CENWS-OD-TS-DMMO

Corrects volumes for each DMMU and total Project

MEMORANDUM FOR: RECORD March 26, 2009 (errata correction February 1, 2010)

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED MAINTENANCE DREDGED MATERIAL FROM PORT OF SEATTLE TERMINAL 5 MAINTENANCE DREDGING IN ELLIOTT BAY, WASHINGTON EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR OPEN-WATER DISPOSAL AT A DMMP NON-DISPERSIVE OPEN-WATER DISPOSAL SITE.

1. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) on the suitability of an estimated 10,410 cy of maintenance material at Terminal 5 evaluated for open-water unconfined disposal at the Elliott Bay nondispersive open-water disposal site in Seattle, Washington.

Table 1. Terminal 5 Proposed Dredging and DMMU Characteristics.

DMMU ID	Core Station ID	Characterized depth, ft MLLW	Volume (cy)
T5-S1	S1-01, S1-02	-40 to -47 ft MLLW	2,260
T5-S2	S2-01, S2-02	-47.2 to -52 ft MLLW	1,760
T5-S3	S3-01, S3-02, S3-03	-45 to -52 ft MLLW	6,390
Total:			10,410

Table 2. Project DMMP Tracking Details

SAP received	July 9, 2008
SAP approved	July 23, 2008
Sampling dates: Vibracorer	September 23-24, 2008
Final data characterization report (without DMMU volumes or Bioassay Reports) DMMU reconfiguration and Volumes Bioassay Testing Characterization Reports	February 2, 2009 March 3, 2009 March 23, 2009
Recency Determination: Berthing Area: High Concern (2 years)	September 2011
DAIS reference number:	POST5-1-B-F-269

2. Background. The project is generally located in a High Concern CERCLA cleanup designated site within the Harbor Island Operational Unit, and portions of this project were previously characterized under DMMP guidelines in 1992 and 1997, and all material were previously found suitable for open-water disposal at the Elliott By disposal site. The proposed dredging at Terminal 5, involves maintenance dredging along 2,900 linear feet of container cargo pier margin (e.g., estimated dredging prism thickness of 3-7 ft, within the berthing area which has authorized depth of 45 ft MLLW + 2 ft of allowable overdredge depth (South end of berthing area), and 50 ft MLLW + 2 feet allowable overdredge depth (Northern end of berthing area dredging prism).

3. SAP review and Sampling. The draft SAP was submitted to DMMP agencies for review on July 9, 2008 and approved on July 23, 2008. The sampling was initiated on September 23, 2008 and completed on September 24, 2008, and all samples from this High Ranked area were collected by vibracorer to characterize three dredged-material-management units (DMMUs) as depicted in Table 1 and Figure 1. Two vibracore samples were composited for DMMU-S1, two samples were composited for DMMU-S2 and three samples were

composited for DMMU-S3. The proposed stations versus the actual stations are depicted in Figure 1, and several stations required repositioning due to difficulty in collecting a useable vibracore sample.

4. The testing also included evaluation of dioxins/furans, as well as the PSDDA/DMMP Chemical of Concern list, including TBT. The approved sampling and analysis plan was generally followed. The sampling and analysis characterization reports submittal was completed on March 23, 2009 to the DMMP agencies for review, and the DMMP agencies concluded that the quality assurance/quality control guidelines specified by the DMMP were generally complied with, and these data were deemed suitable for decision-making using best-professional-judgment.

4. Chemical Analysis and Comparison with DMMP Marine Guidelines. The Agencies' approved sampling and analysis plan was followed and quality assurance/quality control guidelines specified by PSEP and DMMP were generally complied with. A summary of chemical analysis results for all COC except dioxins/furans is provided in Table 3, and demonstrates that chemicals other than dioxin, for the 3 DMMUs analyzed, DMMU's S1 and S2 had no detected or undetected chemicals exceeding DMMP-Marine guidelines. DMMU-S3 had a TBT pore water Screening Level (SL)/Bioaccumaltion Trigger exceedance quantitated at 1 ppb, and Fluoranthene and Phenanthrene exceedances of the SL. Therefore, DMMU-S3 was subjected to tiered toxicity testing for the later two SL exceedances, prior to conducting bioaccumulation testing for TBT. The results of the toxicity testing are summarized below at paragraph 8, and indicated this DMMU failed toxicity testing interpretation guidelines for dispersive and non-dispersive DMMP open water disposal. Therefore, bioaccumulation testing for TBT was not accomplished.

