

Mouth of the Columbia River

Sediment Evaluation

Abstract

This evaluation was conducted following procedures set forth in the Inland Testing Manual (ITM) and the Ocean Disposal Testing Manual (Green Book), developed jointly by the Corps and EPA to assess dredged material for purposes of disposal. These national guidelines were developed to implement the Clean Water Act (CWA), 40 CFR 230 sec 404 (b)(1) and the Marine Protection, Research and Sanctuary Act (MPRSA). The screening levels (SL) used in this evaluation are those adopted for use in the regional evaluation guidelines, the Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area, November 1998. Tier IIa (physical testing) and Tier IIb (chemical testing) have been completed for this evaluation.

Ten (10) surface grab sediment samples were selected from sites collected as part of the Sediment Trend Analysis study at the Mouth of the Columbia River, September 1-3, 2000 (see Figure 1). All samples were sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical analysis and chemical analyses, to include: inorganic metals (9), total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs). Three (3) samples were submitted for Dioxin/Furan analyses.

Sediment represented by samples collected during this sampling event consisted of 98.11% sand and 1.89% fines, with a median grain size of 0.20 mm. Analyses for this sampling event meet the Tier II guidelines established in the DMEF for open inwater, unconfined placement in a site under the Clean Water Act (CWA), sec 404 or an ODMDS under the Marine Protection, Research and Sanctuary Act (MPRSA) Sec. 102/103, without further characterization.

Introduction

The purpose of this report is to characterize the sediment of portions of the Mouth of the Columbia River for potential dredging activity and disposal. The sampling and analysis objectives are listed below. This report will outline the procedures used to accomplish these goals.

SAMPLING AND ANALYSIS OBJECTIVES

- To characterize sediments in accordance with the regional dredge material testing manual, the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF).

- Collect, handle and analyze representative sediment, of the potential dredging prism, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Characterize sediments to be dredged for evaluation of environmental impact.
- Conduct physical and chemical characterization only for this sediment evaluation, unless DMEF screening levels are exceeded and further characterization (Tier III Biological Assay) is needed to determine disposal method.

Previous Studies

The 1986 Columbia River Coal Export Channel project collected three (3) vibra core samples at the MCR. Sediment grain size varied greatly in each core. The surface through 5 feet of sediment averaged 94.9% sand, 4.8% fines with a 0.14 mm median grain size and volatile solids of 0.9%. The core samples from 5 feet to 18.5 feet averaged 17.2% sand and 82.8% fines, 2.7% volatile solids with a 0.037 mm median grain size. The core depth from 15.5 feet to 25.5 feet averaged 95.5% sand and 4.2% fines, 1.0% volatile solids with a 0.123 mm median grain size. Chemical analyses for these samples indicated a low level of phenols in one core sample at 40 ppb. Currently there is no standard for total phenols, as run on this sample, but the individual phenol compound screening levels range from 29-420 ppb. A total phenol of 40 ppb is not likely to exceed any of the individual phenol screening levels. No PAHs were detected in the samples at the method detection limit of <100 ppb. The top elevation of these cores was 62.5 feet or more below MLLW, which is below any proposed dredging prism. The sampled material containing high degrees of fines (5 feet to 18.5 feet), is not characteristic of sand-wave or cut-line shoals, typically dredged in the MCR.

The MCR main navigational channel was last sampled in 1990. The sediment analyses reported 98.6% sand and 1.4% fines, with a mean grain size of 0.26 mm and volatile solids of 0.6%. The three (3) samples collected during this sampling event were collected from shoals at river mile (RM) 0 through 2 in an area of very high energy, where river flow and tidal currents are extreme.

Current Sampling Event

Ten (10) surface grab sediment samples were selected from sites collected as part of the Sediment Trend Analysis study at the Mouth of the Columbia River, September 1-3, 2000 (see Figure 1). All samples were sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical analysis and chemical analyses, to include: inorganic metals (9), total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs). Three (3) samples were submitted for Dioxin/Furan analyses.

Sediment represented by samples collected during this sampling event consisted of 98.11% sand, 1.89% fines and a mean grain size of 0.16 mm with 0.90% volatile solids.

The potential dredging prism is represented by sand wave or cut line shoals, which by nature of their construction consist of homogeneous material and can be characterized by surface grab samples. All analyses meet the Tier II guidelines established in the DMEF for open inwater, unconfined placement without further characterization.

