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of Engineers®**
Portland District

FERN RIDGE SEDIMENT QUALITY EVALUATION REPORT



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EPA Environmental Protection Agency
USACE U.S. Army Corps of Engineers
ODEQ Oregon Department of Environmental Quality
WDNR Washington
WDOE

DMEF Dredge Material Evaluation Framework
NES Newly Exposed Surface
QA/QC Quality Assurance/Quality Control
TOC Total Organic Carbon
PAH Polynuclear Aromatic Hydrocarbon
PCB Polychlorinated Biphenyl
MDL Method Detection Limit
PQL Practical Quantitation Limit
MRL Method Reporting Limit
ND non-detect
ppm parts per million – mg/kg
ppb parts per billion – ug/kg & ug/L
ppt parts per trillion – ng/kg
SL Screening level
As Arsenic
Cd Cadmium
Ni Nickel
Cu Copper
Sb Thallium
Cr Chromium
Pb Lead
Hg Mercury
Ni Nickel
Ag Silver
Zn Zi

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Note: This Fern Ridge Sediment Quality Evaluation Report was reviewed by the Regional (sediment) Management Team (RMT) in accordance with the DMEF (1998). The RMT consists of Portland District Corps of Engineers, EPA and ODEQ personnel. All comments received have been incorporated into the report and was considered final at the end of the review period, April 8, 2005.



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ABSTRACT

Fern Ridge Reservoir is located approximately 12 miles Northwest of Eugene Oregon. The drainage area is 275 square miles and includes waters from the Long Tom River and Coyote and Amazon Creeks. The main dam is 6,610 feet in length, with a maximum height of 50 feet. The maximum full pool elevation level is 375.1 feet, with the minimum flood control pool elevation at 353.0 feet. The dam embankment was built between 1940 and 1941.

Dam repair tasks include 310,000 CY excavation of the downstream embankment, to include removal of the drainage system. The design plan for the replacement of the current drainage system calls for 90,000 CY fine-filter and 40,000 CY coarse-filter granular material be placed, followed by reconstruction of the primary embankment. Excavated embankment material will be reused in construction of the new embankment; if there is excess material it will potentially be used at environmental restoration sites within the project.

Evaluation of the sediment and soil was conducted following procedures set forth in the U.S. Army Corps of Engineers' "Upland" Testing Manual and the "Inland" Testing Manual, developed jointly by the Corps and the U.S. Environmental Protection Agency, to assess dredged material. Guidelines used are those developed to implement the Clean Water Act. These guidelines and associated screening levels for sediment are those adopted for use in the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF), November 1998 (Signed by USACE, EPA, WDOE, ODEQ and WDNR). While the project is not a dredging project, the procedures and protocols in these guidance manuals were followed to assess both the project sediments and embankment materials.

On February 10, 2005 a total of nine (9) sampling stations were collected and submitted for physical analyses, including total volatile solids, and chemical analyses for metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbon (PAHs). From the Nine (9) sampling stations, five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample were analyzed. In addition, the sediment samples were submitted for an elutriate extraction, with the overlying water analyzed as a whole water fraction and a dissolved water fraction for all chemical methods listed above.

A total of nine (9) stations were sampled, with data presented in Table 2. Five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample (0210FR-P-01) were analyzed. The physical analyses resulted in mean values for the sediment are of 0.14% gravel (0.0%-3% range), 0.96% sand (0.2%-2.1% range), and 98.4% silt/clay (97.8%-99.8% range), with 5.4% volatile solids (3.9%-5.8% range). The physical analyses resulted in mean values for the soil are of 0.9% gravel (0.2%-2.5% range), 31.6% sand (19.4%-42.2% range), and 57.5% silt/clay (57.5%-80.4% range), with 5.4% volatile solids (4.9%-6.4% range). Mean grain-size for all sediment samples is 0.03mm (0.02911mm-0.0349mm range). Mean grain-size for all soil samples is 0.03mm (0.011mm-0.0386mm range). The sediment is classified as fat clay; soil as sandy loam and one sample as lean clay. The sediment contained a uniform thin aerobic layer; approximately 2mm thick (see Figure 2, brown layer).



