CENWS-OD-TS-DM

MEMORANDUM FOR: RECORD **September 30, 2003**

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATIONS AND MAINTENANCE DREDGED MATERIAL FROM THE **DUWAMISH RIVER TURNING BASIN** (CENWS-OD-TS-NS-10) EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT (CWA) FOR OPEN-WATER DISPOSAL AT THE ELLIOTT BAY NONDISPERSIVE DISPOSAL SITE AND/OR FOR BENEFICIAL USE.

1. **Introduction**. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) Agencies' (U.S. Army Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency) with jurisdiction on dredging and disposal on the suitability of up to 66,000 cy of federal maintenance material (15 feet + 2 ft over depth) from the **Duwamish River Navigation Channel**, Seattle, Washington for unconfined open-water disposal at the Elliott Bay open-water disposal site or at an approved beneficial use site. .

   This determination of suitability for open-water disposal is based on the acceptability of the sampling conducted by Seattle District, Corps of Engineers contractors and subcontractors in June 2003 (Table 1). All relevant test data from this sampling event is contained in a report submitted by Anchor Environmental dated September 2003. These data were considered sufficient and acceptable for decision-making by the Agencies.

Table 1. Project Summary.

Time of proposed dredging	Dec. 2003 to Feb. 14, 2004
Proposed disposal sites	Elliott Bay Non-dispersive disposal site, or beneficial use
Sediment ranking	Low moderate
Project last dredged	2001

Table 2. Regulatory Tracking Table.

SAP received	June 5, 2003
SAP Approval date	June 19, 2003
Sampling date(s):	June 26, 2003
Data report submittal date:	September 11, 2003
DAIS Tracking #	DUW04-1-A-F-189
Recency Determination Date: LM Concern (5-7 years)	June 2008 – 2010

2. **Background**. The area proposed for maintenance dredging was last characterized in 1998 and dredged in 2001 (Table 1). Since then, the Lower Duwamish Waterway was added to the EPA Superfund list on September 13, 2001. Because of frequent characterization and dredging of the area of the navigation channel proposed for dredging, there is currently no reason to believe that the Turning Basin portion of the Federal Navigation Channel is of higher concern for contamination than it has been

in the past. In addition, because this material generally is deposited annually during winter storm events from further up the Green-Duwamish River, it is considered a potentially clean source of capping material for remedial actions.

3. **Sampling.** The area proposed for dredging is ranked "low-moderate" by the DMMP agencies, though areas of the Duwamish downstream of the project area are ranked "high." Because the navigation channel and proposed project area lie within the boundaries of this Superfund area, and because the turning basin material is generally considered to be a good source of beneficial use material (e.g. capping), it was considered prudent to test the material at a higher sampling frequency than that typically required by the DMMP for open water disposal. In past characterizations, samples have been composited for analysis, with two or three composites from 2-3 DMMU being used to characterize the low-moderate material. For the 2003 characterization, 5 cores samples, each representing between 10,000 to 15,000 cy of material were analyzed separately. The dredge area represented by each sample was designated a "Dredge Area" (DA) as opposed to a DMMU to acknowledge that this sampling plan was based on a higher frequency of sampling than that required by the DMMP for a low-moderate project. Each DA still maintained the DMMU requirement of dredging independence, such that the area represented by each sample could be dredged independently from surrounding DAs should they have different suitabilities for open water disposal or beneficial use.

   Sampling took place on June 26, 2003, aboard the Corps vessel Puget. The approved SAP was followed and the sampling observed by a DMMP representative. Five core samples were taken with a Vibracorer sampler and processed on board the vessel. Material from each core was composited vertically to the depth of the dredge prism and submitted to Columbia Analytical Services for analysis. Material from the one-foot layer directly below the dredge prism was taken as a Z-sample for four out of the five cores and archived. No Z-sample was collected at S4 due to core refusal at elevation -13.9 MLLW, about 4 feet short of the target sampling depth. Refusal was apparently due to a thick deposit of coarse sand at the sampling location.

