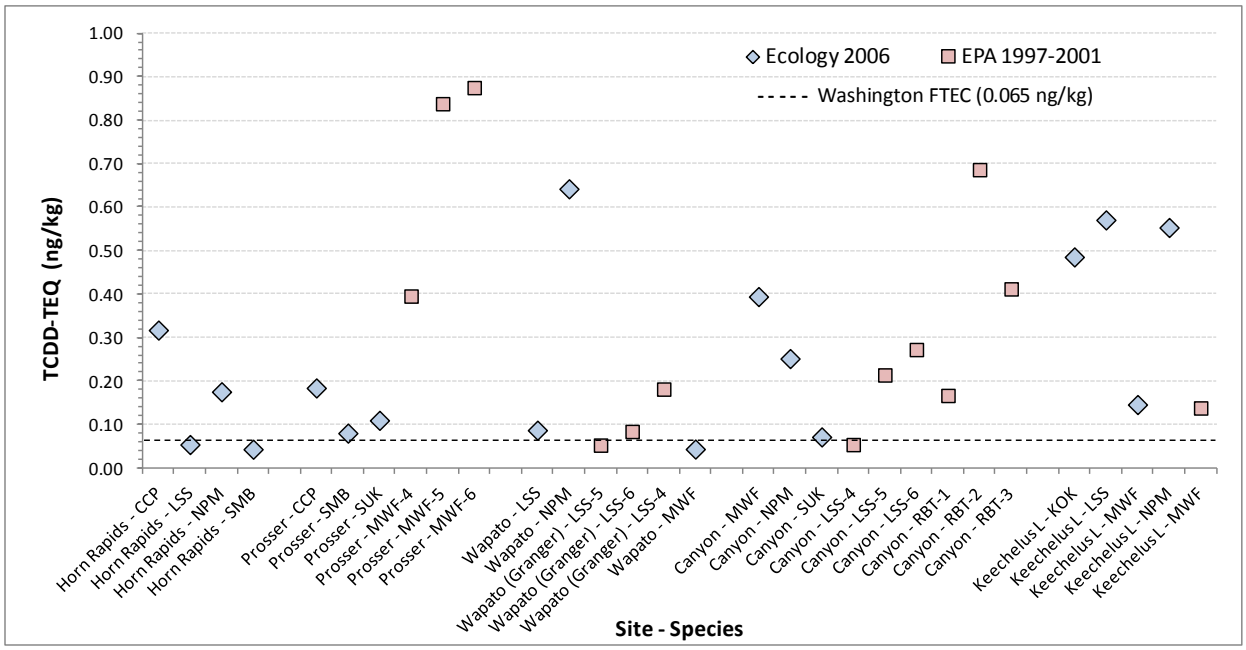

Figure 3. Levels of dioxin/furans in Yakima River fish fillets from two time periods.

Sites are arrayed from downstream to upstream (left to right).
Species Codes: see Figure 1.

4.0 Project Description

The goal of the 2014 monitoring is to develop a robust data set of contaminant levels in fish from the Yakima River to:

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

Review of historical data led to selection of sites, species, analytes, and sample sizes to meet the goals of the current project. The proposed sites and species were most recently sampled in 2006 (Johnson et al., 2007). The Columbia River Basin Fish Contaminant Survey from 1996-98 (EPA, 2002) also evaluated many sites, species, and analytes. These studies provide the bulk of data that will be used for temporal comparisons. Some of these historical data are discussed later in this document. Figure 1 shows the proposed sample locations and Table 3 gives location details for the 2014 sampling.

