CENPS-OP-TS

MEMORANDUM FOR RECORD MARCH 17, 1997

SUBJECT: DETERMINATION OF THE SUITABILITY OF DREDGED MATERIAL TESTED UNDER PSDDA EVALUATION PROCEDURES FOR THE PORT OF SEATTLE TERMINAL 18 DREDGING PROJECT (95-02133) FOR DISPOSAL AT THE ELLIOTT BAY OPEN-WATER SITE.

1. The Port of Seattle proposes to dredge 546,430 cubic yards of material from East Waterway, adjacent to Harbor Island, for improved access to Terminal 18. The following summary reflects the PSDDA agencies' (Corps of Engineers, Environmental Protection Agency, Department of Ecology and Department of Natural Resources) consensus determination of the suitability of the proposed dredged material for disposal at the Elliott Bay nondispersive open-water site.

2. A chronology of documentation and correspondence relevant to this determination is contained in Attachment 1.

3. Dredging projects in the lower Duwamish/Elliott Bay area are ranked "high" by PSDDA [1, page A-10]. However, the Port of Seattle provided sufficient historical data to allow a downranking by the PSDDA agencies of the subsurface sediments (>4 feet) to a "moderate" ranking. The surface sediment remained high-ranked.

4. Sampling and testing were conducted in two phases. Phase 1 included standard PSDDA chemical and biological testing of 86 dredged material management units (DMMUs). In Phase 2, bioaccumulation testing was conducted for 9 of these DMMUs. In addition, three of the original subsurface composite DMMUs were broken into a total of 13 smaller DMMUs and each of these new DMMUs was subjected to standard chemical and biological testing in Phase 2. Attachments 2 and 3 show the DMMUs tested in Phases 1 and 2 respectively. All DMMUs, in both phases, were subjected to concurrent chemical and biological testing. Attachment 4 summarizes the chemical and biological results for both Phase 1 and Phase 2. The following sections provide additional details for the two phases of testing.

Phase 1

5. A total of 86 DMMUs were evaluated (87 DMMUs were proposed in the sampling plan but DMMU 1C01 was eliminated because no sediment was found above the design depth of -51 ft MLLW during sampling). The surface sediment (<4 feet) volume totaled 304,670 cubic yards and was represented by 76 DMMUs. The subsurface sediment (>4 feet) was divided into 10 DMMUs, representing 241,760 cubic yards. See Attachment 2 for individual DMMU volumes.

Chemical Testing:

6. Chemical testing resulted in at least one exceedance of the 1996 PSDDA screening levels (SLs) for all but one of the 86 DMMUs (see Attachment 4); 3C06 was the only DMMU without an SL exceedance. Forty-three DMMUs exceeded at least one bioaccumulation trigger (BT) and 24 DMMUs exceeded at least one maximum level (ML). The BT and ML exceedances are summarized in Attachments 5 and 6 respectively. Of the DMMUs exceeding ML, 16 DMMUs exceeded an ML by a factor of two and/or had more than one ML exceedance. Under the PSDDA evaluation guidelines, these 16 DMMUs can only be considered for open-water disposal if the "dredger's option" is invoked [2, page 5-12]. In addition to standard biological testing, the "dredger's option" entails more extensive sediment evaluation procedures, the requirements for which are to be determined by the PSDDA agencies on a case-by-case basis.

7. The PSDDA evaluation guidelines for tributyltin (TBT) were in a state of flux during Phase 1 of this project. At the time of SAP development, PSDDA required bulk sediment testing for TBT in areas of concern such as East Waterway [1]. The SL and BT had been established at 30 and 219 ug/kg TBT (as tin) respectively, which are equivalent to 73 and 533 ug/kg TBT (as TBT). However, at the same time, an interagency workgroup was in the process of developing guidance for use by EPA Region X in the evaluation of TBT at Superfund sites [3]. Based on this work, the PSDDA agencies proposed revised guidelines [4] which included porewater testing to better determine the bioavailable fraction of TBT.

Under the revised guidelines, an exceedance of 0.15 ug/l TBT (as TBT) in the interstitial water would trigger bioaccumulation testing. Because the Port of Seattle had already conducted bulk sediment testing for TBT on all Phase 1 DMMUs, a compromise was reached between the Port and PSDDA agencies which called for calculation of theoretical porewater concentrations using a relationship developed by National Marine Fisheries Service [5]:

$$\text{interstitial TBT (ug / l)} = \frac{\left(\dfrac{\text{sediment TBT (ug / kg dry weight)}}{\text{sediment TOC content (decimal fraction)}}\right)}{25{,}000 \text{ liters / kg}_{oc}}$$

For example:

$$\text{if dry weight TBT} = 125 \text{ ug / kg (as TBT)}$$

$$\text{and TOC} = 2 \text{ percent}$$

$$\text{then interstitial TBT} = \frac{\left(\dfrac{125 \text{ ug TBT / kg}_{sed}}{0.02 \text{ kg}_{oc} \text{ / kg}_{sed}}\right)}{25{,}000 \text{ liters / kg}_{oc}} = .25 \text{ ug / l (as TBT)}$$

Attachment 7a shows the results of this calculation for each of the DMMUs in Phase 1. The Port of Seattle agreed to conduct porewater testing on archived sediment for those DMMUs whose calculated interstitial TBT concentrations exceeded 0.15 ug/l (as TBT). However, due to a communication problem between Battelle Northwest (the testing lab) and EVS Consultants, the sediment concentrations used in these calculations were expressed on an "as tin" basis rather than "as TBT". As a result, only fifteen DMMUs were extracted for porewater and tested for TBT. Only two of the fifteen DMMUs (1C04 and 1C05) exceeded 0.15 ug/l (as TBT) and required bioaccumulation testing for TBT.

The fact that sediment concentrations used in the calculations had been expressed on an "as tin" basis was not detected until agency review of the data report. The PSDDA agencies conducted a worst-case analysis of the 21 DMMUs which should have been subjected to porewater extraction, but which were not due to the reporting error, and determined that the probability of any of these sediments resulting in adverse bioaccumulation was low. Therefore no further action was taken. See Attachment 7b for details of this analysis.

Biological Testing:

8. Concurrent biological testing was conducted for all 86 DMMUs. The amphipod 10-day acute toxicity test, sediment larval combined mortality and abnormality test and the *Neanthes* 20-day biomass test were run. PSDDA interpretation guidelines [1], as modified by changes made through the annual review process, were used to evaluate the bioassay data. Attachment 4 summarizes the results from all bioassays.

9. Reference sediments for all bioassays were collected from West Beach (Whidbey Island), Cape George and Sequim Bay. Cape George had not previously been used in the PSDDA program and the agencies required that it be analyzed for the full suite of PSDDA chemicals-of-concern. The Port of Seattle elected to conduct chemical testing for both Cape George and Sequim Bay sediments. The results are shown in Attachment 4.

Matchups between DMMUs and references for statistical comparisons were based on the fines-content of the sediment (<62.5 microns). Attachment 8 shows grain-size matches for all Phase 1 DMMUs. Because reference sediment performance problems were encountered, both the primary (preferred) reference and a secondary reference are shown. In those cases where the primary reference failed to meet the performance standard, the secondary reference was used for statistical comparisons.

10. For the amphipod test, the PSDDA agencies required the use of *Eohaustorius* on the basis of data from the National Marine Fisheries Service indicating a greater sensitivity of this genus to environmental TBT than other amphipod genera [6]. The Port of Seattle elected to use *Eohaustorius estuarius* collected from Beaver Creek, Oregon. The negative control sediment was collected at this same location.

The Port of Seattle expressed concern regarding potential ammonia toxicity and proposed reducing ammonia concentrations to nontoxic levels prior to testing using a purging protocol recommended by EPA and the Corps of Engineers [7]. The PSDDA agencies agreed to this procedure.

A threshold of 15 mg/l (porewater) was used to determine which DMMUs required ammonia adjustment. In each of five amphipod batches, some DMMUs exceeded this threshold while others did not. Therefore, each batch was split into two sub-batches, one sub-batch requiring ammonia reduction, the other sub-batch not requiring it. For DMMUs exceeding the ammonia threshold, replacement of two volumes of water per day and constant aeration were used to reduce the concentrations. Periodic monitoring of interstitial ammonia levels provided the feedback required to determine when to terminate the purging process and initiate the bioassay. Attachment 9 differentiates among sub-batches and includes ammonia concentrations for all DMMUs.

Results for the Phase 1 amphipod tests are shown in Attachment 10. The results included 25 DMMUs with hits under the 2-hit rule and 30 DMMUs with hits under the 1-hit rule. The other 31 DMMUs did not score amphipod hits. Hits are also shown in Attachment 9. Of the 69 DMMUs which were purged, 49 exhibited amphipod hits, with 23 hits under the two-hit rule and 26 hits under the one-hit rule.

The Sequim Bay reference sediment failed to meet the performance standard in batch 1b, while the Cape George reference failed to meet the standard in batches 2a, 4a and 5a. In all cases where the primary reference failed to meet the performance standard, the secondary reference was used for bioassay interpretation. The fines content of DMMU 1C34 (38.8%) in batch 5a was nearly equivalent to the mean fines content of the West Beach and Sequim Bay references (39.9%). Therefore, 1C34 was compared to both, resulting in a hit under the one-hit rule when compared to West Beach but no hit when compared to Sequim Bay. Using best professional judgment, the agencies assigned a hit under the two-hit rule to 1C34.

11. For the sediment larval test, the Port of Seattle elected to use *Mytilus galloprovincialis*, collected at Long Beach, California. Ammonia purging was not conducted. Results for the Phase 1 sediment larval tests are shown in Attachment 11. The negative seawater control and reference sediments met performance standards in all three batches that were run. The results included 14 DMMUs with hits under the 2-hit rule and 23 DMMUs with hits under the 1-hit rule. The other 49 DMMUs did not score larval hits.

12. The biomass test employed the test organism *Neanthes arenaceodentata*, cultured by Don Reish at Long Beach State, California. Negative control sediment was collected from Beaver Creek, Oregon. Ammonia purging was not conducted. Results for the Phase 1 biomass tests are shown in Attachment 12. The negative control and reference sediments met performance standards in all five batches that were run. The

results included 4 DMMUs with hits under the 2-hit rule and 22 DMMUs with hits under the 1-hit rule. The other 60 DMMUs did not score biomass hits.

Phase 2

Chemical Testing:

13. The Phase 2 sediment testing data indicated that at least one exceedance of the 1996 PSDDA SLs occurred for 7 of the 13 DMMUs (see Attachment 4). A single bulk sediment BT exceedance occurred with 1C37B exceeding the PCB BT. There were no ML exceedances. Porewater testing for TBT was conducted on all 13 DMMUs. Only 1C08B exceeded the porewater BT of 0.15 ug/l (as TBT).

Biological Testing:

14. Concurrent biological testing was conducted for all 13 DMMUs. The same suite of bioassays and test organisms used in Phase 1 were used in this testing phase. Like Phase 1, ammonia reduction was conducted for some of the DMMUs prior to initiating the amphipod test (see Attachment 9). All negative controls and reference sediments met performance standards in all three bioassays in Phase 2. Attachment 13 shows grain-size matches for Phase 2 DMMUs.

The bioassays resulted in 5 hits under the 2-hit rule for the amphipod test (Attachment 10), two hits each under the 1-hit and 2-hit rules for the larval test (Attachment 11) and one hit under the two-hit rule and four hits under the 1-hit rule for the biomass test (Attachment 12).

Bioaccumulation Testing:

15. While a total of 45 DMMUs exceeded at least one BT in Phases 1 and 2, only 9 of these DMMUs were subjected to bioaccumulation testing. The remaining 36 DMMUs with BT exceedances failed bioassay testing, with the exception of 1C56 which was split into four smaller DMMUs in Phase 2. Attachment 5 shows those DMMUs for which bioaccumulation testing was conducted.

16. Bioaccumulation testing was performed with *Macoma nasuta*, a suspension-feeding/filter-feeding bivalve and *Nephtys caecoides*, a burrowing deposit-feeding polychaete. The two species were tested together in the same aquaria. The standard PSDDA bioaccumulation test duration is 28 days. However, in order to avoid extrapolation of 28-day results to theoretical steady-state conditions, the Port of Seattle proposed extending the test to 45 days to provide a better experimental approximation of steady-state tissue concentrations. The agencies approved this approach subsequent to a review of available literature and national EPA/Corps guidance. The actual test was terminated at 44 days due to an increased rate of mortality near the

end of the test period. The PSDDA agencies agreed that the actual test duration was sufficient to simulate steady-state conditions.