4. **Conventional and Chemical Analysis**. The Agencies' approved sampling and analysis plan was followed, and quality assurance/quality control guidelines specified by PSEP and the DMMP program were generally complied with. Conventional (Table 3) and chemical analyses (Appendix A) were performed by Columbia Analytical Services (CAS) of Kelso, Washington. Also, because this material has been proposed for use as capping material, it was tested for Atterberg Limits--a test used to estimate strength and settling characteristics. Those results are in Appendix C. Chemical analysis results demonstrated that there were no detected or non-detected SL exceedances of any DMMP chemical of concern in any sample.

   Enough porewater for TBT analysis could not be collected for two out of the five samples (S4 and S5), due to the sandy nature of the sediment. The DMMP agencies subsequently directed the laboratory to conduct bulk sediment analysis, rather than porewater, on all five samples. Bulk sediment TBT values were then compared with the bulk sediment SL from which the porewater value was derived, which was 73 µg/Kg TBT (Michelsen et al 1996). Levels found in the sampled sediments ranged from 0.55 to 4.4 µg/Kg TBT, well below the level of concern.

   All data complied with general QA/QC requirements of the DMMP (Table 4) and were acceptable as qualified by the laboratory.

Table 3. Conventional Results.

Parameter		S1	S2	S3	S4	S5
Depth Interval		0-4.8 ft	0-6.1 ft	0-6.5 ft	0-13 ft	0-8.8 ft
Volume, cubic yards		11,641	13,941	10,993	14,582	14,624
Grain Size (%)	Gravel	0.2	0.7	3.4	1.5	1.9
	Total Sand	52.7	61.1	67.8	89.5	90.5
	Silt	34.7	28.3	18.2	6.4	4.6
	Clay	10.9	8.4	6.1	2.3	1.8
	Fines (silt + clay)	45.6	36.7	24.3	8.7	6.4
Total Organic Carbon (%)		2.5	3.1	2.7	0.7	0.8
Total solids (%)		56.5	56.9	60.3	75.8	77.0
Total volatile solids (%)		7.0	7.4	5.8	2.7	2.5
N-Ammonia (mg/kg)		97	100	126	43	15
Sulfide (mg/kg)		987	502	704	243	286

Table 4. QA/QC Warning and Action Limits (DMMP Program).

	QA Element	Warning Limits	Action Limits
Precision	Metals	None	20% RPD or COV
	Organics	35% RPD or COV	50% COV or a factor of 2 for duplicates
Matrix Spikes	Metals	None	75-125% recovery
	Organics:[1] ▪ Volatiles ▪ Semivolatiles and Pesticides	▪ 70-150% ▪ 50-150%	None (however, zero percent recovery may be cause for data rejection)[2]
Reference Materials	Metals	None	95% CI if specified for a particular CRM; 80-120% recovery if not.
	Organics	None	95% CI for CRMs. No action limit for uncertified RMs.
Surrogate Spikes	Volatiles	85% minimum recovery	EPA CLP chemical-specific recovery limits
	Pesticides	60% minimum recovery	
	Semi-volatiles	50% minimum recovery	

5. **Comparison to SMS Guidelines.** All results of the chemical analyses were organic carbon normalized, if necessary, and compared to Washington State Sediment Management Standards (Appendix B). This analysis showed that levels of all detected and most undetected contaminants were below the Sediment Quality Standards (SQS) set by Washington State. One chemical (hexachlorobenzene) was not detected, but the organic carbon normalized detection limit (0.43 mg/kg OC) was slightly above the SQS guidelines (0.37 mg/kg OC). This occurred in S4, with the lowest total organic carbon concentration (0.7%) of all five project samples. This apparent exceedance was likely caused by the low organic carbon concentration as well as a general difficulty for achieving low detection limits for HCB. The DMMP agencies agreed that there is no reason to believe that this non-detected chemical is present at any level of concern. Thus, this analysis indicates that all sediments tested are suitable for beneficial uses under Washington State Sediment Management Standards, including use as cap material.