5. Dioxin Testing Results Summary. Table 4 provides the results of dioxin/furan testing results for the three DMMUs, as follows: DMMU's S1 = 12.1 pptr-TEQ, S2 = 6.31 pptr-TEQ, and S3 = 4.33 pptr-TEQ (U = ½ detection limit).

6. Dioxin Interim Interpretative Framework. The DMMP agencies are currently using an interim process for interpreting dioxin data (http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=DMMO&pagename=Dioxin_Guidelines) pending the development of a programmatic regulatory framework, expected sometime in 2009. The interim guidelines provides a project specific comparison of dioxin/furan concentrations in project dredged material to the disposal site background outside the disposal site. The guidelines applicable to the Elliott Bay non-dispersive disposal site specify the following:
   - ✓ Comparison of dioxin in test sediments to disposal-site background
   - ✓ Background is defined using disposal site specific monitoring, which defined an offsite maximum concentration of 12.2 pptr-TEQ, and an offsite average concentration of 8.7 pptr-TEQ
   - ✓ Dioxin concentrations in any given DMMU may not exceed the site maximum (12.2 pptr-TEQ)
   - ✓ Average dioxin concentrations (weighted to the volume of each DMMU cannot exceed the mean site concentration (8.7 pptr-TEQ)

7. Dioxin Interpretation on Suitability for Unconfined-Open-Water Disposal. As summarized in paragraph 5 above, all three DMMUs were quantitated below the site maximum of 12.2 pptr-TEQ. Table 5 provides the volume weighted averages for DMMU's S1 and S2. DMMU-S3 dropped out of the Volume Weighted Average (WVA) due to bioassay testing results, discussed in paragraph 8. The volume weighted average concentration for the two remaining DMMUs (S1 and S2) totaling 4,020 cy of characterized material is 9.56 pptr-TEQ, which is above the interim Elliott Bay offsite average of 8.7 pptr-TEQ. DMMU-S2 is below the offsite average at 6.3 pptr-TEQ and would be suitable for open-water disposal at the Elliott Bay site.

8. Biological Testing Summary. Bioassay testing results are summarized in Table 6. The results of bioassay testing performed by Northwest Aquatic Sciences indicated that the Carr Inlet Reference sediment and negative control sediment met the DMMP performance guidelines for all bioassays. The amphipod (*Eohaustorius*

estuarius) and 20-day *Neanthes* growth bioassay performed within the parameters of the PSEP/DMMP protocols, and no hits were recorded for these two tests under the DMMP dispersive and non-dispersive guidelines (Table 7). The results for the sediment bivalve larval (*Mytilus galloprovincialis*) bioassay indicated that the seawater control for the bivalve larval test met the quality/control guidelines. The tested sediment for DMMU-S3 registered a 1-Hit response (failure) for both the dispersive and non-dispersive site guidelines compared to the Carr Inlet reference sediment. Therefore this DMMU is not suitable for open-water disposal at the Elliott Bay disposal site, and bioaccumulation testing for DMMU-S3 to evaluate TBT was not accomplished.

9. Suitability for Unconfined-Open Water Disposal. Table 3 summarizes the testing result outcomes for the 3 tested DMMU's. Based on the chemical testing results and toxicity testing results for DMMU-S3, DMMU-S1 and DMMU-S3 are not suitable for unconfined-open-water-disposal, and the cumulative volume of 8,650 cy for these two DMMUs must be disposed at an Ecology approved upland site. The 1,760 cy of material represented by DMMU-S2 is suitable under the interim Dioxin Interpretation Guidelines at the Elliott Bay Site.

