CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD August 23, 2010 (Errata Correction: 12/13/10)

SUBJECT: DETERMINATION ON THE SUITABILITY OF SUPPLEMENTAL CHARACTERIZATION OF PROPOSED DREDGED MATERIAL FROM KING COUNTY DEPARTMENT OF TRANSPORTATION SOUTH PARK BRIDGE PROJECT (CORPS APPLICATION: NWS-2009-1586) IN DUWAMISH RIVER, 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 supplemental suitability determination on additional characterization conducted at South Park Bridge Project, and 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 26,237 cy of sediment in order to install caissons for the bascule foundation of the replacement bridge evaluated for open-water unconfined disposal at the Elliott Bay non-dispersive open-water disposal site in Seattle, Washington.

Table 1. Project DMMP Tracking Details

JARPA APPLICATION NO.	NWS-2009-1586
SAP received	January 13, 2009
SAP approved	
Sampling dates: Mud rotary drill rig (Phase 1: Initial characterization) Mud rotary drill rig (Phase 2: NB-1 (10-14 ft) for Bioaccumulation Testing)	January 20-27, 2009 February 10-12, 2010
Initial Data Characterization Report Revised Characterization Report (Dioxin data corrections, supplemental bioaccumulation data)	June 30, 2010 August 23, 2010
Recency Determination: High Concern (2 years)	February 2012
DAIS reference number:	SPBRP-1-B-F-295

2. <u>Background.</u> The South Park Bridge crosses the Lower Duwamish Waterway (LDW) between Tukwila (northern side) and an unincorporated area of King County (southern side). The existing bridge has reached the end of its useful life and must be demolished. King County plans on constructing a new bridge adjacent to the existing bridge after funding is secured. The new bridge requires the installation of deep caissons as part of the bascule foundation for the replacement bridge. The caissons would be approximately 60 ft square and extend to depths of 75 feet for the south bascule and 100 feet for the north bascule (Figure 1). Sediment will be dredged in preparation for the caisson installation and during caisson construction, with an estimated total volume of sediment to be dredged from both areas of 26,237 cy.

3. King County Department of Transportation conducted an investigation in 2008 to evaluate the geotechnical characteristics of the sediment in the area of the LDW where the caissons would be installed. Sediment borings were collected and subsequently assessed for sediment quality as a screening level evaluation of potential dredged material disposal alternatives. The results of those analyses were coordinated with the DMMP for review, and feedback from DMMP (Attachment 1) were used by WSDOT and their consultants to subsequently design the Sampling and Analysis Plan (SAP) Approach for DMMP characterization articulated in the SAP submitted in January 2009.

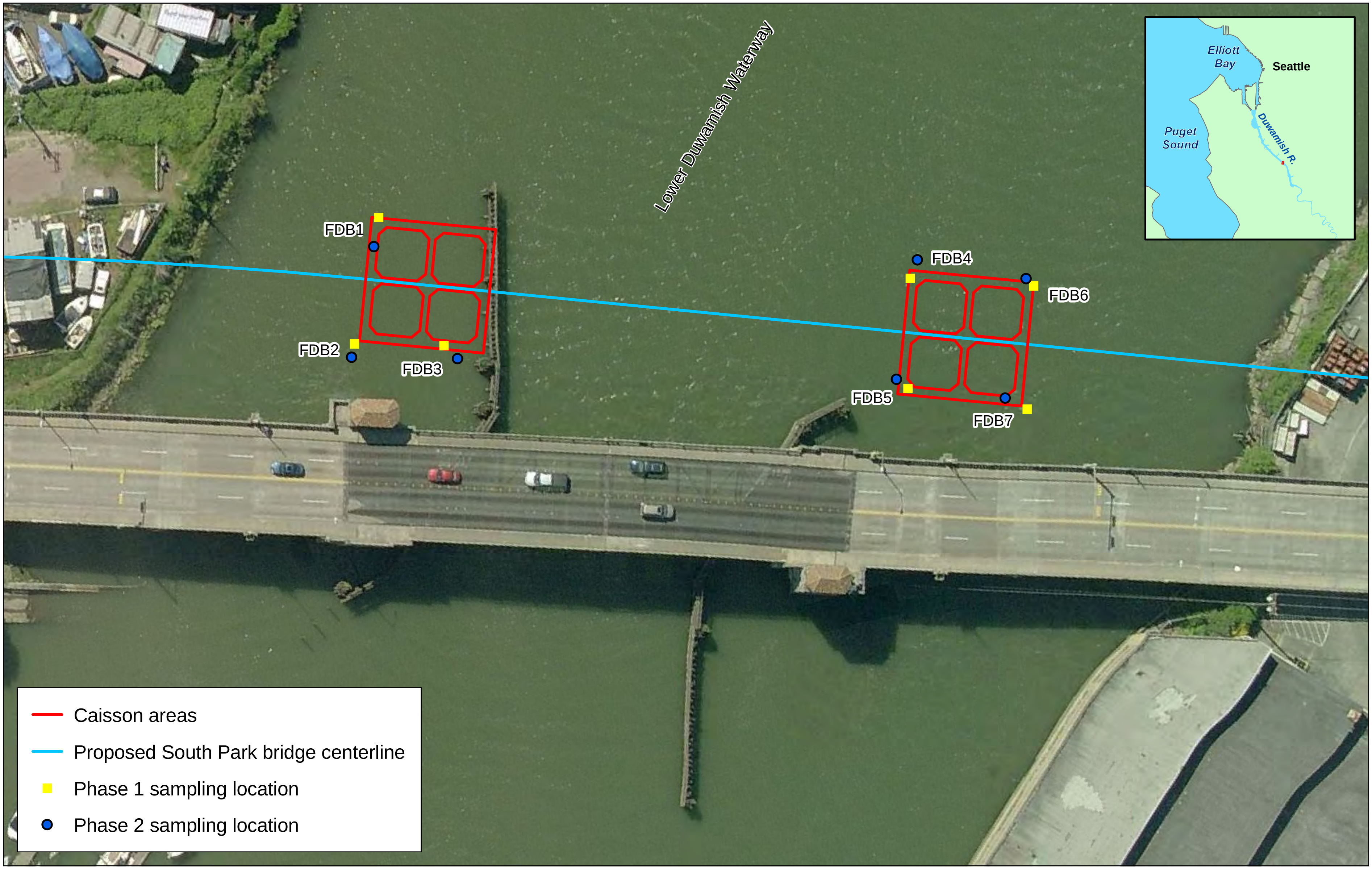

Figure 1. Sampling locations

0 50 100 200 Feet

0 10 20 40 Meters

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Windward environmental LLC

Prepared by MTY 06/16/10; Map #4285; W:\Projects\South Park Bridge replacement\Data\GIS

Table 2. Sediment Characterization Details (Errata revision: 12/9/10)

Location	Depth Interval (ft) Below mudline	DMMU ID	Original Estimated Volume (cy)	Revised Volume Estimate (cy)	Testing Rationale
South bascule	0 – 6	None	1,100	1,150.2 (includes 30.2 cy sand blanket)	Unsuitable based on previous testing results (Wilbur, 2004)
	6 – 10	SB-1	750	*	DMMP testing (this SDM)
	10 – 14	SB-2	750	*	DMMP testing (this SDM)
	14 – 18	SB-3	750	*	Archive pending review of overlying sediment quality
	18 – 75	None	8,000	*	Native (no testing required)
	Cofferdam backfill Material to be excavated for caisson construction	None	Omitted	5,415 (total volume placed: 7,855)	Not tested. Upland material, unsuitable for DMMP disposal
	Backfill Material removed prior to cofferdam removal	None	Omitted	1,040	Not tested. Upland material, Unsuitable for DMMP disposal
North bascule	0 – 10	None	1,850	1,897.2 (includes 30.2 cy sand blanket)	Unsuitable based on previous testing results (Wilbur, 2004)
	10 – 14	NB-1	750	*	DMMP testing (this SDM)
	14 – 18	NB-2	750	*	Archive pending review overlying sediment quality; PCBs analyzed in Phase II
	18 – 100	None	11,500	*	Native (no testing required)
	Cofferdam backfill Material to be excavated for caisson construction	None	Omitted	5,415 (total volume placed: 7,855)	Not tested. Upland material, unsuitable for DMMP disposal
	Backfill Material removed prior to cofferdam removal	None	Omitted	1,040	Not tested. Upland material, Unsuitable for DMMP disposal
Total estimated volume (Tested)			26,200	26,237	Testing outcome in SDM
Backfill Material (Upland)			Omitted	12,910	Unsuitable for DMMP disposal

*Estimated volumes are unchanged or lower than the original volume estimates

Table 3. Sampling Coordinates for Phase I and II and Compositing and DMMU Description.

Location	Core ID	Date	Coordinates		DMMU ID	Depth (ft)	Analyses
			Latitude	Longitude			
Phase I South Bascule	FDB1	1/27/09	47.529044	122.314686	SB-2	10 - 14	DMMP analytes & Dioxins
	FDB2	1/27/09	47.528989	122.314457			
	FDB3	1/26/09	47.529102	122.314427	SB-3	14 - 18	archive
Phase I North Bascule	FDB4	1/20/09	47.529704	122.314417	NB-1	10 - 14	DMMP analytes & Dioxins, toxicity testing
	FDB5	1/23/09	47.529679	122.314212			
	FDB6	1/21/09	47.529857	122.314367			
	FDB7	1/22/09	47.529825	122.314140	NB-2	14 - 18	Phase I archive; PCBs analyzed Phase II
Phase 2 South Bascule	FDB1	2/12/10	47.529033	122.314633	SB-1	6 – 10	DMMP analytes
	FDB2	2/12/10	47.528983	122.314433			
	FDB3	2/12/10	47.529116	122.314399			
Phase 2 North Bascule	FDB4	2/10/10	47.529716	122.314450	NB-1	10 - 14	PCBs, bioaccumulation testing
	FDB5	2/10/10	47.529666	122.314233			
	FDB6	2/10/10	47.529849	122.314383			
	FDB7	2/10/10	47.529800	122.314166			

4. Additional Details regarding the Bridge Construction. A 721 cy sand blanket will be placed on top of the contaminated sediments at the pile driving locations prior to installing the work trestles and cofferdams. As noted in Table 2, an estimated 30.2 cy of sand blanket (up to 1 foot in depth) would subsequently be removed inside each of the two cofferdams as part of the excavation process and disposed at an approved upland site along with the underlying contaminated material at both bascules. The purpose of the sand blanket is to minimize re-suspension of underlying contaminated sediments, while piles are being driven and later removed.

5. Following the initial excavation within the two 71-ft. by 71-ft. cofferdams, they will be backfilled to depth of approximately 42 ft. to support the initial caisson construction. The volume required will be 15,710 cy (7,855 cy within each cofferdam), which will be upland sourced material. As noted in Table 2, 5,415 cy will be removed within each bascule cofferdam for bascule pier construction. Once the caissons are in place, the backfill material remaining between the caissons and the interior walls of the cofferdams will be removed down to the riverbed prior to removing the cofferdam structures. That volume would represent an additional volume of backfill material of 1,040 cy per pier (2,080 cy total). Upland sourced material is not suitable for unconfined open-water disposal.

6. Sampling and Analysis Plan Submittal/Approval. The SAP was submitted to the DMMP for review on January 13, 2009 with an anticipated sampling date of January 19, 2009, which did not give the DMMP agencies enough time to formally complete their review and approval of the SAP before sampling was initiated, although DMMP agencies had previously approved the sampling design.

7. Phase I Sampling. Sampling was initiated on January 20, 2009 and completed on January 27, 2009 with a mud rotary drill rig during Phase I at three stations within the South Bascule, and at four stations within the North Bascule as summarized in Tables 2 and 3 (DMMU's SB-2, NB-1, and NB-2), and depicted in Figure 1.

8. Phase II Sampling. Sampling was initiated on February 10, 2010 and completed on February 12, 2010 at the previously occupied three coring stations (mud rotary drill) in the South Bascule, and the previously occupied four coring stations at the North Bascule (Table 3). Samples at the South bascule were collected and composited for analysis of the 6 – 10 ft layer (DMMU-SB-1) for DMMP analytes, excluding dioxin[1], whereas the cores collected within DMMU-NB-1 (10 – 14 ft layer) at the North bascule for bioaccumulation testing.

9. The Phase 1 testing for DMMU's SB-2 and NB-1 included evaluation of dioxins/furans, as well as the PSDDA/DMMP Chemical of Concern list, including TBT. The sampling and analysis plan was generally followed. The sampling and analysis characterization report was initially submitted on June 30, 2010 to the DMMP agencies for review, and a revised report was submitted on August 13, 2010, which corrected dioxin TEQ summaries incorrectly tabulated in earlier report. This report also contained the Phase 2 bioaccumulation testing results as well as NB-1 sediment chemistry for the 14 to 18 ft depths. After reviewing, 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.