6. **Suitability.** This memorandum documents the suitability of proposed dredged sediments from the Duwamish navigation channel for disposal at a DMMP open-water disposal site, or at an approved beneficial use site. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the previously described testing, the DMMP agencies concluded that **66,000 cy are suitable** for open water disposal.

   This determination of suitability does not preclude the consideration of this material for an appropriate beneficial use. It does not constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

7. **References.**

Anchor Environmental 2003. Sediment characterization results for the Duwamish River Navigational Channel Turning Basin. Prepared for the Seattle District, US Army Corps of Engineers, September 2003.

Michelsen, T; T Shaw & S Stirling, 1996. PSDDA Issue Paper & SMS Technical Information Memorandum: Testing, reporting, and evaluation of tributyltin data in PSDDA and SMS programs. Dr. Teresa Michelsen (Washington Department of Ecology), Travis C. Shaw (Corps of Engineers) and Stephanie Stirling (Corps of Engineers) for the PSDDA/SMS agencies, October 1996.

Concur:

10/2/03
Date

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APPENDIX A

Chemical results compared to DMMP guidelines

	DMMP Criteria			Sample ID				
	SL	BT	ML	S1	S2	S3	S4	S5
Metals (mg/kg-DW)								
Antimony	150		200	0.09 UJ	0.07 UJ	0.06 UJ	0.04 UJ	0.05 UJ-
Arsenic	57	507.1	700	6.3	6.5	5.2	4.4	3.9
Cadmium	5.1	11.3	14	0.185	0.183	0.126	0.09	0.088
Chromium	---	267	---	14	16.3	11.9	11.2	9.97
Copper	390	1027	1300	21.3	22.1	15.3	12.3	11.5
Lead	450	975	1200	11.1	11.6	8.29	6.45	6.62
Mercury	0.41	1.5	2.3	0.07	0.07	0.07	0.04	0.04
Nickel	140	370	370	13	14.7	12	11.1	10.4
Selenium	---	3	---	0.4 J	0.4 J	0.3 J	0.2 J	0.2 J
Silver	6.1	6.1	8.4	0.22 J	0.07 J	0.06 J	0.06 J	0.06 J
Zinc	410	2783	3800	50.6	56.6	43.2	41.5	38.8
Tributyltin (µg/kg-DW)								
Tributyltin	---	---	---	4.4	2.2	1.5 J	0.59 J	0.55 J
LPAHs (µg/kg-DW)								