10. This memorandum affirms the suitability of the sediment proposed for dredging at the Port of Seattle Terminal 5 maintenance dredging area for unconfined-open-water disposal at the Elliott Bay non-dispersive disposal site. However, this suitability determination does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. 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.

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Concur:

4/2/2009
Date

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4/02/09
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04/02/2009
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April 2 2009
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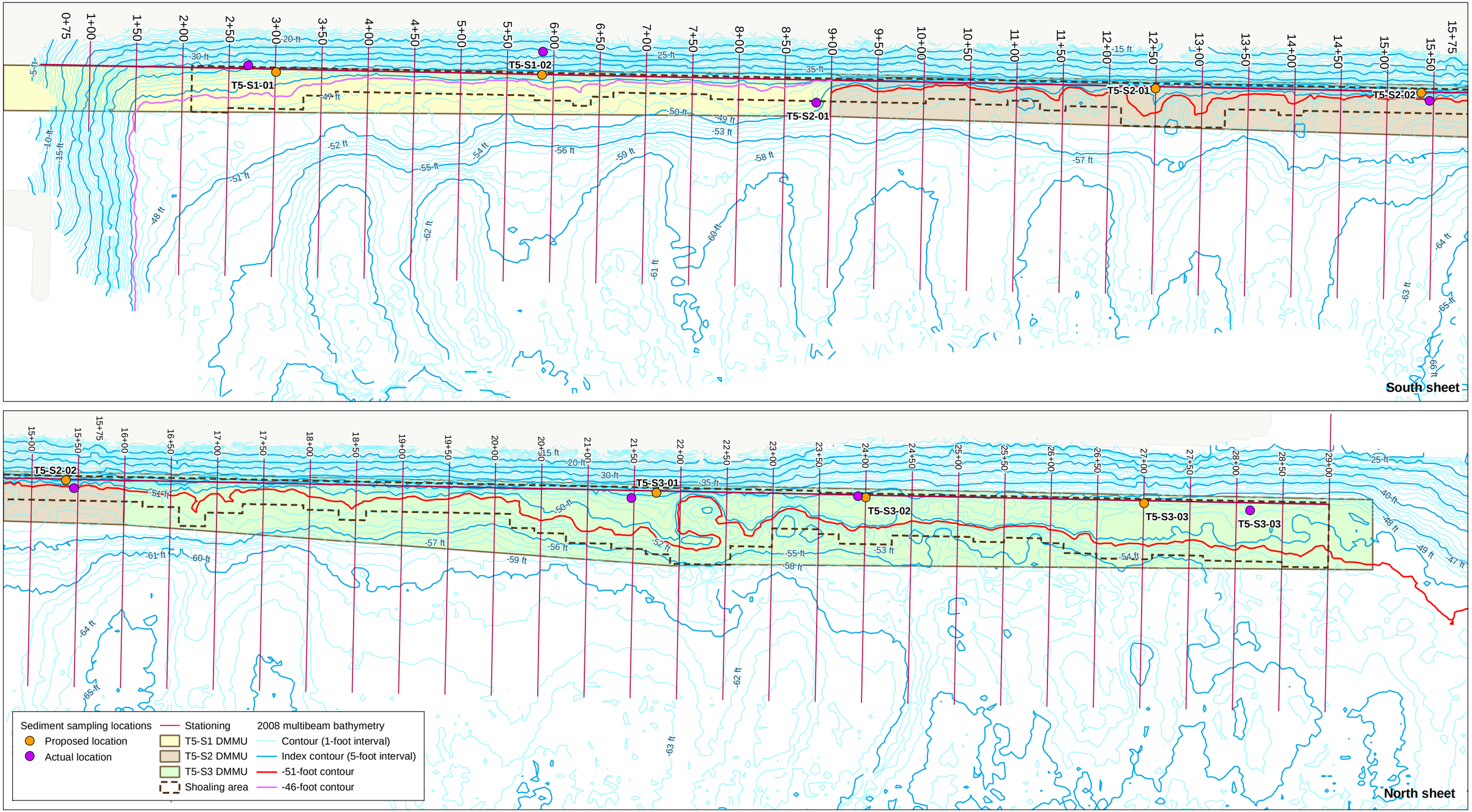

