Spokane River Regional Toxics Task Force Evaluation of PCBs in Spokane River Redband Trout

Prepared for:
Spokane River Regional Toxics Task Force

With support from:
Washington State Department of Fish & Wildlife
Washington State Department of Ecology

~~June~~ July ~~16~~20, 2021
FINAL APPROVAL DRAFT

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Executive Summary

The Spokane River and Lake Spokane have been placed on the State of Washington's 303(d) list of impaired waters because of concentrations of polychlorinated biphenyls (PCBs) that exceed water quality standards. To address these impairments, the Department of Ecology (Ecology) is pursuing a toxics reduction strategy that included the establishment of a Spokane River Regional Toxics Task Force (Task Force) to identify and reduce PCBs at their source in the watershed. One of the key missions of the Task Force is to make measurable progress toward meeting applicable water quality criteria for PCBs. Demonstrating that this progress is occurring requires a long-term monitoring program, and development of such a program was identified as a priority activity as an outcome of a May 2019 Data Synthesis Workshop. The Task Force subsequently endorsed a long-term monitoring program consisting of parallel effort monitoring PCB concentrations in the water column (using semipermeable membrane devices) and fish tissue (using year old Redband Trout).

The Washington State Department of Fish and Wildlife (WDFW) in coordination with the Spokane River Regional Toxics Task Force (SRRTTF) conducted a study to quantify concentrations of polychlorinated biphenyls (PCBs) in wild Redband Trout from the Spokane River. The results of this study are designed to serve as a baseline for PCB concentrations in fish tissue and will be used as one measure of the effectiveness of PCB control actions aimed at the reduction of PCBs in the Spokane River. Fish collection was conducted in the fall of 2020 and is intended to be repeated in two-year increments.

Fish were collected in four reaches of the river, selected to be comparable to past studies while including new reaches with similar hydrology for direct comparison across a geographic range (Lee et al, 2020). The following conclusions can be gathered from the data collected:

- PCB concentrations in rainbow trout are of a similar order of magnitude to those observed during 2005 and 2012, although results are not directly comparable due to differences in the age of trout collected (multiple age classes vs. year old fish) and method of analysis (fillets vs. whole fish) between prior studies and this one.
- PCBs concentrations were higher at a statistically significant level in the Mission Reach (Crestline Street to Division Street) than in all other reaches except Water St. to TJ Meenach Bridge. The Mission Reach was previously found by Ecology (Era-Miller, 2020) to have elevated PCB concentrations in biofilm during monitoring conducted in 2018 and 2019.
- One of the reaches originally intended to be studied, directly downstream of the WA/ID state line, was dropped from consideration due to the absence of trout in that area during the survey period. Fish tissue results from the remaining five reaches will provide a suitable data set for serving as a measure of the effectiveness of PCB control actions being implemented by the Task Force.

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1 Introduction

Sections of the Spokane River and Lake Spokane have been placed on the State of Washington's 303(d) list of impaired waters because of concentrations of polychlorinated biphenyls (PCBs) that exceed water quality standards. To address these impairments, the Department of Ecology (Ecology) is pursuing a toxics reduction strategy that included the establishment of a Spokane River Regional Toxics Task Force (Task Force) to identify and reduce PCBs at their source in the watershed. One of the key missions of the Task Force is to make measurable progress toward meeting applicable water quality criteria for PCBs. Demonstrating that this progress is occurring requires a long-term monitoring program, and development of such a program was identified as a priority activity as an outcome of a May 2019 Data Synthesis Workshop. The Task Force subsequently endorsed a long-term monitoring program consisting of parallel effort monitoring PCB concentrations in the water column (using semipermeable membrane devices) and fish tissue (using year old Redband Trout).

The study uses index reaches that are comparable to past studies while including new reaches with similar hydrology for direct comparison across a geographic range. The study reduces variability by limiting the sampling to a single species of similar size and age. Additionally, fish processing and analysis methods are being standardized to provide directly comparable results over time. The standardization allows the study to be repeated for use as a "yardstick" to monitor PCB concentrations in fish tissue over time. These analyses will provide a direct link to the efficacy of control actions on the bioaccumulation of PCBs in the tissue of Redband Trout in the Spokane River. This differs from the objectives of previous studies of fish tissue PCB conducted by the Washington Department of Ecology.

This report documents the results of the above monitoring program and subsequent analyses. It is divided into sections of:

- Sampling activities
- Analytical results
- Data interpretation

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2 Sampling Activities

The field monitoring program consisted of five one-day sampling events at five reaches of the Spokane River. Sampling activities are described below, divided into sections corresponding to:

- Sampling locations
- Monitoring dates
- Field sampling activities
- Quality assurance

2.1 Sampling Locations

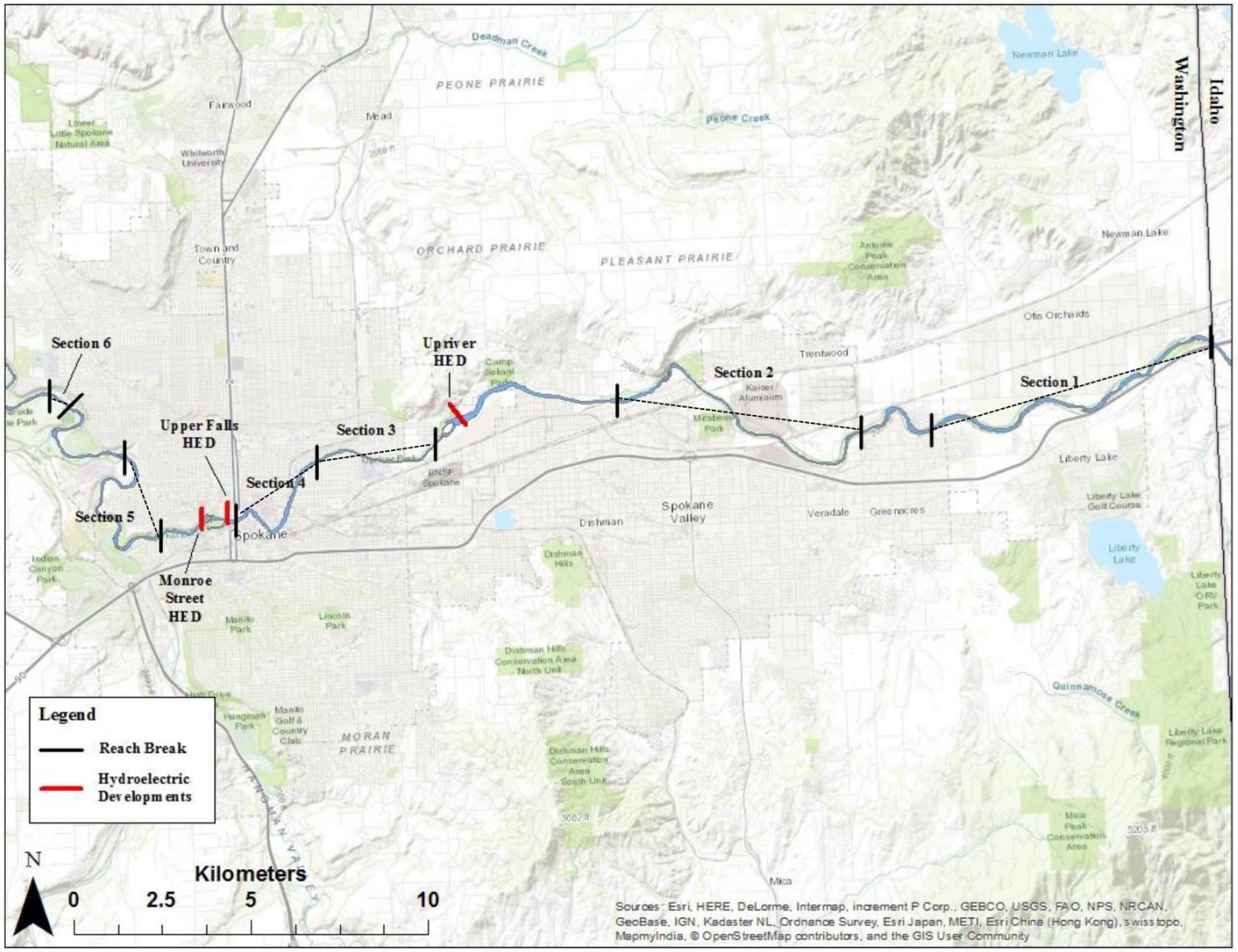
Sampling locations consisted of six reaches of the Spokane River between the Washington/Idaho State Line and Nine Mile Dam. Reach descriptions and geographic coordinates are provided in Table 1 and mapped in Figure 1.

