Supplemental Environmental Analysis
For Purposes of
2003-2004 Dredging
(Lower Snake and Clearwater Rivers, Washington and Idaho)

ATTACHMENT E

Physical and Chemical Characterization of the Sediments in Areas of the Lower Snake River Proposed for Dredging in 2003/2004:

Draft Summary

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1.0 INTRODUCTION

Sediment samples were collected from the lower Snake River and near the mouth of the Clearwater River during April 2003. The sample sites were located in ten potential dredge areas between river mile (RM) 8 and RM 143 on the lower Snake River, as well as up to about RM 1.5 on the Clearwater River (Table 1). One in-reservoir disposal site near RM-116 was also considered. The samples were analyzed for a suite of physical and chemical parameters to further characterize the substrate in specific areas prior to a proposed 2003/2004 dredging event.

Several of the proposed dredging regions identified in this plan were last sampled in 2000. As such, the primary objectives of this study were to:

- Update previous data to account for new sedimentation.
- Obtain a better understanding of the current chemical characteristics of the sediments within proposed dredging areas in the lower Snake River.
- Compare current information to historical data from the same locations.
- Determine the suitability of the dredge material for in-reservoir disposal.

The results summarized in this report are based on provisional data. A complete analysis of the finalized data, along with a comparison to previous information, will be completed by the end of August 2003.

2.0 METHODS

The methods employed for the field and laboratory segments of the project are only summarized here. Detailed information is provided in USACE (2003).

2.1 Field Methods

The fieldwork was contracted to QA Systems and completed during a five-day interval during April 2003. Each sampling location was identified by approximate Washington State plane coordinates and river mile location (Table 1). The stations were located and positions recorded during the fieldwork with the aid of a differentially corrected global positioning system (DGPS) using NAD27 as the reference.

Sample collection followed a systematic approach. A spud sampler was initially used to determine the approximate sediment size (cobbles and gravel versus fines). If no sample was collected, the boat was moved a minimum of 10 ft and the area re-sampled. If a spud sample greater than one-foot thick was recovered a 3-in Balchek sampler was utilized. A Shipek sampler was employed if the sediment depth was less than one foot. Samples that contained primarily cobble and gravel material were photographed digitally along with an identification number for documentation. If most of the grab sample material was smaller than gravel then it was distributed into appropriate containers. Corps of Engineer personnel from Walla Walla District (NWW) coordinated the shipment of these samples to the designated laboratories.

2.2 Laboratory Methods

The sediment samples were subjected to several analyses. They were initially evaluated for total volatile solids (TVS) and particle size. Samples that contained greater than 5% TVS and where more than 20% passed a No. 230 sieve were processed for Tier IIB analytes. The parameters slated for this level of analysis included metals, semi-volatile organics, pesticides, herbicides, polycyclic aromatic hydrocarbons (PAHs), and poly chlorinated biphenyls (PCBs). Samples testing positive for organic compounds were also analyzed for total organic carbon (TOC). Dioxin screens and analyses were only completed on selected samples retrieved from Lower Granite pool. Oil, grease, and total petroleum hydrocarbons (TPH) analyses were restricted to samples collected from boat basins, port areas, and tugboat turning areas.

Four laboratories were utilized for the analyses. The three primary laboratories, the analyses they were responsible for, and methods used are presented in Table 2. Split samples were sent to GeoLab for independent analyses. All of the laboratories followed the QA/QC protocols prescribed for QA-1 (PTI, 1989). Kismet Scientific Services will complete the data review and validation, and this information will be included in the final report.

3.0 RESULTS AND DISCUSSION

3.1 Particle Size and TVS

Substrate particle size and TVS data were used during the process of determining which samples were analyzed for additional chemical constituents as described above. Forty-two percent of the sample IDs shown in Table 3 proceeded to the next level of analysis. The quantity from individual areas ranged from zero percent in the navigation channels below Ice Harbor, Lower Monumental, and Lower Granite dams to 100% at RM-116 and Willow Boat Landing.

3.2 Ammonia

Ammonia is a compound that is essential to living organisms and often occurs at elevated concentrations in lake, river, and wetland sediments. However, this nutrient can also have detrimental effects to the biota at high concentrations.

The lowest sediment concentrations identified in the samples were about 18 mg/L at Swallows Beach, Port of Clarkston, and in the Snake River below the confluence (Table 4). Interestingly, the highest concentration (128 mg/L) also originated from the Port of Clarkston area. Average concentrations from areas where multiple samples were collected ranged from 42 mg/L in the main channel of the Snake River to 67 mg/L and 76 mg/L in the Port of Clarkston and Greenbelt Boat Basin, respectively.