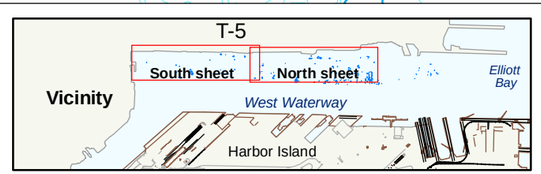

0 50 100 150 200 Feet

0 25 50 75 Meters

N

Figure 1. T-5 proposed and actual sediment sampling locations

Prepared by CEH, 01/30/09, MAP 3647, W:\Projects\T-18_T-5 dredging\Data\GIS\T5

Table 3. Chemistry Testing Results for Terminal 5 compared to DMMP Guidelines.

				DMMU ID	T5-S1	T5-S2	T5-S3	REF
	DMMP Criteria			Sample Depth	0 – 2.5 ft	0 – 2 ft	0 – 3 ft	0.3 ft
Chemical	SL	BT	ML	Unit	T5-S1-CS	T5-S2-CS	T5-S3-CS	Carr Inlet
TCLP Metals								
Arsenic	na	na	na	mg/L	0.2 U	0.2 U	0.2 U	
Barium na		na	na	mg/L	**0.11**	**0.12**	**0.14**	
Cadmium	na	na	na	mg/L	0.01 U	0.01 U	0.01 U	
Chromium na		na	na	mg/L	**0.03**	**0.04**	**0.02**	
Lead	na	na	na	mg/L	0.1 U	0.1 U	0.1 U	
Mercury	na	na	na	mg/L	0.0001 U	0.0001 U	0.0001 U	
Selenium	na	na	na	mg/L	0.2 U	0.2 U	0.2 U	
Silver	na	na	na	mg/L	0.02 U	0.02	0.02	
Metals								
Antimony	150	150	200	mg/kg dw	7 UJ	7 UJ	6 UJ	
Arsenic 57		507.1	700	mg/kg dw	**10**	7 U	**7**	
Cadmium	5.1	nc	14	mg/kg dw	0.4	0.3 U	0.3 U	
Chromium nc		267	nc	mg/kg dw	**26.3**	**20**	**17.7**	
Monobutyltin as ion	nc	nc	nc	µg/L	**0.012**	**0.012**	**0.012**	
Dibutyltin as ion	nc	nc	nc	µg/L	0.012 U	0.012 U	**0.03**	
Tributyltin as ion	0.15	0.15	nc	µg/L	**0.12**	**0.089**	**1**	
PAHs								
1-Methylnaphthalene	nc nc nc			µg/kg dw	**15 J**	19 U	**130 J**	
2-Methylnaphthalene	670	nc	1,900	µg/kg dw	**22 J**	**19 U**	**220 J**	
Acenaphthene	500	nc	2,000	µg/kg dw	**25**	**23**	**430 J**	
Acenaphthylene	560	nc	1,300	µg/kg dw	**22**	**19 U**	**34 J**	
Anthracene	960	nc	13,000	µg/kg dw	**83 J**	**48 J**	**530 J**	
Benzo(a)anthracene	1,300	nc	5,100	µg/kg dw	**200 J**	**130 J**	**630 J**	
Benzo(a)pyrene	1,600	nc	3,600	µg/kg dw	**290**	**170**	**450 J**	
Benzo(b)fluoranthene	nc nc nc			µg/kg dw	**320 J**	**200 J**	**420 J**	
Benzo(g,h,i)perylene	670	nc	3,200	µg/kg dw	**82**	**83**	**170 J**	
Benzo(k)fluoranthene	nc nc nc			µg/kg dw	**390**	**160**	**640 J**	
Total benzofluoranthenes	3,200	nc	9,900	µg/kg dw	**710 J**	**360 J**	**1,060 J**	
Chrysene	1,400	nc	21,000	µg/kg dw	290	180	670 J	
Dibenzo(a,h)anthracene	230	nc	1,900	µg/kg dw	31	20	80 J	
Dibenzofuran	540	nc	1,700	µg/kg dw	**20 J**	19 U	290 J	
Fluoranthene	1,700	4,600	30,000	µg/kg dw	**350 J**	**210 J**	**2,000 J**	
Fluorene	540	nc	3,600	µg/kg dw	**31**	**14 J**	**420 J**	
Indeno(1,2,3-cd)pyrene	600	nc	4,400	µg/kg dw	**88**	**68**	**190 J**	
Naphthalene	2,100	nc	2,400	µg/kg dw	**24**	**26**	**360 J**	
Phenanthrene	1,500	nc	21,000	µg/kg dw	**220**	**110**	**2,000**	
Pyrene 2,600		11,980	16,000	µg/kg dw	**690**	**330**	**1,500**	
Total HPAHs	12,000	nc	69,000	µg/kg dw	**2,730 J**	**1,550 J**	**6,800 J**	
Total LPAHs	5,200	nc	29,000	µg/kg dw	**410 J**	**220 J**	**3,800 J**	
cPAHs - mammal - half RL	nc	nc	nc	µg/kg dw	**405 J**	**236 J**	**677 J**	
Phthalates								
Bis(2-ethyl)phthalate	8300	nc nc		µg/kg dw	**610 J**	**74 J**	**74 J**	
Butyl benzyl phthalate	970	nc	nc	µg/kg dw	**60**	**19 U**	**14 J**	
Diethyl phthalate	1200	nc	nc	µg/kg dw	20 U	**19**	17 J	
Dimethyl phthalate	1400	nc	nc	µg/kg dw	20 U	19 U	19 UJ	
Di-n-butyl phthalate	5100	nc	nc	µg/kg dw	20 U	19 U	19 UJ	
Di-n-octyl phthaltate	6200	nc	nc	µg/kg dw	20 U	19 U	19 U	
Other SVOCs								
1,2,4-Trichlorobenzene	31	nc	64	µg/kg dw	6 UJ	5.6 U	5 UJ	
1,2-Dichlorobenzene	35	nc	110	µg/kg dw	1.2 UJ	1.1 U	1.0 UJ	