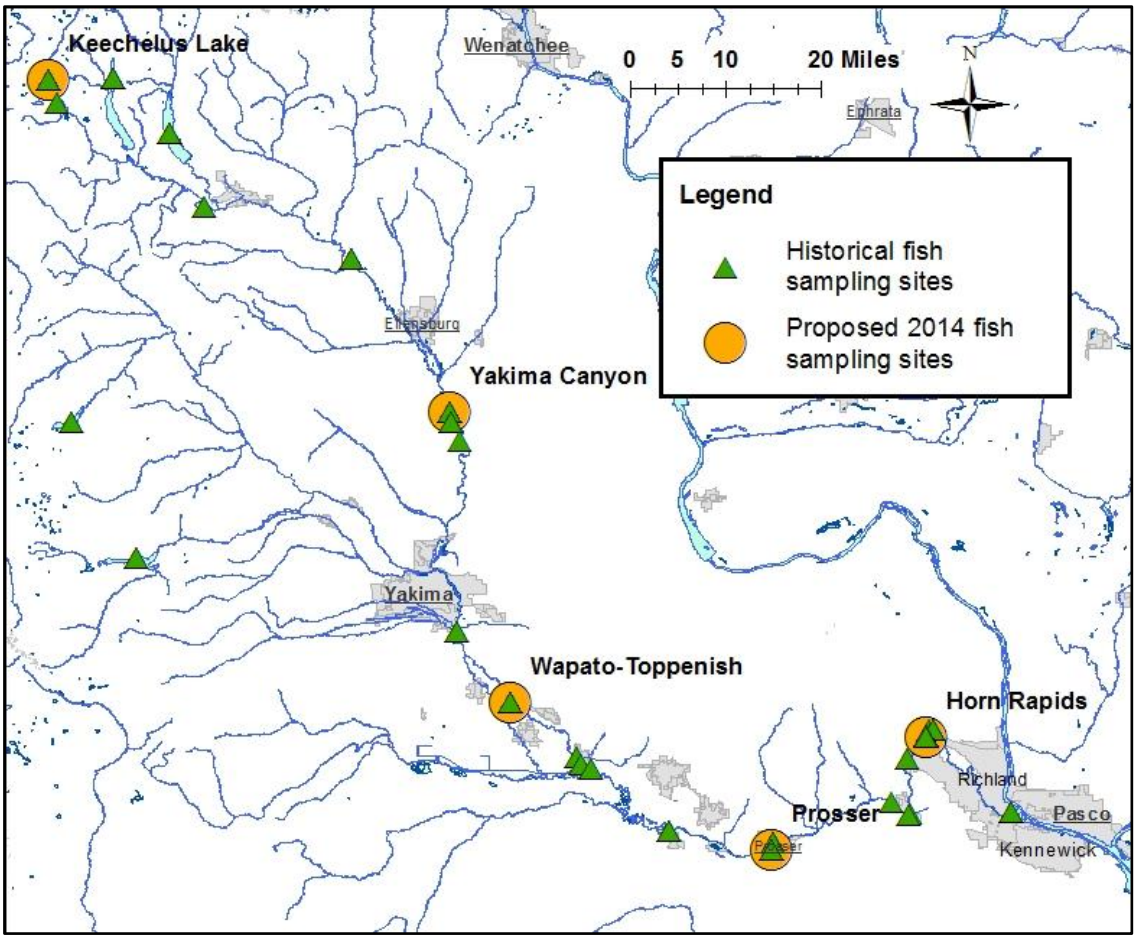

Figure 4. Proposed sampling locations, FFCMP 2014.

Table 3. Sample location information, FFCMP 2014.

Site Name	River Mile	Field Abbr	Latitude N	Longitude W	EIM Location ID	EIM Location NHD Reach Code
Horn Rapids	18-24	HOR	46.3706	119.4367	HORN RAPIDS-F	17030003000089
Prosser	47-50	PRO	46.2015	119.7796	PROSSER-F	17030003000143
Wapato-Toppenish	80-96	WAP	46.4274	120.3516	WAPATO TOPNSH-F	17030003003742
Canyon	135-143	CAN	46.8692	120.4820	CANYON-F	17030001000153
Keechelus Lake	entire lake	KEE	47.3687	121.3809	KEECHELUS-F	17030001014133

Site selection was described in the original QAPP and is refined here for the 2014 effort. The key characteristics of sites selected for long term monitoring in the Yakima River basin are:

- Elevated concentrations of key contaminants 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.
- Different areas of basin represented: lower river, middle river, and headwaters lake.
- Ability to collect desired species: access, permits, species abundance.

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

This project will use data that Ecology and other organizations previously collected. 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.

Three to four species will be targeted at each site and three to seven composite samples of each species will be analyzed (Table 4). The number of composite samples for individual cases of site and species is varied, and Ecology will attempt to balance the importance of that site/species combination with monitoring goals and laboratory budget. Estimates of Minimum Detectable Change, discussed below, were considered in the selection of samples sizes. Each composite sample will consist of five fish of similar size from the same species. The target size range (total length) will be site- and species-specific and is designed to match size ranges from historical collections. A subset of samples will be analyzed for PCB congeners to help inform statewide strategies for addressing widespread PCB contamination in the environment.