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The chemical analyses indicated only extremely low levels of contamination in any of the samples, with all levels well below their respective DMEF screening levels (SLs). No pesticides or PCBs were detected in any of the samples at very low detection levels. Several PAHs and metals were detected, but at low levels. Semi-volatile detection levels were sufficiently low enough to evaluate material, with the exception of 2-Methyl phenol, 2,4-Dimethyl Phenol and Benzoic Alcohol; while none of these compounds were detected, these compounds had elevated detection levels in some samples, however no detections of these compounds were detected in the elutriate water analyses, at sufficiently low detection levels. The elutriate test exposes sediment to water in the laboratory, to simulate a physical disturbance (such as erosion or dredging) that might introduce contamination contained in the sediment, into the water column. The elutriate tests performed on Fern Ridge sediment indicated non-detect (ND) in both the whole and dissolved water fractions for Pesticides, PCBs and PAHs, with sufficiently low detection levels to evaluate material tested. Metals were detected at low levels in all samples; these levels are considered to be natural background levels. The quality assurance (QA) sample split sample, sent to a separate laboratory for analyses, had sufficiently low detection levels and good correlation with the primary lab sample split. Analyses of the representative sediments, within the minimum pool, indicate no environmental concerns from contamination due to erosion, if the material were to pass the dam or be absorbed into the water column, due to either storm events or lowering of the pool to less than historic minimum operating pool elevations.

INTRODUCTION

This sampling event characterized the sediment within the minimum flood control pool to determine contamination levels and physical characteristics that exist within the sediment. There are 5 sampling stations within the minimum flood control pool. Two (2) stations are located near the face of the dam, at the water control outlet and east end of the dam. The additional 3 stations were collected from the delta areas where sediment collects, within the minimum pool, created by inflow from the Long Tom River and Coyote and Amazon Creeks. These areas were targeted to represent sediments that could erode if the pool elevation drops below the minimum flood control pool. In addition, 4 surface grab samples were collected from the downstream slope of the dam, where excavation is planned for the drain repair. Because the dam was constructed in the early 1940s before the manufacturing and wide use of "modern" pesticides, such as DDT and other contaminants associated with industry in the area, the surface soil is more likely to be contaminated than the fill used to create the dam in 1941, therefore surface grab samples should adequately characterize these materials.

The sampling and analysis objectives are stated in the Sampling and Analysis Plan (SAP February 2005), and are, also, listed below. This report will characterize the sediment within the minimum flood control pool and soil on the slope of the dam, where excavation is planned for the drain repair.

Sampling and Analysis Objectives

- To characterize sediments in accordance with the regional dredge material testing manual protocols, the Dredge Material Evaluation Framework for the Lower Columbia



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River Management Area (DMEF), as well as, the Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or upland Confined Disposal Facilities – Testing manual (Upland Testing Manual).

- Collect, handle and analyze representative sediment from Fern Ridge Reservoir minimum operating pool and the downstream slope of the dam, where excavation is planned for the drain repair, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Analyze for full suite of physical and chemical parameters as outlined in the DMEF (1998) Tier II a & b. DMEF – Table 8.1 contains the list of analytes and methods of analysis. Elutriate tests will be conducted on the inwater sediment deltas created by the Long Tom River, Coyote Creek and Amazon Creek, on both the whole and dissolved water fractions.

PREVIOUS STUDIES

In May 1996 two sediment samples were taken from the “A” channel of Amazon creek south of Royal Ave. about 15 to 30 feet upstream of the road. They were subjected to physical and chemical analyses. Chemical tests measured metals, TOC, pesticides/PCBs, PAHs and phenols content. Under the screening levels (SL) in place in 1996 Zinc exceeded the SL by 8 ppb (ug/kg). Under the SL’s adopted in the 1998 DMEF, none of the analytes exceeded their respective SL.

Two sediment samples were taken from the main channel of Amazon Creek on June 10, 1998, approximately 125 – 175 feet south of Royal Ave Bridge (<3 miles upstream of the reservoir). The samples were sent to Sound Analytical laboratory of Seattle, WA, for physical and chemical analyses, to include: metals total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs). The proposed dredge material from this project was determined to be acceptable for both in-water and upland disposal. No significant, adverse ecological impacts were expected from such disposal in terms of sediment toxicity.

No other known sampling has occurred in this area.

CURRENT SAMPLING EVENT/DISCUSSION

On February 10, 2005 a total of five (5) surface grab sediment and four (4) surface soil samples were submitted for physical analyses including total volatile solids and were, also, analyzed for metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbon (PAHs). In addition, the sediment samples were submitted for an elutriate extraction, with the overlying water analyzed as a whole water fraction and a dissolved water fraction for all methods listed above for sediment analysis.