Table 3. Chemistry Testing Results for Terminal 5 compared to DMMP Guidelines.

				DMMU ID	T5-S1	T5-S2	T5-S3	REF
	DMMP Criteria			Sample Depth	0 – 2.5 ft	0 – 2 ft	0 – 3 ft	0.3 ft
Chemical	SL	BT	ML	Unit	T5-S1-CS	T5-S2-CS	T5-S3-CS	Carr Inlet
1,3-Dichlorobenzene	170	nc	nc	µg/kg dw	1.2 UJ	1.1 U	1.0 UJ	
1,4-Dichlorobenzene	110	nc 120		µg/kg dw	**10 J**	1.1 U	1.0 UJ	
2,4-Dimethylphenol	29	nc	210	µg/kg dw	20 U	19 U	19 UJ	
2-Methylphenol	63	nc	77	µg/kg dw	20 U	19 U	19 UJ	
4-Methylphenol	670	nc	3,600	µg/kg dw	20 U	19 U	19 UJ	
Benzoic acid	650	nc	760	µg/kg dw	200 U	190 U	190 UJ	
Benzyl alcohol	57	nc	870	µg/kg dw	20 U	19 U	19 UJ	
Hexachlorobenzene	22	168	230	µg/kg dw	0.97 U	0.97 U	0.97 U	
Hexachlorobutadiene	29	nc	270	µg/kg dw	0.97 U	0.97 U	0.97 U	
Hexachloroethane	1,400	nc	14,000	µg/kg dw	20 U	19 U	19 UJ	
n-Nitrosodiphenylamine	28	nc	130	µg/kg dw	20 U	19 U	19 U	
Pentachlorophenol	400	504	690	µg/kg dw	98 U	96 U	96 UJ	
Phenol	420	nc	1,200	µg/kg dw	20 U	19 U	19 UJ	
PCBs								
Aroclor-1016	nc	nc	nc	µg/kg dw	19 U	19 U	19 U	
Aroclor-1221	nc	nc	nc	µg/kg dw	19 U	19 U	19 U	
Aroclor-1232	nc	nc	nc	µg/kg dw	19 U	19 U	19 U	
Aroclor-1242	nc	nc	nc	µg/kg dw	19 U	19 U	19 U	
Aroclor-1248	nc nc nc			µg/kg dw	**21**	19 U	19 U	
Aroclor-1254	nc nc nc			µg/kg dw	**31**	**22**	**25 J**	
Aroclor-1260	nc	nc	nc	µg/kg dw	19 U	19 U	19 U	
Total PCBs	130		3,100	µg/kg dw	**52**	**22**	**25 J**	
Total PCBs (TOC-Normalized)		38		mg/kg-OC	**3.3**	**1.9**	**3.6**	
Pesticides								
2,4'-DDD	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
2,4'-DDE	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
2,4'-DDT	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
4,4'-DDD	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 UJ	
4,4'-DDE	nc	nc	nc	µg/kg dw	3.1 U	1.9 U	2.0 U	
4,4'-DDT	nc	nc	nc	µg/kg dw	1.9 U	**4.0**	2.0 UJ	
Total DDT	6.9	50	69	µg/kg dw	3.1 U	**4.0**	2.0 UJ	
Aldrin	10	nc	nc	µg/kg dw	0.97 U	0.97 U	0.97 U	