Table 1. 2021 Fish Sampling Reaches

Reach	Description	Latitude (start, end)	Longitude (start, end)
1	WA/ID State Line to McMillan Rd.	47.6986647° N 47.6787307° N	-117.0444273° W -117.1483812° W
2	Flora Road to Donkey Island	47.6787307° N 47.6892723° N	-117.17507466° W -117.2627728° W
3	Upriver Dam to Crestline St.	47.681113° N 47.6772427° N	-117.33394842° W -117.3789251° W
4	Crestline St. to Division St.	47.6772427° N 47.6626718° N	-117.3789251° W -117.4112242° W
5	Water Ave. to T.J. Meenach Bridge	47.6598654° N 47.6801865° N	-117.4391485° W -117.4525107° W
6	Riverside Water Reclamation Facility to the Kayak Takeout Site	47.6598654° N 47.6801865° N	-117.4391485° W -117.4525107° W

2.2 Monitoring Dates

Monitoring was conducted across five dates in the fall of 2020, starting on October 9 and concluding on December 8. The intent was to capture 25 fish per reach. In most cases, all 25 fish in a reach were captured in a single day. The one exception was the reach between Water Ave. and T. J. Meenach Bridge (Reach 5), where fish collection was split between October 28 and December 8. The number of fish collected by reach and date are provided in Table 2. Fish were not collected from Reach 1 due to the absence of trout in that area during the survey period.


Section 6
Upper Falls HED
Section 3
Upriver HED
Section 2
Section 1
Section 4
Section 5
Monroe Street HED
Spokane
Legend
Reach Break
Hydroelectric Developments
N
Kilometers
0
2.5
5
10
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Deadman Creek
PEONE PRAIRIE
Peone Creek
Newman Lake
Washington
Idaho
Fairwood
Mead
Whitworth University
Lower Little Spokane Natural Area
Town and Country
ORCHARD PRAIRIE
PLEASANT PRAIRIE
Antoine Peak Conservation Area
Otis Orchards
Trentwood
Kaiser Aluminum
Mirabeau Park
Liberty Lake
Liberty Lake Golf Course
Spokane Valley
Veradale
Greenacres
Dishman
Dishman Hills
Dishman Hills Conservation Area - North Unit
Dishman Hills Conservation Area - South Unit
Indian Canyon Park
Manito Park
Lincoln Park
Hangman Park
Manito Golf & Country Club
MORAN PRAIRIE
Quinnamose Creek
Liberty Lake Regional Park
Liberty Lake ORV Park
Mica Peak Conservation Area
Mica
BNSF Spokane

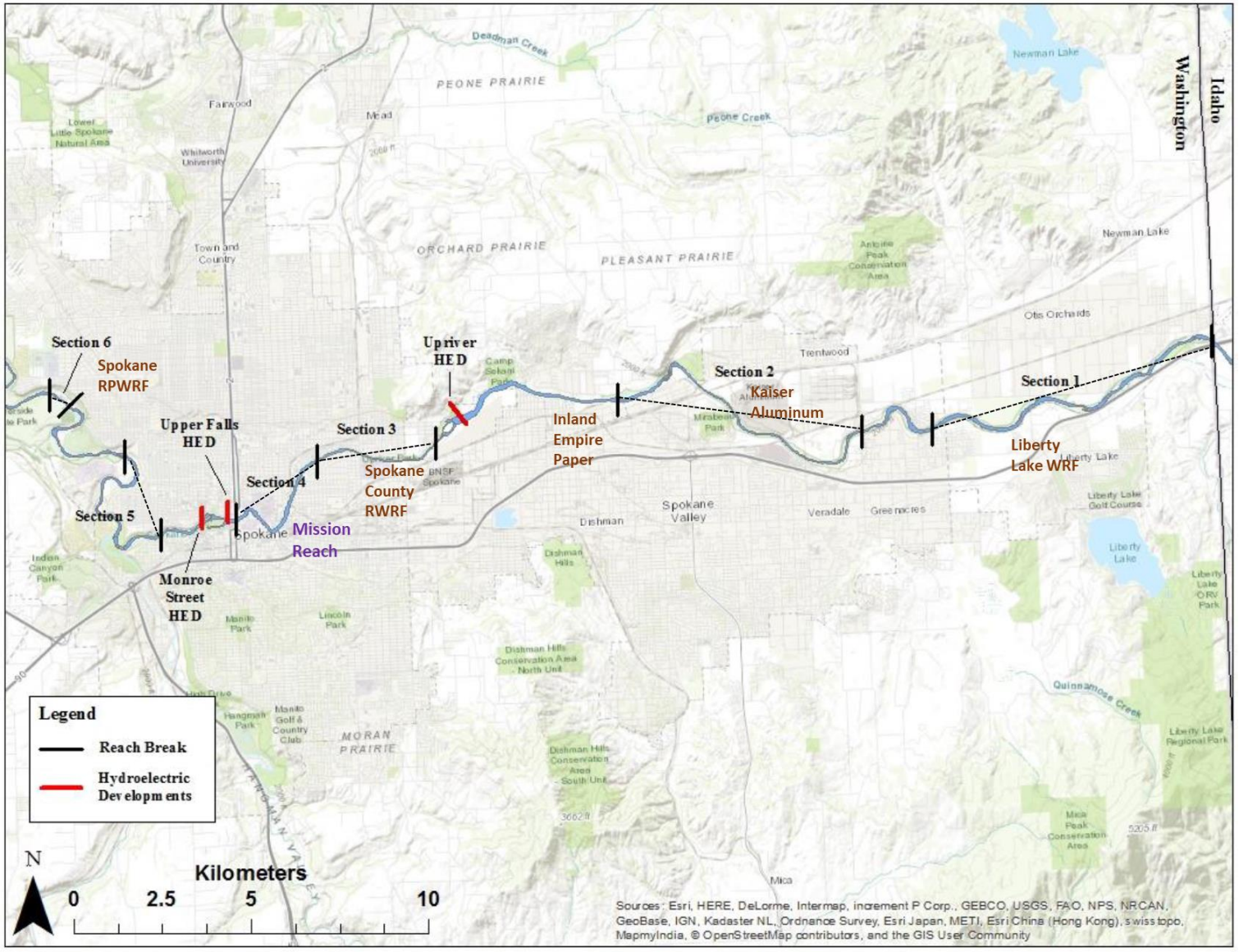


Figure 1. Sampling Locations for 2020 Fish Sampling (adapted from Lee et al, 2020 to show location of Mission Reach and known PCB loads)