For the long-term monitoring goal, the Minimum Detectable Change (MDC) in contaminant level between two sample events (e.g., 2006 and 2014) was estimated for various sites, species, contaminants, and sample sizes. The MDC is the change in contaminant concentration that would be considered statistically significant (Tetra Tech, 2011). The MDC estimate uses concentration and variance information from historical data with selected statistical test, significance level, and sample sizes for a proposed sampling effort. Table 5 shows how the MDC was estimated for 4,4'-DDE at two sites.

Table 4. Sample plan and estimated laboratory costs, FFCMP 2014.

Sites	Species	Number of Samples			
		Hg	**CP, PCBa, PBDE, lipid**	**PCB congener, lipid**	**PCDD/F, lipid**
Horn Rapids	CCP	3	5		3
	LSSw	3	7	3	
	NPM	3	5		3
	SMB	3	3		
Prosser	CCP	3	5		3
	LSSw	3	7		
	NPM	3	5		3
	SMB	3	3		
Wapato - Toppenish	LSSw	3	7		
	MWF	3	5	3	3
	NPM	3	5		3
Yakima Canyon	LSSw	3	7		
	MWF	3	5	3	3
	NPM	3	5		3
Keechelus Lake	LSSw	3	3		
	MWF	3	3		3
	NPM	3	3		3
	KOK	3	3		
Total # field samples		54	86	9	30
Total # lab QC analyses		6	10	2	3
Total # analyses		60	96	11	33
Cost per analysis		$ 50	$ 620	$ 675	$ 531
Subtotal Cost		$ 3,000	$ 59,520	$ 7,425	$ 17,531
Cost grand total		**$ 87,476**			

Species codes: CCP: Common carp; KOK: kokanee; LSSw: Largescale sucker – whole fish; MWF: Mountain whitefish; NPM: Northern pikeminnow; SMB: Smallmouth bass.

Table 5. Estimated minimum detectable change in 4,4'-DDE for fish at two sites.

Sample Year	Sites -->	Horn Rapids				Prosser		
	Species code -->	CCP	LSSw	NPM	SMB	CCP	LSSw	SMB
2006	result 1	990	264	110	78	750	312.6	43
	result 2	500	182	65	59	380	268	32
	result 3	380	148	60	37	360	242.6	17
	n_1 - number of samples	3	3	3	3	3	3	3
	$mean_1$	623	198	78	58	497	274	31
	standard deviation	323	60	28	21	220	35	13
	variance (Var_1)	104433	3569	758	421	48233	1256	170
2014	n_2 - number of samples	5	7	5	3	5	7	3
	variance (Var_2)	104433	3569	758	421	48233	1256	170
Minimum Detectable Change (MDC) calculation	Degrees of Freedom (DoF)	6	8	6	4	6	8	4
	t-critical (1-sided a=0.05)	1.943	1.860	1.943	2.132	1.943	1.860	2.132
	Var_1/n_1	34811	1190	253	140	16078	419	57
	Var_2/n_2	20887	510	152	140	9647	179	57
	SqRt of $Var_1/n_1 + Var_2/n_2$	236	41	20	17	160	24	11
	MDC= t-crit*(SqRt of $Var_1/n_1 + Var_2/n_2$)	459	77	39	36	312	45	23
	MDC as % (= MDC*$mean_1$)	74%	39%	50%	62%	63%	17%	74%

Species codes: See Table 3.

The data from Johnson et al. (2007) were used in the MDC estimates because multiple-field replicates, using different species at different sites, provided estimates of variance for individual combinations of site, species, and contaminant level. Assumptions for these MDCs were based on use of a one-sided, two-sample t-test with a significance level of 5% (alpha = 0.05). The ranges of estimated MDCs from the 2006 results for individual site-species cases for selected analytes using the proposed sampling plan are:

- 4,4'-DDE: 17-91%, mean of 56%.
- Dieldrin: 24-95%, mean of 49%.
- Toxaphene: 1-124%, mean of 39%.
- t-PCBs: 21-127%, mean of 54%.

