A Department of Ecology Report

Reconnaissance Survey on Metals, Semivolatiles, and PCBs in Sediment Deposits Behind Upriver Dam, Spokane River

Abstract

Metals, semivolatile organic compounds, and PCBs were analyzed in sediment samples from four sites behind Upriver Dam on the Spokane River, collected during October 1999. This work was done in support of ongoing environmental studies of the Spokane River. As in many other parts of the river, sediment quality screening guidelines were exceeded for zinc, lead, cadmium, and PCBs. Several additional semivolatile compounds, including polyaromatic hydrocarbons, phenol, 4-methylphenol, retene, benzyl alcohol, and benzoic acid, also appeared to be chemicals of potential concern at some sites. Biological testing is recommended to verify the presence of toxic conditions.

Project Description

In response to a request from the Washington State Department of Ecology (Ecology) Eastern Regional Office (ERO), the Ecology Environmental Assessment Program (EAP) conducted a reconnaissance survey of the sediments behind Upriver Dam on the Spokane River. ERO wanted to determine if there were depositional areas behind the dam that had accumulated sediments contaminated with metals, PCBs, or other chemicals. Previous sampling in this area had been limited. This information was of possible importance to the ongoing U.S. Environmental Protection Agency (EPA) Spokane River Basin-wide Remedial Investigation and Feasibility Study.

The reconnaissance survey was conducted on October 14, 1999. Sediment samples were collected along nine bank-to-bank transects between river mile 80.2 and 83.4 (Figure 1). Along each transect, samples of the river bed were inspected from a series of 0.02 m^2 Ponar grabs. When fine material was found, a larger 0.06 m^2 Ponar was used to take samples for grain size determination and to archive for possible chemical analysis.

ERO subsequently decided to analyze sediment samples from four sites (Figure 1): three near-bank samples close to Upriver Dam, and a fourth sample 3.2 miles above the dam, also near the river bank. Chemicals analyzed included priority pollutant metals, semivolatile organic compounds, PCBs, and total organic carbon. PCBs were analyzed as Aroclor equivalents, with one sample also being analyzed for individual PCB congeners.

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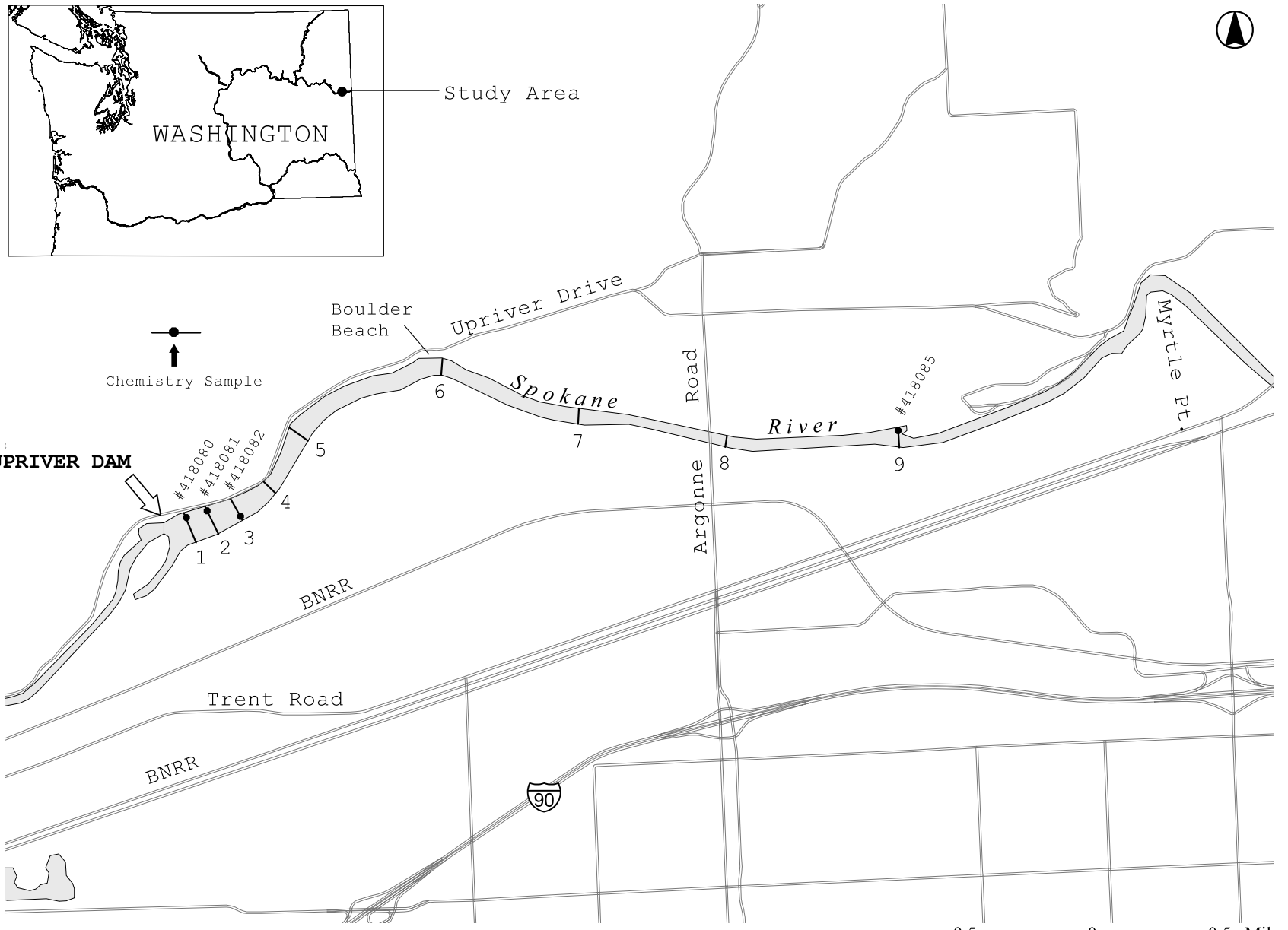