Table 2. Sampling Dates and Number of Fish Collected by Reach

Reach	Location Descriptor	Number of Fish Collected	Date
2	Flora Road to Donkey Island	25	10/20/2020
3	Upriver Dam to Crestline Street	25	10/09/2020
4	Crestline Street to Division Street	25	10/22/2020
5	Water Ave. to TJ Meenach Bridge	13	10/28/2020
5	Water Ave. to TJ Meenach Bridge	12	12/08/2020
6	Riverside WRF to kayak takeout site	25	10/28/2020

2.3 Field Sampling Activities

The field sampling activities as planned and implemented are detailed in the project QAPP (Lee et al, 2020). This section summarizes those activities. Sampling was conducted by boat electrofishing. A crew of two to three individuals, one boat captain/rower and one to two netters, conducted the surveys. A maximum of two sampling passes were conducted at each of the six survey reaches. Sampling was conducted along the left or right shoreline for approximately 600 seconds of "electrofishing on" time. The crew then anchored and processed the samples (if any). The boat crew then crossed the river and sample the opposite shoreline for approximately 600 seconds. This process was repeated until the full sample (n=25) for the survey reach was or the end of the reach was encountered. If necessary, WDFW conducted a second sampling pass. Wild fish were identified as those having an intact adipose fin. All hatchery fish planted in the Spokane River have their adipose fins clipped prior to release. Fin condition was also examined in the field for deformities indicative of hatchery origin (in case of a poor or missed fin clip). As a precaution, fish with deformed fins (i.e., bent dorsal, bent pectorals, missing pectoral fins) but having an intact adipose fin were not used for the study.

Biological data collected on each fish included total length (mm) and weight (g). Fish did not have age or sex determined as the variability presented by those characteristics are accounted for based on the targeted total lengths of the fish (200-300 mm) which represent sub-adult and sexually immature fish. Sample collection location data included GPS coordinates (start and end) of the survey reach, date of collection, and time of day.

2.4 Quality Assurance

Field samples were shipped to AXYS Analytical Laboratories, Ltd. in Sidney, British Columbia for compositing (five whole fish per composite) and analysis of PCB concentrations (Method 1668), % lipids and % moisture.

2.4.1 Data Quality Assessment

All data were reviewed for quality assurance in accordance with the project QAPP and as noted in the laboratory EDD-Excel files provided in the appendix. Data quality indicators evaluated for PCBs included the following:

- Daily Calibration Verification
- Lab Control Sample Recovery
- Sample and Method Blank Surrogate Recovery
- Matrix Spike Sample Recovery
- Duplicate sample relative percent differences (RPDs)
- Completeness

All reviewed quality control (QC) results for PCBs comply with QAPP data quality indicators, with the following exceptions:

- Four congener values were flagged for failing the lab control sample (OPR) %R evaluation for the duplicate sample from Reach 4.
- Four congener values were flagged for failing the lab control sample (OPR) %R evaluation for the duplicate sample from Reach 6.
- One congener value was flagged for failing the duplicate sample relative percent difference criterion for the duplicate sample from Reach 6.

There are no changes to PCB result values as a result of this assessment, although data qualifiers were added to select samples subject to high relative percent difference and lab control sample (OPR) %R evaluation as described above.

2.4.2 Blank Correction

Total PCB concentrations were corrected for method blank contamination following the procedures defined in the QAPP. Specifically, individual congeners found in the sample at a concentration less than three times the associated blank concentration were flagged and excluded from calculation of homolog and total PCB concentration. All total PCB and homolog results reported below are blank corrected using the above method. It should be noted that there is no standard blank correction method, and numerous approaches are utilized, both nationally and within the Spokane River Basin. The selection of the most appropriate blank correction methodology must consider factors such as study objectives, sample matrix, sampling methodology, expected range of results, and tolerance for biased results.

3 Analytical Results

This section summarizes the results of the 2020 monitoring, in terms of concentrations of total PCBs and individual homologs. Furthermore, a detailed listing of PCB homolog concentrations for each composite is provided in Appendix A, and full laboratory data sheets are provided in Appendix C.

3.1 Total PCBs

Total PCB concentrations are shown below in Figure 2 and Table 3 for all Spokane River reaches. PCB concentrations are consistently less than 20 ug/kg at the most upstream reach (Reach 2) and increase to 25 to 55 ug/kg at the next reach downstream (Station 2). Fish tissue PCB concentrations peak at Reach 4, ranging from 40 to 160 ug/kg. Concentrations decrease moving downstream to Reach 5, ranging from 50 to 100 ug/kg. Concentrations continue to decrease moving downstream to Reach 6, ranging from 30 to 50 ug/kg. Additional interpretation of these data is provided subsequently in Section 4 of this report.

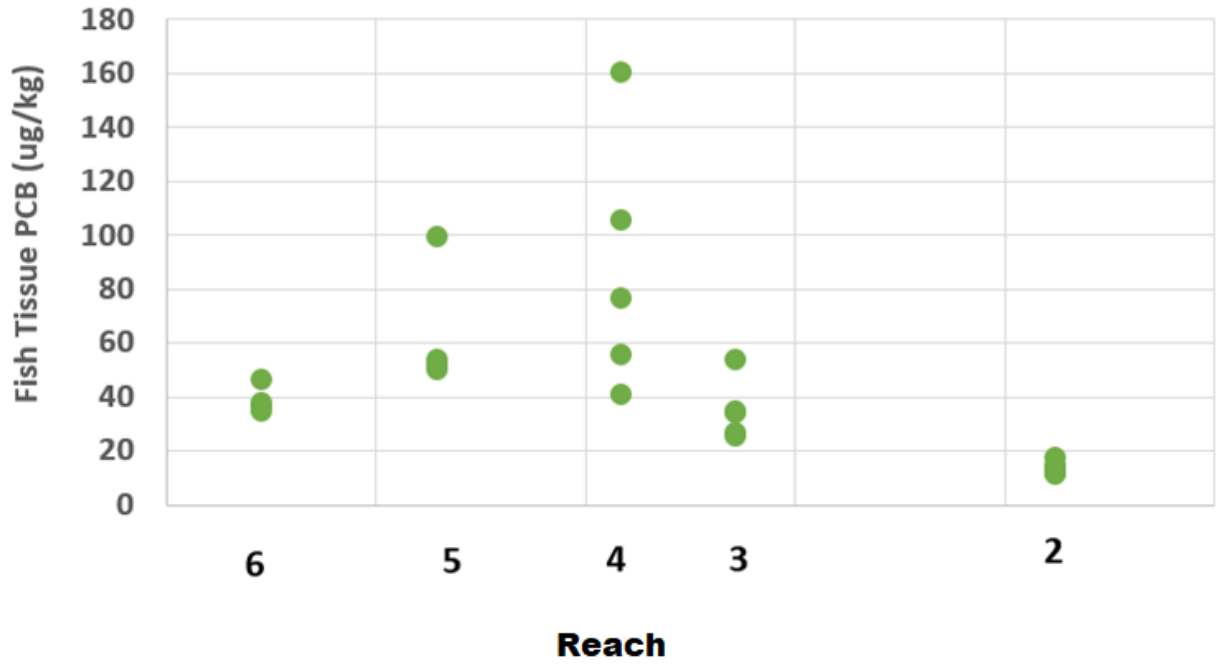


Figure 2. Spokane River Fish Tissue Total PCB Concentrations (ug/kg) Measured during 2020