10. 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 Phase 1 and 2 chemical analysis results for all COC except dioxins/furans is provided in Table 4, and demonstrates that all chemicals other than dioxin were either detected or undetected under the DMMP Guidelines except PCBs and Total DDT within DMMU-NB-1 (10 to 14 ft depth). PCBs in this sample (91 mg/kg-organic carbon normalized) exceeded both SL and Bioaccumulation Trigger in this sample, and DDT was undetected over the SL (28 ug/kg U). Based on these testing results, DMMU-NB-1

1 The DMMP decided that dioxin analysis was not required for the Phase 2 testing of DMMU SB-1 (6 – 10 ft below mudline) based on weight-of-evidence in light of low dioxin concentrations observed (0.888 pptr-TEQ) in the Phase 1 SB-2 sample, which represents the underlying sediments (10 - 14ft below mudline) at this location. Additionally, chemical concentrations were low for all other COCs from SB-1.

was first subject to toxicity testing described in paragraph 14 below, and subsequently to bioaccumulation testing for PCBs described below in paragraphs 15 through 23.

11. Dioxin Testing Results Summary. Table 5 provides the results of dioxin/furan testing results for two DMMUs as follows: DMMU-SB-2 = 0.685 pptr-TEQ and DMMU-NB-1 = 1.57 pptr-TEQ (U = ½ detection limit).

12. 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 2010. The interim guidelines provide 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:

    a. Comparison of dioxin in test sediments to disposal-site background
    b. 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
    c. Dioxin concentrations in any given DMMU may not exceed the site maximum (12.2 pptr-TEQ)
    d. Average dioxin concentrations (weighted to the volume of each DMMU cannot exceed the mean site concentration (**8.7 pptr-TEQ**)

13. Dioxin Interpretation on Suitability for Unconfined-Open-Water Disposal. As summarized in paragraph 9 above, DMMU-SB-2 and DMMU-NB-1 were quantitated below the site maximum of 12.2 pptr-TEQ and below the offsite average of 8.7 pptr-TEQ, and would be suitable for unconfined open-water disposal at the Elliott Bay site based on these testing results. The volume weighted average for these two DMMUs is 1.13 pptr-TEQ, which is well below the offsite average of 8.7 pptr-TEQ (Table 6).

14. Toxicity Testing Results for DMMU-NB-1. Table 7a depicts the toxicity testing summary for DMMU-NB-1 due to PCB SL exceedances. Testing was conducted within the 8-week holding time, and the three toxicity tests met all data quality objectives and test acceptability guidelines specified by the DMMP, including control and reference sediment (Carr Inlet) (Table 7b). The bivalve larval test (*Mytilus galloprovincialis*) exhibited a 2-hit response under the non-dispersive site guidelines, and a 1-hit response under the dispersive site guidelines. No other hits were recorded for the other two toxicity tests (e.g., 10-acute toxicity test with *Eohaustorius estuaries*; and the 20-day juvenile polychaete survival and growth bioassay with *Neanthes arenaceodenta*). Therefore, based on these testing results, DMMU-NB-1 is suitable for non-dispersive site disposal at the Elliott Bay site.

15. Bioaccumulation Testing. Bioaccumulation testing of DMMU-NB-1 was performed with *Macoma nasuta*, a facultative deposit feeding/suspension feeding bivalve and *Nephtys caecoides*, a burrowing facultative deposit feeding/carnivorous polychaete. The two species were tested together in the same 10-gallon aquaria. The standard PSDDA bioaccumulation test duration is 28 days, but was extended to 45-days to provide a better approximation of steady-state tissue concentrations for the tested chemical (total PCBs) (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/bioac_00-erratum_09.pdf).

16. As called for in the bioaccumulation protocol, five replicate 10-gallon aquaria were utilized for the negative control, the reference sediment, and for the single tested DMMU-NB-1. Routine water quality metrics (temperature, salinity, dissolved oxygen, pH) were monitored during the exposure period, and the testing conditions employed were Temperature: 15 ± 1°C; Salinity: >25 ‰ ± 2 ‰; Photoperiod: 16 hours/Light: 8 hours/Dark; with gentle aeration to insure that dissolved oxygen does not fall below 40% saturation. All surviving test organisms at the end of the test were depurated 24-hours prior to storing for analysis. During the exposure period, supplemental sediment additions of 0.175 L/week were added to each replicate aquarium, beginning on day 7 of the test. No supplemental feeding of test species was conducted during the 45-day exposure period.

Table 4. South Park Bridge: DMMP Characterization Report Summary

					DMMU ID:			DMMU-SB-1 (South Bascule)			DMMU-SB-2 (South Bascule)			DMMU-NB-1 (North Bascule)			DMMU-NB-2 (North Bascule)		
								Depth: 6 -10 ft (Phase 2)			Depth: 10-14 ft (Phase 1)			Depth: 10 - 14 ft (Phase 1)			Depth: 14 - 18 ft (Archived) (Phase 1)		
		DMMP				SMS		mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ
CHEMICAL NAME	Units	SL	BT	ML	Units	SQS	CSL	DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Antimony		150		200				7.0		u	7.0		uj	6.0		uj	**NT**		
Arsenic	mg/kg	57	507.1	700	mg/kg	57	93	**8.0**			7.0		u	6.0		u	**NT**		
Cadmium	mg/kg	5.1	11.3	14	mg/kg	5.1	6.7	0.30		u	0.30		u	0.30		u	**NT**		
Chromium	mg/kg	(2)	267	(2)	mg/kg	260	270	**18.3**			**15.9**			**12.4**			**NT**		
Copper	mg/kg	390	1,027	1,300	mg/kg	390	390	**19.5**			**18.5**			**16.7**			**NT**		
Lead	mg/kg	450	975	1,200	mg/kg	450	530	**5.0**			**7.0**			**5.0**			**NT**		
Mercury	mg/kg	0.41	1.5	2.3	mg/kg	0.41	0.59	**0.04**			**0.07**			0.06		u	**NT**		
Nickel	mg/kg	140	370	370	mg/kg	--	--	**14.0**			**11.0**			**8.0**			**NT**		
Selenium	mg/kg	(2)	**3**	(2)	mg/kg	--	--	0.70		u	0.7		u	0.7		u	**NT**		
Silver	mg/kg	6.1	6.1	8.4	mg/kg	6.1	6.1	0.4		u	0.4		u	0.40		u	**NT**		
Zinc	mg/kg	410	2,783	3,800	mg/kg	410	960	**39.0**			**40.0**			**30.0**			**NT**		
TBT ion (porewater)	ug/L	0.15	0.15		ug/L	0.05	0.35	0.008		u	0.008		u	0.008		u	**NT**		
Naphthalene	ug/kg	2,100		2,400	mg/kg-OC	99	170	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Acenaphthylene	ug/kg	560		2,000	mg/kg-OC	66	66	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Acenaphthene	ug/kg	500		2,000	mg/kg-OC	16	57	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Fluorene	ug/kg	540		3,600	mg/kg-OC	23	79	55.0	**4.8**		19.0	1.76	u	20.0	2.0	u	**NT**		
Phenanthrene	ug/kg	1,500		2,100	mg/kg-OC	100	480	19.0	1.7	u	**21.0**	**1.94**		**14.0**	**1.4**	j	**NT**		
Anthracene	ug/kg	560		13,000	mg/kg-OC	220	1,200	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
2-Methylnapthalene	ug/kg	670		1,900	mg/kg-OC	38	64	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Total LPAH	ug/kg	5,200		29,000	mg/kg-OC	370	780	55.0	4.8	u	**21.0**	**1.94**		**14.0**	**1.4**		**NT**		
Fluoranthene	ug/kg	1,700	4,600	30,000	mg/kg-OC	160	1,200	19.0	1.7	u	**39.0**	**3.61**		**36.0**	**3.6**		**NT**		
Pyrene	ug/kg	2,600	11,980	16,000	mg/kg-OC	1,000	1,400	**44.0**	**3.9**		**34.0**	**3.15**		**61.0**	**6.1**		**NT**		
Benzo(a)anthracene	ug/kg	1,300		5,100	mg/kg-OC	110	270	19.0	1.7	u	**13.0**	**1.20**	j	**21.0**	**2.1**		**NT**		
Chrysene	ug/kg	1,400		21,000	mg/kg-OC	110	460	19.0	1.7	uj	**15.0**	**1.39**	j	**27.0**	**2.7**		**NT**		
Total Benzo(b+k)fluoranthenes	ug/kg	3,200		9,900	mg/kg/OC	230	450	19.0	1.7	uj	19.0	1.76	u	**52.0**	**5.2**	j	**NT**		
Benzo(a)pyrene	ug/kg	1,600		3,600	mg/kg-OC	99	210	19.0	1.7	u	19.0	1.76	u	**24.0**	**2.4**		**NT**		
Indeno(1,2,3-cd)pyrene	ug/kg	600		4,400	mg/kg-OC	34	88	19.0	1.7	u	19.0	1.76	u	**10.0**	**1.0**	j	**NT**		
Dibenzo(a,h)anthracene	ug/kg	230		1,900	mg/kg-OC	12	33	**24.0**	**2.1**		19.0	1.76	u	20.0	2.0	u	**NT**		
Benzo(g,h,l)perylene	ug/kg	670		3,200	mg/kg-OC	31	78	19.0	1.7	u	19.0	1.76	u	**12.0**	**1.2**	j	**NT**		
Total HPAH	ug/kg	12,000		69,000	mg/kg-OC	960	5,300	**68.0**	**6.0**		**62.0**	**5.74**	j	**233**	**23.3**	j	**NT**		
1,3-Dichlorobenzene	ug/kg	170			mg/kg-OC	2.3	2.3	1.0	0.1	u	1.4	0.13	u	1.2	0.12	u	**NT**		
1,4-Dichlorobenzene	ug/kg	110		120	mg/kg-OC	3.1	9	1.0	0.1	u	1.4	0.13	u	1.2	0.12	u	**NT**		
1,2-Dichlorobenzene	ug/kg	35		110	mg/kg-OC	2.3	2.3	1.0	0.1	u	1.4	0.13	u	1.2	0.12	u	**NT**		
1,2,4-Trichlorobenzene	ug/kg	31		64	mg/kg-OC	0.81	1.8	5.2	0.5	u	6.8	0.63	u	5.8	0.58	u	**NT**		
Hexachlorobenzne (HCB)	ug/kg	22	168	230	mg/kg-OC	0.38	2.3	0.96	0.1	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Dimethylphthalate	ug/kg	71		1,400	mg/kg-OC	53	53	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Diethylphthalate	ug/kg	200		1,200	mg/kg-OC	61	110	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Di-n-butylphthalate	ug/kg	1,400		5,100	mg/kg-OC	220	1,700	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Butylbenzylphthalate	ug/kg	63		970	mg/kg-OC	4.9	64	19.0	1.7	u	19.0	1.76	u	**13.0**	**1.3**	j	**NT**		
Bis(2-ethylhexyl)phthalate	ug/kg	1,300		8,300	mg/kg-OC	47	78	19.0	1.7	u	**67.0**	**6.20**		**280.0**	**28.0**		**NT**		
Di-n-octylphthalate	ug/kg	6,200		6,200	mg/kg-OC	58	4,500	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Phenol	ug/kg	420		1,200	ug/kg	420	1,200	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
2-Methylphenol	ug/kg	63		77	ug/kg	63	63	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
4-Methylphenol	ug/kg	670		3,600	ug/kg	670	670	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
2,4-Dimethylphenol	ug/kg	29		210	ug/kg	29	29	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Pentachlorophenol	ug/kg	400		690	ug/kg	360	690	97.0	8.5	u	97.0	8.98	u	99.0	9.9	u	**NT**		
Benzyl alcohol	ug/kg	57		87	ug/kg	57	73	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Benzoic acid	ug/kg	650		760	ug/kg	650	650	190.0	16.7	u	190.0	17.6	u	200.0	20.0	u	**NT**		
Dibenzofuran	ug/kg	540		1,700	mg/kg-OC	15	58	**NT**			**NT**			**NT**			**NT**		
Hexachloroethane	ug/kg	600		1,600	mg/kg-OC			19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Hexachlorobutadiene	ug/kg	29		270	mg/kg-OC	3.9	6.2	0.96	0.1	u	19.0	1.76	u	20.0	2.0	u	**NT**		
N-Nitrosodiphenylamine	ug/kg	280		130	mg/kg-OC	11	11	19.0	1.7	u	19.0	1.76	u	20.0	2.0	u	**NT**		
Trichloroethene	ug/kg	160		1,600	ug/kg	--	--	1.0		u	1.4		u	1.2		u	**NT**		
Tetrachloroethene	ug/kg	57		210	ug/kg	--	--	1.0		u	1.4		u	1.2		u	**NT**		
Ethylbenzene	ug/kg	10		50	ug/kg	--	--	1.0		u	1.4		u	1.2		u	**NT**		
Total Zylene (sum of o-,m-,p-)	ug/kg	40		160	ug/kg	--	--	1.0		u	1.4		u	1.2		u	**NT**		
4,4'-DDE	ug/kg							1.9		u	2.0		u	8.8		u	**NT**		
4,4'-DDD	ug/kg							1.9		u	2.0		u	8.8		u	**NT**		
4,4'-DDT	ug/kg							1.9		u	2.0		u	28.0		u	**NT**		
Total DDT (sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT)	ug/kg	6.9	50	69		--	--	1.9		u	2.0		u	28.0		u	**NT**		
Aldrin	ug/kg	10				--	--	1.9		u	0.98		u	4.4		u	**NT**		
Chlordane	ug/kg	10	37			--	--	0.96		u	0.98		u	4.4		u	**NT**		
Dieldrin	ug/kg	10				--	--	1.9		u	2.0		u	8.8		u	**NT**		
Heptachlor	ug/kg	10				--	--	0.96		u	0.98		u	4.4		u	**NT**		
Alpha-BHC	ug/kg		10			--	--	0.96		u	0.98		u	4.4		u	**NT**		
Gamma-BHC (Lindane)	ug/kg	10				--	--	0.96		u	0.98		u	4.4		u	**NT**		
Aroclor 1016	ug/kg							3.9		u	19.0		u	88.0		u	19.0		u
Aroclor 1221	ug/kg							3.9		u	19.0		u	88.0		u	19.0		u
Aroclor 1232	ug/kg							3.9		u	19.0		u	88.0		u	19.0		u
Aroclor 1242	ug/kg							3.9		u	19.0		u	88.0		u	19.0		u
Aroclor 1248	ug/kg							3.9		u	19.0		u	110.0		u	19.0		u
Aroclor 1254	ug/kg							3.9		u	19.0		u	**360.0**			19.0		u
Aroclor 1260	ug/kg							3.9		u	19.0		u	**550.0**			19.0		u
Total PCBs	**ug/kg**	**130.0**	**38*****	**3,100.0**				3.9		u	19.0		u	**910.0**			19.0		u
Total PCBs (TOC-normalized)	**mg/kg**				**mg/kg-OC**	**12.0**	**65.0**	0.34	0.34	u		1.8	u	**91.0**	**91.0**			2.4	u