Samples were collected and handled using standard protocol for chain of custody and cooling of samples during shipping. Quality control method blanks and matrix spikes/matrix spike duplicates were run in conjunction with the analyses of the samples collected. Laboratory contamination was present in the method blank for some phthalate analytes, which were flagged appropriately. All analyses are calculated on a dry weight bases.

Results/Discussion

Physical and Volatile Solids: Data for these analyses are presented in Table 1. All samples submitted for analyses met or exceeded ranking guidelines of the DMEF Tier IIa for an exclusionary ranking (<20% fines and <5% volatile solids). All samples submitted were gray in color and classified as “poorly graded sand”, with a mean of 98.11% sand, 1.89% fines, with a median grain-size of 0.16mm. Volatile solids ranged from 0.13% to 1.56% with a mean of 0.90%.

Metals, Total Organic Carbon (TOC): Data for these analyses are presented in Table 2. Low levels of most metals analyzed were found in all of the samples collected, but levels do not approach the SL. The highest level detected was for zinc, which is 10.3% of the SL. TOC ranged from 360 to 680 mg/kg, with a mean of 529 mg/kg.

Pesticide/PCBs, Phenols, Phthalates and Misc. Extractables: Data for these analyses are presented in Table 3. Four (4) phthalates were detected at levels <6.9% of the SL (the laboratory method blank, also, contained phthalates). Neither PCBs nor total DDT or its breakdown products, DDD and DDE, were detected above the method detection limit (MDL) in any of the samples analyzed.

Polynuclear Aromatic Hydrocarbons (PAHs): Data for these analyses are presented in Tables 4 & 5. Two (2) individual “low molecular weight” PAHs were detected at levels above the method detection limit, but at only 2.4% or less of the SL. Five (5) “high molecular weight” PAHs were found in one (1) sample (C973) only, at levels <0.4% (37.5 ppb) of the total high PAHs screening level of 12,000 ppb.

Dioxin/furan – Method 8290: Data for these analyses are presented in Tables 6 & 12. This method provides procedures for the detection and quantitative measurement of polychlorinated dibenzo-p-dioxins (tetra- through octachlorinated homologues; PCDDs), and polychlorinated dibenzofurans) (tetra- through octachlorinated homologues; PCDFs) in a variety of environmental matrices and at part-per-trillion (ppt) concentrations. The PCDDs include 75 individual compounds, and the PCDFs include 135 individual compounds. These individual compounds are technically referred to as congeners. Only 7 of the 75 congeners of PCDDs are thought to have “dioxin-like” toxicity; these are

ones with chlorine substitutions in, at least, the 2,3,7,8 positions. Only 10 of the 135 possible congeners of PCDFs are thought to have “dioxin-like” toxicity, these, also, are ones with substitutions in the 2,3,7,8 positions. For risk assessment purposes, a toxicity equivalency procedure was developed to describe the cumulative toxicity of these mixtures. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the PCDD and PCDF congeners. These TEF values have been adopted by international convention (U.S. EPA, 1989; Ahlborg, et al., 1994). TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1.0. All other congeners have lower TEF values ranging from 0.5 to 0.001 for dioxin/furans. Calculating the toxic equivalency (TEQ) of a mixture involves multiplying the concentration of individual congeners by their respective TEF. For undetected congeners, detection limits will be divided by two and used in calculations. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture.

Very low levels of some of the total congeners were detected in two (2) samples (CRM-VC-02 and CRM-VC-03). The *guidance states that a bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg (pptr), will trigger the requirement to perform bioaccumulation testing. The total toxic equivalent (TEQ) concentration for sample CRM-VC-02 was 0.7227 ng/Kg and for sample CRM-VC-03 was 0.81205 ng/kg.

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA, 1989; Ahlborg, et al., 1994).

Conclusion

Collection and evaluation of the sediment data was completed using guidelines from the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF). The DMEF is a regional manual developed jointly with regional EPA, Corps, Oregon Dept. of Environmental Quality and Washington Depts. of Ecology and Natural Resources. The screening levels used are those adopted for use in the DMEF, final November 1998. The DMEF Tiered testing approach requires that material in excess of 20% fines and greater than 5% volatile solids, as well as any material with prior history or is suspected (“reason to believe”) of being contaminated, be subjected to chemical as well as physical analyses. Under the Tiered approach, if the chemical analytical results do not exceed the established screening levels of the DMEF, the material is considered suitable for unconfined in-water disposal with out further characterization.