Table 3. Spokane River Fish Tissue Total PCB Concentrations (ug/kg) Measured during 2020

	Fish Composite				
Reach	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**
2	17.2	13.1	11.3	13.8	11.1
3	33.3	25.2	53.5	34.3	26.2
4	76.1	159.7	104.5	55.2	40.4
5	99.2	51.5	51.6	53.2	50.0
6	36.0	37.4	46.2	35.9	34.2

3.2 Homolog Distributions

Homolog distributions for each reach are summarized in Figures 3 through 7, showing average concentration by homolog across all samples within a given reach. These data are provided in tabular format for each individual sample in Appendix A. All reaches except Reach 4 have penta- and hexa-chlorinated homologs as the most prevalent. Concentrations in Reach 4 are dominated by the tetra-chlorinated homolog.

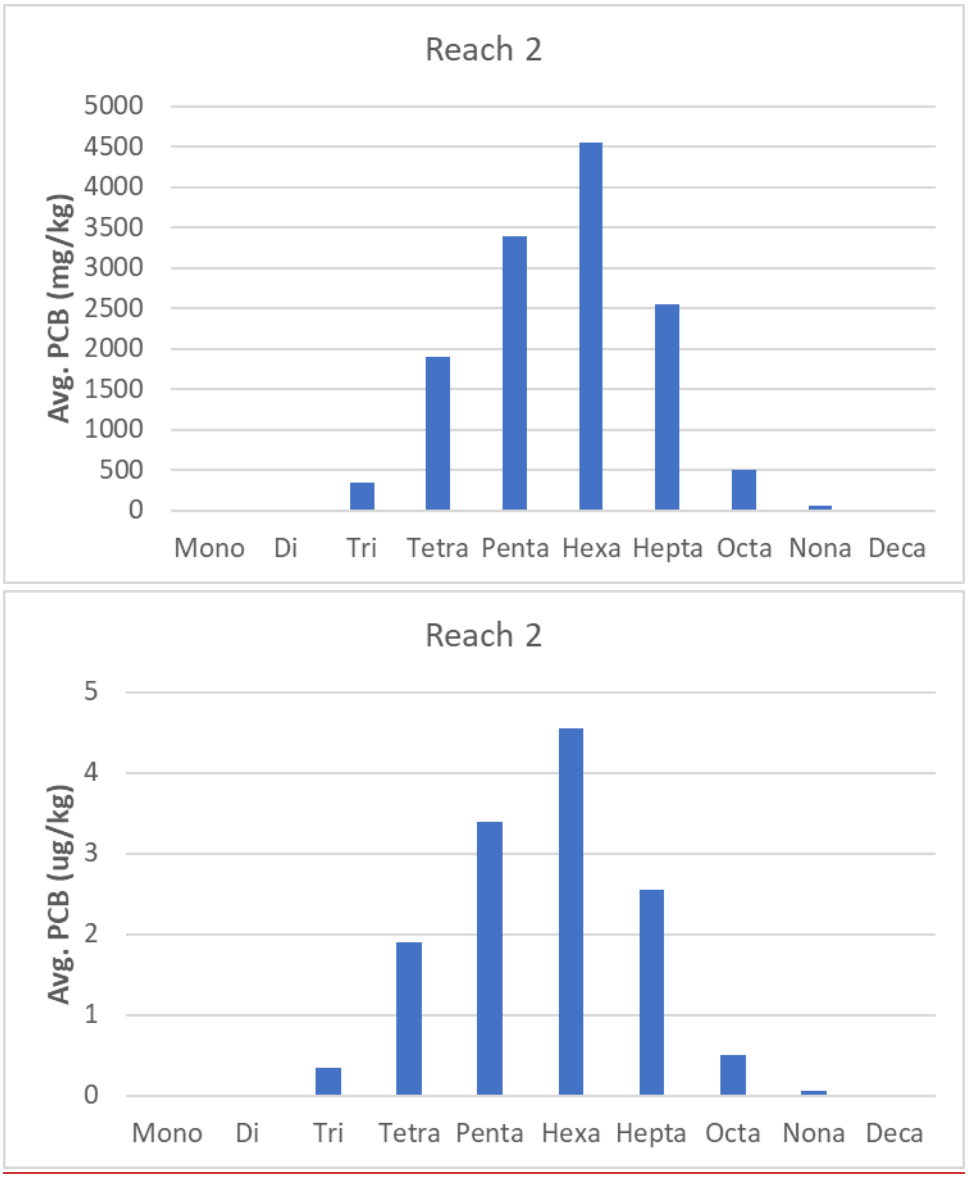


Figure 3. Average Blank-Corrected Homolog Concentrations for All Fish from Reach 2.