Figure 1. Location of Sediment Transects above Upriver Dam (chemistry sample number shown)

Methods

Sampling methods followed Puget Sound Estuary Program (PSEP, 1996) protocols and Sediment Management Standards requirements (Ecology, 1995a,b).

Sampling site coordinates were recorded from a hand-held GPS. The coordinates were later verified and adjusted if needed with an in-house GIS program.

The chemistry samples were of the top-10 cm surface layer. The material was removed with stainless steel scoops and homogenized by stirring in stainless steel bowls. Subsamples of the homogenized sediment were placed in 8-oz glass jars with Teflon lid liners, cleaned to EPA QA/QC specifications (EPA, 1990), or Whirl-Pak bags for grain size.

Stainless steel scoops and buckets used to manipulate the sediments were cleaned by washing with Liquinox detergent, followed by sequential rinses with tap water, dilute nitric acid, de-ionized water, and pesticide-grade acetone. The equipment was then air-dried and wrapped in aluminum foil. The grabs were cleaned similarly and wrapped in aluminum foil before going into the field. Between samples the grabs were washed by brushing with site water.

The samples were put in individual polyethylene bags and placed on ice immediately after collection. Grain size samples were analyzed by Rosa Environmental & Geotechnical Laboratory in Seattle. The chemistry samples were frozen in a secure freezer at Ecology headquarters and shipped to Manchester Laboratory on January 4, 2000. Chain-of-custody was maintained.

The methods used to analyze the samples are shown in Table 1.

Table 1. Analytical Methods for Upriver Dam Sediment Samples

Analysis	Method	Method No.
Be,Cd,Cr,Cu,Ni,Pb,Sb,Zn	ICP	SW6010
Arsenic	GFAA	SW7060
Selenium	GFAA	SW7740
Thallium	GFAA	SW7841
Mercury	CVAA	EPA245.5
Semivolatiles	GC/MS	SW8270
PCBs	GC/ECD	SW8082
Grain Size	Sieve & Pipet	PSEP
Total Organic Carbon	PSEP Methods	PSEP
Percent Solids	Gravimetric	PSEP

PSEP = Puget Sound Estuary Program

Data Quality

Manchester staff prepared written reviews on the quality of the chemical data for this project. The reviews include an assessment of sample condition on receipt at the laboratory, compliance with holding times, and results for instrument calibration, procedural blanks, laboratory control samples, standard reference materials, surrogates, matrix spikes, and matrix spike duplicates. The data reviews and complete chemical data are contained in a separate data appendix (Johnson, 2000).