Sediment represented by samples collected during this sampling event consisted of The mean value of the physical analyses, of the material represented by this sampling event, is 98.11% sand, 1.89% fines and a mean grain size of 0.16 mm with 0.90% volatile solids. Few chemicals of concern were detected above the method detection levels, with all levels well below the DMEF Tier IIb screening levels. The Mouth of the Columbia River is ranked

“Exclusionary” in the DMEF (Table 5-3). The physical and chemical analyses of this sampling event uphold the exclusionary ranking.

Analyses for this sampling event meet the Tier II guidelines established in the DMEF for open inwater, unconfined placement in an estuarine site under the Clean Water Act (CWA), sec 404 or an ODMDS under the Marine Protection, Research and Sanctuary Act (MPRSA) Sec. 102/103, without further characterization.

References

1. U.S. Army Corps of Engineers, Portland District, Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. 1998 Final. Dredge Material Evaluation Framework for the Lower Columbia River Management Area.
2. U. S. Environmental Protection Agency and U. S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters – Testing Manual, dated (referred to as the “Inland Testing Manual”).
3. The Clean Water Act, 40 CFR 230 (b) (1).
4. Britton, J. U.S. Army Corps of Engineers, Portland District. August 1990. Mouth of Columbia River Sediment Evaluation.
5. Deep Water Site sampling event, Tier II physical and chemical analyses. September 2000.

Physical Analysis

Sample I.D.	Grain Size (mm)			%					
	Median		Mean	Gravel	Sand	Silt/Clay	Volatile solids		
C1058	0.20		0.17	0.00	99.46	0.54		0.90	
C1035	0.19		0.15	0.00	98.39	1.61		0.93	
C1009	0.23		0.18	0.00	99.17	0.83		0.88	
C973	0.20		0.22	0.00	98.77	1.23		0.81	
C621	0.29		0.20	0.00	97.55	2.45		0.75	
C937	0.22		0.18	0.00	95.92	4.08		0.13	
C537	0.20		0.17	0.00	97.43	2.57		1.56	
C451	0.17		0.12	0.00	97.53	2.47		0.70	
C394	0.17		0.12	0.00	98.52	1.48		1.10	
C450	0.17		0.12	0.00	98.34	1.66		1.20	
Mean	0.20		0.16	0.00	98.11	1.89		0.90	

Inorganic Metals and TOC

Sample I.D.	As	Sb	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)									
C1058	1.5 B2	0.17 J,B1	0.17 J	7.9	2.5	<0.028	9.5	0.042 J	46	360
C1035	1.8 B2	0.32 J,B1	0.21 J	5.7	2.2	<0.028	8.6	0.063 J	30	410
C1009	1.6 B2	0.22 J,B1	0.28 J	7.2	2.2	<0.027	11	0.048 J	39	410
C973	2.5 B2	<0.20	0.30 J	5.6	2.5	<0.025	7.9	<0.012	28	380
C621	1.8 B2	<0.15	0.24 J	6.8	2.3	<0.026	11	0.041 J	33	680
C937	2.0 B2	<0.16	0.31 J	6.1	2.6	<0.026	9.3	0.050 J	31	640
C537	2.1 B2	<0.21	0.35 J	6.7	2.7	<0.029	10	0.055 J	36	540
C451	1.8 B2	<0.16	0.34 J	8.6	2.9	<0.027	13	0.050 J	41	600
C394	2.0 B2	<0.22	0.33 J	9.0	3.0	<0.028	14	0.062 J	49	670
C450	2.0 B2	<0.17	0.34 J	8.7	3.4	<0.027	13	0.054 J	40	600
Screening level (SL)	57	150	5.1	390	450	0.41	140	6.1	410	
Mean	1.9	0.20	0.29	7.2	2.6	ND	10.7	0.048	37	529
Maximum	2.5	0.32	0.35	9.0	3.4	ND	14	0.063	49	680

*J = Estimated value (reported values are above the MDL, but below the PQL).

*B1 = Low level contamination was present in the method blank, analytical result is < 10 times blank concentration.