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The chemical analyses indicated only extremely low levels of contamination in any of the samples, with all levels well below their respective DMEF screening levels (SLs). No pesticides or PCBs were detected in any of the samples at very low detection levels. Several PAHs and metals were detected, but at low levels. Semi-volatile detection levels were sufficiently low enough to evaluate material, with the exception of 2-Methyl phenol, 2,4-Dimethyl Phenol and Benzoic Acid; these compounds had slightly elevated detection levels in some samples, however this is not a significant problem, due to elutriate testing performed on all material. The elutriate test exposes sediment to water in the laboratory to simulate a physical disturbance (such as erosion or dredging) that might introduce contamination contained in the sediment into the water column. The elutriate tests performed on Fern Ridge sediment indicated non-detect (ND) in both the whole and dissolved water fractions, with sufficiently low detection levels to evaluate material tested. In addition the quality assurance (QA) sample split sample that was sent to a separate laboratory for analyses had sufficiently low detection levels for these parameters and indicated ND for compounds in question. It is estimated that with sampler penetration and sediment compression that the surface grab sediment samples had a penetration of up to 10". With the low flow of the Long Tom river and both Coyote and Amazon Creeks that this is sufficient penetration to evaluate potentially eroded sediments in the event the pool is lowered below minimum operating pool elevation. Analyses of the representative sediments indicate no environmental concerns from contamination, if the material were to pass the dam due to either storm events or lowering of the pool to less than historic minimum operating pool elevations.

Table 1: Fern Ridge Sampling Station Information

Sample Location Lake				Water Depth
0210FR-P-01	Lat: N 44°07'09.5"	Lon: W 123°18'07.4"	Name: WPT 001*	3'
0210FR-P-02	Lat: N 44°06'43.0"	Lon: W 123°18'35.3"	Name: WPT 002*	1'
0210FR-P-03	Lat: N 44°06'16.4"	Lon: W 123°18'14.3"	Name: WPT 003*	1'
0210FR-P-04	Lat: N 44°06'13.4"	Lon: W 123°17'26.9"	Name: WPT 004*	1.5'
0210FR-P-05	Lat: N 44°06'54.1"	Lon: W 123°17'03.2"	Name: WPT 005*	1.5'
Sample Location Downstream Dam Face				Collection Depth
0210FR-P-06	Lat: N 44°07'10.0"	Lon: W 123°17'55.7"	Name: WPT 006*	0.5'
0210FR-P-07	Lat: N 44°07'07.7"	Lon: W 123°17'44.9"	Name: WPT 007*	0.5'
0210FR-P-08	Lat: N 44°07'05.1"	Lon: W 123°17'29.8"	Name: WPT 008*	0.5'
0210FR-P-09	Lat: N 44°07'01.1"	Lon: W 123°17'08.5"	Name: WPT 009*	0.5'
Coordinated are NAD 1983, Oregon State Plane South				
* See Sample location map page 13				

RESULTS

Physical and Volatile Solids (ASTM methods)

A total of nine (9) stations were sampled, with data presented in Table 2. Five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample (0210FR-P-01) were analyzed. The physical analyses resulted in mean values for the sediment are of 0.14% gravel (0.0%-3% range), 0.96% sand (0.2%-2.1% range), and 98.4% silt/clay (97.8%-99.8% range), with 5.4% volatile solids (3.9%-5.8% range). The physical analyses



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resulted in mean values for the soil are of 0.9% gravel (0.2%-2.5% range), 31.6% sand (19.4%-42.2% range), and 57.5% silt/clay (57.5%-80.4% range), with 5.4% volatile solids (4.9%-6.4% range). Mean grain-size for all sediment samples is 0.03mm (0.02911mm-0.0349mm range). Mean grain-size for all soil samples is 0.03mm (0.011mm-0.0386mm range). The sediment is classified as fat clay; soil as sandy loam and one sample as lean clay.

Metals (EPA method 6010/7471), Total Organic Carbon (EPA method 9060)

A total of nine (9) stations were sampled, with data presented in Table 3. Five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample (0210FR-P-QA) were analyzed. The TOC ranged from 15 to 31 mg/kg in the samples.

Low levels of all 9 metals tested for were detected in one or more sample, but no levels approached their respective DMEF SL.

Pesticides/PCBs (EPA method 8080), Phenols, Phthalates and Miscellaneous Extractables (EPA method 8270)

A total of nine (9) stations were sampled, with data presented in Table 4. Five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample (0210FR-P-QA) were analyzed. No pesticides (including DDT) or PCB aroclors were detected in any of the samples, with sufficiently low detection levels achieved.