Table 4. South Park Bridge: DMMP Characterization Report Summary

						DMMU ID:		DMMU-SB-1 (South Bascule)			DMMU-SB-2 (South Bascule)			DMMU-NB-1 (North Bascule)			DMMU-NB-2 (North Bascule)		
								Depth: 6 -10 ft (Phase 2)			Depth: 10-14 ft (Phase 1)			Depth: 10 - 14 ft (Phase 1)			Depth: 14 - 18 ft (Archived) (Phase 1)		
			DMMP			SMS		mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ	mg/kg-dry wgt	mg/kg-OC	VQ
CHEMICAL NAME	Units	SL	BT	ML	Units	SQS	CSL	DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Dioxin (TEQ: see Table 6 for detailed results)	ng/kg										0.685			1.57					
Total Solids	%							71.0			68.1			70.1, 74.5			75.6		
Total Volatile Solids	%							3.06			2.7			2.1			NT		
Total Organic Carbon	%							1.14			1.08			1.0 (BT = .736)			0.79		
Total Ammonia	mg/kg							44.6			50.4			14.5			6.45		
Total Sulfides	mg/kg							308.0			384.0			397.0			63.4		
Gravel	%							0.8			3.3			3.1			1.2		
Sand	%							75.5			64.6			78.5			90.8		
Silt	%							20.7			25.4			14.4			5.3		
Clay	%							3.6			6.6			4.0			2.6		
Fines (percent silt + clay)	%							24.3			32.0			18.4			7.9		
Eohaustorius estuarius hits:														NH					
Mytilus galloprovincialis hits:														2H					
Neanthes arenaceodentata hits:														NH					
Bioassay Determination: **(P/F)**								NA			NA			PASS (ND)			NA		
BTs exceeded:								No			No			Yes			No		
Bioaccumulation conducted:								No			No			Yes			No		
Bioaccumulation Determination: **(P/F)**														PASS (BPJ)					
ML Rule exceeded:								No			No			No			No		
PSDDA Determination:								PASS			PASS			PASS (ND)			PASS		
DMMU Volume:	cy							750			750			750			750		
Rank											H			H					
Mean Core sampling depth	ft							4'			4'			4'			4'		
Maximum sampling depth (mudline) (with Z-sample)	ft							6' to 10 '			10' to 14'			10' to 14'			14' to 18'		
DMMU ID:								DMMU-SB-1 (South Bascule)			DMMU-SB-2 (South Bascule)			DMMU-NB-1 (North Bascule)			DMMU-NB-2 (North Bascule)		

Legend:

SL = Screening Level exceedance
BT = Bioaccumulation Trigger exceedance
P = Pass (Suitable for UCOWD)
SQS = Sediment Quality Standards exceedance (SMS)
CSL = Cleanup Screening Level exceedance (SMS)
NH = No Hit
NT = Not Tested
2H = 2 Hit Response
ND = Nondispersive site Disposal

VQ = Validation Qualifier
UCOWD = Unconfined open-water disposal
u = undetected at the reporting limit
uj = result undetected at the estimated reporting limit shown
j = Estimated Concentration (< reporting limit)

Table 5. South Park Bridge Dioxin Testing Results Summary

Dioxin/furan	WHO (05) TEF	DMMU ID / Sample Depth / Unit	DMMU-SB-2 (South Bascule) -10 to 14 ft (MLLW) DMMU-S1	LQ	TEQ	DMMU-NB-1 (North Bascule) -10 to 14 ft (MLLW) DMMU-S2	LQ	TEQ
2,3,7,8-TCDD 1		ng/kg dw	0.0446	u	0.0223	**0.0811**		**0.0811**
1,2,3,7,8-PeCDD 1		ng/kg dw	0.223	u	0.1115	0.222	u	0.111
1,2,3,4,7,8-HxCDD 0.1		ng/kg dw	0.223	u	0.01115	0.222	u	0.0111
1,2,3,6,7,8-HxCDD 0.1		ng/kg dw	0.293	u	0.01465	**1.21**		**0.121**
1,2,3,7,8,9-HxCDD 0.1		ng/kg dw	0.223	u	0.01115	**0.523**		**0.0523**
1,2,3,4,6,7,8-HpCDD 0.01		ng/kg dw	**6.48**		**0.0648**	**33.7**		**0.337**
OCDD 0.0003		ng/kg dw	**62.8**		**0.01884**	**275**		**0.0825**
2,3,7,8-TCDF 0.1		ng/kg dw	0.116	u	0.0058	**0.201**		**0.0201**
1,2,3,7,8-PeCDF 0.03		ng/kg dw	0.223	u	0.003345	0.222	u	0.00333
2,3,4,7,8-PeCDF	0.3	ng/kg dw	**0.612**		**0.1836**	**0.787**		**0.2361**
1,2,3,4,7,8-HxCDF	0.1	ng/kg dw	**1.03**		**0.103**	**2.06**		**0.206**
1,2,3,6,7,8-HxCDF	0.1	ng/kg dw	0.263	u	0.01315	**0.553**		**0.0553**
1,2,3,7,8,9-HxCDF	0.1	ng/kg dw	**0.476**		**0.0476**	**0.786**		**0.0786**
2,3,4,6,7,8-HxCDF	0.1	ng/kg dw	0.223	u	0.01115	0.288	u	0.0144
1,2,3,4,6,7,8-HpCDF	0.01	ng/kg dw	**5.62**		**0.0562**	**12.8**		**0.128**
1,2,3,4,7,8,9-HpCDF	0.01	ng/kg dw	**0.407**		**0.00407**	**1.38**		**0.0138**
OCDF	0.0003	ng/kg dw	**7.93**		**0.002379**	**59.8**		**0.01794**
Total TEQ: (u = 1/2)					**0.685**			**1.57**
Total TEQ: (u = 0)					**0.48**			**1.43**
Total TOC, %:					**1.08**			**1.0, 0.736**

LQ = Laboratory Qualifier

U = not detected at given concentration

Table 6. South Park Bridge Volume Weighted Average (VWA) Dioxin Concentrations

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
SB-2	-10 to -14'	750	0.685	ng/kg-dw	514	ng x cy/kg	30%	% of Total DMMU
NB-1	-10 to -14'	750	1.57	ng/kg-dw	1,178	ng x cy/kg	70%	% of Total DMMU
Totals (Suitable):		1,500	cy		1,691	ng x cy/kg	1.13	ng/kg-dw/Project (VWA)

Table 7a. Bioassay Testing Results Summary for DMMU-NB-1 (10-14 ft)

Bioassay Evaluation Guidelines	Amphipod Test Criteria	Results	Status	Larval Test Criteria	Results	Status	Neanthes Test Criteria	Results	Status	DMMP Determination
Negative control performance standard		0%	Pass	Nc/I ≥ 0.70	0.99	Pass	Mc ≤ 10%	0%	Pass	
							MIGc ≥ 0.38	0.75	Pass	
Reference sediment performance standard	Mr-Mc ≤ 20%	3%	Pass	Nr/Nc ≥ 0.65	0.84	Pass	Mr ≤ 20%	4%	Pass	
							MIGr/MIGc ≥ 0.80	1.1	Pass	
Dispersive disposal	Mt - Mc > 20%	1.0%	Pass	Nt/Nc < 0.80	0.585	**Yes**	MIGt/MIGc < 0.80	1.1	Pass	**Not Suitable Dispersive Site Disposal**
	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%	2.0%	Pass	Nr/Nc - Nt/Nc > 0.15	0.26	**1-Hit**	MIGt/MIGr < 0.70	1.0	Pass	
Non-dispersive disposal	Mt - Mc > 20%	1.0%	Pass	Nt/Nc < 0.80	0.585	**Yes**	MIGt/MIGc < 0.80	1.1	Pass	**Suitable Non-Dispersive Site Disposal**
	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%	2.0%	Pass	Nr/Nc - Nt/Nc > 0.30	0.26	**2-Hit**	MIGt/MIGr < 0.50	1.0	Pass	

Legend.

M = mortality

N = normal larvae

I = Initial Count

MIG = mean individual growth rate

Table 7b. – DMMP EVALUATION GUIDELINES (BIOASSAYS)

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

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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17. The following deviations from the standard DMMP bioaccumulation testing protocol occurred and were not brought to the attention of the DMMP agencies until the conclusion of the test:

    a) In resampling to collect the sediment required to conduct the bioaccumulation test for DMMU-NB-1, the applicant failed to collect sufficient volume of test sediment as prescribed by the bioaccumulation protocol. Therefore, the testing laboratory (Northwestern Aquatic Sciences) utilized 3.4 L of sediment/aquaria, rather than the 4.0 L / aquaria called for by the protocol.

    b) As a result of the lower volume of sediment available for bioaccumulation testing, the initial stocking density of both test species (Macoma, *Nephtys*) was lower than recommended by the protocol (*Macoma*: stocked with 12 clams rather than 15 recommended; *Nephtys*: stocked with 20 worms rather than 60 recommended by protocol).

    c) The lower stocking density combined with weight loss during the 45-day testing exposure period resulting in insufficient biomass for both species to accomplish the 5-replicate analysis per treatment (e.g., control, reference, test sediment) recommended by the bioaccumulation protocol. For *Nephytys*, there was sufficient biomass to conduct only single un-replicated analyses of initial and 45-day control, reference, and test sediment. For *Macoma*, 3 replicate analyses were conducted for Day 0 (control), 45-Day control, and test sediment, with sufficient biomass for the full five replicate analyses for the *Macoma* reference treatment.

18. Survival was generally good as shown in Attachment 2 for both test species, with higher survival noted for *Nephtys*. Attachment 3 summarizes the initial and final biomass for both Macoma and *Nephtys* on day 0 and day 45 of the test, and both species lost weight during the exposure period, with *Macoma* averaging 79% of the initial weight. Forty-five-day *Nepthys* lost more weight compared to *Macoma*, weighing 51% of the initial worm weight in controls. Weight losses observed in reference and treatment (NB-1) were 67% and 62%, respectively, as compared to the initial weights, which were somewhat higher than the control worms.