An example using 4,4'-DDE in common carp (CCP) from Horn Rapids may help interpret the MDC estimate information above. The mean concentration in 2006 was 623 ug/kg (Table 5). For 2014, the target sample size is 5 composite samples and the variance (Var_2 in Table 5) of the 2014 results is assumed to be the same as in 2006 (Var_1). The estimated MDC is 459 ug/kg, which is 74% of the 2006 mean of 623 ug/kg. This estimate suggests that the 2014 result would need to be less than or equal to 164 ug/kg (623-459=164) for a statistically significant difference between the 2006 and 2014 levels.

Mercury in fish remains a concern statewide. All samples collected during this project will be analyzed for mercury concentration. Previous mercury data are from 1984 and 1996-98 (Table 1). Mercury levels in fish fillets from these studies ranged from 67 to 780 ug/kg and represent sites from the mouth to the Yakima Canyon. More recent data on mercury from the Horn Rapids site

comes from Ecology's statewide effort to determine temporal trends in mercury in bass (Meredith and Friese, 2011). Horn Rapids was most recently sampled in 2005 and 2010 as part of this effort.

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 2014.

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 sample collecting, processing, and transporting 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 with report.
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.
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.
Chris Coffin WQP – CRO 509-575-2821**	Unit Supervisor, CRO Watershed Unit	Helps coordinate and communicate with TMDL and Watershed Leads and local groups about Ecology's water quality improvement work.

** TMDL Contacts listed at: www.ecy.wa.gov/programs/wq/tmdl/contacts.html

EAP: Environmental Assessment Program
SCS: Statewide Coordination Section
EIM: Environmental Information Management database
QAPP: Quality Assurance Project Plan
CRO: Central Regional Office
WQP: Water Quality Program

Table 7. Schedule for completing field, laboratory, and report tasks, FFCMP 2014.

Field and laboratory work	Due date	Lead staff
Field work completed	November 2014	Casey Deligeannis
Sample processing completed	January 2015	Casey Deligeannis
Laboratory analyses completed	July 2015	MEL
Environmental Information System (EIM) database		
EIM user study ID	FFCMP14	
Product	Due date	Lead staff
EIM data loaded	August 2015	Casey Deligeannis
EIM data verification	September 2015	To be determined
EIM complete	October 2015	Casey Deligeannis
Final report		
Author lead / Support staff	Keith Seiders / Casey Deligeannis	
Schedule		
Draft due to supervisor	September 2015	
Draft due to client/peer reviewer	October 2015	
Draft due to external reviewer(s)	October 2015	
Final (all reviews done) due to publications coordinator	November 2015	
Final report due on web	December 2015	

6.0 Quality Objectives

Table 8 shows Measurement Quality Objectives (MQOs).

Table 8. Measurement quality objective, FFCMP 2014.

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%
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). Electrofishing will be the primary fish collection method. 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 2014.

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
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

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). PCDD/Fs will be analyzed 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 2014.

Parameter	Methods, RLs, Sample n			
	Number of Samples & Arrival Date [a]	Expected Range of Results [b]	Reporting Limits [c]	Analytical Method
Mercury	54, January 2015	10 - 1000 ug/kg	17 ug/kg	EPA 245.6 (CVAA)
Chlorinated pesticides	86, January 2015	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	86, January 2015	0.5 - 100 ug/kg, depending on Aroclor	1.1 – 5 ug/kg	EPA 8082 (GC/ECD); MEL SOP
PCB congeners	9, January 2015	0.005 - 10 ug/kg, depending on congener	0.003-0.01 ug/kg	EPA 1668A (HiRes GC/MS)
PCDD/Fs	30, January 2015	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	86, January 2015	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	86, January 2015	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 2014.

Parameter	Analytical Method	Lab Duplicates	Lab Control Standards	Surrogates	MS/MSD	Method Blanks
Mercury	EPA 245.6 (CVAA)	1/ batch [a]	1/batch	NA	NA	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.

References

Davis, D. and A. Johnson. 1994. Washington State Pesticide Monitoring Program: Reconnaissance Sampling of Fish Tissue and Sediments (1992). Washington State Department of Ecology, Olympia, WA. Publication No. 94-194.

Davis, D., D. Serdar, and A. Johnson. 1998. Washington State Pesticide Monitoring Program: 1995 Fish Tissue Sampling Report. Washington State Department of Ecology, Olympia, WA. Publication No. 98-312.