17. Five replicate aquaria were run for the negative control, reference sediments and each DMMU. Tissue concentrations were compared statistically to the appropriate reference sediment, based on grain-size comparisons. The results are shown in Attachment 14. In many cases the sediment concentration determined in Phase 2 was lower than that determined in Phase 1 (see Attachment 15). The ratio of Phase 1 to Phase 2 sediment concentrations is shown in Attachment 16. In order to reflect "worst-case" conditions, tissue concentrations for those DMMUs with higher Phase 1 sediment chemistry were multiplied by the appropriate ratio and the statistical comparison repeated. Attachment 17 shows the results of the statistical comparisons using adjusted tissue concentrations.

18. The PSDDA agencies agreed that statistical difference from reference is a necessary, but not sufficient, condition to determine a DMMU unsuitable for open-water disposal. For those DMMUs which 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) Actions Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food; b) PSDDA Target Tissue Concentration Values for Chemicals of Concern to Human Health; and c) ecological effects data from the literature.

a) The FDA guidelines for the chemicals of concern addressed by T18 bioaccumulation testing are as follows [7]:

methyl mercury:	1.0 ppm ww
DDT + DDE:	5.0 ppm ww
PCBs:	2.0 ppm ww
TBT:	no guideline

b) The agencies re-evaluated the risk-based approach that had been adopted by PSDDA in 1988 [8] to set target tissue concentrations for human health (see Attachment 18). The agencies determined that the methodology was still sound. Using current EPA slope factors and reference doses, the PSDDA target tissue concentrations are as follows:

mercury:	450 ppm ww
Total DDTs:	44 ppm ww
PCBs:	2.0 ppm ww
TBT:	43 ppm ww (as TBT)

c) In conjunction with the Port of Seattle, EVS Consultants and Battelle Northwest, the PSDDA agencies reviewed the literature for ecological effects. Attachment 19 provides data relating effects to tissue concentrations. The

agencies reviewed this data in the context of PSDDA site management objectives [8, page II-144]:

> "The biological testing guidelines for Site Condition II, which allow for minor significant effects in the laboratory tests, suggest that some biological effects may be expected at the disposal site. The severity and extent of biological effects are not expected to be great because the majority of the species found at the preferred disposal sites are not known to be acutely sensitive to chemicals of concern. Effects associated with Site Condition II will include sublethal effects and, potentially, an increase in the mortality of the more sensitive but less abundant crustacean species. Cumulative effects are expected to consist of a reduction in population and community biomass and an increase in the tissue concentration levels of chemicals of concern."

In reviewing the available data, the agencies focused on marine organisms and endpoints that were the same or similar to endpoints used in the PSDDA suite of bioassays (mortality and growth). Much less emphasis was given to molecular, cellular, behavioral and morphological effects whose ecological relevance could not be determined. While the agencies understood that scientific advances may demonstrate the ecological importance of such effects, it was not possible at this time to evaluate them in the context of Site Condition II.

It was clear that for PCBs and mercury, human health concerns occurred at lower tissue concentrations than did ecological effects. Conversely, for TBT and DDT, ecological effects occurred at lower concentrations than human health effects. Based on an evaluation of the literature, the PSDDA agencies established levels of 2.0 ppm ww (as TBT) (Widdows and Page, 1993) and 3.0 ppm ww (Childress, 1971 and Allison et al., 1964) for TBT and Total DDT respectively to comply with Site Condition II.

The most conservative concentration for each of the chemicals was chosen for interpretation of the bioaccumulation test data:

mercury:	1.0 ppm ww
Total DDTs:	3.0 ppm ww
PCBs:	2.0 ppm ww
TBT:	2.0 ppm ww (as TBT)

The agencies used best professional judgment in developing these interpretation guidelines to meet PSDDA disposal site management objectives; achievement of other sediment management objectives will require additional evaluation. These guidelines are subject to change for future PSDDA projects as additional bioaccumulation data become available.

19. Each DMMU was compared to these interpretation guidelines using a one-tailed one-sample t-test (see Attachment 14). DMMU 1C04 exceeded the guideline for TBT, thereby failing the bioaccumulation test. This failure was corroborated by a mean mortality of 42% in *Nephtys caecoides* for 1C04, which was statistically different from reference. None of the other DMMUs exceeded the interpretation guidelines. For those DMMUs that did not fail the bioaccumulation test outright, a "worst-case" analysis was made, multiplying tissue concentrations by the ratio of Phase 1 sediment concentrations to Phase 2 sediment concentrations. No additional DMMUs failed the bioaccumulation guidelines in this analysis (see Attachment 17).

Suitability Determination

20. The PSDDA agencies accepted the data as sufficient to make a suitability determination for open-water disposal. Attachment 4 includes the suitability determination for each DMMU and summarizes the essential chemical and biological testing information forming the basis for these determinations.

A total of 273,540 cubic yards in 45 DMMUs passed PSDDA evaluation guidelines and are suitable for open-water disposal at the Elliott Bay non-dispersive site. Forty-nine DMMUs, representing 264,810 cubic yards, failed bioassay or bioaccumulation testing and are unsuitable for open-water disposal. DMMUs 1C03 and 1C06 (8,080 CY total) passed bioassay testing but must be assessed further under the dredger's option to remain eligible for open-water disposal. Until this assessment has been completed, these two DMMUs are considered unsuitable for open-water disposal based on exceedances of the ML rule. See Attachments 20 and 21 for plan views of the suitability determinations for surface and subsurface DMMUs respectively.

21. This memorandum documents the suitability of the proposed dredged sediments for disposal at the Elliott Bay open-water disposal site. It does not constitute final agency approval of the project. During the public comment period which follows a public notice, the resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act. If a Section 404 permit is issued for this project, a dredging plan must be developed and submitted prior to dredging to the Enforcement Section of the Regulatory Branch of the Seattle District Corps of Engineers. This plan must include technology and methodology which are technically adequate to separate suitable from unsuitable material.

Port of Seattle Terminal 18 (95-02133)
PSDDA Suitability Determination
March 17, 1997

Concur:

3/17/97
Date

David F. Fox
David Fox, P.E.
Seattle District Corps of Engineers

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Date

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Environmental Protection Agency, Region X

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21 Attachments
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DMMO file

Justine Barton/EPA
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Tom Gries/DOE
Teresa Michelsen/DOE
Ted Benson/DNR

References:

[1] PSDDA, 1989, *Management Plan Report, Unconfined Open-Water Disposal of Dredged Material, Phase II.*

[2] PSDDA, 1988, *Management Plan Report, Unconfined Open-Water Disposal of Dredged Material, Phase I.*

[3] EPA, 1996, *Recommendations for Screening Values for Tributyltin in Sediments at Superfund Sites in Puget Sound, Washington.* Prepared for the Region X Superfund Program by Weston, Inc., Seattle.

[4] Michelsen, T., T.C. Shaw and S.K.Stirling, 1996, *Testing, Reporting, and Evaluation of Tributyltin Data in PSDDA and SMS Programs*, In Sediment Management Annual Review Meeting Minutes, May 8, 1996.

[5] Meador, J.P., C.A. Krone, D.W. Dyer and U. Varanasi, 1996, *Toxicity of Sediment-Associated Tributyltin to Infaunal Invertebrates: Species Comparison and the Role of Organic Carbon.*

[6] Meador, J.P., U. Varanasi and C.A. Krone, 1993, *Differential sensitivity of marine infaunal amphipods to tributyltin*, Marine Biology, 116, 231-239.

[7] USACE/EPA, 1994, *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (Draft)..*

[8] PSDDA, 1988, *Evaluation Procedures Technical Appendix, Phase I.*

Abbreviations used in Attachments

Abbreviation	Meaning
BSAP	bioaccumulation sampling and analysis plan
BT	bioaccumulation trigger
CG	Cape George
D	dilution
DMMO	Dredged Material Management Office
DMMU	Dredged Material Management Unit
DO	dredger's option (additional assessment required)
E	estimate
EVS	EVS Consultants
F	fail
H	high rank
HPAH	high molecular weight polycyclic aromatic hydrocarbons
J	estimate
KG	kilogram
L	liter
LPAH	low molecular weight polycyclic aromatic hydrocarbons
LQ	lab qualifier
M	moderate rank
MG	milligram
ML	maximum level
N	no
NA	not analyzed
NG	nanogram
OC	organic carbon normalized
P	pass
PCBs	polychlorinated biphenyls
PSDDA	Puget Sound Dredged Disposal Analysis
SAP	sampling and analysis plan
SB	Sequim Bay
SL	screening level
TBT	tributyltin
U	undetected
UG	microgram
VQ	validated qualifier
WB	West Beach
X	hit under the two-hit rule or an affirmative designation
XX	hit under the one-hit rule
Y	yes

CHRONOLOGY OF DOCUMENTATION AND CORRESPONDENCE
PORT OF SEATTLE TERMINAL 18 (95-02133)

Document/Correspondence	Date
Port of Seattle letter requesting downrank of subsurface sediments	10/13/95
PSDDA agency letter approving downrank of subsurface sediments	11/20/95
EVS sampling and analysis plan (SAP) submitted on behalf of the Port of Seattle	12/4/95
PSDDA agency letter requesting a SAP addendum	1/18/96
EVS SAP addendum submitted	2/23/96
EVS letter with revised DMMU boundaries, volumes, etc.	2/29/96
PSDDA agency letter approving revised SAP	3/6/96
EVS bioaccumulation sampling and analysis plan (BSAP) submitted on behalf of the Port of Seattle	5/10/96
PSDDA letter approving field sampling portion of the BSAP	5/23/96
EVS final BSAP submitted on behalf of the Port of Seattle	6/4/96
EVS memorandum documenting the agreement between the Port of Seattle and the PSDDA agencies regarding an evaluation process for tributyltin	6/4/96
DMMO email to EVS with comments on revised BSAP and request for additional information	6/18/96
EVS letter with response to comments on the BSAP	7/3/96
EVS letter requesting an extended bioaccumulation period to model steady state	7/11/96
EVS sampling and analysis results and appendices submitted	1/29/97
EVS paper presenting contaminant loss data associated with ammonia purging (final data submittal required for suitability determination)	2/26/97
EVS letter with final revised DMMU volumes	3/17/97
EVS revised sampling and analysis results submitted	pending

Phase 1 Dredged Material Management Units
Port of Seattle Terminal 18 (95-02133)

DMMU	Surface vs. Subsurface	Volume (cubic yds)	DMMU	Surface vs. Subsurface	Volume (cubic yds)	DMMU	Surface vs. Subsurface	Volume (cubic yds)
1C03	Surface	4000	1C32	Surface	4030	2C05	Surface	4680
1C04	Surface	4000	1C33	Surface	4030	2C06	Surface	5020
1C05	Surface	3910	1C34	Surface	4030	2C07	Surface	4030
1C06	Surface	4080	1C35	Surface	4020	2C08	Surface	4030
1C07	Surface	4350	1C36	Surface	4030	2C09	Surface	3980
1C08	Surface	5300	1C37	Surface	4030	2C10	Surface	3990
1C09	Surface	3900	1C38	Surface	4030	2C11	Surface	3990
1C10	Surface	3900	1C39	Surface	4030	2C12	Surface	3990
1C11	Surface	3690	1C40	Surface	4080	2C13	Surface	4000
1C12	Surface	2830	1C41	Surface	3900	2C14	Surface	4000
1C13	Surface	4170	1C42	Surface	4030	2C15	Surface	4000
1C14	Surface	4000	1C43	Surface	4030	2C16	Surface	4000
1C15	Surface	4090	1C44	Surface	4030	2C17	Surface	4000
1C16	Surface	3690	1C45	Surface	4030	2C18	Surface	4000
1C17	Surface	4110	1C46	Surface	4180	2C19	Surface	4000
1C18	Surface	4040	1C47	Surface	4360	2C20	Surface	4000
1C19	Surface	3540	1C48	Surface	4030	2C21	Sub Surface	24620
1C20	Surface	4000	1C49	Surface	4030	2C22	Sub Surface	24220
1C21	Surface	3770	1C50	Surface	4030	2C23	Sub Surface	27180
1C22	Surface	4200	1C51	Surface	4030	2C24	Sub Surface	19860
1C23	Surface	3920	1C53	Sub Surface	25420	3C01	Surface	3660
1C24	Surface	3790	1C54	Sub Surface	26700	3C02	Surface	3520
1C25	Surface	3790	1C55	Sub Surface	23150	3C03	Surface	4000
1C26	Surface	4030	1C56	Sub Surface	23350	3C04	Surface	4000
1C27	Surface	3950	1C57	Sub Surface	22360	3C05	Surface	3240
1C28	Surface	4060	2C01	Surface	4160	3C06	Surface	3380
1C29	Surface	3950	2C02	Surface	4070	3C07	Sub Surface	24900
1C30	Surface	4030	2C03	Surface	4460	4C01	Surface	4000
1C31	Surface	4030	2C04	Surface	4360			