19. <u>Tissue Chemistry</u>. Attachment 4 provides the full PCB Aroclor analysis results for both species for PCB tissue analyses. As noted earlier, there was insufficient biomass for both species at the end of the 45-day exposure period to conduct the full five replicate analyses per treatment (e.g., control, reference, test sediment) as required by the DMMP bioaccumulation protocol.

20. Tissue concentrations of PCB from the 45-day exposures were compared statistically to the appropriate reference sediment for *Macoma* only. As noted in Table 8, the calculated ratios of initial to retested sediment PCB concentrations were used to adjust the observed tissue concentrations, as the retested PCBs were lower than the initial result by a 5.1 ratio. Statistical comparisons of the test DMMU and reference tissue concentrations for the final interpretation "worst case" analyses were based on the adjusted tissue concentrations. The summary PCB tissue data interpretation is provided in Table 9.

21. <u>Bioaccumulation Interpretation</u>. The DMMP agencies agreed that comparing statistical differences from reference is a necessary, but not sufficient condition to determine a DMMU unsuitable for open-water disposal. For those DMMUs that were statistically greater than reference, a more in depth evaluation was required to determine the significance of the bioaccumulation that had occurred. This evaluation focused on a) Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food; b) DMMP target tissue concentration value for chemicals of concern to human health.

Table 8. Sediment: Initial and Retested Total PCB Ratio for DMMU-NB-1

DMMU-NB-1 (10 -14 ft) North Bascule				
Chemical	Units	Initial (I)	Retest (R)	**Ratio: I/R**
Total PCB (dry weight)	ug/kg	910	180	**5.1**
Total PCBs (TOC normalized)	mg/kg	91.0	24	**3.8**
TOC %	%	1.0	0.736	

Table 9. Bioaccumulation Testing Results Summary for DMMU-NB-1*

			DMMU_NB-1 (10 - 14 ft)											
			Macoma nasuta						Nephtys caecoides					
CHEMICAL NAME	Units	Guideline	DMMU tissue (Initial)(m	DMMU tissue (unadjusted)	DMMU tissue (adjusted)	Reference (CR-23 Mod)	Statistically different from reference	statistically below guideline	DMMU tissue (Initial)	DMMU tissue (unadjusted)	DMMU tissue (adjusted)	Reference (CR-23 Mod)	Statistically different from reference	statistically below guideline
Total PCBs	ug/kg-ww	750	5 (u)	**121**	**617**	4 (u)	**Yes**	**Yes**	8 (u)	**65**	**332**	4 (u)	**ND**	**ND**

Note: (1) All tissue concentrations for Total PCBs were analyzed on a wet weight basis to facilitate guideline

(2) Adjustments to tissue concentrations based on initial sediment versus retested sediment concentration ratios (see Table 8).
Concentration ratios greater than 1 were adjusted.

ND = Not Determined

	Target Tissue Guideline exceeded
NFAR	**No further Action Required, DMMU Unsuitable for unconfined-open water disposal**

***Attachment 1** provides full Bioaccumulation Tissue PCB Aroclor Testing Summary

a) The FDA guidelines for PCBs is as follows: 2.0 ppm ww

b) The DMMP TTL for PCBs: 750 ppb (0.75 ppm) ww

22. The DMMP agencies re-evaluated the PCB TTL for human health (December 1999 DMMP Memo attached as Attachment 5). Recalculation of the PCB TTL for the Elliott Bay disposal site included using an updated cancer slope factor, recent fish consumption data, and consideration of PCB biomagnification due to trophic transfer. Based on this analysis, an interim TTL for total PCBs (Aroclor) of 750 ppb (0.75 ppm) wet weight was used to interpret bioaccumulation data for the South Bridge Project. These guidelines will likely change in the future as the DMMP review the bioaccumulation testing and TTLs guidance for Puget Sound.

23. The bioaccumulation testing results for both species using sediments from DMMU-NB-1 were compared to the TTL interpretation guideline. The single DMMU was quantitated less than the TTL for both species, and was subjected to a one-tailed one-sample t-test for the replicated *Macoma* tissue (see Table 9). An alpha level (the probability of making a Type I error, rejecting the null hypothesis of no difference between test, reference, and TTL responses when, in fact, they are not different) of 0.1 was selected for these statistical comparisons by the DMMP agencies to reflect the higher within sample variability, and to increase the power of the test to discriminate between reference, TTL and test responses. The test results for *Macoma* were statistically greater than the reference sediment, but below the TTL. Therefore, based on these bioaccumulation testing results DMMU-NB-1 sediments are suitable for open-water disposal at the Elliott Bay site.

24. <u>Suitability for Unconfined-Open Water Disposal</u>. Table 10 provides the testing results summary for four tested DMMUs (SB-1, SB-2, NB-1, and NB-2) amounting to 3,000 cy. DMMU-SB-3 (750 cy) underlying tested DMMU's SB-1 and SB-2 was found to be suitable based on best professional judgment, after reviewing the overlying sediment quality results for SB-1 and SB-2. Native material underlying South and North bascules, amounting to 8,000 cy and 11,500cy respectively was found to be suitable based on best professional judgment after reviewing the overlying sediment quality results at both locations. The results summarized in this suitability determination indicate that a total volume of 23,250 cy is suitable for unconfined-open-water disposal at the Elliott Bay non-dispersive site.

25. As summarized in Table 10, surface material amounting to a total cumulative volume of 3,057.4 cy at both bascules (includes 60.4 cy of sand blanket material), which was not tested during this characterization effort, but sediment testing conducted in 2004[2] were previously reviewed by DMMP, and found to be unsuitable for unconfined-open-water disposal (Attachment 1). At the South bascule, the top 6 feet of material (cumulative volume = 1,150.2 cy, which also includes removal of 30.2 cy sand blanket), and at the North bascule, the top 10 feet of material (cumulative volume = 1,897.2 cy, which also includes removal of 30.2 cy sand blanket) is unsuitable for open-water disposal, and must be disposed at an Ecology approved upland disposal site.

26. As previously discussed, and summarized in Table 10, the 5,415 cy of backfilled upland sourced material will be removed within each bascule cofferdam after bascule pier construction for a total of 10,830 cy. Once the caissons are in place, the backfill material remaining between the caissons and the interior walls of the cofferdams will be removed down to the riverbed prior to removing the cofferdam structures. That volume would represent an additional volume of backfill material of 1,040 cy per pier, or 2,080 cy total.

27. This memorandum documents the suitability testing outcome for the testing conducted for the proposed dredging at the South Park Bridge Project for unconfined-open-water disposal at the Elliott Bay non-dispersive disposal

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2 Wilbur Consulting. 2004. Final preliminary site investigation report for the South Park Bridge project. Prepared for King County Department of Transportation. Wilbur Consulting, Inc., Seattle, WA

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.

Table 10. DMMU Specific and Total Project Testing Outcome Summary (Errata revision: 12/9/10).

Location	Depth Interval (ft) Below mudline	DMMU ID	Original Estimated Volume (cy)	Revised Volume Estimate (cy)	Suitability Outcome
South bascule	0 – 6	None	1,100	1,150.2 (includes 30.2 cy sand blanket)	Unsuitable based on previous testing results (Wilbur, 2004)
	6 – 10	SB-1	750	*	Suitable
	10 – 14	SB-2	750	*	Suitable
	14 – 18	SB-3	750	*	Suitable (no testing required based on overlying sediment quality results)
	18 – 75	None	8,000	*	Suitable: Native (no testing required)
	Cofferdam backfill material excavated for caisson construction	None	Omitted	5,415	Unsuitable
	Backfill material removed prior to cofferdam removal	None	Omitted	1,040	Unsuitable
North bascule	0 – 10	None	1,850	1,897.2 (includes 30.2 cy sand blanket)	Unsuitable based on previous testing results (Wilbur, 2004)
	10 – 14	NB-1	750	*	Suitable (based on toxicity and bioaccumulation testing results)
	14 – 18	NB-2	750	*	Suitable (PCB testing only)
	18 – 100	None	11,500	*	Suitable: Native (no testing required)
	Cofferdam backfill material excavated for caisson construction	None	Omitted	5,415	Unsuitable
	Backfill material removed prior to cofferdam removal	None	Omitted	1,040	Unsuitable
Total estimated Suitable volume			23,250 cy	*	
Total estimated Unsuitable volume			2,950 cy	3,057.4 cy (includes 60.4 cy sand blanket)	Based on 2004 testing results (Wilbur Consulting, 2004)
			Omitted	12,910 cy backfill material	

*The estimated volumes are either unchanged or lower than the original volume estimates

SUBJECT: DETERMINATION ON THE SUITABILITY OF SUPPLEMENTAL CHARACTERIZATION OF PROPOSED DREDGED MATERIAL FROM KING COUNTY DEPARTMENT OF TRANSPORTATION SOUTH PARK BRIDGE PROJECT (CORPS APPLICATION: NWS-2009-1586) DREDGING PROJECT 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

Concur:

12/20/2010
Date

David R. Kendall, Ph.D., Seattle District Corps of Engineers

12/13/2010
Date

Erika Hoffman, Environmental Protection Agency

12/13/2010
Date

Laura Inouye, Ph.D., Washington Department of Ecology

12/14/2010
Date

Dave Vagt, Washington Department of Natural Resources

Copied furnished:
Jack Kennedy, Corps Regulatory Project Manager
Jim Sussex, King County
Joanna Florer, Windward Environmental
Erika Hoffman, EPA
Laura Inouye, Ph.D. Department of Ecology
Dave Vagt, DNR
DMMO file

Attachment 1. DMMP Coordination on SPB Project

From: Kendall, David R NWS [mailto:David.R.Kendall@usace.army.mil]
Sent: Tuesday, December 16, 2008 2:40 PM
To: Turney, Julia
Cc: WASSON, COURTNEY (DNR); Inouye, Laura (ECY);
Hoffman.Erika@epamail.epa.gov
Subject: RE: Dredged Material Management Program Review of the South Park Bridge Foundation Sampling Data
Importance: High

Hi Julia: After reviewing your questions, and coordinating with my DMMP agency counterparts (e.g. I received input back from EPA and Ecology), here is our interpretation on an approach that DMMP would consider for characterization purposes.

1. The 0-10 ft dredging prisms for both North and South Piers would be considered unsuitable with upland disposal, and no DMMP Characterization.

The DMMP Characterization would include the following:
2. Collect a single core sample at each location (e.g., North Pier and South Pier) from 0-18 ft below mudline, with one vertically composited sample collected from the 10-14 ft layer for analysis of DMMP Chemicals of Concern (The full DMMP list + dioxin/furans), and one vertically composited sample from the 14-18 ft layer (archived). Depending onn the analysis results of the two 10-14 ft composited samples, the archived samples may be analyzed, if the overlying sample results indicate that sediment quality exceedances of DMMP COC are noted.

3. Collect and archive enough sample from each location (10-14 ft) for toxicity testing if needed.

4. The 18 ft to 75 ft and 18 ft to 100 ft material would be considered "Native" material and not subject to DMMP testing, and would be considered suitable for unconfined-open-water disposal.

5. A Sampling and analysis plan would need to be submitted/approved prior to collecting samples as outlined. I have linked our Chemical of Concern

List and links to our Users Manual, which provide general information regarding sampling requirements.
http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/2007_COCs.pdf
http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/July_2008_UM.pdf

Please let me know if you have further questions.

David

David R. Kendall, Ph.D.
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email: david.r.kendall@nws02.usace.army.mil

From: Turney, Julia [mailto:Julia.Turney@kingcounty.gov]
Sent: Friday, December 12, 2008 3:22 PM
To: Kendall, David R NWS
Cc: LINO461@ecy.wa.gov; Hoffman, Erika; courtney.wasson@dnr.wa.gov
Subject: RE: Dredged Material Management Program Review of the South Park Bridge Foundation Sampling Data

Hi David,

Thank you for your comments. This feed back is very helpful and we appreciate your offer to work with our consultant to develop the sampling plan. You had asked a question about depth to native sediments and material volumes. I've responded to these questions below and have included a question that was raised during our discussions yesterday. I left you a voice mail about this today.

1) You had asked a question about where "native ground" started. The boring logs for SB-4 and SB-5 in the Duwamish identify the change from fill to alluvial deposits between 10 and 20 feet below ground surface (bgs), 16 feet bgs in Boring SB-5. This depth is consistent with the excavation and dredge records for the Duwamish channel. The sediment density (as determined from blow counts during drilling) increases below 10 feet, indicating that native ground has been reached. You noted the high sediment quality below 50 feet.