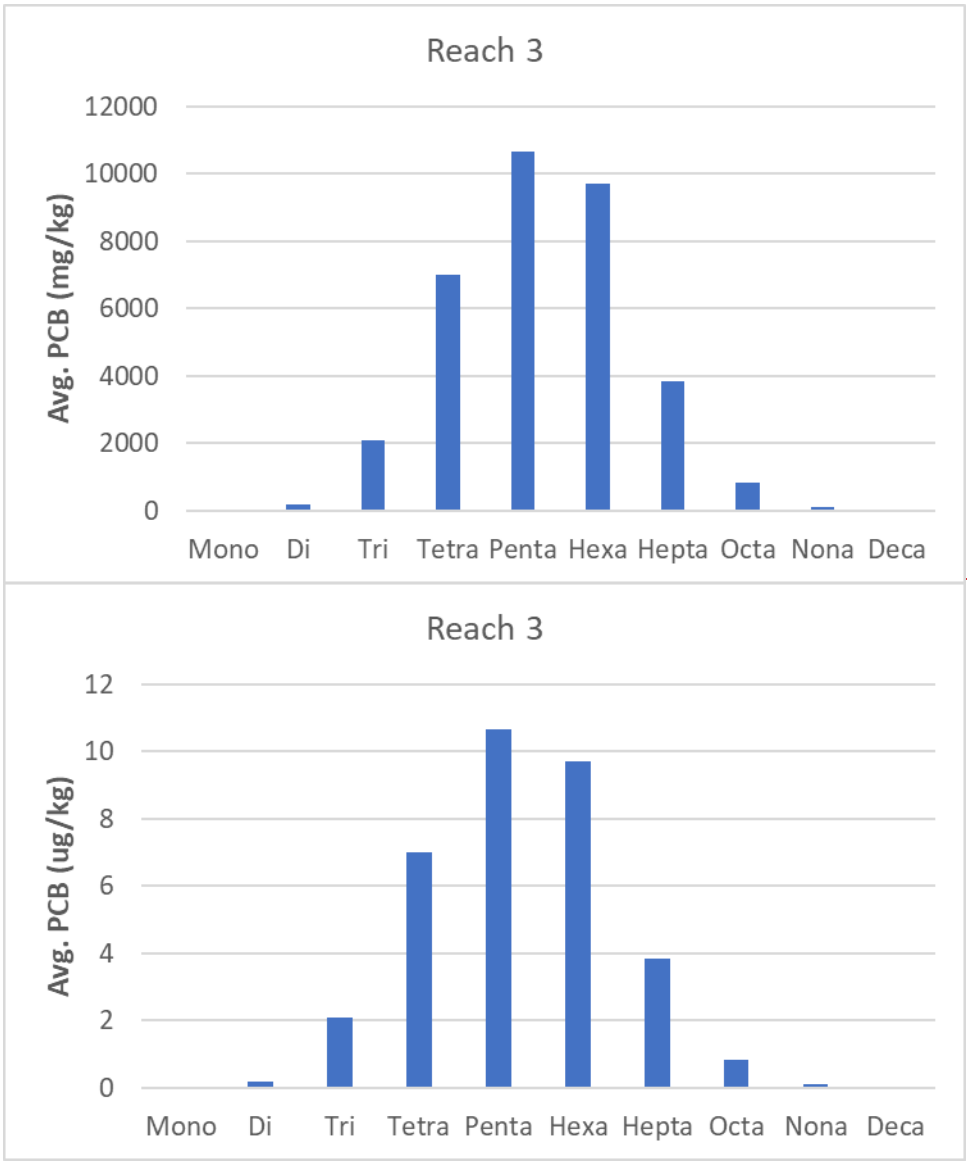


Figure 4. Average Blank-Corrected Homolog Concentrations for All Fish from Reach 3.

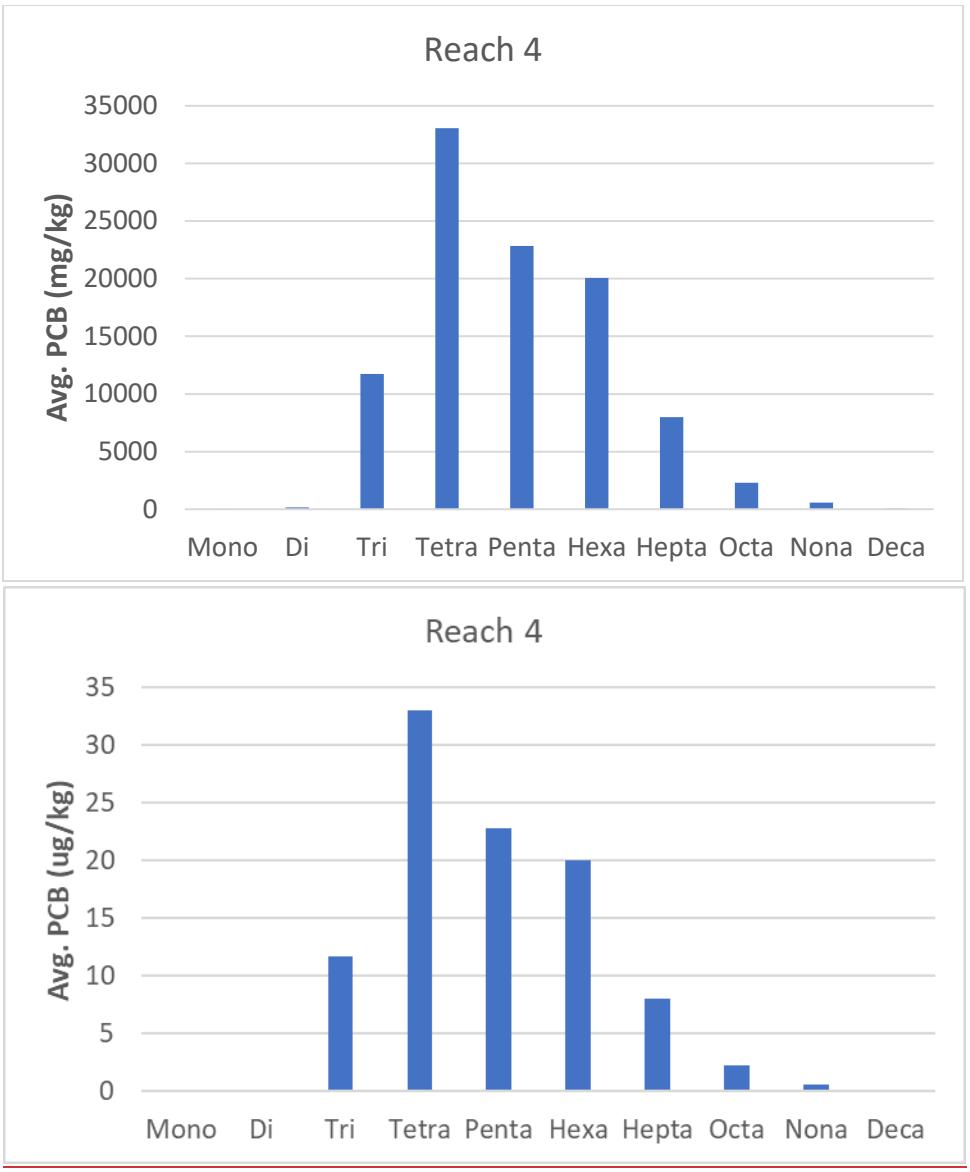


Figure 5. Average Blank-Corrected Homolog Concentrations for All Fish from Reach 4.