Overall, the quality of the data is good. The following problems were encountered, some of which required qualification of the data:

Metals

Matrix spike recoveries for antimony were low (34 - 46%). All antimony data were qualified as estimates (J flag). Mercury analysis exceeded the holding time in the samples from transects 2, 3, and 9. Because these samples were stored unfrozen for approximately one month, the mercury results may underestimate actual concentrations. The transect 1 sample did not exceed the mercury holding time.

Semivolatiles

Phenol, benzoic acid, and four phthalates were detected in the method blank. These compounds were considered native to the sample when the on-column concentration was at least five times greater than the blank or ten times greater for phthalates.

Matrix spikes were not recovered for 4-chloroaniline, 3-nitroaniline, and hexachloropentadiene. Data for these compounds were rejected in the spiked sample (transect 9). N-nitroso-di-N-propylamine and 4-nitroaniline results were qualified as estimates in this sample because of matrix spike recoveries below 50%. Results for several additional semivolatiles were qualified as estimates because the concentrations detected were below the reporting limit.

PCBs

Due to possible interferences (overlap) between PCB-1242 and -1248, and between -1248 and 1254, results for -1242 and -1254 were qualified as estimates. The PCB-1260 result for transect 9 was qualified as an estimate due to the concentrations being below the reporting limit.

Results

Field Observations

The grabs returned gravel, cobble, or hit hard substrates in most areas. Sandy material was however encountered close to Upriver Dam at the locations shown in Figure 2. Silty sand was found at the right bank end of transect 4 (facing downstream) inside a bend in the river.