Polynuclear Aromatic Hydrocarbons (EPA method 8270C)

A total of nine (9) stations were sampled, with data presented in Table 5. Five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample (0210FR-P-QA) were analyzed. All samples contained low levels of most of the "low molecular weight" PAHs and "High molecular weight" PAHs. The highest total for any sample for "low" molecular weight PAHs is 23 ug/kg total PAHs. The highest total for any sample for "high" molecular weight PAHs is 128 ug/kg total PAHs. All levels are well below DMEF SL values.

CONCLUSION

This sampling event characterized the sediment within the minimum flood control pool to determine contamination levels and physical characteristics that exist within the sediment. There are 5 sampling stations within the minimum flood control pool. Two (2) stations are located near the face of the dam, at the water control outlet and east end of the dam. The additional 3 stations were collected from the delta areas where sediment collects, within the minimum pool, created by inflow from the Long Tom River and Coyote and Amazon Creeks. These areas were targeted to represent sediments that could erode if the pool elevation drops below the minimum flood control pool. In addition, 4 surface grab samples were collected from the downstream slope of the dam, where excavation is planned for the drain repair. Because the dam was constructed in the early 1940s before the manufacturing of "modern" pesticides, such as DDT and other contaminants associated with industry in the area, the surface soil is more likely to be



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Five (5) sediment samples, four (4) soil samples and one (1) quality assurance (QA) sediment split sample (0210FR-P-01) were analyzed. The physical analyses resulted in mean values for the sediment are of 0.14% gravel (0.0%-3% range), 0.96% sand (0.2%-2.1% range), and 98.4% silt/clay (97.8%-99.8% range), with 5.4% volatile solids (3.9%-5.8% range). The physical analyses resulted in mean values for the soil are of 0.9% gravel (0.2%-2.5% range), 31.6% sand (19.4%-42.2% range), and 57.5% silt/clay (57.5%-80.4% range), with 5.4% volatile solids (4.9%-6.4% range). Mean grain-size for all sediment samples is 0.03mm (0.02911mm-0.0349mm range). Mean grain-size for all soil samples is 0.03mm (0.011mm-0.0386mm range). The sediment is classified as fat clay; soil as sandy loam and one sample as lean clay.

The chemical analyses indicated only extremely low levels of contamination in any of the samples, with all levels well below their respective DMEF screening levels (SLs). No pesticides or PCBs were detected in any of the samples at very low detection levels. Several PAHs and metals were detected, but at low levels. Semi-volatile detection levels were sufficiently low enough to evaluate material, with the exception of 2-Methyl phenol, 2,4-Dimethyl Phenol and Benzoic Alcohol; while none of these compounds were detected, these compounds had elevated detection levels in some samples, however no detections of these compounds were detected in the elutriate water analyses, at sufficiently low detection levels. The elutriate test exposes sediment to water in the laboratory, to simulate a physical disturbance (such as erosion or dredging) that might introduce contamination contained in the sediment, into the water column. The elutriate tests performed on Fern Ridge sediment indicated non-detect (ND) in both the whole and dissolved water fractions for Pesticides, PCBs and PAHs, with sufficiently low detection levels to evaluate material tested. Metals were detected at low levels in all samples; these levels are considered to be natural background levels. The quality assurance (QA) sample split sample, sent to a separate laboratory for analyses, had sufficiently low detection levels and good correlation with the primary lab sample split. Analyses of the representative sediments, within the minimum pool, indicate no environmental concerns from contamination due to erosion, if the material were to pass the dam or be absorbed into the water column, due to either storm events or lowering of the pool to less than historic minimum operating pool elevations.



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Table 2: Physical Analysis and Volatile Solids

Sample I.D.	Grain Size (mm)	Percent (%)			
	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
0210FR-P-01	0.0291	0.0	0.2	99.8	5.8
0210FR-P-02	0.0331	0.0	0.4	99.6	5.1
0210FR-P-03	0.0349	0.3	1.0	98.7	7.3
0210FR-P-04	0.0340	0.3	1.1	98.6	5.1
0210FR-P-05	0.0337	0.1	2.1	97.8	3.9
Mean Sediment (1-5)	0.0330	0.14	0.96	98.9	5.4
0210FR-G-06	0.0292	0.5	30.3	69.2	5.1
0210FR-G-07	0.0386	0.3	42.2	57.5	4.9
0210FR-G-08	0.0110	0.2	19.4	80.4	6.4
0210FR-G-09	0.0278	2.5	34.3	63.2	5.0
Mean Soil (6-9)	0.0267	0.88	31.6	67.6	5.4

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Table 3: Inorganic Metals and TOC - Sediment, Soil & Elutriate Water - Dissolved/Total