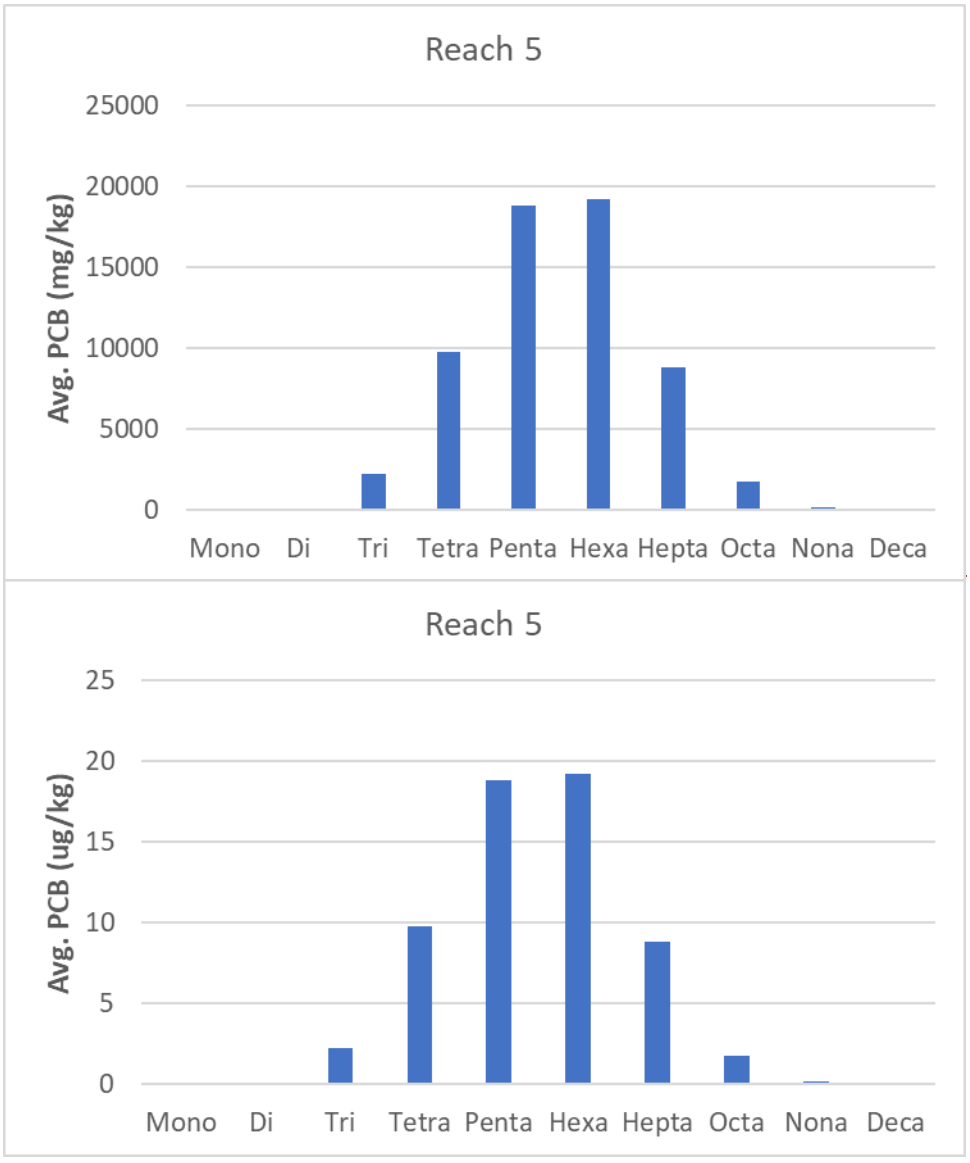


Figure 6. Average Blank-Corrected Homolog Concentrations for All Fish from Reach 5.

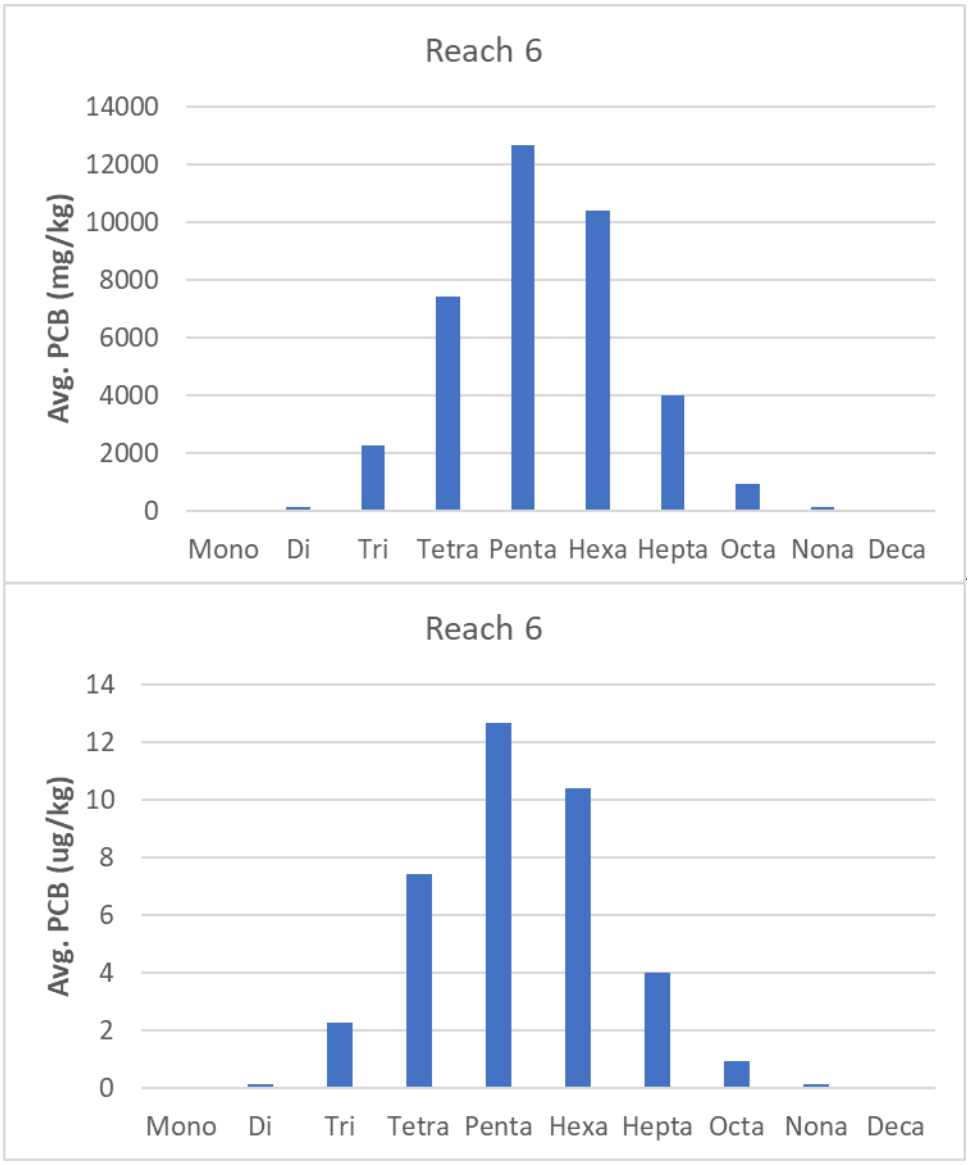


Figure 7. Average Blank-Corrected Homolog Concentrations for All Fish from Reach 6.

4 Data Interpretation

The objective of this sampling is to provide present day baseline concentration against which future concentrations can be compared to evaluate. This section provides an interpretation of the PCB results provided in Section 3 in term of:

- Analysis of differences in total PCB concentration between stations
- Comparison to fish tissue PCB concentrations from prior years
- Comparison to regulatory thresholds
- Correlation between homolog distributions in fish and primary loading sources

4.1 Analysis of Differences in Total PCB Concentration between Stations

The results presented above were analyzed to assess whether statistically significant differences existed in fish tissue concentrations between reaches of the river, following the work done on 2012 fish tissue data by Seiders et al (2014). The null hypothesis was that no differences between concentrations at various locations existed. An alpha level of 0.05 was chosen to ensure that there was a low probability (5%) that the results from the test were not due to chance. The Mann-Whitney test was used to compare results between each station. Interpretations of these operations are summarized in Table 4.

Table 4. Outcome of Statistical Tests for Difference between Reaches in PCB Concentrations in Spokane River Redband Trout Tissue

Reach	Relation	Reach		Reach	Relation	Reach		Reach	Relation	Reach
2	<	3		4	>	2		6	>	2
2	<	4		4	>	3		6	=	3
2	<	5		4	=	5		6	<	4
2	<	6		4	>	6		6	=	5
3	>	2		5	>	2				
3	<	4		5	=	3				
3	=	5		5	=	4				
3	=	6		5	=	6				

Results of the statistical comparisons can be summarized as follows. PCB concentrations in Redband trout in Reach 2 were significantly lower than concentrations in all other reaches. PCB concentrations in Redband trout in Reach 4 were significantly greater than concentrations in all other reaches except Reach 5. No other statistically significant differences between concentrations were observed.

4.2 Comparison to Fish Tissue PCB Concentrations from Prior Years

The Washington State Department of Ecology measured fish tissue PCB concentrations of several fish species including rainbow trout in the Spokane River in 2012 (Seiders et al, 2014) and 2005 (Serdar and Johnson, 2006). Fish tissue concentrations are not directly comparable between the 2020 results and those from prior years, because:

- Tissue PCB concentrations from 2020 were measured using whole fish, while the 2005 and 2012 studies used fillets.
- The 2020 study collected only juvenile fish, while the 2005 and 2012 studies examine a wide range of age and size classes.