*B2 = Low level contamination was present in the method blank, analytical result is > 10 times blank concentration.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Pesticides/PCBs, Phenols, Phthalates, Herbicides and Extractables

Sample I.D.	Pesticides				Phthalates			
	ug/kg (ppb)							
	4,4'- DDD	4,4'- DDE	4,4'- DDT	Total DDT	Di-n-butyl phthalate	Diethyl phthalate	bis(2-Ethyl) hexzyl phthalate	Butyl Benzyl phthalate
C1058	<0.15	<0.18	<0.23	ND	26 J,B1	<2.7	34 B1	<1.9
C1035	<0.15	<0.18	<0.22	ND	120 B1	13.0 J	72 B1	12.0 J
C1009	<0.15	<0.18	<0.22	ND	29 B1	8.0 J	570 B2	<1.9
C973	<0.15	<0.18	<0.22	ND	33 B1	5.4 J	77 B1	<2.0
C621	<0.14	<0.17	<0.21	ND	230 B1	56	190 B1	<1.9
C937	<0.16	<0.19	<0.23	ND	41 B1	6.7 J	110 B1	3.5 J
C537	<0.15	<0.18	<0.22	ND	41 B1	7.4 J	82 B1	<2.0
C451	<0.15	<0.18	<0.22	ND	38 B1	5.7 J	60 B1	2.9 J
C394	<0.15	<0.18	<0.22	ND	24 J, B1	<2.7	63 B1	<1.9
C450	<0.15	<0.18	<0.23	ND	27 B1	<2.8	47 B1	<2.0
Screen level (SL)	DDD + DDE + DDT =			6.9	5100	1200	8300	970
Mean	ND	ND	ND	ND	61	11	131	32
Maximum	ND	ND	ND	ND	230	56	570	12

PCBs = Non-detect (ND) <13.0 ppb (SL = 130 ppb).

*J = Estimated value (reported values are above the MDL, but below the PQL).

*B1 = Low level contamination was present in the method blank, indicated in parenthesis, analytical result is < 10 times blank concentration.

*B2 = Low level contamination was present in the method blank, indicated in parenthesis, analytical result is > 10 times blank concentration.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Polynuclear Aromatic Hydrocarbons (PAHs)
Low Molecular Weight Analytes
ug/kg (ppb)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phenanthrene	Total Low PAHs
C1058	<0.91	<1.0	<1.3	<1.0	<1.8	<2.5	<0.85	ND
C1035	<0.91	<1.1	<1.3	13 J	<1.9	<2.5	6.7	19.7
C1009	<0.92	<1.1	<1.3	<1.1	<1.9	<2.6	<0.86	ND
C973	<0.95	<1.1	<1.3	<1.1	<1.9	<2.7	4.6	4.6
C621	<0.89	<1.0	<1.2	<1.0	<1.8	<2.5	25	25
C937	<0.95	<1.1	<1.3	<1.1	<1.9	<2.7	<0.89	ND
C537	<0.94	<1.1	<1.3	<1.1	<1.9	<2.6	3.5	3.5
C451	<0.92	<1.1	<1.3	<1.1	<1.9	<2.6	<0.86	ND
C394	<0.90	<1.0	<1.2	<1.0	<1.8	<2.5	<0.84	ND
C450	<0.94	<1.1	<1.3	<1.1	<1.9	<2.6	<0.88	ND
Screen level (SL)	500	560	960	540	670	2100	1500	5200
Mean	ND	ND	ND	1.3	ND	ND	4.5	Total
Maximum	ND	ND	ND	13	ND	ND	25	52.8

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Polynuclear Aromatic Hydrocarbons (PAHs)
High Molecular Weight Analytes
ug/kg (ppb)

Sample I.D.	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(g,h,i) perylene	Chrysene	Pyrene	Benzo(a) pyrene	Dibenz(a,h) anthracene	Indeno (1,2,3-cd) pyrene	Fluoranthene	Total High PAHs
C1058	<0.82	<1.1	<1.1	<0.39	<1.1	<0.73	<1.1	<0.60	<0.97	<0.82	ND
C1035	<0.83	<0.86	<0.86	<0.39	<1.1	<0.73	<1.1	<0.60	<0.97	<0.83	ND
C1009	<0.83	<0.87	<0.87	<0.39	<1.1	<0.74	<1.1	<0.61	<0.97	<0.83	ND
C973	<0.86	6.2	6.2	<0.40	4.3	12	4	<0.63	<1.0	11	37.5
C621	<0.80	<0.84	<0.84	<0.38	<1.0	<0.71	<1.0	<0.58	<0.94	<0.80	ND
C937	<0.86	<1.1	<1.1	<0.41	<1.1	<0.76	<1.1	<0.63	<1.0	<0.86	ND
C537	<0.85	<0.89	<0.89	<0.40	<1.1	<0.75	<1.1	<0.62	<1.0	<0.85	ND
C451	<0.84	<0.87	<0.87	<0.39	<1.1	<0.74	<1.1	<0.61	<0.98	<0.84	ND
C394	<0.81	<0.85	<0.85	<0.38	<1.1	<0.72	<1.1	<0.59	<0.95	<0.81	ND
C450	<0.85	<0.89	<0.89	<0.40	<1.1	<0.76	<1.1	<0.62	<1.0	<0.85	ND
Screen level (SL)	1300	3200	3200	670	1400	2600	1600	230	600	1700	12000
Mean	ND	0.62	0.62	ND	0.43	1.2	0.4	ND	ND	1.1	
Maximum	ND	6.2	6.2	ND	4.3	12	4	ND	ND	11	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Table 6, Mouth of the Columbia River (MCR)