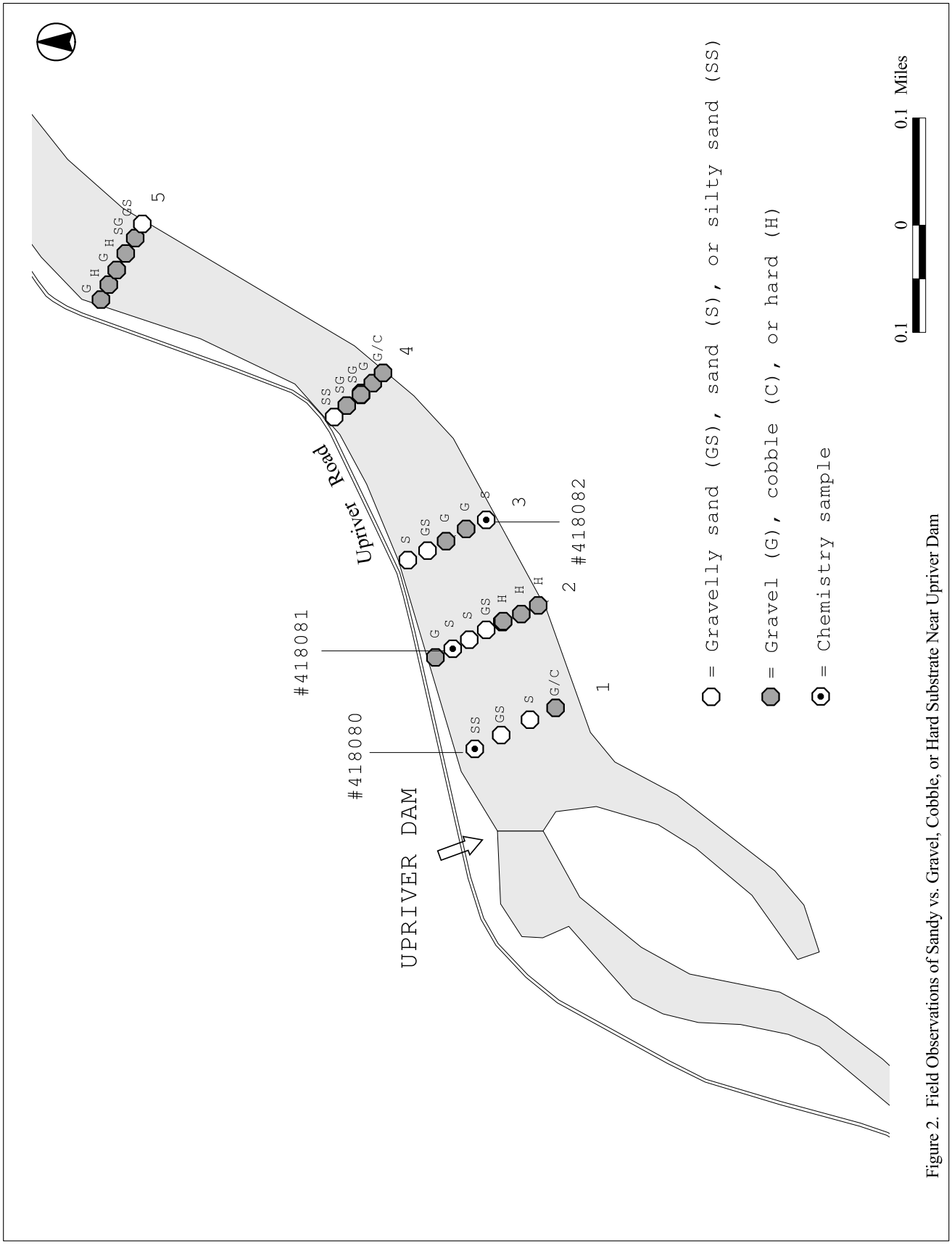

Figure 2. Field Observations of Sandy vs. Gravel, Cobble, or Hard Substrate Near Upriver Dam

Downstream from this point, deposits of sand or gravelly sand progressively occupied more of the river bed. Sand predominated along transect 1 just upstream of the dam, except on the left (south) side of the channel.

Some sand or gravelly sand was also encountered at the left bank ends of transects 3 and 5. Sand and finer material also was found further upstream in a small embayment at the right bank end of transect 9 (Figure 1).

Chemical analysis was conducted on samples of the finest recoverable material encountered along transects 1, 2, and 3, and on the sandy sample from transect 9. The first three consisted of silty sand or sand that appeared to be enriched with organic matter, relative to other samples examined. The fourth sample was collected from an embayment below and island/bar feature positioned along the right (left) bank. The locations of the four chemistry samples were as follows (NAD27 datum):

- Site 1 sample – 47° 41' 11.1'' x 117° 19' 35.3''
- Site 2 sample – 47° 41' 12.5'' x 117° 19' 26.3''
- Site 3 sample – 47° 41' 10.6'' x 117° 19' 16.0''
- Site 9 sample – 47° 41' 23.3'' x 117° 15' 57.2''

Appendix A has locations and descriptions of each grab sample from the transects.

Chemicals Detected

Table 2 summarizes results from the physical/chemical analyses. Because of the large number of semivolatiles analyzed, only data for detected compounds are shown. Detection limits for remaining compounds can be found in Johnson (2000).

Grain size analysis showed that sand comprised 75% or more of the material at the four sample sites. The site 1 and 3 samples had high concentrations of total organic carbon (8.4 - 13.7%) compared to 2 and 9 (1.8 - 3.6%). The field notes indicate sites 1 and 3 contained plant fragments or wood chips.

Metals concentrations were similar at sites 1, 2, and 9. Sites 1 and 3 had much higher concentrations of zinc, lead, and arsenic, possibly due to the slightly higher relative percentage of silt. Antimony and silver were only detected at site 3.

Polyaromatic hydrocarbons (PAH), 4-methylphenol, dibenzofuran, retene, benzyl alcohol, and benzoic acid were detected at all or most sites. These semivolatiles are commonly reported in urban sediments. Except for benzyl alcohol and benzoic acid, concentrations were much higher at sites 1 and 2, both located along the right bank of the river. Petroleum and combustion of fossil fuel are sources of PAH. 4-methylphenol, dibenzofuran, and retene are often associated with wood waste.

Table 2. Summary of Physical/Chemical Data on Upriver Dam Sediments Collected October 14, 1999 [only detected semivolatiles shown]