Total LPAH	5200	---	29000	60.4	78.6	70.3	81.1 J-	32.6
Naphthalene	2100	---	2400	2.5 J	3.3 J	4.3 J	1.9 J-	1.7 U
Acenaphthylene	560	---	1300	2.5 U	2.5 U	2.4 U	1.9 UJ-	1.9 U
Acenaphthene	500	---	2000	3.5 J	3.5 J	4.0 J	3.1 J-	1.3 J
Fluorene	540	---	3600	4.9 J	5.5 J	5.8 J	5.2 J-	2.3 U
Phenanthrene	1500	---	21000	38	51	42	56 J-	27
Anthracene	960	---	13000	8.3 J	11	8.0 J	12 J-	4.3 J
[1] 2-Methylnaphthalene	670	---	1900	3.2 J	4.3 J	6.2 J	2.9 J-	1.6 U
HPAHs (µg/kg-DW)								
Total HPAH	12000	---	69000	432	518	375	497 J-	234
Fluoranthene	1700	4600	30000	88	110	80	120 J-	54
Pyrene	2600	11980	16000	72	85	61	85 J-	44
Benzo(a)anthracene	1300	---	5100	32	39	27	39 J-	18
Chrysene	1400	---	21000	48	66	41	49 J-	24
Total benzofluoranthenes	3200	---	9900	85	93	73	83 J-	41
Benzo(a)pyrene	1600	---	3600	37	44	31	43 J-	20
Indeno(1,2,3-cd)pyrene	600	---	4400	31	37	27	36 J-	16
Dibenzo(a,h)anthracene	230	---	1900	7.1 J	7.1 J	6.5 J	7.2 J-	3.2 J
Benzo(g,h,i)perylene	670	---	3200	32	37	28	35 J-	14
Chlorinated Hydrocarbons (µg/kg-DW)								
1,3-Dichlorobenzene	170	---		2.9 U	2.9 U	2.7 U	2.2 UJ-	2.1 U
1,4-Dichlorobenzene	110	---	120	3.4 U	3.4 U	3.2 U	2.6 UJ-	2.5 U
1,2-Dichlorobenzene	35	---	110	2.4 U	2.3 U	2.2 U	1.8 UJ-	1.7 U
1,2,4-Trichlorobenzene	31	---	64	2.7 U	2.7 U	2.5 U	2.0 UJ-	2.0 U
Hexachlorobenzene	22	168	230	3.8 U	3.7 U	3.5 U	2.8 UJ-	2.8 U
Phthalates (µg/kg-DW)								
Dimethylphthalate	1400	---	---	5.1 J	4.2 J	3.0 U	2.4 UJ-	2.4 U
Diethylphthalate	1200	---	---	6.2 U	6.2 U	5.9 U	4.7 UJ-	4.6 U
Di-n-butylphthalate	5100	---	---	22	36	20	6.5 J-	12
Butylbenzylphthalate	970	---	---	13	11	11	7.3 J-	5.6 J
Bis(2-Ethylhexyl)phthalate	8300	---	---	150 J	150 J	110 J	54 J-	34 UJ
Di-n-octylphthalate	6200	---	---	2.2 U	2.2 U	2.0 U	1.6 UJ-	1.6 U
Phenols (µg/kg-DW)								
Phenol	420	---	1200	12 UJ	16 UJ	14 UJ	4.6 UJ-	4.4 UJ
2-Methylphenol	63	---	77	6.1 U	6.0 U	5.7 U	4.5 UJ-	4.5 U
4-Methylphenol	670	---	3600	12	40	51	3.9 UJ-	3.8 U
2,4-Dimethylphenol	29	---	210	9.8 U	9.7 U	9.2 U	7.3 UJ-	7.2 U
Pentachlorophenol	400	504	690	16 U	15 U	15 U	12 UJ-	12 U