Sample I.D. & Matrix	As	Cd	Sb	Cu	Pb	Ni	Ag	Zn	Hg	TOC	
*0210FR-P-QA Sediment mg/kg	2.84	<0.0344	0.624B1	32.8	16.9	15.4	0.152	50.3	0.0277	15000	
0210FR-P-01	Sediment mg/kg	2.40	<0.060	<0.28	26.9	13.6	8.65	<0.082	38.7	<0.09	17000
	Whole water mg/L	0.106	0.0327	<0.010	1.16	0.494	0.427	<0.005	1.88	0.0014	-
	Dissolved water mg/L	0.018	<0.00022	<0.002	0.0068	0.0084	0.0021	<0.001	0.19	<0.00020	-
0210FR-P-02	Sediment mg/kg	3.06	<0.066	<0.30	27.2	14.4	9.45	<0.090	41.3	<0.10	17000
	Whole water mg/L	0.108	0.0133	0.0133	0.770	0.333	0.280	<0.005	1.22	0.00060	-
	Dissolved water mg/L	0.0041	<0.00022	<0.002	0.031	0.026	0.0056	<0.001	0.35	<0.00020	-
0210FR-P-03	Sediment mg/kg	3.88	0.182	<0.26	25.9	13.3	11.1	<0.079	51.1	<0.09	23000
	Whole water mg/L	0.0795	0.0142	0.0191	0.717	0.276	0.318	<0.005	1.33	0.00042	-
	Dissolved water mg/L	0.0058	<0.0002	<0.002	0.010	0.0052	0.0034	<0.001	0.16	<0.00020	-
0210FR-P-04	Sediment mg/kg	4.32	<0.058	1.09	29.8	13.1	9.52	<0.079	41.0	<0.09	15000
	Whole water mg/L	0.0905	0.0151	<0.010	0.874	0.298	0.300	<0.005	1.28	0.00047	-
	Dissolved water mg/L	0.0049	<0.00022	<0.002	0.026	0.0090	0.0062	<0.001	0.34	<0.00020	-
0210FR-P-05	Sediment mg/kg	3.18	<0.047	<0.214	18.2	10.1	5.82	<0.064	29.8	0.11	12000
	Whole water mg/L	0.0743	0.00628	<0.010	0.607	0.255	0.235	<0.005	1.03	0.00033	-
	Dissolved water mg/L	0.0067	0.00041	<0.002	0.028	0.024	0.0084	<0.001	0.37	<0.00020	-
0210FR-G-06	Sediment mg/kg	3.29	0.188	<0.138	12.9	11.2	7.25	<0.041	37.9	0.04	31000
0210FR-G-07	Sediment mg/kg	2.70	0.130	<0.132	7.30	8.43	5.89	<0.039	26.1	0.04	27000
0210FR-G-08	Sediment mg/kg	3.69	0.252	<0.135	13.2	14.2	6.51	<0.040	27.5	0.04	14000
0210FR-G-09	Sediment mg/kg	2.71	<0.028	<0.129	10.2	8.17	4.97	<0.038	17.2	<0.04	17000
DMEF Screening level sediment(SL)	57	5.1	150	390	450	140	6.1	410	0.41	-	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
 *0210FR-P-QA is a field split of 0210FR-P-01- sent to different laboratories for analyses.
 Symbol (-) = Not analyzed



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Table 4: Pesticides, PCBs - Sediment, Soil & Elutriate Water - Dissolved/Total