Site Number:	1	2	3	9
Sample Number:	018080	018081	018082	018085
Ancillary Parameters (%)				
Gravel	5.1	1.8	12.8	5.7
Sand	77.6	92.5	74.6	92.1
Silt	17.3	5.7	12.7	2.2
Clay	0.0	0.0	0.0	0.0
Total Organic Carbon	8.4	3.6	13.7	1.8
Solids	30	55	15	69
Metals (mg/Kg, dry weight)				
Zinc	**3280**	**1990**	**8960**	**1410**
Lead	**564**	**342**	**1420**	**308**
Copper	**43**	**27**	**34**	**15**
Chromium	**24**	**18**	**14**	**15**
Cadmium	**27**	**13**	**14**	**4.6**
Nickel	**16**	**11**	**21**	**7.6**
Arsenic	**12**	**5.8**	**35**	**3.8**
Beryllium	**0.51**	**0.33**	**0.47**	**0.26**
Mercury	**0.024**	**0.12** J	**0.17** J	**0.064** J
Selenium	**0.35**	0.3 U	**0.73**	0.3 U
Antimony	5 UJ	5 UJ	**17** J	5 UJ
Silver	1 U	1 U	**1.5**	1 U
Thallium	0.6 U	0.6 U	0.6 U	0.6 U
Semivolatiles (ug/Kg, dry weight)				
Low Molecular Weight PAH				
Naphthalene	**973**	**637**	**31** J	**43**
2-Methylnaphthalene	**94**	**498**	**28** J	**42**
1-Methylnaphthalene	**65**	**318**	**20** J	**39**
Acenaphthylene	**198**	**138**	67 U	14 U
Acenaphthene	**45**	**238**	67 U	14 U
Fluorene	**33**	**232**	67 U	**0.4** J
Phenanthrene	**489**	**1800**	**31** J	**69**
Anthracene	**64**	**413**	67 U	**8.9** J
Total LPAH	**1961**	**4274**	**110**	**202**

Table 2 (continued)

Site Number:	1	2	3	9
Sample Number:	018080	018081	018082	018085
Semivolatiles (continued)				
High Molecular Weight PAH				
Fluoranthene	**412**	**1680**	**13** J	**64**
Pyrene	**378**	**1700**	**13** J	**58**
Chrysene	**102**	**588**	**23** J	**38**
Benzo(a)anthracene	**51**	**553**	67 U	**24**
Benzo(b)fluoranthene	**93**	**344**	67 U	**37**
Benzo(k)fluoranthene	**67**	**402**	29 J	**25**
Benzo(a)pyrene	**118**	**460**	67 U	**30**
Indeno(1,2,3-cd)pyrene	**100**	**264**	67 U	**46**
Dibenzo(a,h)anthracene	28 U	**37**	67 U	14 U
Benzo(ghi)perylene	**86**	**240**	67 U	**31**
Total HPAH	**1407**	**6268**	**49**	**353**
Phenols				
Phenol	**239**	**110**	67 U	77 U
Pentachlorophenol	**74**	20 U	67 U	14 U
2-Methylphenol	**32**	20 U	67 U	14 U
4-Methylphenol	**1820**	**1820**	**47**	**41**
Dichlorobenzenes				
1,2-Dichlorobenzene	**4.5** J	20 U	67 U	14 U
1,4-Dichlorobenzene	**21** J	20 U	67 U	14 U
Phthalates				
Dimethylphthalate	**41**	20 U	67 U	14 U
Diethylphthalate	**14** J	20 U	67 U	14 U
Di-N-butylphthalate	**114**	45 U	338 U	14 U
Miscellaneous Compounds				
Carbazole	28 U	**109**	67 U	14 U
Dibenzofuran	**79**	**126**	67 U	**19**
Retene	**29900** E	**5440** E	**2640**	**809**
Benzyl Alcohol	**89**	**34**	**708**	**26**
Benzoic Acid	**1660**	**834**	**2650**	**753**

Table 2 (continued)

Site Number:	1	2	3	9
Sample Number:	018080	018081	018082	018085
Polychlorinated Biphenyls (ug/Kg, dry weight)				
PCB-1016	7.3 U	4.7 U	17 U	3.7 U
PCB-1221	7.3 U	4.7 U	17 U	3.7 U
PCB-1232	7.3 U	4.7 U	17 U	3.7 U
PCB-1242	**180** J	**32** J	17 U	7.5 U
PCB-1248	**960**	**195**	17 U	**51** J
PCB-1254	**110** J	**20** J	17 U	**16** J
PCB-1260	**23**	**6.6** J	17 U	7.5 U
Total PCBs	**1273**	**254**	ND	**67**

U = not detected at or above reported value
J = estimated value
UJ = not detected at or above reported estimated value
E = concentration exceeds calibration range
ND = not detected

Low concentrations of several additional semivolatiles were detected at site 1 only. These included pentachlorophenol, 2-methylphenol, dichlorobenzenes, and three phthalates.