	DMMP Criteria			Sample ID				
	SL	BT	ML	S1	S2	S3	S4	S5
Miscellaneous (µg/kg-DW)								
Benzyl alcohol	57	---	870	11	24	23	4.9 UJ-	4.9 U
Benzoic acid	650	---	760	170 U	170 U	160 U	130 UJ-	130 U
Dibenzofuran	540	---	1700	3.5 J	4.1 J	4.7 J	2.9 J-	1.7 U
Hexachloroethane	1400	---	14000	3.9 U	3.9 U	3.7 U	3.0 UJ-	2.9 U
Hexachlorobutadiene	29	---	270	2.5 U	2.5 U	2.4 U	1.9 UJ-	1.9 U
n-Nitrosodiphenylamine	28	---	1300	3.9 U	3.9 U	3.7 U	3.0 UJ-	2.9 U
Volatiles (µg/kg-DW)								
Trichloroethene	160	---	1600	0.50 U	0.50 U	0.47 U	0.37 U	0.37 U
Tetrachloroethene	57	---	210	0.55 U	0.55 U	0.52 U	0.41 U	0.41 U
Ethylbenzene	10	---	50	1.1 U	1.1 U	0.95 U	0.76 U	0.75 U
Total Xylenes	40	---	160	2.7 U	2.7 U	2.5 U	2.0 U	2.0 U
m,p-Xylenes	---	---	---	2.7 U	2.7 U	2.5 U	2.0 U	2.0 U
o-Xylene	---	---	---	1.3 U	1.3 U	1.2 U	0.92 U	0.90 U
Pesticides (µg/kg-DW)								
Total DDT	6.9	50	69	2.4	3.8	1.9	0.96 U	0.64 J
4,4'-DDD	---	---	---	0.88 J	0.87 J	0.44 J	0.27 J	0.64 J
4,4'-DDE	---	---	---	1.5 J	1.3	1.7 J	0.62 U	0.45 J
4,4'-DDT	---	---	---	2.4	2.5	1.9	0.96 U	0.64 J
Aldrin	10	---	---	0.45 U	1.1 U	1.5 J	0.33 U	0.33 U
Dieldrin	10	---	---	1.0 U	1.6 J	0.14 U	0.80 J	0.59 U
alpha-BHC	---	---	---	0.20 J	0.47 J	0.20 J	0.088 U	0.086 U
gamma-BHC (Lindane)	10	---	---	0.14 U	1.1 U	0.13 U	0.11 U	0.099 U
Total Chlordane Isomers	10	37	---	1.59 J	1.1 U	0.56 J	0.75 J	0.22 J
Heptachlor	10	---	---	1.0 U	0.097 U	1.0 U	0.25 J	1.0 U
alpha-Chlordane	---	---	---	0.44 J	1.1 U	0.53 U	0.053 U	0.052 U
gamma-Chlordane	---	---	---	0.71 J	1.1 U	0.56 J	0.50 J	0.22 J
cis-Nonachlor	---	---	---	1.0 U	0.51 U	0.89 U	0.14 U	0.050 U
trans-Nonachlor	---	---	---	0.44 J	1.1 U	1.0 U	0.53 U	0.61 U
PCBs (µg/kg-DW)								
Total PCBs	130	---	3100	42	38	31	14.4	10.8
Aroclor 1016	---	---	---	3.2 U	3.2 U	3.0 U	2.4 U	2.4 U
Aroclor 1221	---	---	---	3.2 U	3.2 U	3.0 U	2.4 U	2.4 U
Aroclor 1232	---	---	---	3.2 U	3.2 U	3.0 U	2.4 U	2.4 U
Aroclor 1242	---	---	---	3.2 U	3.2 U	3.0 U	2.4 U	2.4 U
Aroclor 1248	---	---	---	23	21	17	6.7 J	4.4 J
Aroclor 1254	---	---	---	3.2 U	3.2 U	3.0 U	2.4 U	2.4 U
Aroclor 1260	---	---	---	19	17	14	7.7 J	6.4 J
Organic Carbon Normalized								
PCBs/Pesticides (mg/kg-OC)								
Total PCBs	---	38	---	1.65	1.22	1.16	2.22	1.44
alpha-BHC	---	10	---	0.008 J	0.015 J	0.007 J	0.014 U	0.011 U