The relationship between sediment ammonia concentrations and those in the overlying water during dredging are not well defined in the Snake River. Ammonia is rapidly converted to ammonium, the non-toxic form, under aerobic conditions. Furthermore, the potential detrimental impacts of any ammonia concentrations are minimized during winter conditions. The final project report will include a further analysis of this subject using some of the empirical models that have recently been developed. Additionally, monitoring of water-column concentrations will occur outside the mixing zone during dredging.

3.3 Metals

The average data for twenty of the metals on the target analysis list (TAL) evaluated during this project were compared to the Puget Sound Dredged Disposal Analysis (PSDDA) guidance manual (PTI, 1989) sediment criteria and average Washington State values developed by the WADOE (Table 5). The maximum concentrations determined at any of the USACE sample sites were also less than the levels identified in the PSDDA criteria. The overall means for the lower Snake River data were also less than or equal to eastern Washington and state-wide averages (San Juan, 1994) for almost all of the elements. The one exception was selenium that averaged 0.57 mg/L throughout the state but 2.45 mg/L during this project.

3.4 Pesticides

The sediments were tested for organophosphorus pesticides, acid herbicides, urea pesticides, and carbamate pesticides. Almost all of the compounds tested were below instrument detection limits as summarized in Table 6 that lists the pesticides and herbicides by class that were tested for but not detected. The only positive results occurred for the pesticide linuron (CAS # 330-55-2), with six quantifiable detections from thirty-four possible site sample analyses. Two of the laboratory results were from the Swallows boat landing area sample set, with site SWBL21A3 at 41 ppb and SWBL21A2 at 76 ppb. Since SWBL21A3 was the blind duplicate QA/QC sample for the SWBL21A2 station location the detection originated from only one sample location. There was also a single detection below the confluence of the Snake and Clearwater Rivers at SRBC84G1 location where a concentration of 77 ppb was determined. Linuron was also discovered at the RM-116 proposed disposal site at a concentration of 28 ppb. The two final that produced positive results were from Willows Boat Landing with WBL9X1A at 42 ppb and WBLX93A at 35 ppb.

Linuron is a chlorinated urea herbicide that is applied both pre- and post-emergence (Thompson, 1993) as a photosynthetic inhibitor (BCPC, 1977). It is commonly used on asparagus, soybeans, potatoes, and winter wheat (Thompson, 1993). The persistence of linuron in soil is variable depending on moisture content and soil type (EPA, 1984). It is slightly toxic to mallard ducks (LC50=3438 ppm) and ring-necked pheasants (LC50=3,083, NOEL=100 ppm) but only slightly toxic to fresh water rainbow trout (16.4 ppm) (EPA, 1995). However, it is highly toxic to the in-star invertebrate zooplankton species *Daphnia magna* (120 ppb) and moderately toxic (1,100 ppb) to adult *Daphnia magna* (EPA, 1995).

Linuron detections for all sediment sites tested ranged from 28 to 77 ppb. Dredging activity could release a small amount into the water column. The EPA examined peer-reviewed literature and concluded that Linuron is slightly mobile in course soils and relatively immobile in fine-textured soils (EPA, 1995). The detections found during this study all came from sediments with relatively high percentages of silts and volatile solids. Linuron has been found to degrade with a half-life of 49 days under aerobic conditions and in less than 3 weeks under anaerobic conditions (EPA, 1995). Current analytical detection limits of 25 ppb would probably fail to detect Linuron in the water during the proposed November to February work window. Based on approximate half-lives (assuming that there would be no additional loading to the sediments) concentrations would probably range from 3.5 ppb to about 9.6 ppb. As such, it is anticipated that Linuron would not pose a measurable risk to the aquatic environment during the winter work window.

3.5 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are a class of very stable organic molecules made up of only carbon and hydrogen. These molecules are flat with each carbon having three neighboring atoms, much like graphite. PAHs are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances (ATSDR, 1995).

One hundred seventy compounds were included in the EPA 8270C analysis. Fifteen of these were present at concentrations above laboratory PQLs. A comparison of maximum study concentrations with a list of target analytes and associated PSDDA and UTS criteria is presented in Table 7. This data shows that the peak lower Snake and Clearwater River concentrations determined were less than the criterion – often by an order of magnitude, or more.

3.6 Oil, Grease, and TPH

Samples for oil, grease, and TPH diesel/motor oil analyses were collected from seven dredge areas. The oil and grease content of the sediments ranged from 70 mg/L (Illia Boat Landing) to 817 mg/L (Greenbelt Boat Basin) (Table 4). The Port of Clarkston and Greenbelt Boat Basin had the highest calculated averages of 465 mg/l and 483 mg/L, respectively.