This depth is the transition zone between sand-silt sediments and predominately finer silt deposits.

2) The sediment volume estimates for the upper contaminated sediments (historic Duwamish deposits since 1911) would be 70' x 70' x 16' (worst case depth of contamination) for a volume of 2900 cubic yards for upland disposal for each pier. The volume of native sediments below the channel bottom would be 16,151 cubic yards in the north pier. The south pier is expected to be shallower and would generate 9800 cubic yards of native material. The total open water disposal volume would be approximately 26,000 cubic yards of native material for open water disposal.

3) We are planning seven borings, three at one pier location and four at the second pier. Your email noted that at most two samples per boring location would be needed. We wanted to confirm whether you were suggesting numbers of samples per boring, not per pier. The answer to this question will help us with estimating our contract supplement.

Thank you again.

Julia Turney
206-296-0267
julia.turney@kingcounty.gov

From:. Kendall, David R NWS [mailto:David.R.Kendall@usace.army.mil]
Sent: Friday, December 05, 2008 2:24 PM
To: Turney, Julia
Cc: LINO461@ecy.wa.gov; Hoffman, Erika; courtney.wasson@dnr.wa.gov
Subject: Dredged Material Management Program Review of the South Park Bridge Foundation Sampling Data
Importance: High

Hi Julia: I wanted to get you my impressions on the data provided relative to DMMP requirements. Unfortunately, because of workload issues, my DMMP agency counterparts have not had a chance to review and provide input, so the comments I am providing are mine alone. I have linked my colleagues, so they can embellish or provide their individual input to this exchange. The data you provided show a relatively contaminated sediment layer down to 10 feet, especially for PCBs, which will likely not meet our open-water disposal guidelines. The sediment quality data for borings below 10 feet down to 100 feet look much better and generally depict relatively clean sediments.

The detection limit exceedances in SQS noted for Butyl-benzyl-phthalate appear to be largely due to low TOC's in those sediments, ranging from 0.24 to 0.34%. The Butyl-benzyl-phthalate expressed on a dry weight basis are all well below the DMMP Screening Levels (e.g., 63 ppb), and would not be a problem. Characterization of the material below 10 feet, would generally require analysis of all DMMP Chemicals-of-Concern (COC)
(http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/2007_COCs.pdf). The results reported for the samples below 10 feet do not include PCBs, and ionizable organic compounds (phenol, 1-methyphenol, 2,4-dimethylphenol, pentachlorophenol, Benzyl alcohol, Benzoic acid), which would need to be quantified for a DMMP evaluation.

The relatively high sediment quality in the deeper sampling depths (>50 feet) lead me to ask the question, do the geotechnical boring logs note the "Native" sediment contact layer? We can consider giving Native sediments a pass without sediment testing requirements, but generally would require analysis of the first 4-8 feet of that layer to demonstrate the sediment quality as part of the DMMP evaluation.. You indicated in your earlier email, that the total volume to be removed and managed is 31,758 cy.

It would be helpful to know what the volume is of the top 7-10 feet of material, that appears to be heavily contaminated with PCBs, and the volume of the remaining subsurface material including Native sediments? Given the volume stipulated, which is less than 31,000 cy with the surface sediment removal, the volume to be characterized within each subsurface location is probably less than 15,000 cy, which under a Moderate ranking, would be a, minimum of one analysis at each location. Therefore, the likely testing that would be required at both locations to evaluate the subsurface sediment quality should be at most no more than 2 analyses per boring location. We would be happy to work with you or your contractor to scope out a sampling/testing strategy that meets our needs. Please call me if you have any questions about my analysis of likely DMMP testing requirements for your project.

David

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Phone: 206/764-3768
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SOIL BORINGS SB4 and SB5
DATA SUMMARY REPORT

South Park Bridge Replacement Project
Seattle, Washington

Prepared by

King County Department of Transportation
Road Services Division
201 S Jackson Street
Seattle, WA 98104

November 12, 2008

ACRONYMS

SUMMARY

FIGURES

TABLES

REFERENCES

Abbreviations and Acronyms

ACM	asbestos-containing materials
ASTM	American Society for Testing and Materials
CFR	Code of Federal Register
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
DSOA	Duwamish Sediment Other Area
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
LBP	lead-based paint
LDW	Lower Duwamish Waterway
LUST	leaking underground storage tank
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
MTCA	Model Toxics Control Act
MW	monitoring well
PCB	polychlorinated biphenyl
PCE	perchloroethylene
PP	priority pollutant
ppm	parts per million
PSDDA	Puget Sound Dredge Disposal Analysis
RCRA	Resource Conservation and Recovery Act
SB	soil boring
CSL	cleanup screening level
SMS	Sediment Management Standard
SQG	small quantity generator
SQS	sediment quality standard
SVOC	semi-volatile organic compound
TBT	tri-butyl tin
TCE	trichloroethylene
TEF	toxicity equivalent factor
TPH	total petroleum hydrocarbons
TOC	total organic carbon
U.S. EPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code

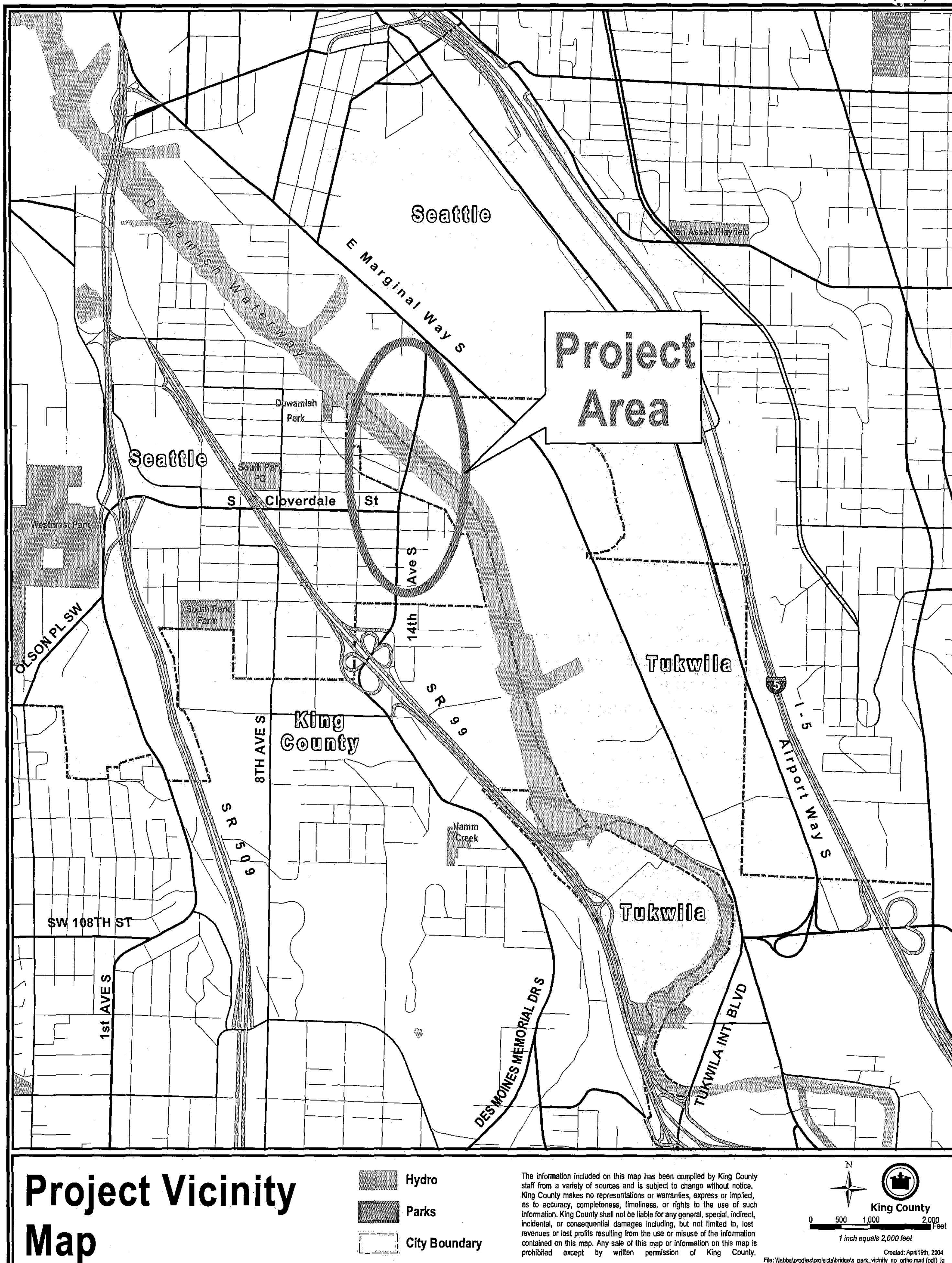
Seattle
Van Asselt Playfield
Duwamish Waterway
E Marginal Way S
Project Area
Duwamish Park
Seattle
South Park PG
S Cloverdale St
Westcrest Park
14th Ave S
South Park Farm
OLSON PL SW
Tukwila
5
I-5
Airport Way S
S R 99
King County
8TH AVE S
S R 509
Hamm Creek
SW 108TH ST
Tukwila
1st AVE S
DES MOINES MEMORIAL DR S
TUKWILA INT. BLVD
Project Vicinity Map
Hydro
Parks
City Boundary
The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.
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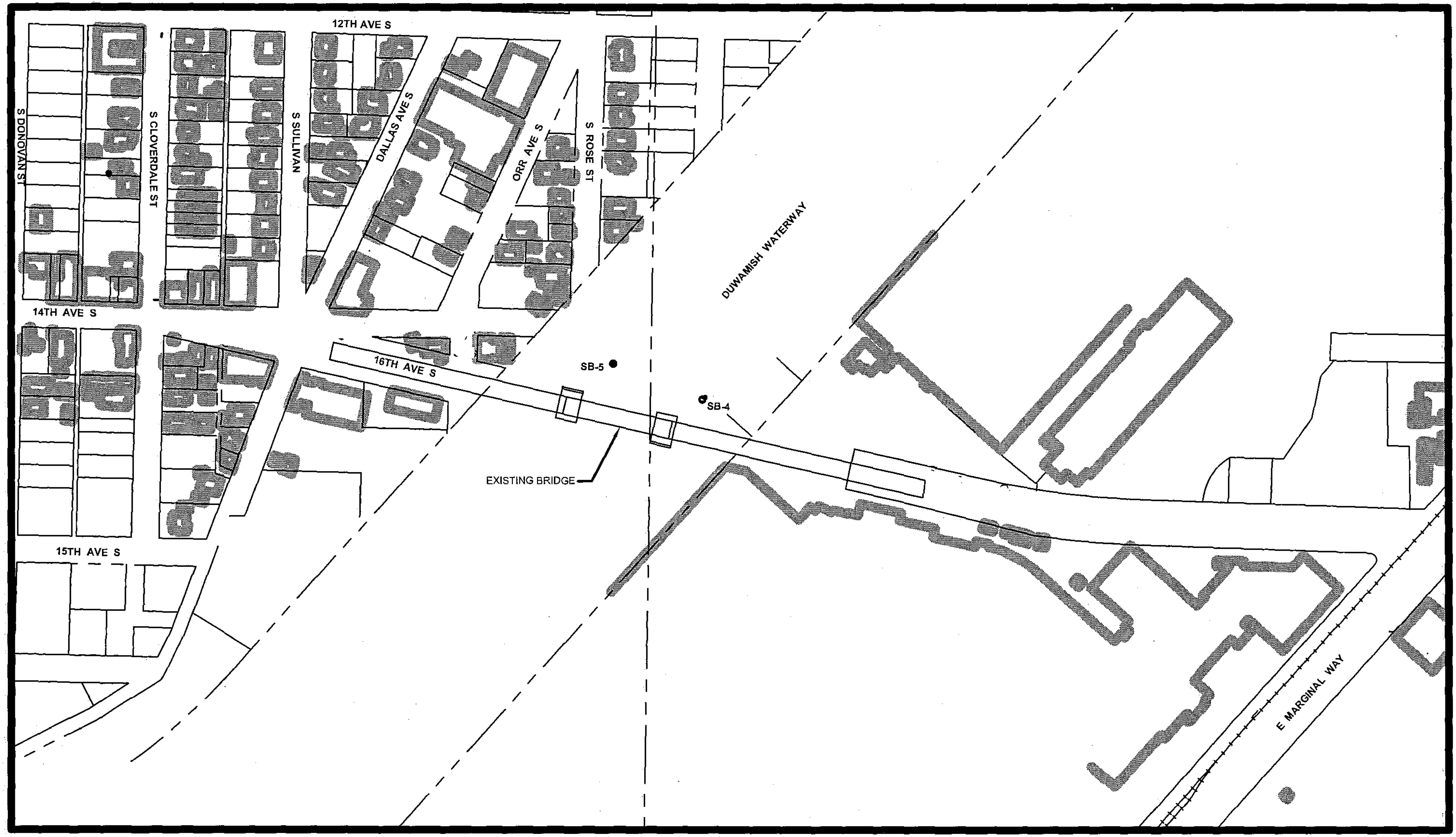
Figure 1



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0 200
SCALE IN FEET

LEGEND

- Soils Borings
- Monitoring Well

Figure 2
Boring Location Map

2003 Sediment Borings SB-4 and SB-5 (Herrera, 2008)

Borings SB-4 and SB-5 were drilled approximately 5 meters (16.4 feet) downstream of the existing bridge, with SB-4 near the north riverbank and SB-5 near the south riverbank of the waterway (Figure 2). Sediment samples were collected from both borings, extending down from the water/mud line interface to maximum depths of 100 feet (SB-4) and 75 feet (SB-5). A total of 11 sediment samples were analyzed for Puget Sound Dredge Disposal Analysis (PSDDA) volatiles, PSDDA SVOCs, PSDDA pesticides/PCBs, metals, total organic carbon (TOC), and tri-butyl tin (TBT). Complete laboratory analytical reports, including sample chain-of-custody forms, and laboratory quality assurance/quality control documentations of all sediment samples collected from SB-4 and SB-5 are presented on a CD-ROM in Appendix C of the 2003 preliminary site investigation report (Wilbur 2004b).