Notes:

U: The compound was analyzed for, but not detected ("Non-detect") at or above the method detection limit (MDL).

J: The result is an estimated concentration based on either a laboratory quality control sample exceedence, or the reported concentration is less than the method reporting limit (MRL) but greater than the MDL.

J+: The result is an estimated quantity, but the result may be biased high.

J-: The result is an estimated quantity, but the result may be biased low.

UJ: The analyte was not detected above the reported sample quantitation limit. However, the reported quantification limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

DW: Dry weight

OC: Organic carbon

[1] 2-Methylnaphthalene is not added to other LPAHs as part of the total LPAH levels.

APPENDIX B

Chemical results compared to SMS guidelines

	SQS	CSL	S1	S2	S3	S4	S5
Antimony			0.09 N	0.07 N	0.06 N	0.04 BN	0.05 BN
Arsenic	57	93	6.3	6.5	5.2	4.4	3.9
Cadmium	5.1	6.7	0.185	0.183	0.126	0.09	0.088
Chromium	260	270	14	16.3	11.9	11.2	9.97
Copper	390	390	21.3	22.1	15.3	12.3	11.5
Lead	450	530	11.1	11.6	8.29	6.45	6.62
Selenium			0.4 B	0.4 B	0.3 B	0.2 B	0.2 B
Silver	6.1	6.1	0.22 J	0.07 J	0.06 J	0.06 J	0.06 J
Zinc	410	3800	50.6	56.6	43.2	41.5	38.8
Phenols (µg/kg-DW)							
Phenol	420	1200	12 UJ	16 UJ	14 UJ	4.6 UJ-	4.4 UJ
2-Methylphenol	63	63	6.1 U	6.0 U	5.7 U	4.5 UJ-	4.5 U
4-Methylphenol	670	670	12	40	51	3.9 UJ-	3.8 U
2,4-Dimethylphenol	29	29	9.8 U	9.7 U	9.2 U	7.3 UJ-	7.2 U
Pentachlorophenol	360	690	16 U	15 U	15 U	12 UJ-	12 U
Miscellaneous (µg/kg-DW)							
Benzyl alcohol	57	73	11	24	23	4.9 UJ-	4.9 U
o-Xylene			1.3 U	1.3 U	1.2 U	0.92 U	0.90 U
Organic Carbon Normalized							
LPAHs (mg/kg-OC)							
Total LPAH	370	780	2.38	2.53	2.63	12.48 J-	4.35
Naphthalene	99	170	0.1 J	0.11 J	0.16 J	0.29 J-	0.23 U
Acenaphthylene	66	66	0.1 U	0.08 U	0.09 U	0.29 UJ-	0.25 U
Acenaphthene	16	57	0.14 J	0.11 J	0.15 J	0.48 J-	0.17 J
Fluorene	23	79	0.19 J	0.18 J	0.22 J	0.8 J-	0.31 U
Phenanthrene	100	480	1.5	1.64	1.57	8.62 J-	3.6
Anthracene	220	1200	0.33 J	0.35	0.3 J	1.85 J-	0.57 J
2-Methylnaphthalene	38	64	0.13 J	0.14 J	0.23 J	0.45 J-	0.21 U
HPAHs (mg/kg-OC)							
Total HPAH	960	5300	17.01	16.66	14.03	76.49 J-	31.23
Fluoranthene	160	1200	3.46	3.54	3	18.46 J-	7.2
Pyrene	1000	1400	2.83	2.73	2.28	13.08 J-	5.87
Benzo(a)anthracene	110	270	1.26	1.25	1.01	6 J-	2.4
Chrysene	110	460	1.89	2.12	1.54	7.54 J-	3.2
Total benzofluoranthenes	230	450	3.35	2.99	2.73	12.77 J-	5.47
Benzo(a)pyrene	99	210	1.46	1.41	1.16	6.62 J-	2.67
Indeno(1,2,3-cd)pyrene	34	88	1.22	1.19	1.01	5.54 J-	2.13
Dibenzo(a,h)anthracene	12	33	0.28 J	0.23 J	0.24 J	1.11 J-	0.43 J
Benzo(g,h,i)perylene	21	78	1.26	1.19	1.05	5.38 J-	1.87
Chlorinated Hydrocarbons (mg/kg-OC)							
1,4-Dichlorobenzene	3.1	9	0.13 U	0.11 U	0.12 U	0.4 UJ-	0.33 U
1,2-Dichlorobenzene	2.3	2.3	0.09 U	0.07 U	0.08 U	0.28 UJ-	0.23 U
1,2,4-Trichlorobenzene	0.81	1.8	0.11 U	0.09 U	0.09 U	0.31 UJ-	0.27 U
Hexachlorobenzene	0.38	2.3	0.15 U	0.12 U	0.13 U	0.43 UJ-	0.37 U
Phthalates (mg/kg-OC)							
Dimethylphthalate	53	53	0.2 J	0.14 J	0.11 U	0.37 UJ-	0.32 U
Diethylphthalate	61	110	0.24 U	0.2 U	0.22 U	0.72 UJ-	0.61 U
Di-n-butylphthalate	220	1700	0.87	1.16	0.75	1 J-	1.6
Butylbenzylphthalate	4.9	64	0.51	0.35	0.41	1.12 J-	0.75 J
bis(2-Ethylhexyl)phthalate	47	78	5.91 J	4.82 J	4.12 J	8.31 UJ-	4.53 J
Di-n-octylphthalate	58	4500	0.09 U	0.07 U	0.07 U	0.25 UJ-	0.21 U