Phase 2 Dredged Material Management Units
Port of Seattle Terminal 18 (95-02133)

DMMU	Surface vs. Subsurface	Volume (cubic yds)	Collected for Bioaccum	Component of Phase I Subsurface DMMU	Reason for Split
1C03	Surface	4000	X		
1C04	Surface	4000	X		
1C05	Surface	3910	X		
1C14	Surface	4000	X		
1C20	Surface	4000	X		
1C48	Surface	4030	X		
1C51	Surface	4030	X		
2C03	Surface	4460	X		
2C13	Surface	4000	X		
1C07B	Sub Surface	2310		2C21	composite failed bioassays
1C08B	Sub Surface	3560		2C21	composite failed bioassays
2C01B	Sub Surface	7660		2C21	composite failed bioassays
2C02B	Sub Surface	6010		2C21	composite failed bioassays
2C06B	Sub Surface	5080		2C21	composite failed bioassays
1C37B	Sub Surface	2770		1C55	composite failed bioassays
1C42B	Sub Surface	9050		1C55	composite failed bioassays
1C43B	Sub Surface	7920		1C55	composite failed bioassays
1C55XSB	Sub Surface	3410		1C55	composite failed bioassays
1C48B	Sub Surface	3800		1C56	composite exceeded BT
1C48NB	Sub Surface	3750		1C56	composite exceeded BT
1C48SB	Sub Surface	3550		1C56	composite exceeded BT
1C49B	Sub Surface	12250		1C56	composite exceeded BT