PCBs were detected at sites 1, 2, and 9. The highest concentration of total PCBs was found at site 1 (1,273 ug/Kg) and site 2 (254 ug/Kg). PCB concentrations at site 3 were less than 17 ug/Kg. The results of PCB congener analysis on the site 1 sample are in Appendix B.

Sediment Quality Guidelines

To identify chemicals of potential concern in the Upriver Dam sediments, results were compared to sediment quality guidelines from various sources (Table 3). An Ecology study (Cubbage et al., 1997) proposed Freshwater Sediment Quality Values from an analysis of bioassay and chemistry data in Ecology's Freshwater Sediment Quality (FSEDQUAL) database on freshwater sediments statewide. The Province of Ontario (Persaud et al., 1993) has determined Severe Effects Levels from simultaneously collected data on benthic invertebrate communities and chemical concentrations in freshwater sediments. The National Biological Service analyzed sediment bioassay data to derive Probable Effect Concentrations and other benchmarks for the Great Lakes (EPA, 1996). Finally, EPA's Office of Solid Waste and Emergency Response (OSWER) used

Table 3. Freshwater Sediment Quality Guidelines

Chemical Parameter	Freshwater Sediment Quality Value[1]	Severe Effects Level[2]	Probable Effect Concentration[3]	Ecotox Threshold[4]
Metals (mg/Kg, dry weight)				
Zinc	410	820	1,530	150
Lead	450	250	396	47
Copper	390	110	78	34
Chromium	260	110	160	81
Cadmium	5.1	10	12	1.2
Nickel	46	75	38	21
Arsenic	57	33	57	8.2
Mercury	0.41	2	- -	0.15
Antimony	3	- -	- -	- -
Silver	6.1	- -	- -	- -
Organics (ug/Kg, dry weight)				
Total LPAH	27,000	- -	3,400	- -
Total HPAH	36,000	- -	4,400	- -
Total PAH	60,000	10,000	13,700	4,000
Phenol	48	- -	- -	- -
1,2-Dichlorobenzene	- -	- -	- -	340
1,4-Dichlorobenzene	- -	- -	- -	350
Diethylphthalate	- -	- -	- -	630
Di-N-butylphthalate	43	- -	- -	11,000
Carbazole	140	- -	- -	- -
Dibenzofuran	32,000	- -	- -	2,000
PCB-1248	21	150	- -	- -
PCB-1254	7.3	34	- -	- -
PCB-1260	- -	24	- -	- -
Total PCBs	21	530	245	23

[1]Cubbage et al. (1997)

[2]Persaud et al. (1993) - Note: organics SELs are mg/Kg TOC; PCB guidelines are tentative.

[3]EPA (1996)

[4]OSWER (1996) - Note: assumes 1% TOC

equilibrium partitioning theory to develop Ecotox Thresholds for screening contaminants at CERCLA sites (OSWER, 1996). The Probable Effect and Ecotox values in Table 3 were taken from tabulations in Jones et al. (1997).

For some of the organic compounds detected in the Upriver Dam sediments, either no freshwater guideline was available or the guidelines were limited to the OSWER calculated values, as opposed to guidelines based on biological effects. Therefore, for screening purposes, the Upriver data were also compared to the state marine sediment management standards (Table 4) as recommended by Cubbage et al. (1997).

None of the above sources had guidelines for retene. An Apparent Effects Threshold (AET) of 1,700 – 2,000 ug/Kg (dry weight) has been determined for retene in Puget Sound sediments (PTI, 1989). The AET approach was used to derive the state marine standards.

Table 5 shows which chemicals exceeded one or more of the above screening guidelines in each of the Upriver Dam sediment samples. Consistent with previous data on this part of the river, zinc, lead, cadmium, and PCBs exceeded screening guidelines in most samples. Other chemicals that exceeded screening guidelines were arsenic, antimony, and mercury at site 3; PAH at site 2; phenols at sites 1 and 2; retene at sites 1, 2, and 3; benzyl alcohol at sites 1 and 3; and benzoic acid at all sites.

Chemicals that were an order of magnitude or more above the screening guidelines determined by Cubbage et al. (1997) for Washington State freshwater sediments included zinc (all sites), lead (site 3), cadmium (sites 1, 2, and 3), antimony (site 3), and phenol and PCBs (sites 1 and 2). Other chemicals well above the state marine standards or marine AET were 4-methylphenol (sites 1 and 2), retene (site 2), benzyl alcohol (site 3), and benzoic acid (sites 1 and 3). These exceedances are summarized in Table 6 as being those with the greatest potential for adverse effects in the river.