Since the natural organic breakdown products from plant and animal matter contribute to the oil and grease content, TPH for diesel and motor oil were completed to identify those components. The values reported for TPH diesel at the Port of Lewiston, Illia Boat Landing, and Willow Boat Landing were all less than detection limits. Of the samples actually tested for TPH diesel (six from Port of Clarkston, three from Greenbelt Boat Basin, and two from the Snake River below the confluence), all but one from the Port of Clarkston had concentrations that ranged from 28 to 82 mg/L. The one additional sample from the Port of Clarkston had a concentration of less than 28 mg/L. The TPH motor oil results paralleled the TPH diesel data, but were four to five times higher.

The concentrations of petroleum products in dredged sediments are not the primary determinant for in-water disposal. The interim Lower Columbia testing framework (USEPA/USACE, 1998) does not consider petroleum products a contaminant, and no screening levels are available from the framework. Rather, current regulations rely on chemical tests for PAH compounds in the material to determine suitability for unconfined aquatic disposal. All samples that were analyzed for chemical contaminants were tested for PAHs. The presence of oil and grease in dredged material may be a consideration if the material is to be placed upland.

3.7 Dioxins

Dioxin and furan congeners were analyzed in samples collected from three separate areas in Lower Granite reservoir. The results showed that 2,3,7,8-TCDD was not detected at RM-116, Port of Clarkston, or in the Snake River below the confluence (Table 8). Several of the other congeners presented in the same table were not detected either. The two congeners that occurred in the highest concentrations were 1,2,3,4,6,7,8-HpCDD (2.03 to 4.95 ppt) and 1,2,3,4,6,7,8,9-OCDD (10.99 to 38.38 ppt). However, when the toxic equivalent (TEQ) was calculated using maximum concentrations from each area, the results were less by more than an order of magnitude than the bioaccumulation screening criteria.

4.0 SUMMARY

The sediments at sixty-eight sites in the lower Snake River and a segment of the Clearwater River were evaluated during the latter part of April 2003. Samples from twenty-five of these sites were further processed for Tier IIB analyses based on TVS concentrations and particle size distribution.

The majority of the provisional results were either below instrument detection limits or less than established sediment criteria. The twenty-two metals that constitute the TAL were at concentrations less than the PSDDA criteria and typically lower than state-wide averages. Approximately 200 organic herbicides, pesticides, and industrial compounds were considered. All of them, including DDT, dioxin, and PCBs, were either not detected or present in quantities that are not considered harmful to the environment. TPH-diesel concentrations were all ≤82 ppm.

One compound, ammonia, does warrant further consideration. This nitrogen species was present in concentrations ranging from 18 to 128 mg/L. As the relationship between sediment ammonia concentrations and those in the overlying water during dredging or disposal are not well defined, the Corps will monitor water-column concentrations outside the mixing zone during dredging and disposal to ensure that regulatory action limits are not exceeded.

A final, and more comprehensive, report will be available in August 2003. This document will include the verified data sets, a comparison of 2003 information to that previously collected, and QA/QC documentation.

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Table 1. Locations, names, and types of samples collected during the study.

Area	Station ID Name	Sample Site Name	Sample Type	Approx River Mile
Swallows Beach	SWBL21A2	LGR142.1A2	Regular	142.0
	SWBL21A3	LGR142.1A3	Duplicate and Blank	
	SWBL20B2	LGR142.0B2	Regular	142.0
	SWB19A1	LGR141.9A1	Regular	141.8
	SWB19A2	LGR141.9A2	Regular	141.8
Greenbelt Boat Basin	GBB95E2A	LGR139.5E2A	Regular	139.5
	GBB95E2B	LGR139.5E2B	Duplicate and Blank	
	GBB94E1	LGR139.4E1	Regular	139.4
	GBB94E2	LGR139.4E2	Regular	139.4
	GBB94E3	LGR139.4E3	Regular	139.4
	GBB93E4	LGR139.3E4	Regular	139.3
	GBB93E1	LGR139.3E1	Regular	139.3
	GBB93E2	LGR139.3E2	Duplicate and Split	
Snake River Near Confluence	SRBC91XA	LGR139.1XA	Regular	139.1
	SRBC91XB	LGR139.1XB	Duplicate	
	SRBC91H	LGR139.1H	Regular	139.1
	SRBC91G	LGR139.1G	Regular	139.1
	SRBC91F	LGR139.1F	Regular	139.1
	SRBC89X	LGR138.9X	Regular	138.9
	SRBC89H	LGR138.9H	Regular	138.9
	SRBC89G	LGR138.9G	Regular	138.9
	SRBC89F	LGR138.7F	Regular	138.7
	SRBC87E	LGR138.7E	Regular	138.7
	SRBC87D	LGR138.7D	Regular	138.7
	SRBC84G1	LGR138.4G1	Regular	138.4
	SRBC84G2	LGR138.4G2	Duplicate and Split	
	SRBC84F	LGR138.4F	Regular	138.4
	SRBC84E	LGR138.4E	Regular	138.4
	SRBC81F1	LGR138.1F1	Regular	138.1
	SRBC81F2	LGR138.1F2	Duplicate and Blank	
	SRBC81E	LGR138.1E	Regular	138.1
	SRBC81D	LGR138.1D	Regular	138.1
Clearwater River Near Confluence	CLW14C	CLW1.4C	Regular	1.4
	CLW14B	CLW1.4B	Regular	1.4
	CLW13C1	CLW1.3C1	Regular	1.3
	CLW13C2	CLW1.3C2	Duplicate and Blank	
	CLW13B	CLW1.3B	Regular	1.3
	CLW11C	CLW1.1C	Regular	1.1
	CLW11B	CLW1.1B	Regular	1.1
	CLW09B	CLW0.9B	Regular	0.9
	CLW17B	CLW0.7B	Regular	0.7
	CLW15B2	CLW0.5B2	Regular	0.5