Dieldrin	10	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
gamma-BHC	10	nc	nc	µg/kg dw	0.97 U	0.97 U	0.97 U	
alpha-Chlordane	nc	10	nc	µg/kg dw	0.97 U	0.97 U	0.97 U	
gamma-Chlordane	nc	nc	nc	µg/kg dw	2.3 U	0.97 U	0.97 U	
Total chlordane	10	37	nc	µg/kg dw	2.3 U	1.9 U	2.0 U	
Heptachlor	10	nc	nc	µg/kg dw	0.97 U	0.97 U	0.97 U	
cis-Nonachlor	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
Oxychlordane	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
trans-Nonachlor	nc	nc	nc	µg/kg dw	1.9 U	1.9 U	2.0 U	
VOCs								
Ethylbenzene	10	nc	50	µg/kg dw	1.2 U	1.1 U	1.0 U	

Table 3. Chemistry Testing Results for Terminal 5 compared to DMMP Guidelines.

	DMMP Criteria			DMMU ID	T5-S1	T5-S2	T5-S3	REF
				Sample Depth	0 – 2.5 ft	0 – 2 ft	0 – 3 ft	0.3 ft
Chemical	SL	BT	ML	Unit	T5-S1-CS	T5-S2-CS	T5-S3-CS	Carr Inlet
Tetrachloroethene	57	nc	210	µg/kg dw	1.2 U	1.1 U	1.0 U	
Trichloroethene	160	nc	1,600	µg/kg dw	1.2 UJ	1.1 U	1.0 UJ	
o-Xylene	nc	nc	nc	µg/kg dw	1.2 UJ	1.1 U	1.0 U	
m,p-Xylene	nc	nc	nc	µg/kg dw	1.2 U	1.1 U	1.0 U	
Total xylenes	40	nc	160	µg/kg dw	1.2 UJ	1.1 U	1.0 U	
Dioxin/furan (TEQ: u = 1/2 DL)	nc nc nc			ng/kg dw	**12.1**	**6.31**	**4.33**	
Total Solids				%	64	70.5	73.4	75.5
Total Volatile Solids				%	4.64	2.77	2.33	1.03
Total Organic Carbon				%	1.57	1.18	0.702	0.398
Total Ammonia				mg/kg-dw	13.8	28.6	14.6	na
Total Sulfides				mg/kg-dw	812	542 J	374	na
Gravel				%	11.8	7.7	2.6	na
Sand				%	63.9	72.8	84.6	na
Silt				%	18.3	14	8.6	na
Clay				%	6	5.4	4.2	na
Fines (percent silt + clay)				%	24.3	19.4	12.8	na
Eohaustorius estuarius hits:					na	na	No Hit	
Mytilus galloprovincialis hits:					na	na	**1H**	
Neanthes arenaceodentata hits:					na	na	No Hit	
Bioassay Determination: (P/F)					na	na	**Fail (B)**	
BTs exceeded:					no	no	yes	
Bioaccumulation conducted:					no	no	no	
ML Rule exceeded:					no	no	no	
PSDDA Determination:					**Fail (C)**	**PASS (C)**	**Fail (B)**	
DMMU Volume:					2260	1760	6390	