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	1C03		1C04		1C05		1C06		1C07		1C08		1C09		1C10		1C11	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	2													-			1.7	
Copper	MG/KG	81		810																	89	
Lead	MG/KG	66		660																	130	
Mercury	MG/KG	0.21	1.5	2.1									0.71		1.1						0.59	
Silver	MG/KG	1.2	4.6	6.1																	1.9	U
Zinc	MG/KG	160		1600																	180	
TBT (bulk sediment as TBT)	UG/KG				671	D	1120	J	332		307						212		256			
TBT (calculated porewater as TBT)	UG/L		0.15		2.07		3.21		1.43		1.29						1.02		0.854			
TBT (measured porewater as TBT)	UG/L		0.15				0.207		0.209													
2-Methylnaphthalene	UG/KG	67		670							120	D	68									
Acenaphthene	UG/KG	63		630			86				260	D	150		110							
Acenaphthylene	UG/KG	64		640																		
Anthracene	UG/KG	130		1300							170	D	210						280			
Fluorene	UG/KG	64		640			75				260	D	200		140				95			
Naphthalene	UG/KG	210		2100							220	D										
Phenanthrene	UG/KG	320		3200			340				740	D	810		600				360			
Total LPAH	UG/KG	610		6100							1770	D	1533		1086				1008			
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500															900			
Benzo(a)pyrene	UG/KG	680	4964	6800															1000			
Benzo(b+k)fluoranthenes	UG/KG	800		8000															1660			
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700															1100	D		
Fluoranthene	UG/KG	630	4600	6300									890		790				2000	D		
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	210		95		77		170	D	150		98				410			
Pyrene	UG/KG	430		7300	920	D	910		840	D	1400	D	1100		670		620		2800	D	1100	D
Total HPAH	UG/KG	1800		51000	4000		2888		1994		4409	D	3839		2678		2025		10283	D	3660	
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73							*150*	D										
Dibenzofuran	UG/KG	54		540							170	D	84		67				70			
N-nitrosodiphenylamine	UG/KG	28	161	220																		
2-Methylphenol	UG/KG	20		72							21	UD										
2,4-Dimethylphenol	UG/KG	29		50																		
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690																		
Phenol	UG/KG	120	876	1200																		
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64																		
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230							25	UD										
Hexachlorobutadiene	UG/KG	29	212	290							33	UD										
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37		16	UD	21	D														
Alpha chlordane	UG/KG	10	37		44	UD	16	UD														
Dieldrin	UG/KG	10	37		34	D	13	D													14	D
Gamma-HCH (Lindane)	UG/KG	10			16	UD																
Heptachlor	UG/KG	10	37		16	UD																
Total DDD,DDE and DDT	UG/KG	6.9	50	69	*71*	D	20	UD	9.5	UD	11	UD							10	UD	29.7	D
PCBs, total	UG/KG	130		2500	*4900*	D	1100	D	840	D	243								168	D	570	D
PCBs, total	MG/KG OC		38.0		376.9	D	78.6	D	90.3	D												
Organic carbon, total	%				1.3		1.4		0.93		0.95		1.7		1.2		0.83		1.2		1.6	
Total solids	%				69.4		68.9		72.5		67.2		54		55.4		71.8		68.1		57.2	
Total volatile solids	%				3.6		3.6		2.8		2.5		5.9		4.7		1.9		3.6		5	
Ammonia, total	MG/KG				5.9		16	E	6.1	E	22		200		180		17		9.1		50	
Total Sulfides	MG/KG				540		730	J	190	J	650		320		800		430		180		1000	
Fines, percent (silt+clay)	%				26.2		36.2		23.2		32.4		90.4		94.6		45.3		39		74.2	
preferred reference match:					WB		CG		WB		WB		SB		SB		CG		CG		SB	
Mytilus galloprovincialis hits:													X		X		X					
Eohaustorius estuarius hits:							X						X		XX				X			
Neanthes arenaceodentata hits:													XX		XX							
Bioassay Pass/Fail:					P		P		P		P		F		F		P		P		P	
BTs exceeded:					X		X		X													
Bioaccumulation conducted:					X		X		X													
Bioaccumulation Pass/Fail:					P		F		P													
ML rule exceeded:					X						X											
PSDDA determination:					DO		F		P		DO		F		F		P		P		P	
DMMU volume (cubic yards):					4000		4000		3910		4080		4350		5300		3900		3900		3690	
DMMU:					1C03		1C04		1C05		1C06		1C07		1C08		1C09		1C10		1C11	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	1C12		1C13		1C14		1C15		1C16		1C17		1C18		1C19		1C20	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	2.6				1				2.5		3				3.1		3	
Copper	MG/KG	81		810	92								94		120	J			130	J	130	
Lead	MG/KG	66		660	140		94		81				130		200				190		210	
Mercury	MG/KG	0.21	1.5	2.1	0.6		0.247		0.235				0.61		0.709		0.247		0.611		0.74	
Silver	MG/KG	1.2	4.6	6.1	2.2								2.4		2.8	J			3.1	J	3	
Zinc	MG/KG	160		1600	200								190		260				240		310	
TBT (bulk sediment as TBT)	UG/KG						408				205						119					
TBT (calculated porewater as TBT)	UG/L		0.15				1.94				0.891						0.496					
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670											87	UD			94	D		
Acenaphthene	UG/KG	63		630									97	D	87	UD			82	D		
Acenaphthylene	UG/KG	64		640											87	UD						
Anthracene	UG/KG	130		1300			140		350	D			260	D	150	D			250	D	150	D
Fluorene	UG/KG	64		640									120	D	100	D			130	D	97	D
Naphthalene	UG/KG	210		2100															850	D		
Phenanthrene	UG/KG	320		3200					330	D			380	D					330	D		
Total LPAH	UG/KG	610		6100					885	D			911	D					1736	D		
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500					540	D			530	D					640	D		
Benzo(a)pyrene	UG/KG	680	4964	6800																		
Benzo(b+k)fluoranthenes	UG/KG	800		8000															1030	D		
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700					690	D			770	D					820	D		
Fluoranthene	UG/KG	630	4600	6300			750		1400	D			1300	D	860	D			1200	D	830	D
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	70	D	89		170	D			190	D	190	D			290	D	190	D
Pyrene	UG/KG	430		7300	1000	D	1200	D	2000	D	550		1400	D	1200	D	470		2500	D	940	D
Total HPAH	UG/KG	1800		51000	3000	D	3881	D	5990	D	2155		5700	D	4500	D			7346	D	4070	D
Benzoic acid	UG/KG	400		690											430	UD						
Benzyl alcohol	UG/KG	25		73	31	UD							29	UD	52	UD			30	UD	33	UD
Dibenzofuran	UG/KG	54		540											87	UD			70	D		
N-nitrosodiphenylamine	UG/KG	28	161	220	31	UD							29	UD	52	UD			30	UD	33	UD
2-Methylphenol	UG/KG	20		72	26	UD			21	UD			24	UD	43	UD			25	UD	27	UD
2,4-Dimethylphenol	UG/KG	29		50											43	UJ						
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690	130	UD							120	UD	220	UD			120	UD	140	UD
Phenol	UG/KG	120	876	1200															130	D	160	D
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64	16	UD							14	UD	26	UD			15	UD	16	UD
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230	31	UD			25	UD			29	UD	52	UD			30	UD	33	UD
Hexachlorobutadiene	UG/KG	29	212	290	41	UD			33	UD			38	UD	70	UD			39	UD	43	UD
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37																11	D	12	D
Alpha chlordane	UG/KG	10	37		11	D									12	UD			13	D	14	D
Dieldrin	UG/KG	10	37		23	D			11	D			18	D	25	D			23	D	23	J
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69	42	D	35.4	D	19.8	D			34	D	46				50		41	D
PCBs, total	UG/KG	130		2500	1480	D	340	D	770	D			850	D	1290	D			1760	D	1380	D
PCBs, total	MG/KG OC		38.0		87.1	D	40.5	D	42.8	D			44.7	D	49.6	D			70.4	D	60.0	D
Organic carbon, total	%				1.7		0.84		1.8		0.92		1.9		2.6		0.96		2.5		2.3	
Total solids	%				54.5		72.5		69		66.8		59.3		49.8		72.4		57.8		53	
Total volatile solids	%				5.5		3		3		3.5		5.5		5.9		2.8		5.3		6.6	
Ammonia, total	MG/KG				83		12	E	65		19	E	160		110		8.4	E	140		160	
Total Sulfides	MG/KG				1400		590	J	330		540	E	360		110		240	J	1000		390	J
Fines, percent (silt+clay)	%				78.5		24.2		44.3		70.5		71.6		87.4		41.3		72.6		83.5	
preferred reference match:					SB		WB		CG		CG		CG		SB		CG		SB		SB	
Mytilus galloprovincialis hits:					X								X		X							
Eohaustorius estuarius hits:					X		XX						X		XX				XX		X	
Neanthes arenaceodentata hits:													X									
Bioassay Pass/Fail:					F		F		P		P		F		F		P		F		P	
BTs exceeded:					X		X		X				X		X				X		X	
Bioaccumulation conducted:									X												X	
Bioaccumulation Pass/Fail:									P												P	
ML rule exceeded:																						
PSDDA determination:					F		F		P		P		F		F		P		F		P	
DMMU volume (cubic yards):					2830		4170		4000		4090		3690		4110		4040		3540		4000	
DMMU:					1C12		1C13		1C14		1C15		1C16		1C17		1C18		1C19		1C20	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	1C39		1C40		1C41		1C42		1C43		1C44		1C45		1C46		1C47	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	3.3	J							2.6	J	2.2	J	6.7	J				
Copper	MG/KG	81		810	140								100		100		140				120	
Lead	MG/KG	66		660	280						84		170		210		370					
Mercury	MG/KG	0.21	1.5	2.1	12.7						0.285		0.771		0.835		1.45					
Silver	MG/KG	1.2	4.6	6.1	3.1								3.3		1.4	U	3					
Zinc	MG/KG	160		1600	440								250		270		420					
TBT (bulk sediment as TBT)	UG/KG						145								398				151			
TBT (calculated porewater as TBT)	UG/L		0.15				0.581								0.442				0.547			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670	1100	D					130	D	74	UD	110	D	1900	D				
Acenaphthene	UG/KG	63		630	190	D					3400	D	74	UD	99	D	220	D				
Acenaphthylene	UG/KG	64		640	130	UD					75	D	74	UD			79	UD				
Anthracene	UG/KG	130		1300	280	D					1700	D	280	D	170	D	630	D				
Fluorene	UG/KG	64		640	260	D					1600	D	140	D	130	D	250	D				
Naphthalene	UG/KG	210		2100	280	D					540	D					310	D				
Phenanthrene	UG/KG	320		3200	1100	D					3400	D	350	D	490	D	980	D				
Total LPAH	UG/KG	610		6100	3210	D					10845	D	862	D	1069	D	4290	D				
Dibenz(a,h)anthracene	UG/KG	120		1200	130	UD					200	D										
Benz(a)anthracene	UG/KG	450		4500							2700	D	610	D			500	D				
Benzo(a)pyrene	UG/KG	680	4964	6800							1900	D										
Benzo(b+k)fluoranthenes	UG/KG	800		8000							3500	D	1280	D			910	D				
Benzo(g,h,i)perylene	UG/KG	540		5400							890	D										
Chrysene	UG/KG	670		6700							3400	D	850	D								
Fluoranthene	UG/KG	630	4600	6300	1100	D					10000	D	1300	D	840	D	1200	D				
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	260	D	110		150		900	D	320	D	120	D	140	D	100		100	
Pyrene	UG/KG	430		7300	1400	D	670		1500	D	9600	D	1900	D	1100	D	2400	D	500		650	
Total HPAH	UG/KG	1800		51000	5380	D	2187		4148	D	33090	D	7312	D	3960	D	6230	D			1966	
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73	77	UD							44	UD	30	UD	48	UD				
Dibenzofuran	UG/KG	54		540	130	UD					630	D	74	UD			79	UD				
N-nitrosodiphenylamine	UG/KG	28	161	220	77	UD							44	UD	30	UD	48	UD				
2-Methylphenol	UG/KG	20		72	64	UD							37	UD	25	UD	40	UD				
2,4-Dimethylphenol	UG/KG	29		50	64	UD							37	UJ			40	UD				
4-Methylphenol	UG/KG	120		1200	130	UD																
Pentachlorophenol	UG/KG	100	504	690	320	UD							180	UJ	130	UD	200	UD				
Phenol	UG/KG	120	876	1200	240	D							140	D	140	D						
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64	43	D							22	UD	15	UD	24	UD				
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230	77	UD					24	UD	44	UD	30	UD	48	UD				
Hexachlorobutadiene	UG/KG	29	212	290	100	UD					32	UD	59	UD	40	UD	63	UD				
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870														3400	D				
Diethyl phthalate	UG/KG	97			130	UD																
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160	25																	
Aldrin	UG/KG	10	37		25	D							14	D	15	D	20	UD	11	D		
Alpha chlordane	UG/KG	10	37		35	D									20	UD	53	UD				
Dieldrin	UG/KG	10	37		40	D							18	D	24	D	86	D				
Gamma-HCH (Lindane)	UG/KG	10															20	UD				
Heptachlor	UG/KG	10	37														20	UD				
Total DDD,DDE and DDT	UG/KG	6.9	50	69	171	D			9.1	UD	14	D	27.9	D	59	D	145	D	10	UD	10	UD
PCBs, total	UG/KG	130		2500	2880	D			180	UD	440	D	1490	D	3080	D	5550	D	200	UD	290	D
PCBs, total	MG/KG OC		38.0		60.0	D							64.8	D	85.6	D	102.8	D				
Organic carbon, total	%				4.8		1		0.52		1.4		2.3		3.6		5.4		1.1		1.3	
Total solids	%				45.8		71.9		78.8		71.2		57.2		55.8		52.6		69.2		70.5	
Total volatile solids	%				9.8		2.4		1.8		3.4		5.9		7		9.2		3.1		2.9	
Ammonia, total	MG/KG				400		4.2		4.3		22		120		140	E	300		4.6		4	
Total Sulfides	MG/KG				4800		620		170	J	430	J	1500	J	610		1000		450	J	240	J
Fines, percent (silt+clay)	%				81		34.3		21.2		33.1		71.9		80.5		63.7		40.1		31.6	
preferred reference match:					SB		CG		WB		WB		CG		SB		CG		CG		WB	
Mytilus galloprovincialis hits:					XX						XX		XX		X		XX					
Eohaustorius estuarius hits:					XX						X		X		X		X					
Neanthes arenaceodentata hits:					XX												XX					
Bioassay Pass/Fail:					F		P		P		F		F		F		F		P		P	
BTs exceeded:					X						X		X		X		X					
Bioaccumulation conducted:																						
Bioaccumulation Pass/Fail:																						
ML rule exceeded:					X						X						X					
PSDDA determination:					F		P		P		F		F		F		F		P		P	
DMMU volume (cubic yards):					4030		4080		3900		4030		4030		4030		4030		4180		4360	
DMMU:					1C39		1C40		1C41		1C42		1C43		1C44		1C45		1C46		1C47	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	1C48		1C49		1C50		1C51		1C53		1C54		1C55		1C56		1C57	
				Rank:	H		H		H		H		M		M		M		M		M	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	LQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	1.4		2				3.6	J					1.1					
Copper	MG/KG	81		810	86		130				140											
Lead	MG/KG	66		660	150		200				310						96					
Mercury	MG/KG	0.21	1.5	2.1	0.524		0.819		0.39		1.66		0.475		0.601		0.531		0.325		0.379	
Silver	MG/KG	1.2	4.6	6.1			1.8				2.3											
Zinc	MG/KG	160		1600	170		260				390											
TBT (bulk sediment as TBT)	UG/KG																					
TBT (calculated porewater as TBT)	UG/L		0.15																			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670							120	D			79							
Acenaphthene	UG/KG	63		630							190	D					*960*					
Acenaphthylene	UG/KG	64		640																		
Anthracene	UG/KG	130		1300	160		140				270	D					490					
Fluorene	UG/KG	64		640			69				210	D					250					
Naphthalene	UG/KG	210		2100																		
Phenanthrene	UG/KG	320		3200							1000	D					1300	D				
Total LPAH	UG/KG	610		6100							1890	D					3236	D				
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500							630	D					790					
Benzo(a)pyrene	UG/KG	680	4964	6800																		
Benzo(b+k)fluoranthenes	UG/KG	800		8000							1060	D					1190					
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700							770	D					970					
Fluoranthene	UG/KG	630	4600	6300	660		710				1700	D					3100	D				
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	170		210				250	D					290					
Pyrene	UG/KG	430		7300	1200	D	1100	D			2200	D	450		470		2600	D				
Total HPAH	UG/KG	1800		51000	4112	D	4341	D			6380	D					9842	D				
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73							33	UD										
Dibenzofuran	UG/KG	54		540							91	D					200					
N-nitrosodiphenylamine	UG/KG	28	161	220							33	UD										
2-Methylphenol	UG/KG	20		72							27	UD										
2,4-Dimethylphenol	UG/KG	29		50																		
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690							140	UD										
Phenol	UG/KG	120	876	1200			130															
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64							16	UD										
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230							33	UD										
Hexachlorobutadiene	UG/KG	29	212	290							44	UD										
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37				11	D			20	D										
Alpha chlordane	UG/KG	10	37								22	UD										
Dieldrin	UG/KG	10	37		12	D	13	D			24	D										
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69	12	D	14	D	18.6	D	50	D	11.9	D	9.4		11	UD	10	UD		
PCBs, total	UG/KG	130		2500	1200	D	1100	D	500	D	1020	D	386	D	590	D	580	D	670	D		
PCBs, total	MG/KG OC		38.0		75.0	D	50.0	D											39.4	D		
Organic carbon, total	%				1.6		2.2		1.5		3.5		1.5		1.7		1.7		1.7		1	
Total solids	%				64.9		56.3		60.3		52.3		65		59.1		65.3		67.7		73.1	
Total volatile solids	%				4.6		6.2		5.1		7.4		4.5		5.3		4.8		4.1		2.8	
Ammonia, total	MG/KG				60		120		85	E	150		120	J	330		130		130		84	E
Total Sulfides	MG/KG				850	J	740	J	1200		220	J	NA		NA		160	J	790	J	NA	
Fines, percent (silt+clay)	%				53.3		77.6		75		76.3		79.3		89		70.3		61.3		37.5	
preferred reference match:					CG		SB		SB		SB		SB		SB		CG		CG		CG	
Mytilus galloprovincialis hits:							X								X		XX					
Eohaustorius estuarius hits:							X				XX				X		XX					
Neanthes arenaceodentata hits:											X				XX							
Bioassay Pass/Fail:					P		F		P		F		P		F		F		>BT		P	
BTs exceeded:					X		X				X								X			
Bioaccumulation conducted:					X						X											
Bioaccumulation Pass/Fail:					P						P											
ML rule exceeded:																						
PSDDA determination:					P		F		P		F		P		F		N/A		N/A		P	
DMMU volume (cubic yards):					4030		4030		4030		4030		25420		26700		phase 2		phase 2		22360	
DMMU:					1C48		1C49		1C50		1C51		1C53		1C54		1C55		1C56		1C57	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	2C01		2C02		2C03		2C04		2C05		2C06		2C07		2C08		2C09	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6											1.3	J	3.7		2.5		2.9	
Copper	MG/KG	81		810													120		89		100	J
Lead	MG/KG	66		660			80								99		190		130		170	
Mercury	MG/KG	0.21	1.5	2.1			0.89		0.64		0.336		0.614		0.882		0.636		0.49		0.525	
Silver	MG/KG	1.2	4.6	6.1													2.9		1.8		2.2	J
Zinc	MG/KG	160		1600											190		260		210		240	
TBT (bulk sediment as TBT)	UG/KG																					
TBT (calculated porewater as TBT)	UG/L		0.15																			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670													77		110		280	D
Acenaphthene	UG/KG	63		630													130		65		110	D
Acenaphthylene	UG/KG	64		640																	78	UD
Anthracene	UG/KG	130		1300									200				260		160		170	D
Fluorene	UG/KG	64		640									77		77		180		110		200	D
Naphthalene	UG/KG	210		2100																		
Phenanthrene	UG/KG	320		3200													510		370		670	D
Total LPAH	UG/KG	610		6100			634	J									1254		875		1522	D
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500													460					
Benzo(a)pyrene	UG/KG	680	4964	6800																		
Benzo(b+k)fluoranthenes	UG/KG	800		8000													1000					
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700													700					
Fluoranthene	UG/KG	630	4600	6300													1000		720		870	D
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200			170		180		140	D	100		160		200		130		170	D
Pyrene	UG/KG	430		7300			970	D	740		490	D	720		730		1200		1100		1200	D
Total HPAH	UG/KG	1800		51000			3390	D	2660		1940	D	2570		3047		5230		3890		4130	D
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73							26	UD									47	UD
Dibenzofuran	UG/KG	54		540													66				78	UD
N-nitrosodiphenylamine	UG/KG	28	161	220																	47	UD
2-Methylphenol	UG/KG	20		72							22	UD									39	UD
2,4-Dimethylphenol	UG/KG	29		50																	39	UJ
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690							110	UD									190	UD
Phenol	UG/KG	120	876	1200																		
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64																	23	UD
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230							26	UD									47	UD
Hexachlorobutadiene	UG/KG	29	212	290							35	UD									62	UD
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37						11	D												
Alpha chlordane	UG/KG	10	37														13	D			11	D
Dieldrin	UG/KG	10	37														23	D	16	D	21	D
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69			12	D	44	D	10.3	D			7.8	UD	40	D	26	D	42	D
PCBs, total	UG/KG	130		2500					830	D	416	D					2080	D	770	D	1510	D
PCBs, total	MG/KG OC		38.0						51.9	D		D					94.5	D	48.1	D	58.1	D
Organic carbon, total	%				0.78		1.9		1.6		1.2		1.3		1.8		2.2		1.6		2.6	
Total solids	%				73.9		64.1		66.9		65		55.5		54.4		48.6		55.4		55.2	
Total volatile solids	%				2.2		4.5		3.9		3.1		4.1		4.4		7		5.4		5.4	
Ammonia, total	MG/KG				3.4		29		18		11		65		160		170		130		200	
Total Sulfides	MG/KG				61		160		170	J	600		1300		1400		1400		2800		820	
Fines, percent (silt+clay)	%				39.3		67		63.9		75.1		94.2		93.2		87.2		74.5		77.7	
preferred reference match:					CG		CG		CG		SB		SB		SB		SB		SB		SB	
Mytilus galloprovincialis hits:							X										XX		XX		XX	
Eohaustorius estuarius hits:							X				XX				XX		X		XX		XX	
Neanthes arenaceodentata hits:															XX		XX		XX		XX	
Bioassay Pass/Fail:					P		F		P		F		P		F		F		F		F	
BTs exceeded:									X								X		X		X	
Bioaccumulation conducted:									X													
Bioaccumulation Pass/Fail:									P													
ML rule exceeded:																						
PSDDA determination:					P		F		P		F		P		F		F		F		F	
DMMU volume (cubic yards):					4160		4070		4460		4360		4680		5020		4030		4030		3980	
DMMU:					2C01		2C02		2C03		2C04		2C05		2C06		2C07		2C08		2C09	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	2C10		2C11		2C12		2C13		2C14		2C15		2C16		2C17		2C18	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	2.7		6		1.5				7.9		6.7		7.4		4.1	J	3.3	J
Copper	MG/KG	81		810	100	J	140						220	J	220	J	200	J	180		210	
Lead	MG/KG	66		660	170		260		110				450		420		480		660		300	
Mercury	MG/KG	0.21	1.5	2.1	0.59		0.807		0.444		0.569		1.02		1.12		0.92		1.58		1.51	
Silver	MG/KG	1.2	4.6	6.1	2.3	J	3		2.1				10	J	8.4	J	12	J	2.6		4.1	
Zinc	MG/KG	160		1600	240		410		170				550		630		510		480		430	
TBT (bulk sediment as TBT)	UG/KG																					
TBT (calculated porewater as TBT)	UG/L		0.15																			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670	77	D	1300						3700	D	2300	D	3100	D	2900	D	1100	D
Acenaphthene	UG/KG	63		630	120	D	480						540	D	500	D	340	D	440	D	250	D
Acenaphthylene	UG/KG	64		640	76	UD							190	UD	130	UD	180	UD	79	UD	79	UD
Anthracene	UG/KG	130		1300	280	D	600						600	D	490	D	380	D	530	D	300	D
Fluorene	UG/KG	64		640	220	D	590		76				920	D	750	D	600	D	620	D	370	D
Naphthalene	UG/KG	210		2100			280						440	D	370	D	300	D	860	D	390	D
Phenanthrene	UG/KG	320		3200	720	D	1800	D					2700	D	2500	D	1900	D	3900	D	1500	D
Total LPAH	UG/KG	610		6100	1527	D	5107	D					8900	D	6910	D	6620	D	9250	D	3910	D
Dibenz(a,h)anthracene	UG/KG	120		1200									190	UD	130	UD	180	UD				
Benz(a)anthracene	UG/KG	450		4500			750						700	D	620	D	670	D	980	D	640	D
Benzo(a)pyrene	UG/KG	680	4964	6800															910	D		
Benzo(b+k)fluoranthenes	UG/KG	800		8000			1220						940	D	1010	D	890	D	2090	D	1070	D
Benzo(g,h,i)perylene	UG/KG	540		5400															550	D		
Chrysene	UG/KG	670		6700			1000						1000	D	950	D	940	D	1400	D	810	D
Fluoranthene	UG/KG	630	4600	6300	1100	D	1800	D	710				2400	D	1900	D	2100	D	2900	D	1600	D
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200			220		140		82		220	D	330	D	270	D	520	D	340	D
Pyrene	UG/KG	430		7300	1200	D	1800	D	950				2400	D	2400	D	2000	D	3600	D	1700	D
Total HPAH	UG/KG	1800		51000	4408	D	7580	D	3377				8440	D	8110	D	7650	D	12950	D	7040	D
Benzoic acid	UG/KG	400		690									960	UD	630	UD	910	UD				
Benzyl alcohol	UG/KG	25		73	45	UD							120	UD	76	UD	110	UD	48	UD	47	UD
Dibenzofuran	UG/KG	54		540	76	UD	240						330	D	290	D	190	D	440	D	130	D
N-nitrosodiphenylamine	UG/KG	28	161	220	45	UD							120	UD	76	UD	110	UD	48	UD	47	UD
2-Methylphenol	UG/KG	20		72	38	UD							96	UD	63	UD	91	UD	40	UD	39	UD
2,4-Dimethylphenol	UG/KG	29		50	38	UJ							96	UJ	63	UJ	91	UJ	40	UJ	39	UJ
4-Methylphenol	UG/KG	120		1200									190	UD	130	UD	180	UD				
Pentachlorophenol	UG/KG	100	504	690	190	UD							480	UD	320	UD	450	UD	200	UD	200	UJ
Phenol	UG/KG	120	876	1200	150	D	230						360	D	340	D	370	D	220	D	410	D
1,2-Dichlorobenzene	UG/KG	19	37	350															79			
1,2,4-Trichlorobenzene	UG/KG	13		64	23	UD							58	UD	38	D	55	UD	57	D	24	UD
1,4-Dichlorobenzene	UG/KG	26	190	260													130		900			
Hexachlorobenzene	UG/KG	23	168	230	45	UD							120	UD	76	UD	110	UD	48	UD	47	UD
Hexachlorobutadiene	UG/KG	29	212	290	61	UD							150	UD	100	UD	150	UD	63	UD	63	UD
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870										6900	D	4000	D	9300	D	3200	D		
Diethyl phthalate	UG/KG	97											190	UD	130	UD	180	UD				
Dimethyl phthalate	UG/KG	160	1168										190	UD			180	UD				
Ethylbenzene	UG/KG	10	27	50									35		12		64		62			
Xylenes	UG/KG	12		160			13		16				100		44		290		170		16	
Aldrin	UG/KG	10	37				12	D					24	UD	42	D	23	UD	44	D	39	D
Alpha chlordane	UG/KG	10	37				16	D	11	D			64	UD	63	UD	62	UD	57	D	52	UD
Dieldrin	UG/KG	10	37		15	D	36	D	17	D			100	D	89	D	76	D	140	D	61	D
Gamma-HCH (Lindane)	UG/KG	10											24	UD	24	UD	23	UD	20	UD	20	UD
Heptachlor	UG/KG	10	37										24	UD	24	UD	23	UD	20	UD	20	UD
Total DDD,DDE and DDT	UG/KG	6.9	50	69	31	D	61	D	38	D	11	UD	220		208		180	D	301	D	126	D
PCBs, total	UG/KG	130		2500	920	D	1550	D	860	D	760	D	3900	D	3000	D	3400	D	12100	D	3820	D
PCBs, total	MG/KG OC		38.0		38.3	D	43.1	D	45.3	D	40.0	D	83.0	D	71.4	D	94.4	D	232.7	D	91.0	D
Organic carbon, total	%				2.4		3.6		1.9		1.9		4.7		4.2		3.6		5.2		4.2	
Total solids	%				56.3		46.7		57		65		44.1		45		45.7		53.5		54.2	
Total volatile solids	%				5.2		8.3		6		5.1		9.9		9.9		10.3		12.2		11	
Ammonia, total	MG/KG				120		330		78		39		470		480		580		640	E	500	
Total Sulfides	MG/KG				2000		1200		2400		370	J	3300		1900		4100		4700	J	800	J
Fines, percent (silt+clay)	%				75.1		85		73.8		51.3		87		83.2		76.4		29.3		54	
preferred reference match:					SB		SB		SB		CG		SB		SB		SB		WB		CG	
Mytilus galloprovincialis hits:					X		XX		XX				XX		XX		XX		XX		XX	
Eohaustorius estuarius hits:					XX		XX		X				XX		XX		XX		XX		XX	
Neanthes arenaceodentata hits:					X		XX						XX		XX		XX		XX		XX	
Bioassay Pass/Fail:					F		F		F		P		F		F		F		F		F	
BTs exceeded:					X		X		X		X		X		X		X		X		X	
Bioaccumulation conducted:											X											
Bioaccumulation Pass/Fail:											P											
ML rule exceeded:													X		X		X		X		X	
PSDDA determination:					F		F		F		P		F		F		F		F		F	
DMMU volume (cubic yards):					3990		3990		3990		4000		4000		4000		4000		4000		4000	
DMMU:					2C10		2C11		2C12		2C13		2C14		2C15		2C16		2C17		2C18	