Table 1. Locations, names, and types of samples collected during the study (continued).

Area	Station ID Name	Sample Site Name	Sample Type	Approx River Mile
Clearwater River (cont)	CLW03C	CLW0.3C	Regular	0.3
	CLW00D	CLW0.0D	Regular	0.0
Port of Lewiston	POL13A	CLW1.3A	Regular	1.3
	POL12A	CLW1.2A	Regular	1.2
	POL11A	CLW1.1A	Regular	1.1
Port of Clarkston	POC89J	LGR138.9J	Regular	138.9
(Gateway Dock)	POC89K	LGR138.9K	Regular	138.9
(Grain Terminal)	POC84X	LGR138.4X	Regular	138.4
	POC84H	LGR138.4H	Regular	138.4
(Crane Dock)	POC79A	LGR137.9A	Regular	137.9
	POC79B	LGR137.9B	Regular	137.9
RM-116 Disposal Site	RM1168A	LGR116.8A	Regular	116.6
	RM1167A1	LGR116.7A1	Regular	116.6
	RM1166A1	LGR116.6A1	Regular	116.6
	RM1166A2	LGR116.6A2	Duplicate, blank, split	
Lower Granite Approach	LGOLA4	LGOLA4	Regular	106.9
	LGOLA3	LGOLA3	Regular	107.2
	LGOLA1	LGOLA1	Regular	107.0
Illia Boat Landing	IBL7J1A	LGO103.7J1A	Regular	103.7
	IBL7J1B	LGO103.7J1B	Duplicate and blank	
	IBL7J3	LGO103.7J3	Regular	103.7
Willow Boat Landing	WBL9X1A	LGO87.9X1A	Regular	87.9
	WBL99X2A	LGO87.9X2A	Regular	87.9
	WBL9X2B	LGO87.9X2B	Duplicate, split, blank	
	WBL9X3A	LGO87.9X3A	Regular	87.9
Lower Monumental Approach	HLDLA4	HLDLA4	Regular	41.3
	HLDLA3	HLDLA3	Regular	41.5
	HLDLA1	HLDLA1	Regular	41.4
Ice Harbor Approach	IHNLA8	IHNLA8	Regular	9.0
	IHNLA7A	IHNLA7A	Regular	9.1
	IHNLA7B	IHNLA7B	Duplicate	
	IHNLA6	IHNLA6	Regular	9.1
	IHNLA5	IHNLA5	Regular	9.2
	IHNLA4	IHNLA4	Regular	9.3
	IHNLA3	IHNLA3	Regular	9.4
	IHNLA2	IHNLA2	Regular	9.5
	IHNLA1	IHNLA1	Regular	9.5

Table 2. Contract laboratories utilized, the parameters they were responsible for, and the methods employed.