	SQS	CSL	S1	S2	S3	S4	S5
Miscellaneous (mg/kg-OC)							
Dibenzofuran	15	58	0.14 J	0.13 J	0.18 J	0.45 J-	0.23 U
Hexachlorobutadiene	3.9	6.2	0.1 U	0.08 U	0.09 U	0.29 UJ-	0.25 U
n-Nitrosodiphenylamine	11	11	0.15 U	0.13 U	0.14 U	0.46 UJ-	0.39 U
PCBs (mg/kg-OC)							
Total PCBs	12	65	1.65	1.22	1.16	2.22	1.44

Notes:

Notes:

N: for metals: the matrix spike sample recovery is not within control limits.

U: The compound was analyzed for, but not detected ("Non-detect") at or above the method detection limit (MDL).

J: The result is an estimated concentration based on either a laboratory quality control sample exceedence, or the reported concentration is less than the method reporting limit (MRL) but greater than the MDL.

J+: The result is an estimated quantity, but the result may be biased high.

J-: The result is an estimated quantity, but the result may be biased low.

UJ: The analyte was not detected above the reported sample quantitation limit. However, the reported quantification limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

DW: Dry weight

OC: Organic carbon

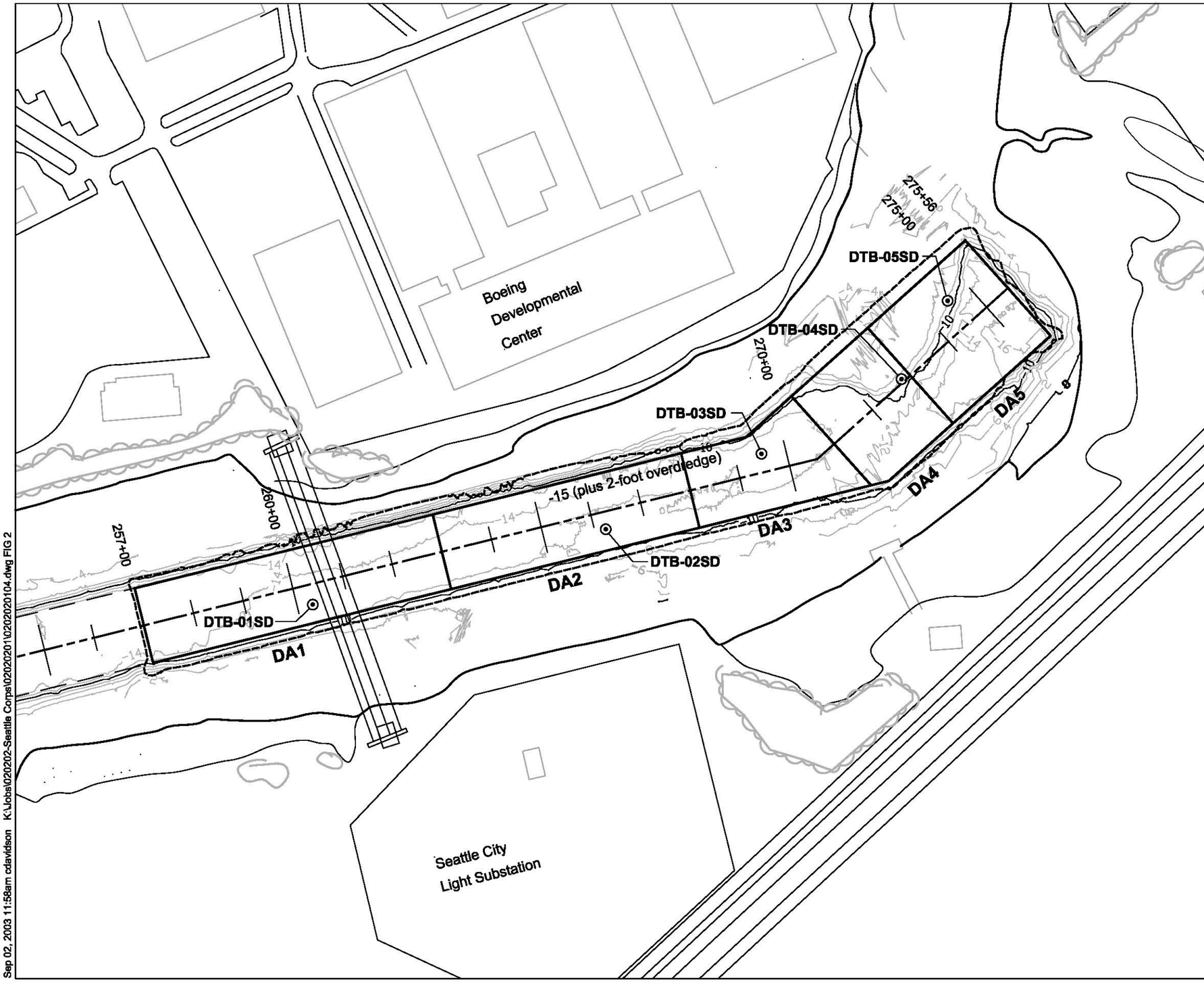
☐ Value in bold box was not detected, but the OC normalized MDL was above SQS. See narrative for discussion.