Sample I.D.		Pesticides			PCBs Aroclors								
		4,4'-DDD	4,4'-DDE	4,4'-DDT	1016	1221	1232	1242	1248	1254	1260	1262	1268
*0210FR-P-QA	Sediment ug/kg	<0.229	<0.225	<0.264	<0.005	<0.005	<0.005	<0.005	<0.005	<0.003	<0.003	-	-
0210FR-P-01	Sediment ug/kg	<1.04	<0.48	<1.09	<8.4	<5.6	<24.5	<4.3	<11.7	<2.8	<9.3	<7.0	<4.7
	Whole water ug/L	<0.006	<0.005	<0.006	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13
	Dissolved water ug/L	<0.007	<0.006	<0.006	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0210FR-P-02	Sediment ug/kg	<1.15	<0.53	<1.21	<8.9	<6.0	<25.9	<4.6	<12.4	<2.9	<9.9	<7.4	<5.0
	Whole water ug/L	<0.006	<0.005	<0.006	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13
	Dissolved water ug/L	<0.006	<0.005	<0.006	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0210FR-P-03	Sediment ug/kg	<0.98	<0.45	<1.03	<7.6	<5.2	<22.3	<3.9	<10.6	<2.5	<8.5	<6.4	<4.3
	Whole water ug/L	<0.006	<0.005	<0.006	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13
	Dissolved water ug/L	<0.007	<0.006	<0.006	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16
0210FR-P-04	Sediment ug/kg	<0.97	<0.45	<1.02	<8.1	<5.5	<23.7	<4.2	<11.3	<2.7	<9.0	<6.8	<4.6
	Whole water ug/L	<0.006	<0.005	<0.006	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13
	Dissolved water ug/L	<0.007	<0.006	<0.006	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16
0210FR-P-05	Sediment ug/kg	<0.82	<0.38	<0.86	<6.2	<4.2	<18.1	<3.2	<8.6	<2.0	<6.9	<5.2	<3.5
	Whole water ug/L	<0.006	<0.005	<0.006	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13	<0.13
	Dissolved water ug/L	<0.007	<0.006	<0.006	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16
0210FR-G-06	Sediment ug/kg	<0.513	<0.237	<0.540	<4.4	<2.9	<12.7	<2.2	<6.1	<1.4	<4.9	<3.7	<2.5
0210FR-G-07	Sediment ug/kg	<0.509	<0.235	<0.535	<4.1	<2.7	<11.9	<2.1	<5.7	<1.3	<4.5	<3.4	<2.3
0210FR-G-08	Sediment ug/kg	<0.523	<0.242	<0.550	<4.1	<2.8	<12.0	<2.1	<5.7	<1.4	<4.6	<3.4	<2.3
0210FR-G-09	Sediment ug/kg	<0.471	<0.217	<0.495	<3.9	<2.6	<11.4	<2.0	<5.5	<1.3	<4.4	<3.3	<2.2
Sediment Screening Level		Total 6.9			Total 130								
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).													
*0210FR-P-QA is a field split of 0210FR-P-01- sent to different laboratories for analyses.													



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Table 5: PAHs - Low Molecular Weight - Sediment, Soil & Elutriate Water - Dissolved/Total

Sample I.D. & Matrix		Ace naphthene	Ace naphthylene	Anthra cene	Fluorene	2-Methyl naphthalene	Naphtha lene	Phen- anthrene	Total Low PAHs
*0210FR-P-QA	Sediment <i>ug/kg</i>	<2	<2	2.7	<2.3	<2.2	<1.6	11.3	14
0210FR-P-01	Sediment <i>ug/kg</i>	<5.4	<5.4	<4.4	<5.8	<20	6.5 J	16 J	23 J
	Whole water <i>ug/L</i>	<1.6	<1.6	<1.2	<0.15	<0.20	<0.19	<1.3	ND
	Dissolved water <i>ug/L</i>	<2.0	<2.1	<1.4	<0.19	<0.25	<0.24	<1.7	ND
0210FR-P-02	Sediment <i>ug/kg</i>	<6.6	<6.6	<5.4	<7.1	<30	<7.4	9.8 J	9.8 J
	Whole water <i>ug/L</i>	<1.7	<1.7	<1.2	<0.16	<0.21	<0.20	<1.4	ND
	Dissolved water <i>ug/L</i>	<1.8	<1.9	<1.3	<1.8	<0.22	<0.22	<1.5	ND
0210FR-P-03	Sediment <i>ug/kg</i>	<5.6	<5.5	<4.5	<5.9	<20	<6.3	8.1 J	8.1 J
	Whole water <i>ug/L</i>	<1.6	<1.7	<1.2	<0.15	<0.20	<0.19	<1.3	ND
	Dissolved water <i>ug/L</i>	<1.9	<2.0	<1.4	<0.18	<0.24	<0.23	<1.6	ND
0210FR-P-04	Sediment <i>ug/kg</i>	<5.3	<5.3	<4.3	<5.7	<20	<6.0	9.1 J	9.1 J
	Whole water <i>ug/L</i>	<1.6	<1.6	<1.1	<0.15	<0.20	<0.19	<1.3	ND
	Dissolved water <i>ug/L</i>	<2.1	<2.1	<1.2	<0.19	<0.25	<0.25	<1.7	ND
0210FR-P-05	Sediment <i>ug/kg</i>	<4.4	<4.4	<3.6	<4.7	<20	<4.9	9.0 J	9.0 J
	Whole water <i>ug/L</i>	<1.6	<1.6	<1.1	<0.15	<0.20	<0.19	<1.3	ND
	Dissolved water <i>ug/L</i>	<1.9	<1.9	<1.3	<0.18	<0.23	<0.22	<0.15	ND
0210FR-G-06	Sediment <i>ug/kg</i>	<2.8	<2.8	<2.3	<3.0	<10	<3.1	<2.4	ND
0210FR-G-07	Sediment <i>ug/kg</i>	<2.7	<2.7	<2.2	<2.9	<11	<3.0	<2.3	ND
0210FR-G-08	Sediment <i>ug/kg</i>	<2.7	<2.7	<2.2	<2.9	<11	<3.1	<2.3	ND
0210FR-G-09	Sediment <i>ug/kg</i>	<2.8	<2.8	<2.3	<3.0	<11	<3.1	<2.4	ND
Sediment Screen level		500	560	960	540	670	2100	1500	5200
<p>J = Estimated value (reported values are above the MDL, but below the PQL). Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit). *0210FR-P-QA is a field split of 0210FR-P-01- sent to different laboratories for analyses.</p>									