Laboratory	Parameter	Method
SVL Analytical	Sieve analysis	ASA D-422
	Total carbon	ASA 29-2.3
	Total volatile solids	APHA 2540E
	Ammonia-N	EPA 350.1
	Nitrite/nitrate-N	EPA 353.2
	Metals	EPA 6010B
	Arsenic	EPA 7061A
	Mercury	EPA 7471
	TPH diesel/ motor oil	EPA 8015A
Anatek Labs, Inc.	PCDDs and PCDFs	EPA 8290
	N-methyl carbamates	EPA 8321A
	Chlorinated herbicides	EPA 8251A
	Semivolatile organic compounds	EPA 8270C
	Organophosphorus compounds	EPA 8141A
	Solvent extractable nonvolatile	EPA 8325
Columbia Analytical Services, Inc.	Dioxin screen	EPA 4425
	Dioxin analysis	EPA 8290

Table 3. Grain size data by Wentworth Class in percent gravel, sand, and fines, plus total volatile solids and ammonia data used to determine Tier II chemical analyses.

Sample Station ID	Gravel (%)	Sand (%)	Fines (%)	TVS (%)	NH_3-N (%)	Tier 2 Analysis Decision
CLW03C	0.0	51.8	48.2	7.31	32.9	YES
CLW05B2						NO RECOVERY
CLW09B	0.0	99.4	0.6	0.39	1.03	NO
CLW00D	0.3	76.2	23.5	7.47	63.5	YES
CLW11B	0.0	99.8	0.2	0.28	1.37	NO
CLW11C	0.0	99.1	1.0	1.00	1.59	NO
CLW13B	0.0	99.4	0.6	0.58	1.1	NO
CLW13C1	0.0	99.8	0.2	0.27	0.61	NO
CLW13C2	0.0	99.7	0.3	0.51	0.99	NO
CWL15B2						NO RECOVERY
CLW14B	0.0	99.7	0.3	0.41	1.49	NO
CLW14C	0.0	99.8	0.2	0.27	0.86	NO
CWL17B						NO RECOVERY
GBB93E1	0.0	89.6	10.5	3.58	40.7	
GBB93E2	0.7	89.3	10.0	3.45	35.3	
GBB93E4	0.0	99.0	1.0	0.84	11.7	NO
GBB94E1	0.1	48.2	51.8	5.93	99.5	YES
GBB94E2	0.3	55.2	44.5	4.86	112	YES
GBB94E3	0.0	85.0	15.1	8.15	153	YES
GBB95E2A	0.0	43.0	57.0	5.74	108	YES
GBB95E2B	0.2	40.7	59.1	5.82	95.6	YES
IBL7J3	1.5	83.3	15.3	3.52	31.1	
IBL7J1A						NO RECOVERY
IBL7J1B						NO RECOVERY
IHNLA1						NO RECOVERY
IHNLA2						NO RECOVERY
IHNLA3						NO RECOVERY
IHNLA4						NO RECOVERY
IHNLA5						NO RECOVERY
IHNLA6						NO RECOVERY
IHNLA7A						NO RECOVERY
IHNLA8						NO RECOVERY
LGLOLA3						NO RECOVERY
LGOLA1						NO RECOVERY
LGOLA4						NO RECOVERY
POC79A	2.7	89.0	8.4	4.53	50.1	
POC79B	0.0	83.1	17.0	9.35	91.7	YES
POC84H	0.2	96.1	3.8	2.74	18.5	
POC84X	0.0	89.3	10.7	7.65	44.3	YES
POC89J	0.9	92.6	6.5	6.74	128	YES
POC89K	0.0	94.7	5.3	4.70	70.4	
POL11A						NO RECOVERY
POL12A						NO RECOVERY
POL13A	0.0	56.9	43.1	6.16	41.6	YES

Table 3. Grain size data by Wentworth Class in percent gravel, sand, and fines, plus total volatile solids and ammonia data used to determine Tier II chemical analyses (con't).