Other Sediment Data

Sediment chemistry data for the portion of the Spokane River between Upriver Dam and the Idaho border have been reported by Johnson et al. (1994); EILS (1995); Huntamer (1995); Hart Crowser (1995); CH2M HILL (1995); and Horowitz (1999).

EILS (1995) reports results from analyzing metals, semivolatiles, and PCBs in a sediment sample located just off the right bank of the river, 0.45 miles above Upriver Dam (Table 7). This site is at approximately the same location as transect 4 in the present study. Additional metals and PCB data for this site are reported in Johnson et al. (1994) and Huntamer (1995). Like present study sites 1 and 2, the EILS (1995) Upriver Dam site had high concentrations of zinc, lead, cadmium, PCB-1248, and three semivolatiles – PAH, 4-methylphenol, and retene. Bioassays with the amphipod *Hyalella azteca* and the Microtox bacterial test showed evidence of significant toxicity relative to laboratory controls (Table 7).

Table 4. Washington State Marine Sediment Management Standards[1]

Chemical Parameter	Sediment Quality Standard	Cleanup Screening Level
Metals (mg/Kg, dry weight)		
Arsenic	57	93
Cadmium	5.1	6.7
Chromium	260	270
Copper	390	390
Lead	450	530
Mercury	0.41	0.59
Silver	6.1	6.1
Zinc	410	960
Nonionizable Organic Compounds (mg/Kg TOC)		
Total LPAH	370	780
Total HPAH	960	5300
1,2-Dichlorobenzene	2.3	2.3
1,4-Dichlorobenzene	3.1	9
Dimethyl phthalate	53	53
Diethyl phthalate	61	110
Di-N-butyl phthalate	220	1700
Dibenzofuran	15	58
Total PCBs	12	65
Ionizable Organic Compounds (ug/Kg, dry weight)		
Phenol	420	1200
2-Methylphenol	63	63
4-Methylphenol	670	670
Pentachlorophenol	360	690
Benzyl alcohol	57	73
Benzoic acid	650	650

[1]173-204 WAC

Table 5. Chemicals Exceeding One or More Screening Guidelines in Upriver Dam Sediments [number entered indicates which guideline was exceeded: 1=FSQV, 2=SEL, 3=PEC, 4=ET, 5=SQS, 6=CSL, 7=AET]

Site Number:	1	2	3	9
Sample Number:	018080	018081	018082	018085
Zinc	1,2,3,4,5,6	1,2,3,4,5,6	1,2,3,4,5,6	1,2,4,5,6
Lead	1,4,5,6	4	1,2,4,5,6	2,4
Copper	4			
Cadmium	1,2,3,4,5,6	1,2,3,4,5,6	1,2,3,4,5,6	4
Arsenic	4		2,4	
Mercury			4	
Antimony			1	
Total LPAH		3		
Total HPAH		3		
Total PAH		4		
Phenol	1	1		
4-Methylphenol	5,6	5,6		
Retene	7	7	7	
Benzyl Alcohol	5,6		5,6	
Benzoic Acid	5,6	5,6	5,6	5,6
PCB-1248	1	1		1
PCB-1254	1	1		1
PCB-1260				
Total PCBs	1,3,4,5	1,3,4		1,4

Key to sediment quality guidelines:
1 = Freshwater Sediment Quality Values (Cubbage et al., 1997)
2 = Severe Effects Level (Persaud et al.. (1993)
3 = Probable Effects Concentration (EPA, 1996)
4 = Ecotox Threshold (OSWER, 1996)
5 = Marine Sediment Quality Standard (173-204 WAC)
6 = Marine Cleanup Screening Level (173-204 WAC)
7 = Marine Apparent Effects Threshold (PTI, 1989)

Table 6. Chemicals an Order of Magnitude Above Freshwater Sediment Screening Guidelines (Cubbage et al., 1997) or Marine Sediment Standards (173-204 WAC) or Marine AETs (PTI, 1989)