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Table 5 (cont'd): PAHs - High Molecular Weight - Sediment, Soil & Elutriate Water - Dissolved/Total

Sample I.D.		Benzo(a)-anthracene	Benzo-fluor-anthenes	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Dibenzo (a,h)anthracene	Fluor-anthene	Total High PAHs
*0210FR-P-QA	Sediment <i>ug/kg</i>	8.3 J	15.5 J	9.4 J	10.6	19.3	<0.63	8.5 J	<1.2	14.3	77 J
0210FR-P-01	Sediment <i>ug/kg</i>	9.0 J	19	20	15 J	22	10 J	9.7 J	<2	23	128
	Whole water <i>ug/L</i>	<1.0	<3.5	<2.1	<0.88	<0.15	<<0.93	<0.90	<0.82	<0.16	ND
	Dissolved water <i>ug/L</i>	<1.3	<4.3	<2.6	<1.1	<0.18	<1.3	<1.1	<1.0	<0.20	ND
0210FR-P-02	Sediment <i>ug/kg</i>	6.5 J	13 J	15 J	11 J	20 J	7.6 J	7.4 J	<4.5	22	102 J
	Whole water <i>ug/L</i>	<1.1	<3.6	<2.2	<0.91	<0.15	<0.96	<0.93	<0.85	<0.17	ND
	Dissolved water <i>ug/L</i>	<1.1	<3.9	<2.3	<0.98	<0.16	<1.0	<1.0	<0.91	<0.18	ND
0210FR-P-03	Sediment <i>ug/kg</i>	4.8 J	9.6 J	13 J	8.3 J	14 J	6.3 J	6.5 J	<3.8	14 J	77 J
	Whole water <i>ug/L</i>	<1.0	<3.5	<2.1	<0.88	<0.15	<0.93	<0.90	<0.82	<0.16	ND
	Dissolved water <i>ug/L</i>	<1.2	<4.1	<2.5	<1.0	<0.17	<1.1	<1.1	<0.97	<0.19	ND
0210FR-P-04	Sediment <i>ug/kg</i>	4.5 J	12 J	12 J	8.3 J	15 J	6.1 J	6.4 J	<3.6	14 J	78 J
	Whole water <i>ug/L</i>	<0.91	<3.4	<2.0	<0.86	<0.14	<0.91	<0.89	<0.80	<0.16	ND
	Dissolved water <i>ug/L</i>	<1.3	<4.4	<2.6	<1.1	<0.18	<1.2	<1.1	<1.0	<0.20	ND
0210FR-P-05	Sediment <i>ug/kg</i>	6.8 J	16	14	12 J	18	8.3 J	8.1 J	<3.0	20	103 J
	Whole water <i>ug/L</i>	<1.0	<3.4	<2.0	<0.86	<0.14	<0.91	<0.89	<0.80	<0.16	ND
	Dissolved water <i>ug/L</i>	<1.2	<4.0	<2.4	<1.0	<0.17	<1.1	<1.0	<0.94	<0.19	ND
0210FR-G-06	Sediment <i>ug/kg</i>	<2.1	2.7 J	<1.7	2.2 J	2.1 J	<2.8	<1.8	<1.9	<3.0	7 J
0210FR-G-07	Sediment <i>ug/kg</i>	<2.0	<3.0	<1.6	<1.8	<1.6	<2.7	<1.7	<1.8	<2.9	ND
0210FR-G-08	Sediment <i>ug/kg</i>	<2.0	<3.1	<1.6	<1.8	<1.7	<2.8	<1.7	<1.8	<2.9	ND
0210FR-G-09	Sediment <i>ug/kg</i>	<2.1	<3.1	<1.6	<1.9	<1.7	<2.8	<1.8	<1.9	<3.0	ND
Screen level (SL)		1300	3200	670	1400	2600	1600	600	230	1700	12000
<p>J = Estimated value (reported values are above the MDL, but below the PQL). Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit). *0210FR-P-QA is a field split of 0210FR-P-01- sent to different laboratories for analyses.</p>											