Sample Station ID	Gravel (%)	Sand (%)	Fines (%)	TVS (%)	NH_3-N (%)	Tier 2 Analysis Decision
RM1168A	0.0	63.3	36.8	3.68	45.2	YES
RM1167A1	0.0	27.8	72.2	6.55	93.4	YES
RM116A1	0.0	40.8	59.2	5.46	60.1	YES
RM116A2	0.0	39.6	60.4	5.44	64.7	YES
SRBC81D	0.0	74.0	26.0	6.22	46.9	YES
SRBC81E	0.0	97.8	2.2	1.09	18.1	NO
SRBC81F1	0.0	97.3	2.7	1.16	24.6	NO
SRBC81F2	0.0	97.5	2.6	1.76	35.8	NO
SRBC84E	0.1	99.3	0.7	0.52	3.65	NO
SRBC84F	0.2	97.7	2.2	1.95	7.5	NO
SRBC84G1	0.0	81.5	18.5	10.08	62.5	YES
SRBC84G2	0.2	83.8	16.0	10.17	18	YES
SRBC87D	0.0	99.7	0.3	0.54	2.46	NO
SRBC87E	0.0	99.1	0.9	0.47	6.7	NO
SRBC89F	0.0	96.5	3.5	1.17	23.9	NO
SRBC89G	0.1	98.6	1.3	0.96	9.87	NO
SRBC89H	0.0	99.6	0.4	0.35	1.24	NO
SRBC89X	0.0	98.1	1.1	0.71	6.81	NO
SRBC91F						NO RECOVERY
SRBC91G						NO RECOVERY
SRBC91H	0.0	99.7	0.3	0.38	1.02	NO
SRBC91XA	3.7	96.4	3.7	1.16	93.9	NO
SRBC91XB	3.7	96.2	3.7	1.25	21.8	NO
SWB19A1	0.0	80.2	19.9	3.59		YES
SWB19A2	0.0	95.7	4.3	1.05		NO
SWBL20B2						NO RECOVERY
SWBL21A2	0.0	58.5	41.5	5.31		YES
SWBL21A3	0.0	58.0	42.0	5.14		YES
WBL9X1A	0.0	12.5	87.5	4.12		YES
WBL9X2A	0.1	23.6	76.3	3.26		YES
WBL9X2B	0.1	24.7	75.2	3.47		YES
WBL9X3A	0.0	26.8	73.2	1.69		YES

Table 4. Comparison of the TOC, TVS, nitrogen, and petroleum data.

Area	Sample ID	Calc. TOC	TVS	NH_3-N	NO_2+ NO_3-N	TPH-Diesel	TPH-Motor Oil	Oil & Grease
Swallows Beach	SWBL21A2	4.41	6,610	67.5	0.6	22.5	102	545
	SWBL21A3	4.52	6,170	68.4	0.5	<21	87	274
	SWB19A2	----	1,730	17.9	----	----	----	121
Greenbelt Boat Basin	GBB95E2A	5.49	5,170	108.0	<0.4	42.5	222	707
	GBB93E1	2.76	4,980	40.7	<0.4	31.4	145	327
	GBB94E1	5.14	6,010	99.5	<1.0	33.5	175	281
Port of Lewiston	POL13A	4.06	6,700	41.6	0.6	<21.0	<42	410
Port of Clarkston	POC84H	1.72	4,120	18.5	<0.4	21.7*	80*	151
	POC84X	6.10	8,560	44.3	<0.4	49.3*	247*	702
	POC89J	4.87	7,360	128.0	<0.4	69.9	290	432
	POC79B	7.06	9,110	91.7	<0.4	68.9	334	390
	POC79A	3.87	5,590	50.1	<0.4	33.2	158	623
	POC89K	2.83	5,990	70.4	<0.4	28.3	145	494
Snake R. below Confluence	SRBC84G1	8.14	10,900	62.5	<0.4	82.0*	432*	----
	SRBC81D	5.02	729	46.9	<0.4	43.9*	185*	----
Illia Boat Landing	IBL7J3	1.10	704	31.1	0.9	<14	<36	70
Willow Boat Landing	WBL9X1A	2.02	719	62.6	<0.4	<20	<49	365
	WBL9X3A	1.64	338	42.6	0.6	<18	<45	257
	WBL9X2B	1.76	693	44.9	<0.4	<18	<45	142
	WBL9X2A	1.52	652	47.1	<0.4	<48	<48	220

* Sample exceeded the EPA holding times by two days.

Table 5. Average 2003 total metals results compared to the PSDDA criteria and WADOE means.

Element	CAS Number	PSDDA Screening Level (mg/L)	PSDDA Biol. Trigger (mg/L)	PSDDA Max Limit (mg/L)	WADOE East. Wash. Mean (mg/L)	WADOE State-wide Mean (mg/L)	USACE 2003 Mean (mg/L)
Aluminum	7429-90-5				15,003		6,789
Antimony	7440-36-0	150	150	200		4.1	1.60
Arsenic	7440-38-2	57	507.1	700	2.70	3.82	2.30
Barium	7440-39-3					164.29	72.08
Beryllium	7440-41-7				0.38	0.76	0.16
Cadmium	7440-43-9	5.1		14		0.63	0.09
Chromium	7440-47-3				18.92	23.37	8.95
Cobalt	7440-48-4					7.82	6.13
Copper	7440-50-8	390		1,300	17.69	20.46	13.28
Iron	7439-89-6				19,936	25,903	13,321
Lead	7439-92-1	450		1,200	6.92	10.05	5.46
Magnesium	7439-95-4						2,600
Manganese	7439-96-5				364.95	592.56	206.00
Mercury	7439-97-6	0.41	1.5	2.3	0.01	0.03	0.03
Nickel	7440-02-0	140	370	370	13.77	21.49	4.03
Selenium	778249-2					0.57	2.45
Silver	7440-22-4	6.1	6.1	8.4		0.43	0.21
Thallium	7440-28-0						1.72
Vanadium	7440-62-2					28.15	36.39
Zinc	7440-66-6	410		3,800	45.74	55.53	32.31

Table 6. Organic compounds that were included in the analyses but were non-detectable at all sites combined.