It is noted that the above two factors work in opposite directions in terms of fish tissue PCB concentration (whole fish tend to have higher PCB concentrations than fillets, while juvenile fish have lower concentrations than the population as a whole).

Concentrations among years appear to follow a similar spatial pattern, with PCB concentrations in the Mission Reach averaging roughly 2 to 2.5 times as high as concentrations in upstream and downstream reaches.

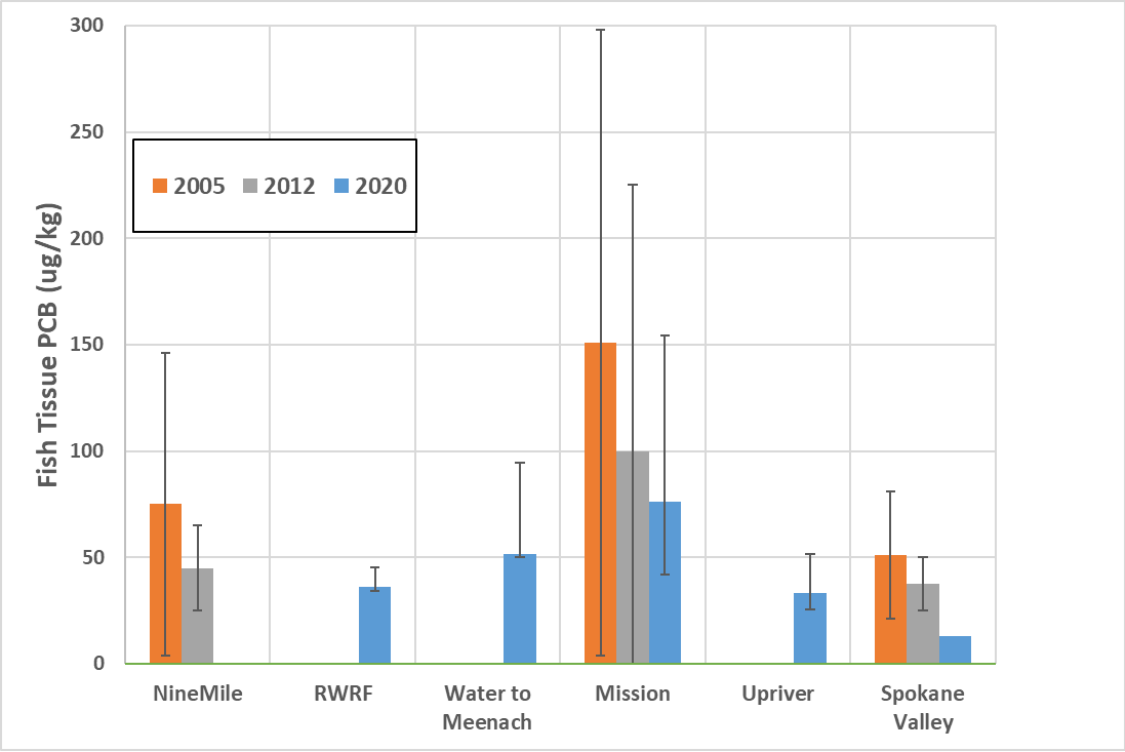


Figure 8. Spokane River Trout Tissue PCB Concentrations between Years and Stations (note: 2020 Fish Represent Whole Body Juvenile Fish While 2005 and 2012 Represent Fillets from a Range of Ages)

4.3 Comparison to Regulatory Thresholds

Ecology assesses PCB-related designated use impairment for fish harvest by using what are called tissue exposure concentrations (TECs). Not to be confused with Fish Tissue Equivalent

Concentrations (FTEC), a TEC represents the tissue level of concern at the adopted fish consumption rate. The TEC for PCBs does not represent a numeric water quality criterion because it has not been adopted into Chapter 173-201A WAC. TECs, however, are considered as part of the State's narrative criterion for purposes of impairment determinations. The threshold for impairment determinations (i.e., placement on the 303(d) list) occurs where the median composite sample value(s) from one or more resident species exceeds the TEC for carcinogens by a factor of ten or more. The TEC for carcinogenic effects for total PCBs is 0.23 ug/kg; therefore, the threshold for impairment due to carcinogenic effects of PCBs is 2.3 ug/kg (Ecology, 2020).

It is emphasized that the fish samples collected as part of this project are neither intended nor suitable for direct comparison to TEC thresholds representing designated use impairment. Ecology (2020) policy specifies that only the edible portions of fish tissue (i.e., skin on or skin off fillets) be used for impairment determinations. This project examined PCB concentrations in whole fish, which tend to have higher PCB concentrations than fillets. Furthermore, Ecology may consider the age of fish examined when determining if the samples in the dataset are representative of the site. This project examined only year-old fish, which tend to have lower PCB concentrations than older fish. Taking these competing factors into effect, fish tissue PCB concentrations for year-old whole trout may differ by a factor of two from fillet-only samples from a more diverse age range of fish.

While direct comparison of fish tissue PCB concentrations observed in this study to TECs is inappropriate, a more qualitative comparison can be informative. Median whole fish PCB concentrations observed in the Spokane River in 2020 ranged from 13 ug/kg in Reach 2 to 76 ug/kg in Reach 4. These values are roughly an order of magnitude larger than the impairment threshold (and two orders of magnitude larger than the TEC for carcinogens), suggesting that present day fish tissue PCB concentrations are likely higher than acceptable levels.

4.4 Correlation between Homolog Distributions in Fish and Primary Loading Sources

The homolog patterns observed in fish tissue generally do not correlate well to the homolog patterns observed in the previously identified primary PCB loading sources. The overall (i.e., considering both wastewater and groundwater) PCB loading from Kaiser Aluminum is dominated by the tetrachloro homolog and secondarily by the trichloro homolog. Fish tissue PCB concentrations in the reach receiving the Kaiser discharge, as well as the next reach downstream, are dominated by the penta- and hexa-chlorinated homologs. PCB loading from Inland Empire Paper (IEP) is dominated by the trichloro homolog, while fish tissue PCB concentrations in the reach downstream of the IEP discharge are dominated by the penta- and hexa-chlorinated homologs. A closer correlation between loading source and fish tissue homolog distribution is observed for the reach receiving discharge from the City of Spokane RPWRF. Both the wastewater load and the fish tissue PCB distributions are dominated by the penta- chlorinated homologs, although it is noted that the pentachloro PCB concentration in fish in this reach is actually lower than concentrations in fish in the reach upstream of the RPWRF discharge. The difference in homolog distributions between the known primary PCB loading sources and fish tissue could be caused by markedly different biocaccumulation rates among homologs and/or the presence of a

previously unidentified source contributing PCBs dominated by penta- and hexachloro-chlorinated homologs.