APPENDIX C

Atterberg Limits
Duwamish Turning Basin O&M
Sampled June 2003

	S1	S2	S3	S4	S5
Atterberg Limits					
Liquid limit	N-P	N-P	N-P	N-P	N-P
Plastic limit	N-P	N-P	N-P	N-P	N-P
Plasticity index	N-P	N-P	N-P	N-P	N-P

Note:
N-P: Non-plastic



DREDGE AREA (DA)	ESTIMATED VOLUME (CY)
1	11,641
2	13,941
3	10,993
4	14,582
5	14,624

⊙ DTB-01SD — SEDIMENT SAMPLE LOCATION AND NUMBER

- - - - - - - - DAYLIGHT LINE FOR DREDGE CUT

———— DREDGE AREA OUTLINE

NOTES:

1. SOUNDINGS AND ELEVATIONS ARE IN FEET AND REFER TO THE PLANE OF MEAN LOWER LOW WATER, NOS.

2. HORIZONTAL CONTROL BASED ON LAMBERT GRID PROJECTION FOR WASHINGTON NORTH ZONE, NAD 83/91

3. BASE MAP PREPARED FROM AERIAL PHOTOGRAPHY FLOWN 26 SEPTEMBER 1996, BY SURVEY BRANCH, SEATTLE DISTRICT, CORPS OF ENGINEERS.

4. CHANNEL ALIGNMENT SHOWN IS ALIGNMENT 1998

5. CONDITION SURVEY: MARCH 17, 2003

6. TOTAL VOLUME CALCULATED BY ANCHOR 5/15/03: 65,781 CY

0 200
Scale in Feet

Sep 02, 2003 11:58am cdavidson K:\Jobs\020202-Seattle Corps\02020201\02020104.dwg FIG 2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Actual Sampling Locations
Duwamish Turning Basin and Navigation Channel