Carbamates		Urea-based		Organic industrial/ Herbicides	
Compound	CAS #	Compound	CAS #	Compound	CAS #
Aldicarb (Temik)	116-06-3	Chlorpropham	101-21-3	2,4-D	94-75-7
Aldicarb Sulfone	1646-88-4	Propham	122-42-9	2,4-DB	94-82-6
Aldicarb sulfoxide	metabolite	Neburon	555-37-3	2,4,5-TP (Silvex)	93-72-1
Aminocarb	2032-59-9	Diuron	330-54-1	2,4,5-T	93-76-5
Bendiocarb	22781-23-3	Monuron	150-68-5	Dacthal (DCPA)	1861-32-1
Carbaryl (Sevin)	63-25-2	Metobromuron	3060-89-7	Dalapon	75-99-0
Carbofuran (Furadan)	1563-66-2	Siduron	1982-49-6	Dicamba	1918-00-9
Dioxacarb	6988-21-2	Floumeturon	2164-17-2	Dichloroprop	120-36-5
3-Hydroxycarbofuran	16655-82-6	Fenuron	101-42-8	Dinoseb	88-85-7
Methiocarb (Mesurol)	2032-65-7	Flirdone	059756-60-4	MCPA	94-74-6
Methomyl (Lannate)	16752-77-5	Tricyclazone	41814-78-2	MCPP	93-65-2
Oxamyl	23135-22-0	Carboxin	5234-68-4	4-Nitrophenol	100-02-1
Propoxur (Baygon)	114-26-1			Pentachlorophenol	87-86-5
				Acifluorfen	50594-66-6
				Bentazon	25057-89-0
				Chloramben	133-90-4
				3,5-Dichlorobenzoic acid	51-36-5
				Picloram	1918-02-1

Table 6. Organic compounds that were included in the analyses but were non-detectable at all sites combined (con't).

Organophosphorus and acid pesticides plus chlorinated herbicides			
Compound	CAS #	Compound	CAS #
Acetophenone	98-86-2	Dinoseb	88-85-7
Alachlor	15972-60-8	Dioxathion	78-34-2
Aldrin	309-00-2	Disulfoton	298-04-4
Anilazine	101-05-3	Endosulfan I	959-98-8
Aramite	140-57-8	Endosulfan II	33213-65-9
Azinphos-methyl	86-50-0	Endosulfan sulfate	1031-07-8
Barban	101-27-9	Dinoseb	88-85-7
alpha-BHC	319-84-6	Dioxathion	78-34-2
ß-BHC	319-85-7	Disulfoton	298-04-4
gamma-BHC	319-86-8	Endosulfan I	959-98-8
d-BHC (Lindane)	58-89-9	Endosulfan II	33213-65-9
Bromoxynil	1689-84-5	Endosulfan sulfate	1031-07-8
Captafol	2425-06-1	Endrin	72-20-8
Captan	133-06-2	Endrin aldehyde	7421-93-4
Carbaryl	63-25-2	Endrin ketone	53494-70-5
Carbofuran	1563-66-2	EPN	2104-64-5
Carbophenothion	786-19-6	Ethion	563-12-2
Chlordane (NOS)	57-74-9	Ethyl carbamate	51-79-6
Chlorfenvinphos	470-90-6	Ethyl methanesulfonate	62-50-0
Chlorobenzilate	510-15-6	Etridiazole	2593-15-9
Chloroneb	2675-77-6	Famphur	52-85-7
Chloropropylate	5836-10-2	Fensulfothion	115-90-2
Chlorothalonil	1897-45-6	Fenthion	55-38-9
Coumaphos	56-72-4	Fluchloralin	33245-39-5
Crotoxyphos	7700-17-6	Heptachlor	76-44-8
Dacthal (DCPA)	2136-79-0	Heptachlor epoxide	1024-57-3
DBCP	96-12-8	Hexachlorocyclopentadiene	77-47-4
4,4'-DDD	72-54-8	Isodrin	465-73-6
4,4'-DDE	72-55-9	Kepone	143-50-0
4,4'-DDT	50-29-3	Leptophos	21609-90-5
Demeton-O	298-03-3	Malathion	121-75-5
Demeton-S	126-75-0	Methoxychlor	72-43-5
Diallate (cis or trans)	2303-16-4	Methyl parathion	298-00-0
Dichlone	117-80-6	Mevinphos	7786-34-7
Dicofol	115-32-2	Mexacarbate	315-18-4
Dichlorovos	62-73-7	Endrin	72-20-8
Dicrotophos	141-66-2	Endrin aldehyde	7421-93-4
Dieldrin	60-57-1	Endrin ketone	53494-70-5
Dinocap	39300-45-3	EPN	2104-64-5

Table 6. Organic compounds that were included in the analyses but were non-detectable at all sites combined (continued).