Analytical results of these sediment samples are summarized in the attached tables and include the following:

- Diesel- and lube oil-range hydrocarbons were detected in sediment samples collected from both borings at depths between 2.5 and 10 feet below the mud line. No SQS or CSL are established for diesel- and lube oil-range hydrocarbons in sediment. Diesel concentrations ranged between 19 and 130 mg/kg (dry weight) and lube oil concentrations ranged between 22 and 230 mg/kg (dry weight).

- Low concentrations of five VOCs, including methylene chloride, acetone, carbon disulfide, 2-butanone, and 4-isopropyltoluene, were detected in all 11 sediment samples collected from SB-4 and SB-5. No SQS or CSL are established for these VOC constituents in sediment.

- A mixture of PCBs (Aroclors 1248, 1254, and 1260) were identified in six of the 11 samples collected from both borings extending down from the mud line to 10 feet below the mud line; total PCB concentrations exceeded either the SQS criterion (12 mg/kg organic carbon [OC]) or the CSL criterion (65 mg/kg OC) in all six samples.

- Butyl benzyl phthalate was detected in the sediment sample collected at the 7-foot interval below the mud line from SB-4, with the concentration exceeding the SQS criterion of 4.9 mg/kg OC, but below the CSL criterion of 64 mg/kg OC. Bis(2-ethylhexyl)phthalate was detected in samples collected at 5 feet below the mud line from SB-4 and 75 feet below the mud line from SB-5; both concentrations exceeded the CSL criterion (78 mg/kg OC). Other SVOC constituents were either detected below SMS criteria, or not detected.

- Between four and ten metals were detected in all 11 sediment samples from SB-4 and SB-5. None of the metals were detected above applicable SMS criteria. No TBT was detected in any of the samples collected.

Sediment Analytical Results Table – 2003 Preliminary Site Investigation and Lower Duwamish Waterway Group 2003 Sediment Quality Database

. Summary of surface sediment analytical data collected during studies conducted near the bridge from 1995 through 2003
South Park Bridge Replacement Project, Seattle, Washington

Study ID			STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	STHPKBR_EIS	EPA SI	PL2_RFI-2a	PL2_RFI-2a	PL2_RFI-2a	PL2_RFI-2a	PL2_RFI-2a	PL2_RFI-2a	PL2_RFI-2b	PL2_RFI-2b	NOAA SiteChar
Station ID			SB-4	SB-4	SB-4	SB-4	SB-4	SB-4	SB-5	SB-5	SB-5	SB-5	SB-5	SD-DR227	SD-DUW08	SD-DUW09	SD-DUW24	SD-DUW25	SD-DUW33	SD-DUW34	SD-DUW61	SD-DUW78	WST332
Sample ID			SB4-5	SB4-7	SB4-10	SB4-50	SB4-64	SB4-100	SB5-2.5	SB5-5	SB5-7.5	SB5-50	SB5-75	DR227-0000	DUW08-0000	DUW9-0000	DUW24-0000	DUW25-0000	DUW33-0000	DUW34-0000	DUW61-0000	DUW78-0000	WST10-08
Sample Date			7/23/2003	7/23/2003	7/23/2003	7/23/2003	7/23/2003	7/23/2003	7/22/2003	7/22/2003	7/22/2003	7/22/2003	7/22/2003	9/23/1998	10/25/1995	10/25/1995	10/25/1995	10/25/1995	10/25/1995	10/25/1995	4/4/1996	4/4/1996	11/13/1997
Depth (feet bgs)-upper			5	7	10	50	64	100	3	5	7.5	50	75	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
distance from bridge in feet (meters)			16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	16 (5)	100 (30)	100 (30)	70 (21)	60 (18)	125 (38)	100 (30)	110 (30.5)	40 (12)	75 (23)	145 (44)
direction from bridge			Downstream	Downstream	Downstream	Downstream	Downstream	Downstream	Downstream	Downstream	Downstream	Downstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Upstream	Upstream	Upstream	Upstream	Downstream
	SMS[a]																						
Compound	SQS	CSL																					
Total solids (%)			52.4	72.7	70.1	77.9	80.9	83	62.8	63.1	56.6	77.4	81.9										
Total organic carbon (%)			1.4	0.57	1.4	0.9	0.24	0.33	1.5	1.3	2	0.25	0.31	2.0	1.5	2.4	3.4	1.8	1.7	1.3	1.4	2.3	1.46
Percent Gravel (>2mm)															2	5	1	5	0.01	1	5	6	0.1
Percent Sand (2mm-62.5µm)														19	82	45	72	35	84	79	52	40	40
Percent Silt (62.5mm-4µm)														70	12	36	20	8	11	16	32	39	45
Percent Clay (<4µm)														11	2	13	6	2	3	3	9	12	15
Percent Fines (<62.5µm)														81	14	49	26	10	14	19	41	51	
pH			7.5	7.6	6.9	7.2	8.4	8.5	8.4	7.2	7.4	7.2	8.8		8.1	7.7	6.6	7.4	7.4	7.4			
Metals (mg/kg dry weight, ppm)																							
Arsenic	57	93		10 U	7 U	7 U	6 U	6 U	6 U	8	8	22	6 U	7.9				7	9	7 U			
Beryllium	–	–		0.3	0.2	0.2	0.1	0.2	0.3	0.4	0.4	0.4	0.1 U	0.43				0.2	0.2	0.2			
Cadmium	5.1	6.7		1.4	1.6	0.3 U	0.2 U	0.3	0.3	0.8	0.7	3.4	0.2 U	0.21				0.3 U	0.3 U	0.3			
Chromium	260	270		38	42.7	11.2	10.9	19.1	43.5	25.8	26.8	47.4	8.8	27				19	24	30 J			
Copper	390	390		51.7	42.7	15	13.3	22.8	28.7	38.6	38.7	44.8	11	37				20 J	23 J	25			
Lead	450	530		38	178	3	2 U	4	7	20	21	28	2 U	12.9				18	37	30			
Mercury	0.41	0.59		0.2	0.08	0.06 U	0.06 U	0.05 U	0.06	0.14	0.14	0.21	0.05 U	0.09				0.05 U	0.08	0.09			
Nickel	–	–		17	17	12	7	19	44	18	19	18	6	20.3				12	16	12			
Selenium	–	–												16 J				7 U	7 U	7 U			
Silver	6.1	6.1		0.6	0.4 U	0.4 U	0.4 U	0.3 U	0.4 U	0.5 U	0.5 U	0.5	0.4 U	0.13				0.4 U	0.4 U	0.4 U			
Thallium	–	–												0.07				7 U	7 U	7 U			
Tin	–	–												4 U									
Vanadium	–	–												69				46	48	51			
Zinc	410	960		97	81	21	18.5	26	65.8	86.6	79.7	80.4	16.7	74				57	66	63			
Petroleum Hydrocarbons (mg/kg dry weight)																							
Diesel-range	–	–	120	130	19	5.0 U	5.0 U	5.0 U	31	73	47	5.0 U	5.0 U										
Motor oil-range	–	–	160	230	22	10 U	10 U	10 U	69	130	75	10 U	10 U										
Polychlorinated biphenyls (ug/kg dry weight)																							
Aroclor 1016	–	–												20 U	43 U	61 U	52 U	48 U	52 U	160 U	53 U	57 U	
Aroclor 1221	–	–												40 U							110 U		
Aroclor 1232	–	–												20 U							53 U		
Aroclor 1242	–	–												20 U	43 U	61 U	52 U	48 U	52 U	160 U	53 U	57 U	
Aroclor 1248	–	–	640	1000	65				250	610	20 U			20 U	45 U	61 U	52 U	48 U	91 U	370 U	53 U	57 U	
Aroclor 1254	–	–	1300	1500	98				220	670	35 U			20 U	170 U	320	530	170	520 U	1200	77	110	
Aroclor 1260	–	–	1200	1700	58				66	320	620			25	820	1200	920	300	4000	2200	100	100	
Total PCBs	–	–	3140	4200	221				536	1600	620			25	820	1520	1450	470	4000	3400	177	210	110
Polychlorinated biphenyls (mg/kg organic carbon)																							
Total PCBs	12	65	224	737	16				36	123	31			1.25	55	63	43	26	235	262	13	9.1	7.5
Nonionizable Organic Compounds (mg/kg organic carbon)																							
Aromatic Hydrocarbons																							
Total LPAH	370	780	1.43	13.16	1.43 U	2.11 U	8.33 U	6.06 U	11.13	16.08	3.65	7.60	6.13	2.50				5.4 U	5.9 U	7.0 U			
Naphthalene	99	170	0.36 U	1.93	0.39 U	0.50 U	1.83 U	1.30 U	0.37 U	0.92	1.45	1.80 U	1.45 U	1.00 U				5.4 U	5.9 U	7.0 U			
Acenaphthylene	66	66	0.79	1.93	0.39 U	0.50 U	1.83 U	1.30 U	0.37 U	2.38	2.25	1.80 U	1.45 U	1.00 U				5.4 U	5.9 U	7.0 U			
Acenaphthene	16	57	0.62	2.81	0.39 U	0.50 U	1.83 U	1.30 U	0.37 U	3.08	1.80	1.80 U	1.45 U	1.00 U				5.4 U	5.9 U	7.0 U			
Fluorene	23	79	1.36 U	3.51 U	1.43 U	2.11 U	8.33 U	6.06 U	1.27 U	2.38	1.00 U	7.60 U	6.13 U	1.00 U				5.4 U	5.9 U	7.0 U			
Phenanthrene	100	480	1.43	8.25	1.43 U	2.11 U	8.33 U	6.06 U	9.33	9.23	2.10	7.60 U	6.13 U	2.50				5.4 U	5.9 U	7.0 U			
Anthracene	220	1200	1.36 U	4.91	1.43 U	2.11 U	8.33 U	6.06 U	1.80	4.46	1.55	7.60 U	6.13 U	1.00 U				5.4 U	5.9 U	7.0 U			
2-Methylnaphthalene	38	64	0.51	1.72	0.39 U	0.50 U	1.83 U	1.30 U	0.63	1.31	1.15	1.80 U	1.45 U	1.00 U				5.4 U	5.9 U	7.0 U			
Total HPAH	960	5300	23.93	153.51	3.93	2.11 U	8.33 U	6.06 U	68.93	90.77	48.50	7.60 U	6.13 U	39.00				18.9	28.8	26.7			
Fluoranthene	160	1200	3.36	16.32	1.79	2.11 U	8.33 U	6.06 U	18.67	26.15	13.00	7.60 U	6.13 U	7.50				10.0	7.6	7.5			
Pyrene	1000	1400	7.86	22.81	2.14	2.11 U	8.33 U	6.06 U	20.00	24.62	12.50	7.60 U	6.13 U	8.50				8.9	8.2	10.8			
Benzo(a)anthracene	110	270	2.21	6.67	1.43 U	2.11 U	8.33 U	6.06 U	4.00	6.85	4.80	7.60 U	6.13 U	3.00				5.4 U	5.9 U	7.0 U			
Chrysene	110	460	3.00	7.72	1.43 U	2.11 U	8.33 U	6.06 U	9.33	10.00	7.50	7.60 U	6.13 U	4.50				5.4 U	6.5	8.5			
Benzo(b)fluoranthene	–	–	1.86	6.67	1.43 U	2.11 U	8.33 U	6.06 U	4.27	5.00	2.05	7.60 U	6.13 U	4.00				5.4 U	5.9 U	7.0 U			
Benzo(k)fluoranthene	–	–	3.43	10.88	1.43 U	2.11 U	8.33 U	6.06 U	5.73	10.77	4.30	7.60 U	6.13 U	4.00				5.4 U	6.5	7.0 U			
Total Benzofluoranthenes	230	450	5.29	17.54	1.43 U	2.11 U	8.33 U	6.06 U	10.00	15.77	6.35	7.60 U	6.13 U	8.00				5.4 U	6.5	7.0 U			
Benzo(a)pyrene	99	210	2.21	82.46	1.43 U	2.11 U	8.33 U	6.06 U	3.33	3.54	2.50	7.60 U	6.13 U	2.50				5.4 U	5.9 U	7.0 U			
Indeno(1,2,3-cd)pyrene	34	88	1.36 U	5.26	1.43 U	2.11 U	8.33 U	6.06 U	1.87	1.92	1.15	7.60 U	6.13 U	2.50				5.4 U	5.9 U	7.0 U			
Dibenz(a,h)anthracene	12	33	0.79	1.14	0.39 U	0.50 U	1.83 U	1.30 U	0.37 U	0.92 U	0.70	1.80 U	1.45 U	1.00 U				5.4 U	5.9 U	7.0 U			
Benzo(g,h,i)perylene	31	78	1.36 U	4.74	1.43 U	2.11 U	8.33 U	6.06 U	1.73	1.85	1.10	7.60 U	6.13 U	2.50				5.4 U	5.9 U	7.0 U			
Total carcinogenic PAHs (mg/kg, dry weight)														0.41				0.097	0.22	0.11			
Total PAHs (mg/kg, dry weight)														0.83				0.34	0.49	0.347			
Phthalate Esters																							
Butyl benzyl phthalate	4.9	64	1.36 U	8.77	1.43 U	2.11 U	8.33 U	6.06 U	1.27 U	1.54 U	1.00 U	7.60 U	80.65 U	1.0				5.4 U	5.9 U	7.0 U			
Bis(2-ethylhexyl)phthalate	47	78	52.86	40.35	5.14	31.11	19.58	9.70	14.67	14.62	1.00	39.20	645.16	7.0				8.9	10.6	10.8			
Di-n-octyl phthalate	58	4500	1.36 U	3.51 U	1.43 U	9.33	8.33 U	6.06 U	1.27 U	1.54 U	1.00 U	7.60 U	38.71	1.0 U				5.4 U	5.9 U	7.0 U			
Miscellaneous Extractables																							
Dibenzofuran	15	58	0.62	2.28	0.39 U	0.50 U	1.83 U	1.30 U	0.37 U	2.31	1.15	1.80 U	1.45 U	1.0 U				5.4 U	5.9 U	7.0 U			
Hexachlorobutadiene	3.9	6.2												1.0 U				10.6 U	12.4 U	13.8 U			
N-nitrosodiphenylamine	11	11																5.4 U	5.9 U	13.8 U			
Ionizable Organic Compounds (ug/kg dry weight)																							
Phenol	420	1200												410				190 U	210 U	180 U			
2-Methylphenol	63	63												20 U				190 U	210 U	180 U			
4-Methylphenol	670	670																97 U	100 U	91 U			
2,4-Dimethylphenol	29	29												20 U				290 U	310 U	270 U			
Pentachlorophenol	360	690												100 U				480 U	520 U	450 U			
Benzyl alcohol	57	73												50 U				480 U	520 U	450 U			
Benzoic acid	650	650												200 U				970 U	1,000 U	910 U			
Volatile Organic Compounds (ug/kg dry weight)																							
Methylene Chloride	–	–	5.5	3.7	2.2 U	5.9	2.7	3.2	2.6 U	3.1	5.2	1.9 U	2.6										
Acetone	–	–	27	32	39	30	19	8.2	36	50	160	16	14										
Carbon Disulfide	–	–	2.5	1.3	2.2	1.5	1.3	0.9 U	7.6	1.2 U	1.4 U	1.0 U	1.0 U										
2-Butanone (methyl ether ketone)	–	–	5.1 U	4.9 U	5.4 U	5.0 U	4.6 U	4.7 U	6.5 U	9.6	35	4.8 U	4.8 U										
4-Isopropyltoluene	–	–	1.0 U	1.0 U	15	1.0 U	0.9 U	0.9 U	1.3 U	1.2 U	1.4 U	1.0 U	1.0 U										