FERN RIDGE SEDIMENT QUALITY EVALUATION

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Figure 1: Fern Ridge Sampling Station Location Map (See page 4; Table 1: Fern Ridge Sampling Station Information)

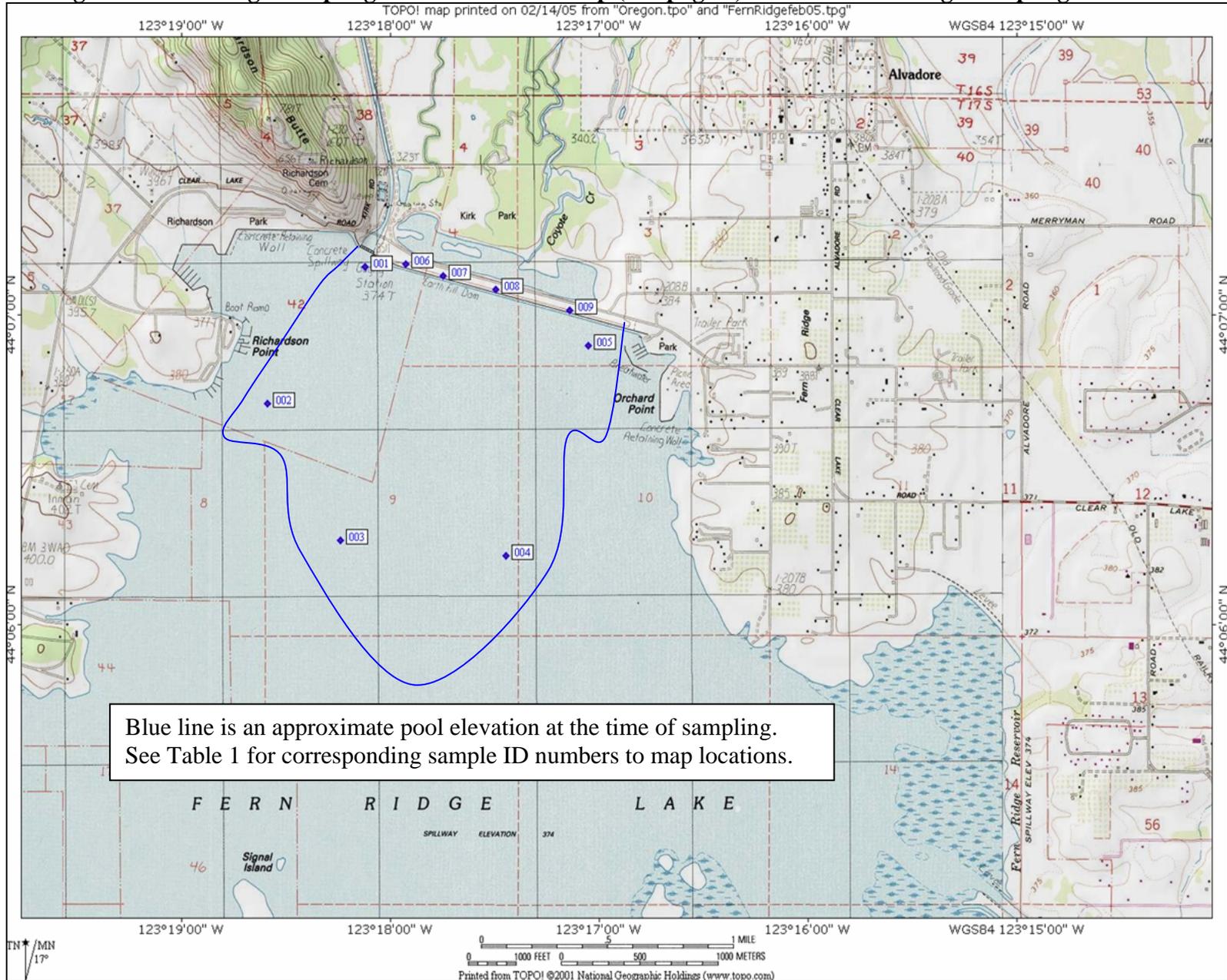


Figure 2: Picture of Sediment Sample



Figure 3: Picture of Soil Sample