Organophosphorus and acid pesticides plus chlorinated herbicides			
Compound	CAS #	Compound	CAS #
Ethion	563-12-2	Mirex	2385-85-5
Ethyl carbamate	51-79-6	Monocrotophos	6923-22-4
Ethyl methanesulfonate	62-50-0	Naled	300-76-5
Etridiazole	2593-15-9	Nitrofen	1836-75-5
Famphur	52-85-7	Parathion	56-38-2
Fensulfothion	115-90-2	Permethrin (cis and trans)	52645-53-1
Fenthion	55-38-9	Phorate	298-02-2
Fluchloralin	33245-39-5	Phosalone	2310-17-0
Heptachlor	76-44-8	Phosmet	732-11-6
Heptachlor epoxide	1024-57-3	Phosphamidon	13171-21-6
Hexachlorocyclopentadiene	77-47-4	Pronamide (propyzamide)	23950-58-5
Isodrin	465-73-6	Propachlor	1918-16-7
Kepone	143-50-0	Simazine	122-34-9
Leptophos	21609-90-5	Sulfallate	95-06-7
Malathion	121-75-5	Sulfotep (TEDP)	3689-24-5
Methoxychlor	72-43-5	Terbufos	13071-79-9
Methyl parathion	298-00-0	Tetrachlorvinphos	961-11-5
Mevinphos	7786-34-7	Thionazine	297-97-2
Mexacarbate	315-18-4	Toxaphene	8001-35-2
O,O,O-Triethyl phosphorothioate	126-68-1	Trifluralin	1582-09-8

Table 7. Comparison of maximum PAH concentrations identified in the samples with the PSDDA and non-wastewater UTS criteria .

PAHs and selected Industrial Compounds by EPA method 8270C	CAS #	PSDDA Screening Level (ppb)	PSDDA Biological Trigger (ppb)	PSDDA Maximum Limit (ppb)	Non-waste-water UTS (ppb)	Study Max (ppb)
Acenaphthene	83-32-9	500		2,000	3,400	15
Anthracene	120-12-7				3,400	24
Benz(a)anthracene	56-55-3	1,300		5,100	3,400	217
Benzo(a)pyrene	50-32-8	1,600	3,600	3,600	3,400	114
Benzo(b)fluoranthene	205-99-2	3,200		9,900	6,800	121
Benzo(g,h,i)perylene	191-24-2	670		3,200	1,800	77
Benzo(k)fluoranthene	207-08-9				6,800	202
Chrysene	218-01-9	1,400		21,000	3,400	122
Dibenzo(a,h)anthracene	53-70-3	230		1,900	8,200	78
Flouranthene		1,700	4,600	30,000	8,200	354
Fluorene		540		3,600	3,400	26
Indeno(1,2,3-cd)pyrene	193-39-5	600		4,400	3,400	68
Naphthalene	91-20-3	2,100		2,400	1,400	323
Phenanthrene	85-01-8	1,500		21,000	5,600	283
Pyrene	129-00-0	2,600		16,000	8,200	369

Table 8. Maximum dioxin and furan concentrations detected by EPA method 8290 at RM-116, Port of Clarkston (POC), and in the Snake River below the confluence (SNRC).

Compound	CAS #	RM-116 (ppt)	POC (ppt)	SNRC (ppt)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	ND	ND	ND
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	ND	ND	ND
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7	ND	ND	ND
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	0.176	ND	0.575
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3	ND	ND	0.584
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-39-4	3.434	2.025	4.955
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9	29.043	10.999	38.48
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	0.636	ND	ND
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	ND	ND	ND
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	ND	ND	ND
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	0.129	ND	0.171
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9	ND	ND	ND
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9	ND	ND	ND
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	ND	ND	ND
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	0.745	0.459	0.875
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	ND	ND	ND
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0	1.982	ND	2.564
P-450 Dioxin and Dioxin-Like Organic Compounds	K2300808	0.047	0.027	0.037
TCDF Confirmed		ND	ND	ND