Site Number:	1	2	3	9
Sample Number:	018080	018081	018082	018085
Zinc	x[1]	x[1]	x[1]	x[1]
Lead			x[1]	
Cadmium	x[1]	x[1]	x[1]	
Antimony			x[1]	
Phenol	x[1]	x[1]		
4-Methylphenol	x[2]	x[2]		
Retene		x[2]		
Benzyl Alcohol			x[2]	
Benzoic Acid	x[2]		x[2]	
PCBs	x[1]	x[1]		

[1]Freshwater screening guideline exceeded
[2]Marine sediment standard or AET (retene) exceeded

Table 7. Summary of Chemistry and Bioassay Data on a 1994 Upriver Dam Sediment Sample[1] (EILS, 1995)

Analysis	Result
Chemistry	
Zinc (mg/Kg, dry)	4050
Lead "	542
Cadmium "	40
PCB-1248 (ug/Kg, dry)	4500
Total PAH "	2757
4-methylphenol "	3590
Retene "	6020
Total organic carbon (%)	13
Fines (% silt + clay)	33
Bioassays	
Hyalella (10-day survival)	50%*
Microtox (EC_{50})	28%*

[1]Sample number 328001
*Significantly different ($p \leq 0.05$) from laboratory control

Conclusion and Recommendations

Potentially significant chemical contamination exists at sites 1, 2, 3, and, to a lesser extent, 9. Further biological testing is recommended to evaluate the presence of toxic conditions. Further evaluation of the contaminated sediments spatial extent is also recommended.

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Appendix A. Depths and Sediment Characteristics of Upriver Dam Sediment Transects, October 1999
[LB = left bank; RB = right bank; facing downstream. Bold font indicates sample taken for chemistry.]

												Coordinates of Center of Transect
Transect #1	Width (ft.) 650	Depth (ft.) Substrate:	LB - -	13 gravel & cobble	22 sand	**22** gravelly sand	**26 silty sand (#418080)**	RB - -				47 40.92 x 117 19.60
Transect #2	Width (ft.) 700	Depth (ft.) Substrate:	LB - -	17 hard	16 hard	17 hard	15 gravelly sand	14 sand	**24 sand (#418081)**	20 gravel	RB - -	47 41.39 x 117 19.76
Transect #3	Width (ft.) 560	Depth (ft.) Substrate:	LB - -	**19 sand w/ wood chips (#418082)**	19 gravel	13 gravel	12 gravelly sand	22 sand/	RB - -			47 41.28 x 117 19.20
Transect #4	Width (ft.) 410	Depth (ft.) Substrate:	LB - -	19 gravel & cobble	24 gravel	19 sandy gravel	20 sandy gravel	12 silty sand	RB - -			47 41.24 x 117 19.25
Transect #5	Width (ft.) 490	Depth (ft.) Substrate:	LB - -	10 gravelly sand	12 sandy gravel	14 hard	20 gravel	20 hard	13 gravel & rocks	RB - -		47 41.70 x 117 19.59
Transect #6	Width (ft.) 360	Depth (ft.) Substrate:	LB - -	17 gravel	19 hard	24 gravel	27 gravel	11 gravel	10 sand	RB - -		47 41.66 x 117 18.28
Transect #7	Width (ft.) 290	Depth (ft.) Substrate:	LB - -	11 hard	22 hard	24 hard	21 hard	14 hard	RB - -			47 41.54 x 117 17.89
Transect #8	Width (ft.) 225	Depth (ft.) Substrate:	LB - -	14 hard	23 hard	17 hard	RB - -					47 41.46 x 117 17.01
Transect #9	Width (ft.) 735	Depth (ft.) Substrate:	LB - -	13 rocks	19 gravel & cobble	7 rocks	3 silty sand	**5 sand (#418085)**	RB - -			47 41.43 x 117 15.79

Appendix B. Results of PCB Congener Analysis on Upriver Dam Sediment Sample 01808, Site #1 (ug/Kg, dry weight)

PCB Congener	Concentration
8	**14**
18	**67**
28	**80** NJ
44	**63**
52	**69**
66	**63**
101	**20**
77	35 UJ
118	**19**
153	**4.7**
105	**9.0**
138	**6.4**
126	0.73 U
128	**1.6**
180	**2.1**
170	**0.96**
187	**1.2**
195	0.73 U
206	0.73 U
81	0.73 U
114	0.73 U
156	**0.86**
169	0.73 U
209	0.73 U

U = not detected at or above reported value
UJ = not detected at or above reported estimated value
NJ = evidence the analyte is present, numerical results is an estimate