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PSDDA Evaluation Summary

				DMMU:	1C21		1C22		1C23		1C24		1C25		1C26		1C27		1C28		1C29	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	1.3	J	1.6				2.3	J	3.5	J			3.6					
Copper	MG/KG	81		810			85				110		140				140					
Lead	MG/KG	66		660	110		140				160		220				230					
Mercury	MG/KG	0.21	1.5	2.1	0.56		0.48		0.23		0.76		0.89		0.33		0.89					
Silver	MG/KG	1.2	4.6	6.1									1.4				3.8					
Zinc	MG/KG	160		1600			200				210		310				340					
TBT (bulk sediment as TBT)	UG/KG								356										122			
TBT (calculated porewater as TBT)	UG/L		0.15						0.838										0.728			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670	70	UD					69	UD	130	UD			450	J				
Acenaphthene	UG/KG	63		630	70	UD					69	UD	130	UD			200				86	D
Acenaphthylene	UG/KG	64		640	70	UD					69	UD	130	UD								
Anthracene	UG/KG	130		1300							160	D	240	D			220				240	D
Fluorene	UG/KG	64		640	70	UD					83	D	140	D			280				89	D
Naphthalene	UG/KG	210		2100																		
Phenanthrene	UG/KG	320		3200													760					
Total LPAH	UG/KG	610		6100									700	D			2010				931	D
Dibenz(a,h)anthracene	UG/KG	120		1200									130	UD								
Benz(a)anthracene	UG/KG	450		4500									580	D							660	D
Benzo(a)pyrene	UG/KG	680	4964	6800																	810	D
Benzo(b+k)fluoranthenes	UG/KG	800		8000									920	D							1690	D
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700									800	D							810	D
Fluoranthene	UG/KG	630	4600	6300							810	D	1400	D			1100				980	D
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	97	D	100		130		83	D	170	D					85		260	D
Pyrene	UG/KG	430		7300	700	D	580		830	D	870	D	2100	D			1200		640		2900	D
Total HPAH	UG/KG	1800		51000	2657	D	2240		3103		3262	D	6610	D			4422		1812		8522	D
Benzoic acid	UG/KG	400		690									660	UJ								
Benzyl alcohol	UG/KG	25		73	42	UD					42	UD	*79*	UD								
Dibenzofuran	UG/KG	54		540	70	UD					69	UD	130	UD			110				89	D
N-nitrosodiphenylamine	UG/KG	28	161	220	42	UD					42	UD	79	UD								
2-Methylphenol	UG/KG	20		72	35	UD					35	UD	66	UD								
2,4-Dimethylphenol	UG/KG	29		50	35	UJ					35	UD	*66*	UJ								
4-Methylphenol	UG/KG	120		1200									130	UD								
Pentachlorophenol	UG/KG	100	504	690	180	UD					170	UD	330	UD								
Phenol	UG/KG	120	876	1200									130	UD								
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64	21	UD					21	UD	39	UD								
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230	42	UD					42	UD	79	UD							24	UD
Hexachlorobutadiene	UG/KG	29	212	290	56	UD					56	UD	100	UD							32	UD
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97											130	UD								
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37										15	D			11	D				
Alpha chlordane	UG/KG	10	37										21	UD	12	D	16	D				
Dieldrin	UG/KG	10	37				12	D			12	D	36	D			27	D				
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69	22.2	D	21.8	D			23	D	*71*	D	14.6	D	*96*	D			11.7	D
PCBs, total	UG/KG	130		2500	510	D	580	D	285	D	780	D	1280	D	249		1260	D			307	D
PCBs, total	MG/KG OC		38.0										45.7	D			45.0	D				
Organic carbon, total	%				1.9		2		1.7		2.1		2.8		1.2		2.8		0.67		1.5	
Total solids	%				61		59		63		61		54		65		48		76		70	
Total volatile solids	%				5.1		5.5		4.1		6		6.8		3.9		7.6		1.7		3.4	
Ammonia, total	MG/KG				93	E	90		13	E	130	E	150	E	66		220		8.7		6.4	E
Total Sulfides	MG/KG				270		770	J	930	J	660		1200		260		230		270		470	J
Fines, percent (silt+clay)	%				86.1		82.4		51.6		85.3		82.5		74.6		85.6		48.3		36.5	
preferred reference match:					SB		SB		CG		SB		SB		SB		SB		CG		CG	
Mytilus galloprovincialis hits:																	XX					
Eohaustorius estuarius hits:							X				X		XX		X		XX				X	
Neanthes arenaceodentata hits:																	XX					
Bioassay Pass/Fail:					P		P		P		P		F		P		F		P		P	
BTs exceeded:													X				X					
Bioaccumulation conducted:																						
Bioaccumulation Pass/Fail:																						
ML rule exceeded:													X									
PSDDA determination:					P		P		P		P		F		P		F		P		P	
DMMU volume (cubic yards):					3770		4200		3920		3790		3790		4030		3950		4060		3950	
DMMU:					1C21		1C22		1C23		1C24		1C25		1C26		1C27		1C28		1C29	