Dioxins/Furans (pg/g, pptr)

Sampled September 1-3, 2000

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
C1058 - Dioxin	2,3,7,8 - TCDD	<0.98	0.49	1.0	0.49	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg, will trigger the requirement to perform bioaccumulation testing.
	Total TCDD	<0.98	0.49	0	0	
	1,2,3,7,8 – PeCDD	<1.8	0.90	0.5	0.45	
	Total PeCDD	<1.9	0.95	0	0	
	1,2,3,4,7,8 – HxCDD	<1.2	0.60	0.1	0.060	
	1,2,3,6,7,8 – HxCDD	<1.3	0.65	0.1	0.065	
	1,2,3,7,8,9 – HxCDD	<1.1	0.55	0.1	0.055	
	Total (other)HxCDD	<1.3	0.65	0	0	
	1,2,3,4,6,7,8-HpCDD	<1.2	0.60	0.01	0.006	
	Total (other) HpCDD	<1.2	0.60	0	0	
	OCDD	<3.3	1.65	0.001	0.00165	
C1058- Furan	2,3,7,8-TCDF	<0.61	0.305	0.1	0.0305	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg, will trigger the requirement to perform bioaccumulation testing.
	Total TCDF	<0.61	0.305	0	0	
	1,2,3,7,8 – PeCDF	<1.0	0.50	0.05	0.025	
	1,3,4,7,8 – PeCDF	<0.98	0.49	0.05	0.0245	
	Total (other) PeCDF	<1.3	0.65	0	0	
	1,2,3,4,7,8 – HxCDF	<0.94	0.47	0.1	0.047	
	1,2,3,6,7,8 – HxCDF	<0.87	0.435	0.1	0.034	
	2,3,4,6,7,8 – HxCDF	<0.98	0.49	0.1	0.049	
	2,3,6,7,8,9 – HxCDF	<0.99	0.495	0.1	0.0495	
	Total (other) HxCDF	<0.99	0.495	0	0	
	1,2,3,4,6,7,8 – HpCDF	<0.87	0.435	0.01	0.00435	
	1,2,3,4,7,8,9 – HpCDF	<1.0	0.50	0.01	0.0050	
	Total (other) HpCDF	<1.0	0.50	0	0	
OCDF	<1.6	0.80	0.001	0.0008		
Total Dioxins/Furans TEQ					1.3973	<15 ng/kg

MDL = Method Detection Limit

TEQ = Toxicity Equivalency Quotient

TEF = Toxicity Equivalency Factors

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA, 1989; Ahlborg, et al., 1994)

Table 6, Mouth of the Columbia River (MCR)

Dioxins/Furans (pg/g, pptr)