Notes:
[a] Washington State Sediment Management Standards (SMS) as defined in the WAC Chapter 173-204, including sediment quality standards (SQSs) and cleanup screening levels (CSL
Nondetected value exceeds SQS criteria
Detected value exceeds SQS criteria
Detected value exceeds CSL criteria
Blank cells indicate the sample either was not analyzed for the constituent or data was not availabl
U = Constituent was not detected above the laboratory reporting limit shown
J = Constituent value shown as an estimated quantity either because the value was below detection limit or due to unmet QC criter
Sources: Wilbur (2004b); LDWG (2003).

Attachment 2. Mean percent survival of Macoma nasuta & Nephtys caecoides during 45-day bioaccumulation test.

Treatment	Macoma nasuta		Nephtys caecoides	
	Mean ± S.D.	n	Mean ± S.D.	n
Control	88.3 ± 4.6	5	99.0 ± 2.2	5
Reference	81.7 ± 10.9	5	98.0 ± 2.7	5
NB-1014-BT	90.0 ± 7.0	5	99.0 ± 4.2	5

SD = Standard Deviation

Attachment 3. Initial and final mean biomass of Macoma nasuta & Nephtys caecoides used in 45-day bioaccumulation test.

Treatment	Macoma nasuta		Nephtys caecoides	
	Mean ± S.D.	n	Mean ± S.D.	n
Day 0	4.41 ± 1.70	15	0.79 ± 0.27	15
Day 45:				
Control	3.82 ± 0.87	15	0.40 ± 0.16	15
Reference	3.28 ± 0.84	15	0.53 ± 0.25	15
NB-1014-BT	3.31 ± 0.79	15	0.49 ± 0.17	15

Attachment 4

Proposed Approach for Developing an Interim Target Tissue Level for Total PCBs Based on Risk to Human Health

Prepared by DMMP Agencies – Seattle, WA
December 21, 1999

Introduction
The Dredged Material Management Program has developed a site-specific, interim target tissue level (TTL) for total PCBs (tPCBs)[1] in benthic organisms based on a recalculation of the TTL used in the March 1997 suitability determination for the Port of Seattle Terminal 18 (95-02133). The human health risk assessment used to derive this interim TTL considers consumption of bottom fish only and uses parameters specific to the Elliott Bay dredged material disposal site. Newly available seafood ingestion rate data for high-end consumers (Native American tribes and Asian/Pacific Islanders) and the estimates of the biomagnification potential of tPCBs between bottom fish and their benthic prey were also used. The interim TTL will be used to determine the suitability of Dredged Material Management Units from the East Waterway Stage II project for disposal at the Elliott Bay site based on statistical comparison to tissue data from laboratory bioaccumulation testing. The TTL is considered interim pending incorporation of new seafood consumption rate information and/or the DMMP adopting different approaches to tPCB measurement and toxicity summation.

This memorandum discusses:

1. Information used to estimate cancer risks associated with human exposure to tPCBs derived from the disposal site,
2. The basis and protectiveness of the interim TTL, and
3. Results of applying the interim TTL to the East Waterway bioaccumulation data.

Human Health Risk Assessment
Concentrations of tPCBs in whole body bottom fish (e.g., English sole) associated with a 10^{-5} risk of excess cancer were estimated for different consumers using the following equation:

$$\text{BF tPCBs} = \frac{(\text{Risk})\,(\text{BW})\,(\text{AT})}{(\text{BF IR})\,(\text{BF fr PS})\,(\text{BF HR/ DS})\,(\text{EF})\,(\text{ED})\,(\text{SF})(\text{CF1})(\text{CF2})}$$

where:

BF tPCBs = Estimated concentration of tPCBs in a bottom fish (ug/kg wet weight whole body)
Risk = Excess cancer risk of 1 x 10^{-5} (unitless)
BW = Body weight (70 kg)
AT = Averaging time (70 years (25,550 days))
BF IR = Ingestion rate of bottom fish (g/day)
BF HR = Home range of a bottom fish (2,334 acres from PSDDA, 1988)
BF fr. PS = Fraction of bottom fish consumed that are from Puget Sound (unitless)
DS = Area of the Elliott Bay disposal site (395 acres)
EF = Exposure frequency (365 days/year)
ED = Exposure duration of consumer group (years)
SF = Cancer slope factor for tPCBs (2.0 mg/kg-day)
CF1 = Conversion factor (kg/g)
CF2 = Conversion factor (mg/ug)

[1] Total PCBs are currently calculated as the sum of the *detected* Aroclor concentrations.

The following assumptions were used in estimating bottom fish tissue concentrations:

- Bottom fish (e.g., English sole) are the only type of seafood consumed that could be exposed to sediment-associated tPCBs at the Elliott Bay disposal site. [2]
- Bottom fish reach the calculated body burden of tPCBs only from exposure to contaminated benthic prey from the Elliott Bay disposal site.

Exposure parameters and bottom fish tPCBs concentrations are presented in Tables 1 and 2. Fish tissue concentrations were estimated using ingestion rate information for tribal (Toy *et al.*, 1996), Asian/Pacific Islander (EPA, 1999), and recreational consumers (Landolt *et al.,* 1985*).* The following parameters varied according to consumer group:

- Percentile ingestion rate of bottom fish among all fish consumed
- Fraction of bottom fish eaten that are caught in Puget Sound (versus eaten at a restaurant or bought at a market)
- Exposure duration (e.g., 30 years for recreational fishers and Asian/Pacific Islanders, 70 years for tribal consumers).[3]

An overview of the excess cancer risks for different consumer populations associated with various concentrations of tPCBs in fish is presented in Table 3. The range of tPCB tissue concentrations evaluated (341 ppb - 7531 ppb wet weight) correspond to the 10^{-5} risk levels for the different consumer populations as calculated in Tables 1 and 2.

Biomagnification

Biomagnification of tPCBs has been widely observed to occur between different trophic levels with increasing concentrations observed for higher level consumers. Particularly high biomagnification factors (BMF) have been observed between benthic/epibenthic organisms and bottom feeding fish (e.g., Metcalfe and Metcalfe, 1997). The most recent TTL for tPCBs (2.0 ppm wet weight) calculated for the Port of Seattle T-18 project did not take biomagnification into account. However, in recalculating this interim TTL we have used a BMF to relate the acceptable concentration in a bottom fish to that in the benthic invertebrates exposed to the sediments.

The agencies have reviewed the available data on concentrations of tPCBs in the tissues of bottom fish and their prey in the Harbor Island/Elliott Bay area and have concluded that this is insufficient for use in calculating a site-specific BMF. For the purposes of developing an interim TTL for the East Waterway Stage II project, the agencies have decided to use a non-site-specific BMF. In consultation with Phil Cook (EPA/ORD, Duluth), a factor of 2 was chosen as a reasonable estimate of the BMF for tPCBs between benthic organisms and bottom feeding fish (whole body basis). This estimate falls within the range of 2 - 4 reported by Metcalfe and Metcalfe (1997) for benthic feeders (sucker and sculpin) and is similar to the value of 2.7 used by the New York/New Jersey Harbor Dredging Forum for summer flounder based on a two-step trophic model originally elaborated by Frank Gobas (Zambrano, 1993).

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[2] PSDDA deep-water disposal sites such as the one in Elliott Bay were originally selected to avoid fishery areas, particularly areas where high concentrations of shellfish may be found.

[3] The DMMP agencies have decided to use a generic exposure time of 70 years for tribal consumers based on assumed patterns of tribal residence. Native Americans, wishing to maintain cultural ties, may relocate over a limited geographic area and continue to visit their usual and accustomed fishing areas. Furthermore, subsistence anglers may share their catch with their families, increasing the effective exposure duration for family members. Efforts to obtain regional data on relocation or duration of residence for local tribes have not been successful. The agencies will reconsider use of the 70 year exposure duration if and when data is available indicating that this is value is overly conservative.