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PSDDA Evaluation Summary

				DMMU:	1C30		1C31		1C32		1C33		1C34		1C35		1C36		1C37		1C38	
				Rank:	H		H		H		H		H		H		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6	2.7	J	4.9	J	4.9	J	5.2	J					3	J	4.2	J	4.1	J
Copper	MG/KG	81		810	100		160		160		170						120		140		150	
Lead	MG/KG	66		660	200		270		290		320						180		240		290	
Mercury	MG/KG	0.21	1.5	2.1	0.33		0.9		1.2		0.884		0.268				0.553		1.4		0.814	
Silver	MG/KG	1.2	4.6	6.1	1.8		2.3		4.7	J	2.4								4		2.8	
Zinc	MG/KG	160		1600	300		340		420		450						230		340		360	
TBT (bulk sediment as TBT)	UG/KG												145									
TBT (calculated porewater as TBT)	UG/L		0.15										0.483									
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670			180	D	*1900*	D	*1600*	D					72	UD	130		*950*	D
Acenaphthene	UG/KG	63		630	550	D	160	D	340	D	*700*	D	66	D			*660*	D	240		200	D
Acenaphthylene	UG/KG	64		640			150	UD	130	UD	160	UD					72	UD			92	UD
Anthracene	UG/KG	130		1300	450	D	410	D	470	D	440	D	200	D	180		660	D	370		670	D
Fluorene	UG/KG	64		640	160	D	270	D	520	D	*730*	D	74	D			230	D	280		330	D
Naphthalene	UG/KG	210		2100					600	D	240	D										
Phenanthrene	UG/KG	320		3200	470	D	490	D	1600	D	2100	D					820	D	560		1200	D
Total LPAH	UG/KG	610		6100	1824	D	1510	D	5430	D	5810	D	772	D	650		2500	D	1651		3530	D
Dibenz(a,h)anthracene	UG/KG	120		1200			150	UD	130	UD	160	UD										
Benz(a)anthracene	UG/KG	450		4500	830	D	840	D	790	D	640	D					1100	D	710		540	D
Benzo(a)pyrene	UG/KG	680	4964	6800									700	D	700		790	D				
Benzo(b+k)fluoranthenes	UG/KG	800		8000	1480	D	1420	D	1280	D	960	D	1380	D	1360		1550	D	1100		950	D
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700	890	D	1100	D	980	D	800	D			700		1500	D	1200		710	D
Fluoranthene	UG/KG	630	4600	6300	2000	D	1900	D	1800	D	1500	D					3300	D	1400	D	1200	D
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	130	D	330	D	240	D	260	D	290	D	280		370	D	250		200	D
Pyrene	UG/KG	430		7300	2100	D	3100	D	3000	D	2100	D	2900	D	3400	D	4100	D	1700	D	1800	D
Total HPAH	UG/KG	1800		51000	7811	D	9700	D	9030	D	6980	D	7008	D	7511	D	13080	D	7218	D	6120	D
Benzoic acid	UG/KG	400		690					630	UD			420	UD								
Benzyl alcohol	UG/KG	25		73			*89*	UD	*76*	UD	*93*	UD					43	UD			55	UD
Dibenzofuran	UG/KG	54		540	96	D	150	UD	130	UD	480	D					140	D	130		140	D
N-nitrosodiphenylamine	UG/KG	28	161	220			89	UD	76	UD	93	UD					42	UD			55	UD
2-Methylphenol	UG/KG	20		72	21	UD	*74*	UD	63	UD	*78*	UD	21	UD			36	UD			46	UD
2,4-Dimethylphenol	UG/KG	29		50			*74*	UD			*78*	UD					36	UD			46	UD
4-Methylphenol	UG/KG	120		1200			150	UD	130	UD	160	UD										
Pentachlorophenol	UG/KG	100	504	690			370	UD	320	UD	390	UD	110	UD			180	UD			230	UD
Phenol	UG/KG	120	876	1200			150	UD	130	D	160	D							260		180	D
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64			44	UD	38	UD	47	UD					22	UD			28	UD
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230	25	UD	89	UD	76	UD	93	UD	25	UD			43	UD			55	UD
Hexachlorobutadiene	UG/KG	29	212	290	33	UD	120	UD	100	UD	120	UD	34	UD			58	UD			73	UD
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870				3700	D	4200	D	4100	D									4200	D
Diethyl phthalate	UG/KG	97					150	UD	130	UD	160	UD										
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50							18											
Xylenes	UG/KG	12		160					17		41										33	
Aldrin	UG/KG	10	37						18	D	22	D					11	D	21	D	21	D
Alpha chlordane	UG/KG	10	37				20	D	25	UD	25	UD					11	D	25	D	26	D
Dieldrin	UG/KG	10	37				38	D	54	D	54	D					20	D	44	D	48	D
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69	15.6	D	*79*	D	*116*	D	*126*	D	20.7	D	9.4	D	43	D	*70*	D	*105*	D
PCBs, total	UG/KG	130		2500	420	D	2170	D	2430	D	*2580*	D	274	D	260	D	1370	D	2220	D	2200	D
PCBs, total	MG/KG OC		38.0				67.8	D	65.7	D	66.2	D					52.7	D	96.5	D	66.7	D
Organic carbon, total	%				1.2		3.2		3.7		3.9		1.2		1.4		2.6		2.3		3.3	
Total solids	%				68		49		45		46.5		70.5		73.9		59.9		49.7		46.8	
Total volatile solids	%				3.6		7.8		8.7		8.6		3.1		2.5		5.4		7.8		8	
Ammonia, total	MG/KG				18	E	160	E	270		260		8.6		13		98	E	220		240	
Total Sulfides	MG/KG				890		2300		1900		1100		440		390	J	1300		2700	J	1600	
Fines, percent (silt+clay)	%				41.3		88.5		88.3		89.9		39.8		29.2		62.1		88.1		87.4	
preferred reference match:					CG		SB		SB		SB		CG		WB		CG		SB		SB	
Mytilus galloprovincialis hits:							XX		X		XX						XX		XX		X	
Eohaustorius estuarius hits:					X		XX		XX		XX		X				XX		XX		XX	
Neanthes arenaceodentata hits:									XX		XX								XX		XX	
Bioassay Pass/Fail:					P		F		F		F		P		P		F		F		F	
BTs exceeded:							X		X		X						X		X		X	
Bioaccumulation conducted:																						
Bioaccumulation Pass/Fail:																						
ML rule exceeded:							X		X		X										X	
PSDDA determination:					P		F		F		F		P		P		F		F		F	
DMMU volume (cubic yards):					4030		4030		4030		4030		4030		4020		4030		4030		4030	
DMMU:					1C30		1C31		1C32		1C33		1C34		1C35		1C36		1C37		1C38	

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PSDDA Evaluation Summary

				DMMU:	2C19		2C20		2C21		2C22		2C23		2C24		3C01		3C02		3C03	
				Rank:	H		H		M		M		M		M		H		H		H	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6			1.6	J					2.2	J								
Copper	MG/KG	81		810									97									
Lead	MG/KG	66		660			130						270									
Mercury	MG/KG	0.21	1.5	2.1	0.22		0.67		0.49		0.22		0.81		0.22		0.43		0.57		0.232	
Silver	MG/KG	1.2	4.6	6.1			1.4						1.6	J								
Zinc	MG/KG	160		1600									320									
TBT (bulk sediment as TBT)	UG/KG																					
TBT (calculated porewater as TBT)	UG/L		0.15																			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670									*760*				120	D				
Acenaphthene	UG/KG	63		630			68						110									
Acenaphthylene	UG/KG	64		640																		
Anthracene	UG/KG	130		1300			170										*1500*	D				
Fluorene	UG/KG	64		640			94		66				200				170	D				
Naphthalene	UG/KG	210		2100																		
Phenanthrene	UG/KG	320		3200			430						650				360	D				
Total LPAH	UG/KG	610		6100			861	J					2020				2283	D				
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500																		
Benzo(a)pyrene	UG/KG	680	4964	6800																		
Benzo(b+k)fluoranthenes	UG/KG	800		8000																		
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700																		
Fluoranthene	UG/KG	630	4600	6300			730															
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200			130		93				94				97	D	120			
Pyrene	UG/KG	430		7300			950						720				480	D	870			
Total HPAH	UG/KG	1800		51000			3725						2474						2347			
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73																		
Dibenzofuran	UG/KG	54		540									63				80	D				
N-nitrosodiphenylamine	UG/KG	28	161	220																		
2-Methylphenol	UG/KG	20		72																		
2,4-Dimethylphenol	UG/KG	29		50																		
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690																		
Phenol	UG/KG	120	876	1200									170									
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64																		
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230																		
Hexachlorobutadiene	UG/KG	29	212	290													31	UD				
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37				11	D					18	UD								
Alpha chlordane	UG/KG	10	37										48	UD								
Dieldrin	UG/KG	10	37				13	D					88	D								
Gamma-HCH (Lindane)	UG/KG	10											18	UD								
Heptachlor	UG/KG	10	37										18	UD								
Total DDD,DDE and DDT	UG/KG	6.9	50	69	11	UD	15	D					*151*	D	10	UD						
PCBs, total	UG/KG	130		2500	220	UD	950	D			200	UD	*3450*	D	230	D						
PCBs, total	MG/KG OC		38.0				47.5	D					95.8	D								
Organic carbon, total	%				1.3		2		1.2		1.1		3.6		1.2		1.3		1.3		0.63	
Total solids	%				63.3		59.1		61.3		71.4		58.4		68.2		74.9		69.3		75.8	
Total volatile solids	%				4.3		6		4		3.3		7.4		4		3.1		3.2		2.3	
Ammonia, total	MG/KG				22		160		180		80		520	J	220		18		13	J	4.1	
Total Sulfides	MG/KG				320	J	1000	J	NA		NA		NA		1200	J	35		130		35	
Fines, percent (silt+clay)	%				76		82.9		83.3		48		72.6		59.3		41.4		51.3		31.7	
preferred reference match:					SB		SB		SB		CG		SB		CG		CG		CG		WB	
Mytilus galloprovincialis hits:							XX						XX		XX				X			
Eohaustorius estuarius hits:							X		XX				XX		X				X			
Neanthes arenaceodentata hits:									XX				XX		X							
Bioassay Pass/Fail:					P		F		F		P		F		F		P		F		P	
BTs exceeded:							X						X									
Bioaccumulation conducted:																						
Bioaccumulation Pass/Fail:																						
ML rule exceeded:													X									
PSDDA determination:					P		F		N/A		P		F		F		P		F		P	
DMMU volume (cubic yards):					4000		4000		phase 2		24220		27180		19860		3660		3520		4000	
DMMU:					2C19		2C20		2C21		2C22		2C23		2C24		3C01		3C02		3C03	