5 References

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Serdar, D. and A. Johnson, 2006. PCBs, PBDEs, and Selected Metals in Spokane River Fish, 2005. Watershed Ecology Section, Environmental Assessment Program, Washington State Department of Ecology. www.ecy.wa.gov/biblio/0603025.html

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Appendix A:
Synoptic Survey Results - PCBs by Homolog

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Table A-1: Blank-Corrected Analytical Results for Reach 2					
Station SR2	1-5	6-10	11-15	16-20	21-25
Total PCBs (pgug/kgl)	17.24	13.11	11.32	13.78	11.12
Total Monochloro Biphenyls (ug/kg pg/l)	0.00	0.00	0.00	0.00	0.00
Total Dichloro Biphenyls (ug/kgpg/l)	0.02	0.02	0.01	0.01	0.01
Total Trichloro Biphenyls (ug/kgpg/l)	0.67	0.24	0.16	0.53	0.16
Total Tetrachloro Biphenyls (ug/kgpg/l)	3.38	1.27	1.16	2.67	0.99
Total Pentachloro Biphenyls (ug/kgpg/l)	4.47	3.32	2.87	3.53	2.74
Total Hexachloro Biphenyls (ug/kgpg/l)	5.12	4.89	4.19	4.25	4.31
Total Heptachloro Biphenyls (ug/kg)	2.93	2.75	2.38	2.29	2.40
Total Octachloro Biphenyls (ug/kgpg/l)	0.58	0.55	0.48	0.44	0.45
Total Nonachloro Biphenyls (ug/kgpg/l)	0.06	0.06	0.05	0.05	0.05
Total Decachloro Biphenyls (ug/kgpg/l)	0.01	0.01	0.01	0.01	0.01
% lipids	5.48	5.67	4.41	4.74	4.22
% moisture	73	74.7	75.9	74.6	75.6

Table A-2: Blank-Corrected Analytical Results for Reach 3					
Station SR3	1-5	6-10	11-15	16-20	21-25
Total PCBs (ug/kgpg/l)	33.34	25.16	53.53	34.30	26.18
Total Monochloro Biphenyls (ug/kg pg/l)	0.00	0.00	0.00	0.00	0.00
Total Dichloro Biphenyls (ug/kgpg/l)	0.21	0.18	0.23	0.25	0.11
Total Trichloro Biphenyls (ug/kgpg/l)	2.09	2.02	2.29	2.61	1.52
Total Tetrachloro Biphenyls (ug/kgpg/l)	7.26	6.30	7.69	8.19	5.62
Total Pentachloro Biphenyls (ug/kgpg/l)	9.80	7.14	19.48	9.22	7.75
Total Hexachloro Biphenyls (ug/kgpg/l)	8.86	5.90	18.14	8.73	6.99
Total Heptachloro Biphenyls (ug/kg)	4.00	2.86	4.70	4.27	3.35
Total Octachloro Biphenyls (ug/kgpg/l)	0.97	0.64	0.87	0.91	0.72
Total Nonachloro Biphenyls (ug/kgpg/l)	0.13	0.10	0.12	0.11	0.09
Total Decachloro Biphenyls (ug/kgpg/l)	0.02	0.02	0.02	0.02	0.01
% lipids	3.9	3.39	3.76	5.04	2.52
% moisture	76.9	74.8	73	74.6	77.5

Table A-3: Blank-Corrected Analytical Results for Reach 4					
Station SR4	1-5	6-10	11-15	16-20	21-25
Total PCBs (ug/kgpg/l)	76.14	159.71	104.53	55.25	156.41
Total Monochloro Biphenyls (ug/kgpg/l)	0.00	0.00	0.00	0.00	0.00
Total Dichloro Biphenyls (ug/kgpg/l)	0.17	0.16	0.24	0.19	0.17
Total Trichloro Biphenyls (ug/kgpg/l)	2.87	25.98	10.57	2.43	27.02
Total Tetrachloro Biphenyls (ug/kgpg/l)	11.99	72.16	29.42	8.98	69.73
Total Pentachloro Biphenyls (ug/kgpg/l)	24.72	28.61	26.56	17.40	27.42
Total Hexachloro Biphenyls (ug/kgpg/l)	25.58	20.34	23.99	17.41	19.93
Total Heptachloro Biphenyls (ug/kg)	8.64	8.50	9.80	7.02	8.17
Total Octachloro Biphenyls (ug/kgpg/l)	1.80	2.97	2.98	1.57	3.00
Total Nonachloro Biphenyls (ug/kgpg/l)	0.33	0.90	0.87	0.22	0.89
Total Decachloro Biphenyls (ug/kgpg/l)	0.04	0.08	0.08	0.04	0.08
% lipids	3.73	3.27	5.02	4.77	2.69
% moisture	75.7	76.8	75	76.2	76.4

Table A-4: Blank-Corrected Analytical Results for Reach 5					
Station SR5	1-5	6-10	11-15	16-20	21-25
Total PCBs (ug/kgpg/l)	40.41	51.45	51.61	53.18	49.99
Total Monochloro Biphenyls (ug/kgpg/l)	0.00	0.00	0.01	0.00	0.00
Total Dichloro Biphenyls (ug/kgpg/l)	0.09	0.17	0.16	0.10	0.07
Total Trichloro Biphenyls (ug/kgpg/l)	1.47	2.55	2.47	2.17	1.74
Total Tetrachloro Biphenyls (ug/kgpg/l)	6.03	9.97	9.85	9.51	8.36
Total Pentachloro Biphenyls (ug/kgpg/l)	12.29	15.87	16.37	16.71	16.79
Total Hexachloro Biphenyls (ug/kgpg/l)	13.07	15.40	15.14	16.49	15.42
Total Heptachloro Biphenyls (ug/kg)	5.79	6.13	6.16	6.67	6.10
Total Octachloro Biphenyls (ug/kgpg/l)	1.41	1.18	1.25	1.32	1.32
Total Nonachloro Biphenyls (ug/kgpg/l)	0.23	0.15	0.16	0.18	0.16
Total Decachloro Biphenyls (ug/kgpg/l)	0.03	0.02	0.03	0.03	0.02
% lipids	4.57	5.22	4.27	3.08	2.52
% moisture	76.2	74	77	76.1	77.4

Table A-5: Blank-Corrected Analytical Results for Reach 6					
Station SR6	1-5	6-10	11-15	16-20	21-25
Total PCBs (ug/kgpg/l)	36.04	37.44	46.18	35.92	34.23
Total Monochloro Biphenyls (ug/kgpg/l)	0.01	0.01	0.01	0.00	0.00
Total Dichloro Biphenyls (ug/kgpg/l)	0.12	0.15	0.13	0.09	0.14
Total Trichloro Biphenyls (ug/kgpg/l)	2.00	2.66	2.61	1.67	2.47
Total Tetrachloro Biphenyls (ug/kgpg/l)	7.01	7.62	8.82	6.33	7.24
Total Pentachloro Biphenyls (ug/kgpg/l)	12.31	12.44	15.56	11.73	11.37
Total Hexachloro Biphenyls (ug/kgpg/l)	9.67	9.73	13.01	10.78	8.75
Total Heptachloro Biphenyls (ug/kg)	3.87	3.77	4.80	4.30	3.33
Total Octachloro Biphenyls (ug/kgpg/l)	0.91	0.91	1.08	0.90	0.79
Total Nonachloro Biphenyls (ug/kgpg/l)	0.13	0.14	0.15	0.11	0.12
Total Decachloro Biphenyls (ug/kgpg/l)	0.01	0.02	0.02	0.01	0.01
% lipids	4.65	6.82	5.66	3.76	5.38
% moisture	75.1	72.8	75	76.9	60.5

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Appendix B:
Quality Assurance Project Plan

Provided separately as an electronic document

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Appendix C: Laboratory Results

Provided separately as electronic spreadsheets

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