Legend:

Fail (B): Fail due to Bioassays
Fail (C): Fail due to Dioxin
Pass (C): Pass due to meeting Dioxin Interim Guideline
Bolded results are Detected
Highlighted result is greater than the DMMP SL
BT – bioaccumulation trigger exceeded
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DMMP – Dredged Material Management Program
DMMU – dredged material management unit
dw – dry weight
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
J – estimated concentration
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
ML – Maximum Level
na – not applicable or not analyzed
nc – no criteria
PAH – polyaromatic hydrocarbon
PCB – polychlorinated biphenyl
RL – reporting limit
SL – Screening Level
SVOC – semivolatile organic compound
TCLP – toxicity characteristic leaching procedure
TEQ – toxic equivalent, calculated using toxicity equivalency factors given by van den Berg et al. (2006)
U – result undetected at reporting limit shown
UJ – result undetected at the estimated reporting limit shown
VOC – volatile organic compound

Table 4. Port of Seattle Terminal 5 Dioxin Testing Results Summary

Dioxin/furan	WHO (05) TEF	DMMU ID	T5-S1			T5-S2			T5-S3		
		SAMPLE DEPTH	0 – 2.5 ft			0 – 2 ft			0 – 3 ft		
		UNIT	T5-S1-CS	LQ	TEQ	T5-S2-CS	LQ	TEQ	T5-S3-CS	LQ	TEQ
2,3,7,8-TCDD	1	ng/kg dw	0.382	J	0.382	0.4		0.4	0.4		0.4
1,2,3,7,8-PeCDD	1	ng/kg dw	1.89	J	1.89	2.2		2.2	0.525	J	0.525
1,2,3,4,7,8-HxCDD	0.1	ng/kg dw	2.63	U	0.1315	2.2	U	0.11	1.28	J	0.128
1,2,3,6,7,8-HxCDD	0.1	ng/kg dw	10.8		1.08	4.07		0.407	3.47		0.347
1,2,3,7,8,9-HxCDD	0.1	ng/kg dw	5.32		0.532	1.77	J	0.177	1.38	J	0.138
1,2,3,4,6,7,8-HpCDD	0.01	ng/kg dw	357		3.57	133		1.33	109		1.09
OCDD	0.0003	ng/kg dw	3310		0.993	1270		0.381	1060		0.318
2,3,7,8-TCDF	0.1	ng/kg dw	1.93		0.193	0.74	U	0.037	0.815		0.0815
1,2,3,7,8-PeCDF	0.03	ng/kg dw	1.3	J	0.039	0.744	J	0.02232	0.469	J	0.01407
2,3,4,7,8-PeCDF	0.3	ng/kg dw	4.17		1.251	1.38	J	0.414	1.16	J	0.348
1,2,3,4,7,8-HxCDF	0.1	ng/kg dw	5.17		0.517	2.38		0.238	2.04	J	0.204
1,2,3,6,7,8-HxCDF	0.1	ng/kg dw	2.52		0.252	0.882	J	0.0882	1.11	J	0.111
1,2,3,7,8,9-HxCDF	0.1	ng/kg dw	1.8	J	0.18	2.2	U	0.11	2.2		0.22
2,3,4,6,7,8-HxCDF	0.1	ng/kg dw	3.91		0.391	1.21	J	0.121	1.41	J	0.141
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg dw	54.7		0.547	22.4		0.224	21.7		0.217
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg dw	4.2		0.042	2.11	J	0.0211	2.15	J	0.0215
OCDF	0.0003	ng/kg dw	199		0.0597	87.3		0.02619	82.4		0.02472
Total TEQ: (u = 1/2)					12.1			6.31			4.33
Total TEQ: (U = 0)					11.9			6.05			4.33
Total TOC, %:					1.57			1.18			0.702