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PSDDA Evaluation Summary

				DMMU:	3C04		3C05		3C06		3C07		4C01		LMCG1		LMCG2		LMSB1		LMSB2	
				Rank:	H		H		H		M		H		P1 Ref		P1 Ref		P1 Ref		P1 Ref	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6									2.7									
Copper	MG/KG	81		810									110									
Lead	MG/KG	66		660			79						150									
Mercury	MG/KG	0.21	1.5	2.1	1.05		0.92						0.68									
Silver	MG/KG	1.2	4.6	6.1									2.5									
Zinc	MG/KG	160		1600									230									
TBT (bulk sediment as TBT)	UG/KG																					
TBT (calculated porewater as TBT)	UG/L		0.15																			
TBT (measured porewater as TBT)	UG/L		0.15																			
2-Methylnaphthalene	UG/KG	67		670																		
Acenaphthene	UG/KG	63		630																		
Acenaphthylene	UG/KG	64		640																		
Anthracene	UG/KG	130		1300			140						150	D								
Fluorene	UG/KG	64		640									90	D								
Naphthalene	UG/KG	210		2100																		
Phenanthrene	UG/KG	320		3200																		
Total LPAH	UG/KG	610		6100			708															
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500																		
Benzo(a)pyrene	UG/KG	680	4964	6800																		
Benzo(b+k)fluoranthenes	UG/KG	800		8000									810	D								
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700																		
Fluoranthene	UG/KG	630	4600	6300									760	D								
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	75		170						210	D								
Pyrene	UG/KG	430		7300	470		1100	D					1100	D								
Total HPAH	UG/KG	1800		51000			3680	D					4300	D								
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73									33	UD							27	UJ
Dibenzofuran	UG/KG	54		540									55	UD								
N-nitrosodiphenylamine	UG/KG	28	161	220									33	UD								
2-Methylphenol	UG/KG	20		72									27	UD							22	J
2,4-Dimethylphenol	UG/KG	29		50																		
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690									140	UD							110	UJ
Phenol	UG/KG	120	876	1200													130	J				
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64									16	UD								
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230									33	UD					24	UJ	27	UJ
Hexachlorobutadiene	UG/KG	29	212	290									44	UD					33	UJ	36	UJ
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37										11	D								
Alpha chlordane	UG/KG	10	37										11	UD								
Dieldrin	UG/KG	10	37										18	D								
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69			13.3	D					36	D								
PCBs, total	UG/KG	130		2500									930	D								
PCBs, total	MG/KG OC		38.0										46.5	D								
Organic carbon, total	%				0.81		2		0.98		1.1		2		1		1.2		2.3		2.3	
Total solids	%				62.8		67.9		71.2		69.7		51.8		56		53		33.9		32.6	
Total volatile solids	%				3.4		3.7		2.8		2.6		6.5		4.2		4.5		7.5		7.3	
Ammonia, total	MG/KG				13	J	23	J	2.5		27	J	98		25		26		26		29	
Total Sulfides	MG/KG				110		190		63		NA		750		74	J	130		570	J	660	
Fines, percent (silt+clay)	%				77.2		53.3		43.3		52.4		84.5		59.9		70.7		74.9		82.1	
preferred reference match:					SB		CG		CG		CG		SB		CG		CG		SB		SB	
Mytilus galloprovincialis hits:																						
Eohaustorius estuarius hits:					XX		X						XX									
Neanthes arenaceodentata hits:																						
Bioassay Pass/Fail:					F		P		P		P		F									
BTs exceeded:													X									
Bioaccumulation conducted:																						
Bioaccumulation Pass/Fail:																						
ML rule exceeded:																						
PSDDA determination:					F		P		P		P		F									
DMMU volume (cubic yards):					4000		3240		3380		24900		4000									
DMMU:					3C04		3C05		3C06		3C07		4C01		LMCG1		LMCG2		LMSB1		LMSB2	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	1C07B		1C08B		1C37B		1C42B		1C43B		1C48B		1C48NB		1C48SB		1C49B	
				Rank:	M		M		M		M		M		M		M		M		M	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6					1.4													
Copper	MG/KG	81		810																		
Lead	MG/KG	66		660					100													
Mercury	MG/KG	0.21	1.5	2.1	0.546		0.268		0.456								0.445					
Silver	MG/KG	1.2	4.6	6.1																		
Zinc	MG/KG	160		1600					170													
TBT (bulk sediment as TBT)	UG/KG																					
TBT (calculated porewater as TBT)	UG/L		0.15																			
TBT (measured porewater as TBT)	UG/L		0.15				0.239	J														
2-Methylnaphthalene	UG/KG	67		670	110																	
Acenaphthene	UG/KG	63		630	320																	
Acenaphthylene	UG/KG	64		640																		
Anthracene	UG/KG	130		1300	740																	
Fluorene	UG/KG	64		640	500		90		85													
Naphthalene	UG/KG	210		2100																		
Phenanthrene	UG/KG	320		3200	2700	D	360															
Total LPAH	UG/KG	610		6100	4500		692															
Dibenz(a,h)anthracene	UG/KG	120		1200																		
Benz(a)anthracene	UG/KG	450		4500	950																	
Benzo(a)pyrene	UG/KG	680	4964	6800	800																	
Benzo(b+k)fluoranthenes	UG/KG	800		8000	1240																	
Benzo(g,h,i)perylene	UG/KG	540		5400																		
Chrysene	UG/KG	670		6700	1100																	
Fluoranthene	UG/KG	630	4600	6300	2100	D																
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	410				100								91					
Pyrene	UG/KG	430		7300	2400	D			620													
Total HPAH	UG/KG	1800		51000	9472	D			2350													
Benzoic acid	UG/KG	400		690																		
Benzyl alcohol	UG/KG	25		73																		
Dibenzofuran	UG/KG	54		540	200																	
N-nitrosodiphenylamine	UG/KG	28	161	220																		
2-Methylphenol	UG/KG	20		72																		
2,4-Dimethylphenol	UG/KG	29		50																		
4-Methylphenol	UG/KG	120		1200																		
Pentachlorophenol	UG/KG	100	504	690																		
Phenol	UG/KG	120	876	1200																		
1,2-Dichlorobenzene	UG/KG	19	37	350																		
1,2,4-Trichlorobenzene	UG/KG	13		64																		
1,4-Dichlorobenzene	UG/KG	26	190	260																		
Hexachlorobenzene	UG/KG	23	168	230																		
Hexachlorobutadiene	UG/KG	29	212	290																		
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870																			
Diethyl phthalate	UG/KG	97																				
Dimethyl phthalate	UG/KG	160	1168																			
Ethylbenzene	UG/KG	10	27	50																		
Xylenes	UG/KG	12		160																		
Aldrin	UG/KG	10	37																			
Alpha chlordane	UG/KG	10	37																			
Dieldrin	UG/KG	10	37																			
Gamma-HCH (Lindane)	UG/KG	10																				
Heptachlor	UG/KG	10	37																			
Total DDD,DDE and DDT	UG/KG	6.9	50	69					29.7													
PCBs, total	UG/KG	130		2500					990													
PCBs, total	MG/KG OC		38.0						49.5													
Organic carbon, total	%				1.5		1.4		2		0.62		0.59		1.3		1.5		1.3		1.2	
Total solids	%				57		61		58		73		75		68.9		71		68.5		69.4	
Total volatile solids	%				6.5		3.9		5.5		2.2		2.7		3.8		4		3.6		4.1	
Ammonia, total	MG/KG				230		210		210		61		54		120		95		98		140	
Total Sulfides	MG/KG				860		380		3700		170		NA		740	J	300		200		610	
Fines, percent (silt+clay)	%				93.9		91.5		97.3		62.5		27		64.2		46.3		57.4		59.3	
preferred reference match:					SB		SB		SB		CG		WB		CG		CG		CG		CG	
Mytilus galloprovincialis hits:					XX		X		XX													
Eohaustorius estuarius hits:					X				X		X				X						X	
Neanthes arenaceodentata hits:					XX		XX		XX												X	
Bioassay Pass/Fail:					F		F		F		P		P		P		P		P		F	
BTs exceeded:							X		X													
Bioaccumulation conducted:																						
Bioaccumulation Pass/Fail:																						
ML rule exceeded:																						
PSDDA determination:					F		F		F		P		P		P		P		P		F	
DMMU volume (cubic yards):					2310		3560		2770		9050		7920		3800		3750		3550		12250	
DMMU:					1C07B		1C08B		1C37B		1C42B		1C43B		1C48B		1C48NB		1C48SB		1C49B	

Port of Seattle Terminal 18 (95-02133)
PSDDA Evaluation Summary

				DMMU:	1C55XSB		2C01B		2C02B		2C06B		CAPGEO		SEQBAY		WESBEC	
				Rank:	M		M		M		M		P2 Ref		P2 Ref		P2 Ref	
Chemical Name	Units	SL	BT	ML	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ	Conc.	VQ
Cadmium	MG/KG	0.96		9.6												-		
Copper	MG/KG	81		810							99							
Lead	MG/KG	66		660														
Mercury	MG/KG	0.21	1.5	2.1							0.491							
Silver	MG/KG	1.2	4.6	6.1														
Zinc	MG/KG	160		1600														
TBT (bulk sediment as TBT)	UG/KG																	
TBT (calculated porewater as TBT)	UG/L		0.15															
TBT (measured porewater as TBT)	UG/L		0.15															
2-Methylnaphthalene	UG/KG	67		670														
Acenaphthene	UG/KG	63		630	76													
Acenaphthylene	UG/KG	64		640														
Anthracene	UG/KG	130		1300														
Fluorene	UG/KG	64		640														
Naphthalene	UG/KG	210		2100														
Phenanthrene	UG/KG	320		3200														
Total LPAH	UG/KG	610		6100														
Dibenz(a,h)anthracene	UG/KG	120		1200														
Benz(a)anthracene	UG/KG	450		4500														
Benzo(a)pyrene	UG/KG	680	4964	6800														
Benzo(b+k)fluoranthenes	UG/KG	800		8000														
Benzo(g,h,i)perylene	UG/KG	540		5400														
Chrysene	UG/KG	670		6700														
Fluoranthene	UG/KG	630	4600	6300														
Indeno(1,2,3-c,d)pyrene	UG/KG	69		5200	82													
Pyrene	UG/KG	430		7300	690													
Total HPAH	UG/KG	1800		51000	2342													
Benzoic acid	UG/KG	400		690														
Benzyl alcohol	UG/KG	25		73											35	U		
Dibenzofuran	UG/KG	54		540											58	U		
N-nitrosodiphenylamine	UG/KG	28	161	220											35	U		
2-Methylphenol	UG/KG	20		72											29	U		
2,4-Dimethylphenol	UG/KG	29		50														
4-Methylphenol	UG/KG	120		1200														
Pentachlorophenol	UG/KG	100	504	690											150	U		
Phenol	UG/KG	120	876	1200														
1,2-Dichlorobenzene	UG/KG	19	37	350														
1,2,4-Trichlorobenzene	UG/KG	13		64											17	U		
1,4-Dichlorobenzene	UG/KG	26	190	260														
Hexachlorobenzene	UG/KG	23	168	230											35	U		
Hexachlorobutadiene	UG/KG	29	212	290											47	U		
Bis(2-ethylhexyl)phthalate	UG/KG	3100	13870															
Diethyl phthalate	UG/KG	97																
Dimethyl phthalate	UG/KG	160	1168															
Ethylbenzene	UG/KG	10	27	50														
Xylenes	UG/KG	12		160														
Aldrin	UG/KG	10	37															
Alpha chlordane	UG/KG	10	37		13	J												
Dieldrin	UG/KG	10	37															
Gamma-HCH (Lindane)	UG/KG	10																
Heptachlor	UG/KG	10	37															
Total DDD,DDE and DDT	UG/KG	6.9	50	69	17.3													
PCBs, total	UG/KG	130		2500	174													
PCBs, total	MG/KG OC		38.0															
Organic carbon, total	%				1.2		0.77		0.94		1.2		1		2.5		0.12	
Total solids	%				77		73		71.3		59.5		63.8		23		78	
Total volatile solids	%				2.2		2.2		2.6		5		3.5		9.3		0.85	
Ammonia, total	MG/KG				30		9.4		32		170		29		51		16	
Total Sulfides	MG/KG				190		160		100		1200		26	J	340	J	25	J
Fines, percent (silt+clay)	%				31.1		41.9		44.7		91.7		50.7		85.2		4.5	
preferred reference match:					CG		CG		CG		SB		CG		SB		WB	
Mytilus galloprovincialis hits:											X							
Eohaustorius estuarius hits:																		
Neanthes arenaceodentata hits:											XX							
Bioassay Pass/Fail:					P		P		P		F							
BTs exceeded:																		
Bioaccumulation conducted:																		
Bioaccumulation Pass/Fail:																		
ML rule exceeded:																		
PSDDA determination:					P		P		P		F							
DMMU volume (cubic yards):					3410		7660		6010		5080							
DMMU:					1C55XSB		2C01B		2C02B		2C06B		CAPGEO		SEQBAY		WESBEC	

Port of Seattle Terminal 18 (95-02133)
Bioaccumulation Trigger Exceedances

	Mercury (mg/kg)	Silver (mg/kg)	Tributyltin (meas. porewater - ug/l as TBT)	Fluoranthene (ug/kg)	1,2-Dichlorobenzene (ug/kg)	1,4-Dichlorobenzene (ug/kg)	Ethylbenzene (ug/kg)	Aldrin (ug/kg)	Alpha chlordane (ug/kg)	Dieldrin (ug/kg)	Total DDD,DDE and DDT (ug/kg)	PCBs, total (ug/kg oc)	Bioaccumulation conducted
BT:	1.5	4.6	0.150	4600	37	190	27	37	37	37	50	38.0	
1C03									44 UD		71 D	377 D	X
1C04			0.207									78.6 D	X
1C05			0.209									90.3 D	X
1C12												87.1 D	
1C13												40.5 D	
1C14												42.8 D	X
1C16												44.7 D	
1C17												49.6 D	
1C19												70.4 D	
1C20												60.0 D	X
1C25											71 D	45.7 D	
1C27											96 D	45.0 D	
1C31										38 D	79 D	67.8 D	
1C32		4.7 J								54 D	116 D	65.7 D	
1C33										54 D	126 D	66.2 D	
1C36												52.7 D	
1C37										44 D	70 D	96.5 D	
1C38										48 D	105 D	66.7 D	
1C39	12.7									40 D	171 D	60.0 D	
1C42				10000 D									
1C43												64.8 D	
1C44											59 D	85.6 D	
1C45									53 UD	86 D	145 D	103 D	
1C48												75.0 D	X
1C49												50.0 D	
1C51	1.7												X
1C56												39.4 D	
2C03												51.9 D	X
2C07												94.5 D	
2C08												48.1 D	
2C09												58.1 D	
2C10												38.3 D	
2C11											61 D	43.1 D	
2C12												45.3 D	
2C13												40.0 D	X
2C14		10 J					35		64 UD	100 D	220	83.0 D	
2C15		8.4 J						42 D	63 UD	89 D	208	71.4 D	
2C16		12 J					64		62 UD	76 D	180 D	94.4 D	
2C17	1.6				79	900	62	44 D	57 D	140 D	301 D	233 D	
2C18	1.5							39 D	52 UD	61 D	126 D	91.0 D	
2C20												47.5 D	
2C23									48 UD	88 D	151 D	95.8 D	
4C01												46.5 D	
1C08B			0.239 J										
1C37B												49.5	