Sampled September 1-3, 2000

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
C621 - Dioxin	2,3,7,8 - TCDD	<0.87	0.435	1.0	0.435	A bulk sediment 2,3,7,8- tetrachlorodibenzo -p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg, will trigger the requirement to perform bioaccumulation testing.	
	Total TCDD	<0.87	0.435	0	0		
	1,2,3,7,8 – PeCDD	<1.7	0.85	0.5	0.425		
	Total PeCDD	<1.7	0.85	0	0		
	1,2,3,4,7,8 – HxCDD	<1.2	0.60	0.1	0.060		
	1,2,3,6,7,8 – HxCDD	<1.3	0.65	0.1	0.065		
	1,2,3,7,8,9 – HxCDD	<1.1	0.55	0.1	0.055		
	Total (other)HxCDD	<1.3	0.65	0	0		
	1,2,3,4,6,7,8-HpCDD	<0.98	0.49	0.01	0.0049		
	Total (other) HpCDD	<0.98	0.49	0	0		
	OCDD	<3.3	1.65	0.001	0.00165		
	C621- Furan	2,3,7,8-TCDF	<0.53	0.265	0.1		0.0265
		Total TCDF	<0.53	0.265	0		0
1,2,3,7,8 – PeCDF		<0.81	0.405	0.05	0.02025		
1,3,4,7,8 – PeCDF		<0.78	0.39	0.05	0.0195		
Total (other) PeCDF		<1.1	0.55	0	0		
1,2,3,4,7,8 – HxCDF		<0.75	0.375	0.1	0.0375		
1,2,3,6,7,8 – HxCDF		<0.71	0.355	0.1	0.0355		
2,3,4,6,7,8 – HxCDF		<0.78	0.39	0.1	0.039		
2,3,6,7,8,9 – HxCDF		<0.80	0.40	0.1	0.040		
Total (other) HxCDF		<0.80	0.40	0	0		
1,2,3,4,6,7,8 – HpCDF		<0.75	0.375	0.01	0.00375		
1,2,3,4,7,8,9 – HpCDF		<0.89	0.445	0.01	0.00445		
Total (other) HpCDF		<0.89	0.445	0	0		
OCDF	<1.3	0.65	0.001	0.00065			
Total Dioxins/Furans TEQ					1.27365	<15 ng/kg	

MDL = Method Detection Limit

TEQ = Toxicity Equivalency Quotient

TEF = Toxicity Equivalency Factors

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA, 1989; Ahlborg, et al., 1994)

Table 6, Mouth of the Columbia River (MCR)

Dioxins/Furans (pg/g, pptr)

Sampled September 1-3, 2000

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
C394 - Dioxin	2,3,7,8 - TCDD	<0.70	0.35	1.0	0.35	A bulk sediment 2,3,7,8- tetrachlorodibenzo -p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg, will trigger the requirement to perform bioaccumulation testing.	
	Total TCDD	<0.70	0.35	0	0		
	1,2,3,7,8 – PeCDD	<2.7	1.35	0.5	0.675		
	Total PeCDD	<2.7	1.35	0	0		
	1,2,3,4,7,8 – HxCDD	<1.8	0.90	0.1	0.090		
	1,2,3,6,7,8 – HxCDD	<1.9	0.95	0.1	0.095		
	1,2,3,7,8,9 – HxCDD	<1.7	0.85	0.1	0.085		
	Total (other)HxCDD	<1.9	0.95	0	0		
	1,2,3,4,6,7,8-HpCDD	<1.7	0.85	0.01	0.0085		
	Total (other) HpCDD	<1.7	0.85	0	0		
	OCDD	<4.8	2.4	0.001	0.0024		
	C394- Furan	2,3,7,8-TCDF	<0.69	0.345	0.1		0.0345
		Total TCDF	<0.69	0.345	0		0
1,2,3,7,8 – PeCDF		<1.6	0.80	0.05	0.040		
1,3,4,7,8 – PeCDF		<1.5	0.75	0.05	0.0375		
Total (other) PeCDF		<2.1	1.05	0	0		
1,2,3,4,7,8 – HxCDF		<1.3	0.65	0.1	0.065		
1,2,3,6,7,8 – HxCDF		<1.2	0.60	0.1	0.060		
2,3,4,6,7,8 – HxCDF		<1.4	0.70	0.1	0.070		
2,3,6,7,8,9 – HxCDF		<1.4	0.70	0.1	0.070		
Total (other) HxCDF		<1.4	0.70	0	0		
1,2,3,4,6,7,8 – HpCDF		<1.3	0.65	0.01	0.0065		
1,2,3,4,7,8,9 – HpCDF		<1.5	0.75	0.01	0.0075		
Total (other) HpCDF		<1.5	0.75	0	0.0075		
OCDF	<2.5	1.25	0.001	0.00125			
Total Dioxins/Furans TEQ					1.70565	<15 ng/kg	

MDL = Method Detection Limit

TEQ = Toxicity Equivalency Quotient

TEF = Toxicity Equivalency Factors

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA, 1989; Ahlborg, et al., 1994)

Figure 1

Mouth of the Columbia River (MCR) September 1, 2000