Table 5. Volume Weighted Average (VWA) Dioxin Concentrations for Port of Seattle Terminal 5 Dredging Project

DMMU Core ID	Depth, ft	Volume (CY)	TCDD/F TEQ	ng/kg-dw	Product (Vol x TEQ)	ng x cy/kg x DMMU	Product/total	Proportional contribution/Suitable DMMU
S1	0-3	2,260	12.1	ng/kg-dw	27,346	ng x cy/kg	71.2%	% of Total DMMU
S2	0-4	1,760	6.3	ng/kg-dw	11,088	ng x cy/kg	28.8%	% of Total DMMU
Totals (Suitable):		4,020	cy		38,434	ng x cy/kg	9.56	ng/kg-dw/Project (VWA)

Both DMMUs meet the offsite maximum of 12.2 pptr-TEQ, but the volume wgt'd average exceeds the Interim Elliott Bay offsite average of 8.7 pptr-TEQ
Only one DMMU (S2) is below the Interim offsite average concentration of 8.7 pptr-TEQ

Table 6. Bioassay Testing Results Summary for DMMU-S3

Bioassay Evaluation Guidelines	Amphipod Test			Larval Test			Neanthes Test		
	Criteria	Results	Status	Criteria	Results	Status	Criteria	Results	Status
Negative control performance standard	Mc ≤ 10%	1%	Pass	Nc/I ≥ 0.70	0.97	Pass	Mc ≤ 10%	4%	Pass
							MIGc ≥ 0.38	0.92	Pass
Reference sediment performance standard	Mr-Mc ≤ 20%	0%	Pass	Nr/Nc ≥ 0.65	0.77	Pass	Mr ≤ 20%	0%	Pass
							MIGr/MIGc ≥ 0.80	1.02	Pass
Dispersive disposal	Mt - Mc > 20%	8.00%	Pass	Nt/Nc < 0.80	0.16	Fail	MIGt/MIGc < 0.80	0.82	Pass
	Mt vs Mr SS (p = 0.05)	Not SS	Not SS	Nt/Nc vs Nr/Nc SS (p = 0.10)	SS	SS	MIGt vs MIGc SS (p = 0.05)	SS	SS
	Mt - Mr > 10%	8.00%	Pass	Nr/Nc - Nt/Nc > 0.15	0.61	Fail	MIGt/MIGr < 0.70	0.8	Pass
Non-dispersive disposal	Mt - Mc > 20%	1.60%	Pass	Nt/Nc < 0.80	0.16	Fail	MIGt/MIGc < 0.80	0.82	Pass
	Mt vs Mr SS (p = 0.05)	Not SS	Not SS	Nt/Nc vs Nr/Nc SS (p = 0.10)	SS	SS	MIGt vs MIGc SS (p = 0.05)	SS	SS
	Mt - Mr > 30%	8.00%	Pass	Nr/Nc - Nt/Nc > 0.30	0.61	Fail	MIGt/MIGr < 0.50	0.8	Pass

Legend.

M = mortality
N = normal larvae
I = Initial Count
MIG = mean individual growth rate
SS = statistically significant
r = reference sediment
c = negative control
t = test sediment

Table 7. – DMMP EVALUATION GUIDELINES (BIOASSAYS)

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Dispersive Disposal Site Interpretation Guidelines		Nondispersive Disposal Site Interpretation Guidelines	
			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$	$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and		$M_T - M_C > 20\%$ and M_T vs M_R SD (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Sediment Larval	$N_C \div I \geq 0.70$	$N_R \div N_C \geq 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs N_R/N_C SD (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C \leq 10\%$ MIG $\geq$ 0.38 mg/ind/day	$MIG_R \div MIG_C \geq 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs MIG_R SD (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normals, I = initial count, MIG = mean individual growth rate,
SD = statistically different, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

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