EPA. 2002. Columbia River Basin Fish Contaminant Survey, 1996-1998. U.S. Environmental Protection Agency, Region 10, Office of Water, Seattle, WA. Publication No. EPA-910/R-02-006. http://yosemite.epa.gov/r10/oea.nsf/0703BC6B0C5525B088256BDC0076FC44/C3A9164ED269353788256C09005D36B7?OpenDocument

EPA. 2009. The National Study of Chemical Residues in Lake Fish Tissue. U.S. Environmental Protection Agency Office of Water and Office of Science and Technology. Publication No. EPA-823-R-09-006. Washington DC. http://water.epa.gov/scitech/swguidance/fishstudies/lakefishtissue_index.cfm

Health. 2009. Yakima River Fish Consumption Advice Fact Sheet. Washington State Department of Health, Olympia, WA. Publication No. DOH 334-200. http://www.doh.wa.gov/CommunityandEnvironment/Food/Fish/Advisories

Hopkins, B., D. Clark, M. Schlender, and M. Stinson. 1985. Basic Water Monitoring Program: Fish Tissue and Sediment Sampling for 1984. Washington State Department of Ecology, Olympia, WA. Publication No. 85-7.

Johnson, A., B. Era-Miller, and R. Coots. 2007. Chlorinated Pesticides, PCBs, and Dioxins in Yakima River Fish in 2006: Data Summary and Comparison to Human Health Criteria. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-036.

Johnson, A., K. Seiders, C. Deligeannis, K. Kinney, P. Sandvik, B. Era-Miller, and D. Alkire. 2006. PBDEs Flame Retardants in Washington Rivers and Lakes: Concentrations in Fish and Water, 2005-06. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-027.

Johnson A., K. Carmack, B. Era-Miller, B. Lubliner, S. Golding, and R. Coots. 2010. Yakima River Pesticides and PCBs Total Maximum Daily Load: Volume 1 - Water Quality Study Findings. Washington State Department of Ecology, Olympia, WA. Publication No. 10-03-018.

Johnson, A. and M. Friese. 2013. An Assessment of the Chlorinated Pesticide Background in Washington State Freshwater Fish and Implications for 303(d) Listings. Washington State Department of Ecology, Olympia, WA. Publication No. 13-03-007.

Johnson, A. and N. Olson. 2001. Analysis and Occurrence of Polybrominated Diphenyl Ethers in Washington State Freshwater Fish. Article in Archives of Environmental Contamination and Toxicology 41, 339-344 (2001). Washington State Department of Ecology, Olympia, WA. Publication No. 01-03-033.

Joy, J., and B. Patterson. 1997. A Suspended Sediment and DDT Total Maximum Daily Load Evaluation Report for the Yakima River. Washington State Department of Ecology, Olympia, WA. Publication No. 97-321.

Joy, J. 2002. Upper Yakima River Basin Suspended Sediment and Organochlorine Pesticide Total Maximum Daily Load. Washington State Department of Ecology, Olympia, WA. Publication No. 02-03-012.

Meredith, C. and M. Friese. 2011. Measuring Mercury Trends in Freshwater Fish in Washington State, 2010 Sampling Results. Washington State Department of Ecology, Olympia, WA. Publication No. 11-03-053.

Rinella, J.F., S.W. McKenzie, J.K. Crawford, W.T. Foreman, P.M. Gates, G.J. Fuhrer, and M.L. Janet. 1992. Surface Water Quality Assessment of the Yakima River Basin, Washington: Pesticide and Other Trace Organic-Compound Data for Water, Sediment, Soil, and Aquatic Biota, 1987-1991. U.S. Geological Survey Open-File Report 92-644. Portland, OR.

Rogowski, D. 2000. Verifying 303(d) DDT/DDE and Dieldrin Listings for the Upper Yakima River. Washington State Department of Ecology, Olympia, WA. Publication No. 00-03-023.

Seiders, K., 2013. Quality Assurance Project Plan: Washington Freshwater Fish Contaminant Monitoring Program. Washington State Department of Ecology, Olympia, WA. Publication No. 13-03-111.

Tetra Tech, 2011. Minimum Detectable Change Analysis. National Nonpoint Source Monitoring Program Tech Notes 7, December 2011. North Carolina State University Water Quality Group, Raleigh, NC. http://www.bae.ncsu.edu/programs/extension/wqg/319monitoring/tech_notes.htm