Calculation of TTLs

Earlier PSDDA assessments as well as remediation projects for tPCBs in Puget Sound (e.g., Manchester Superfund) have used an upper limit of 1 x 10^{-5} excess cancer risk in deriving acceptable concentrations of tPCBs in fish tissue. Based on information provided in Table 3, tPCB concentrations of approximately 600 ppb wet weight in bottom fish exposed to the Elliott Bay disposal site would be protective at the 1 x 10^{-5} risk level for the 90th percentile consumption rate of tribal consumers. Tissue tPCB concentrations of approximately 1500 ppb wet weight would be similarly protective for the general population of Asian/Pacific Islanders. PCB concentrations in fish that are protective at the 1 x 10^{-5} risk level for recreational fishers are considerably higher, falling between 4000 - 7500 ppb depending on the ingestion rate used (Table 2).

As discussed in the preceding section, an estimated biomagnification factor of 2 was used to convert the tPCB concentration in a bottom fish to that in a trophically-linked benthic organism. Using the acceptable fish tissue concentrations for both tribal and Asian/Pacific Islander groups results in TTLs of 300 and 750 ppb wet weight, respectively. Using acceptable fish tissue concentrations for recreational consumer results in TTLs ranging from 2000 to 3750 ppb wet weight (depending on the ingestion rate used).

Selection of an Interim TTL for tPCBs

After considering the information presented in Table 3, the DMMP agencies concluded that an interim TTL for tPCBs based on risk to recreational consumers would not be suitably protective of high end consumers represented by tribes and Asian/Pacific Islanders. However, use of the most protective TTL value (300 ppb wet weight) based on 1 x 10^{-5} risk to tribal consumers may be overprotective, as conservative exposure parameter values were assumed in order to compensate for uncertainties that might underestimate risk. Therefore, the agencies have qualitatively evaluated the extent to which the following assumptions over- and under- estimated exposure (the DMMP's view of the influence on the risk estimate is indicated in parenthesis):

Over-protective assumptions:

- Calculations of risk are based on high-end (tribal and Asian/Pacific Islander) consumption rates rather than those of recreational fishers. (Important influence)
- The fraction of seafood harvested from all of Puget Sound is used in this calculation to represent the fraction of seafood harvested from an area influenced by the Elliott Bay disposal site. This value likely overestimates the fraction harvested from the Elliott Bay. (Important influence)
- Food preparation practices or cooking methods that might reduce tPCB concentrations were not considered in the evaluation. (Important influence)
- The Elliott Bay disposal site is assumed, for the sake of this evaluation, to be uniformly covered with the PCBs from each separately evaluated dredged material management unit. However, each management unit would be in fact mingled with others during physical placement of dredged material at the site, resulting in a *site* concentration, which is lower than many of the management units of concern. Prey items for bottom fish are thus assumed to have uniformly higher tissue concentrations of tPCBs than would be expected. (Possibly important influence)
- Assumption of a 70 year exposure period for tribal consumers is based on patterns of tribal residence rather than site-specific information. (Moderate influence)
- We did not use a whole body/fillet factor to account for the difference in lipid content between the whole fish (higher lipid) and what is typically considered to be the edible portion of a fish (lower lipid) in calculating the interim TTL. Although no specific information is available, it appears culinary practice of some Asian/Pacific Islanders may involve eating the

entire fish rather than fillets. Hydrophobic organic compounds (such as tPCBs) tend to preferentially concentrate in the lipids of aquatic organisms. (Unknown influence)

Under-protective assumptions:

- The 90th percentile Asian/Pacific Islander consumption rates used included non-fish consumers and hence would underestimate the actual bottom fish consumption rate. (Important influence)
- There are scant data available to calculate 90th percentile bottom fish consumption rates for individual ethnic populations that comprise the general category of Asian/Pacific Islanders. Thus the consumption rate for API may not be protective of all individual populations. (Possibly important influence)
- Estimated tissue concentrations of tPCBs in bottom fish are assumed to come solely from their exposure to the disposal site (i.e., existing tPCB body burdens in bottom fish from sources other than the disposal site are not considered). (Minor influence[4])
- Human consumer exposure to Elliott Bay disposal site tPCBs occurs solely through ingestion of bottom fish (i.e., assumes no exposure from eating shellfish or pelagic fish that could pick up tPCBs from disposal site). (Likely to be a minor influence - see footnote #2)
- Non-cancer adverse health effects of tPCBs to human consumers are not considered in risk calculations; cancer risks only are considered. (Unknown but probably minor influence)

Based on the foregoing considerations, the DMMP agencies have concluded that that the assumptions about exposure used in this assessment tend to overestimate the actual exposure. **Thus, the agencies have selected 750 ppb wet weight as the interim TTL for tPCBs in benthic organisms.** The excess cancer risk associated with this interim TTL is 9.7×10^{-6} for the general population of Asian/Pacific Islander consumers and 2.6×10^{-5} for tribal consumers. The DMMP agencies consider the calculated upper risk limit associated with this value to be acceptable for the purposes of deriving an interim TTL for the Elliott Bay dredged material disposal site.

Comparison of Proposed TTL to results of Bioaccumulation Testing

Bioaccumulation data from the East Waterway testing are presented in Appendix 8. Tissue concentrations are corrected for differences between round 1 and round 2 sediment tPCB concentrations. The results of statistical comparisons between the corrected tissue concentrations and the interim TTL of 750 ppb wet weight are indicated. Application of the tPCB TTL results in failure of 3 DMMUs (S-11, S-16, S-23) out of a total of 13 DMMUs tested for tPCBs. A total of 25 DMMUs were tested for bioaccumulation out of 99 DMMUs that were evaluated during the Stage II testing (no bioaccumulation testing was performed on the 8 DMMUs tested from USCG Slip 36 dredging area).

[4] Based on comparison to fish tissue data for Elliott Bay indicating that average tissue concentrations of total PCBs in English sole range from 40-70 ppb wet weight (EVS Solutions, 1999).

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Table 1. Calculation of Allowable Bottom Fish Tissue Concentrations Based on Risk to Tribal and Asian/Pacific Islander Consumers

Risk [1]	Body wt. (kg)	Avg. time [2] (days)	BF [3] ingested (g/day)		BF fraction from PS [4]		Disposal area / BF home range [5]	Exp. [6] freq (days/yr)	Exp. time (years)	Slope Factor mg/kg-day	Calc. Fish PCB conc. ug/kg wet wt.	Source of ingestion rate and BF fraction used	
0.00001	70	25,550	18.3	a	0.17	b	0.169	365	30	2	1,553	All	90th %ile Asians/Pacific Islanders (EPA, 1999)
0.00001	70	25,550	18.5	c	0.13	d	0.169	365	70	2	861	Sqaxin	90th%ile Tribal (from Toy et al., 1996)
0.00001	70	25,550	14.3	e	0.39	f	0.169	365	70	2	371	Tulalip	
0.00001	70	25,550	17.4	g	0.21	h	0.169	365	70	2	567	weighted mean	

[1] Corresponds to 1 additional cancer per 100,000 population

[2] Equivalent to a life expectancy of 70 years.

[3] Bottom Fish

[4] Puget Sound

[5] 395 acres / 2335 acres = 0.169

[6] Exposure

a. 90th %ile consumption rate of bottom fish by Puget Sound Asians and Pacific Islanders (n=202) (EPA, 1999).
Individuals that do not consume bottom fish may be included in consumption rate calculation (Kissinger, personal communication, 1999).

b. Weighted mean of 17% of the bottom fish ingested by Asians and Pacific Islanders interviewed were caught in Puget Sound Waters (vs. purchased) (EPA, 1999).

c. 90th %ile consumption rate of bottom fish by the Squaxin tribe (n=85). Values from Toy et al (1996) adjusted to exclude non-bottom fish consumers (Kissinger, personal communication, 1999).

d. A mean of 13% of the bottom fish ingested by Squaxin tribal members interviewed were caught in Puget Sound Waters (Toy et al., 1996).

e. 90th %ile consumption rate of bottom fish by Tulalip tribal members (n=34). Values from Toy et al (1996) adjusted to exclude non-bottom fish consumers (Kissinger, personal communication, 1999).

f. A mean of 39% of the bottom fish ingested by Tulalip tribal members interviewed were caught in Puget Sound Waters (Toy et al., 1996).

g. 90th %ile weighted consumption rate of bottom fish by both the Squaxin and Tulalip tribes (n=119).
Values from Toy et. al (1996) adjusted to exclude non-bottom fish consumers (Kissinger, personal communication, 1999).

h. Weighted mean of 21% of the bottom fish ingested by Squaxin and Tulalip tribal members interviewed were caught in Puget Sound Waters (Toy et al., 1996).

Table 2. Calculation of Allowable Bottom Fish Tissue Concentration Based on Risk to Recreational Fishers

Risk [1]	Body wt. (kg)	Avg. time [2] (days)	BF [3] ingested (g/day)		BF fraction from PS [4]		Disposal area / BF home range [5]	Exp. [6] freq (days/yr)	Exp. time (years)	Slope Factor mg/kg-day		Calc. Fish PCB conc. ug/kg wet wt.	
0.00001	70	25,550	31	a	0.039	b	0.169	365	30	2		3997	
0.00001	70	1	11	c	0.025	d	0.169	1	1	7.7	c	1956	f
0.00001	70	1	11	c	0.025	d	0.169	1	1	2	g	7531	h

[1] Corresponds to 1 additional cancer per 100,000 population.

[2] Equivalent to a life expectancy of 70 years.

[3] Bottom Fish

[4] Puget Sound

[5] 395 acres / 2335 acres = 0.169

[6] Exposure

a. Median fish consumption rate by recreational fishers based on Landolt et al.1985.
b. Bottom fish represent 3.9% of the seafood caught by recreational anglers.
Mean of data from Landolt et al. (1985) and Simmonds et al. (1998) as reported in EVS (1999).
c. Average daily seafood consumption rate for seafood caught in urban bays by recreational anglers from Landolt et al. (1985).
d. Bottom flatfish represent 2.5% (by weight) of the seafood caught by recreational anglers according to Landolt et al. (1985).
e. Old cancer slope factor for PCBs.
f. The TTL calculation performed for the Port of Seattle T-18 suitability determination (1997, 95-02133) .
did not consider averaging time, exposure frequency, or exposure duration and used the old slope factor (7.7) for PCBs.
g. Updated cancer slope factor for PCBs.
h. Recalculation of the T-18 TTL using the updated slope factor for PCBs.

Table 3. Estimated Risk From Ingestion of PCB-Contaminated Bottom Fish Associated with the Elliot Bay Disposal Site

Allowable tPCB in bottom fish ug/kg wet wt.	***Bottom fish ingestion rates (g/day)***			
	Recreational		Tribal	A/PI
	Mean IR from T-18 SD [1]	Mean IR from WWY RA [2]	90% IR	90% IR
	0.28	1.21	17.4	18.3
7531	1.0E-05	1.9E-05	1.3E-04	4.8E-05
3997	5.3E-06	1.0E-05	7.1E-05	2.6E-05
1553	2.1E-06	3.9E-06	2.7E-05	1.0E-05
1500 [5]	**2.0E-06**	**3.8E-06**	**2.6E-05**	**9.7E-06**
567	7.5E-07	1.4E-06	1.0E-05	3.6E-06
341	4.5E-07	8.5E-07	6.0E-06	2.2E-06

[1] Bottom fish ingestion rate used in March 1997 suitability determination for the Port of Seattle Terminal 18 (95-02133) calculated using an average daily seafood consumption rate (11 g day) and assuming that 2.5% of the fish caught by recreational anglers are bottom fish (both from Landolt et al., 1985). 11 x 0.025 = 0.28

[2] Bottom fish ingestion rate used in West Waterway Human Health Risk Assessment (EVS, 1999) calculated using a median fish consumption rate by recreational fishers (31 g/day) and assuming that bottom fish represent 3.9% of the seafood caught by recreational anglers (Landolt et al., 1985 and Simmonds et al. 1998). 31 x 0.039 = 1.21

[3] 90th percentile of weighted mean tribal bottom fish consumption rate from Toy et al. (1996).

[4] 90th percentile consumption rate by Asians and Pacific Islanders from EPA (1999).

[5] Bolded fish tissue concentration and associated risk estimates were used in calculating interim TTL for East Waterway Project

Risk = [(SF) x (fish tissue PCB) x (bottom fish IR) x (bottom fish home range/site size) x (EF) x (ED) x (0.001kg/g) x (0.001 mg/ug) / (body wt.) (AT)]
Where: SF = Slope factor; IR = ingestion rate; exp. = exposure; freq. = frequency; EF = exposure frequency; ED = Exposure duration