Port of Seattle Terminal 18 (95-02133)
PSDDA Maximum Level Exceedances

	Mercury (mg/kg)	Silver (mg/kg)	2-Methylnaphthalene (ug/kg)	Acenaphthene (ug/kg)	Anthracene (ug/kg)	Fluorene (ug/kg)	Phenanthrene (ug/kg)	Total LPAH (ug/kg)	Fluoranthene (ug/kg)	Pyrene (ug/kg)	Benzoic acid (ug/kg)	Benzyl alcohol (ug/kg)	Dibenzofuran (ug/kg)	2-Methylphenol (ug/kg)	2,4-Dimethylphenol (ug/kg)	1,4-Dichlorobenzene (0g/kg)	Ethylbenzene (ug/kg)	Xylenes (ug/kg)	Total DDD,DDE and DDT (ug/kg)	PCBs, total (ug/kg)	More than two MLs exceeded	2 X ML exceeded
ML:	2.1	6.1	670	630	1300	640	3200	6100	6300	7300	690	73	540	72	50	260	50	160	69	2500		
1C03																			71 D	4900 D	X	
1C06												150 D										X
1C25												79 UD			66 UJ				71 D		X	
1C27																			96 D			
1C31												89 UD		74 UD	74 UD				79 D		X	
1C32			1900 D									76 UD							116 D		X	X
1C33			1600 D	700 D		730 D						93 UD		78 UD	78 UD				126 D	2580 D	X	X
1C36				660 D																		
1C37																			70 D			
1C38			950 D																105 D		X	
1C39	12.7		1100 D									77 UD			64 UD				171 D	2880 D	X	X
1C42				3400 D	1700 D	1600 D	3400 D	10845 D	10000 D	9600 D			630 D								X	X
1C44																				3080 D		
1C45			1900 D																145 D	5550 D	X	X
1C55				960																		
2C11			1300																			
2C14		10 J	3700 D			920 D					960 UD	120 UD		96 UD	96 UJ				220	3900 D	X	X
2C15		8.4 J	2300 D			750 D						76 UD			63 UJ				208	3000 D	X	X
2C16		12 J	3100 D								910 UD	110 UD		91 UD	91 UJ		64	290	180 D	3400 D	X	X
2C17			2900 D				3900 D									900	62	170	301 D	12100 D	X	X
2C18			1100 D																126 D	3820 D	X	
2C23			760																151 D	3450 D	X	X
3C01					1500 D																	

Port of Seattle Terminal 18
Phase 1 TBT Testing

DMMU	Sediment Tributyltin (ug/kg dw)	VQ	Total organic carbon	calculated porewater TBT (ug/l)	measured porewater TBT (ug/l)	LQ
1C03	671.0	D	0.0130	2.065	0.105	
1C04	1124.8	J	0.0140	3.214	0.207	
1C05	331.8		0.0093	1.427	0.209	
1C06	307.4		0.0095	1.294	0.060	
1C07	9.5		0.0170	0.022		
1C08	1.2	U	0.0120	0.004		
1C09	211.8		0.0083	1.021	0.084	
1C10	256.2		0.0120	0.854	0.084	
1C11	118.8		0.0160	0.297	na	
1C12	104.4		0.0170	0.246	na	
1C13	407.5		0.0084	1.940	0.059	U
1C14	67.6		0.0180	0.150		
1C15	205.0		0.0092	0.891	0.031	U
1C16	40.7		0.0190	0.086		
1C17	66.4		0.0260	0.102		
1C18	119.1		0.0096	0.496	0.039	J
1C19	57.8		0.0250	0.093		
1C20	94.9		0.0230	0.165	na	
1C21	17.8		0.0190	0.038		
1C22	39.8		0.0200	0.080		
1C23	356.2		0.0170	0.838	0.081	
1C24	8.8		0.0210	0.017		
1C25	31.2		0.0280	0.045		
1C26	3.8		0.0120	0.013		
1C27	61.0		0.0280	0.087		
1C28	122.0		0.0067	0.728	0.059	
1C29	61.7		0.0150	0.165	na	
1C30	35.6		0.0120	0.119		
1C31	82.0		0.0320	0.102		

DMMU	Sediment Tributyltin (ug/kg dw)	VQ	Total organic carbon	calculated porewater TBT (ug/l)	measured porewater TBT (ug/l)	LQ
1C32	158.1		0.0370	0.171	na	
1C33	136.6		0.0390	0.140		
1C34	144.9		0.0120	0.483	0.046	
1C35	67.6		0.0140	0.193	na	
1C36	84.7		0.0260	0.130		
1C37	116.9		0.0230	0.203	na	
1C38	132.0		0.0330	0.160	na	
1C39	96.6		0.0480	0.081		
1C40	145.2		0.0100	0.581	0.037	U
1C41	43.2		0.0052	0.332	na	
1C42	47.8		0.0140	0.137		
1C43	89.1		0.0230	0.155	na	
1C44	397.7		0.0360	0.442	0.030	U
1C45	113.2		0.0540	0.084		
1C46	150.5		0.0110	0.547	0.041	J
1C47	111.3		0.0130	0.342	na	
1C48	47.8		0.0160	0.120		
1C49	134.4		0.0220	0.244	na	
1C50	32.5		0.0150	0.087		
1C51	81.3		0.0350	0.093		
1C53	1.3		0.0150	0.003		
1C54	1.5		0.0170	0.003		
1C55	9.3		0.0170	0.022		
1C56	3.2		0.0170	0.007		
1C57	1.2	U	0.0100	0.005		
2C01	9.9		0.0078	0.051		
2C02	6.8		0.0190	0.014		
2C03	2.8		0.0160	0.007		
2C04	68.1		0.0120	0.227	na	

DMMU	Sediment Tributyltin (ug/kg dw)	VQ	Total organic carbon	calculated porewater TBT (ug/l)	measured porewater TBT (ug/l)	LQ
2C05	7.3		0.0130	0.022		
2C06	4.0		0.0180	0.009		
2C07	182.0		0.0220	0.331	na	
2C08	87.4		0.0160	0.218	na	
2C09	74.2		0.0260	0.114		
2C10	130.8		0.0240	0.218	na	
2C11	159.8		0.0360	0.178	na	
2C12	65.6		0.0190	0.138		
2C13	32.7		0.0190	0.069		
2C14	94.9	J	0.0470	0.081		
2C15	194.2		0.0420	0.185	na	
2C16	199.8		0.0360	0.222	na	
2C17	38.5		0.0520	0.030		
2C18	30.5		0.0420	0.029		
2C19	15.4		0.0130	0.047		
2C20	87.1		0.0200	0.174	na	
2C21	1.2	U	0.0120	0.004		
2C22	1.2	U	0.0110	0.004		
2C23	21.4		0.0360	0.024		
2C24	2.0		0.0120	0.007		
3C01	9.5		0.0130	0.029		
3C02	9.5		0.0130	0.029		
3C03	13.8		0.0063	0.088		
3C04	9.9		0.0081	0.049		
3C05	47.6		0.0200	0.095		
3C06	23.0		0.0098	0.094		
3C07	1.2	U	0.0110	0.004		
4C01	145.2		0.0200	0.290	na	

Note 1: all concentrations are shown "as TBT"
Note 2: Phase 1 bulk sediment TBT data were validated by EcoChem; Phase 1 porewater data were not validated.
na = not analyzed

Port of Seattle Terminal 18 (95-02133)
Phase 1 TBT Evaluation - "Worst-Case Scenario"

DMMU	Sediment Tributyltin (ug/kg dw)	VQ	Total organic carbon	calculated porewater TBT (ug/l)	measured porewater TBT (ug/l)	LQ	ratio of measured: calculated	calculated times highest ratio	mean Macoma tissue TBT (mg/kg ww)	mean Nephtys tissue TBT (mg/kg ww)
1C04	1124.8	J	0.0140	3.214	***0.207***		0.064		2280	2070
1C03	671.0	D	0.0130	2.065	0.105		0.051			
1C13	407.5		0.0084	1.940	0.059	U	0.030			
1C05	331.8		0.0093	1.427	***0.209***		0.146		650	127
1C06	307.4		0.0095	1.294	0.060		0.046			
1C09	211.8		0.0083	1.021	0.084		0.082			
1C15	205.0		0.0092	0.891	0.031	U	0.035			
1C10	256.2		0.0120	0.854	0.084		0.098			
1C23	356.2		0.0170	0.838	0.081		0.097			
1C28	122.0		0.0067	0.728	0.059		0.081			
1C40	145.2		0.0100	0.581	0.037	U	0.064			
1C46	150.5		0.0110	0.547	0.041	J	0.075			
1C18	119.1		0.0096	0.496	0.039	J	0.079			
1C34	144.9		0.0120	0.483	0.046		0.095			
1C44	397.7		0.0360	0.442	0.030	U	0.068			
1C47	111.3		0.0130	0.342	na			0.050		
1C41	43.2		0.0052	0.332	na			0.049		
2C07	182.0		0.0220	0.331	na			0.048		
1C11	118.8		0.0160	0.297	na			0.044		
4C01	145.2		0.0200	0.290	na			0.043		
1C12	104.4		0.0170	0.246	na			0.036		
1C49	134.4		0.0220	0.244	na			0.036		
2C04	68.1		0.0120	0.227	na			0.033		
2C16	199.8		0.0360	0.222	na			0.033		
2C08	87.4		0.0160	0.218	na			0.032		
2C10	130.8		0.0240	0.218	na			0.032		
1C37	116.9		0.0230	0.203	na			0.030		
1C35	67.6		0.0140	0.193	na			0.028		
2C15	194.2		0.0420	0.185	na			0.027		
2C11	159.8		0.0360	0.178	na			0.026		
2C20	87.1		0.0200	0.174	na			0.026		
1C32	158.1		0.0370	0.171	na			0.025		
1C20	94.9		0.0230	0.165	na			0.024		
1C29	61.7		0.0150	0.165	na			0.024		
1C38	132.0		0.0330	0.160	na			0.023		
1C43	89.1		0.0230	0.155	na			0.023		

Note 1: all concentrations shown are "as TBT"
Note 2: the highest ratio of measured-to-calculated TBT appears in the box
na = not analyzed

Port of Seattle Terminal 18 (95-02133)
Phase 1 Bioassay Reference Comparisons

DMMU	% fines	primary reference	secondary reference	DMMU	% fines	primary reference	secondary reference	DMMU	% fines	primary reference	secondary reference
1C03	26.2	WB	CG	1C32	88.3	SB	CG	2C05	94.2	SB	CG
1C04	36.2	CG	WB	1C33	89.9	SB	CG	2C06	93.2	SB	CG
1C05	23.2	WB	CG	1C34	39.8	CG	WB/SB	2C07	87.2	SB	CG
1C06	32.4	WB	CG	1C35	29.2	WB	CG	2C08	74.5	SB	CG
1C07	90.4	SB	CG	1C36	62.1	CG	SB	2C09	77.7	SB	CG
1C08	94.6	SB	CG	1C37	88.1	SB	CG	2C10	75.1	SB	CG
1C09	45.3	CG	SB	1C38	87.4	SB	CG	2C11	85	SB	CG
1C10	39	CG	WB	1C39	81	SB	CG	2C12	73.8	SB	CG
1C11	74.2	SB	CG	1C40	34.3	CG	WB	2C13	51.3	CG	SB
1C12	78.5	SB	CG	1C41	21.2	WB	CG	2C14	87	SB	CG
1C13	24.2	WB	CG	1C42	33.1	WB	CG	2C15	83.2	SB	CG
1C14	44.3	CG	SB	1C43	71.9	CG	SB	2C16	76.4	SB	CG
1C15	70.5	CG	SB	1C44	80.5	SB	CG	2C17	29.3	WB	CG
1C16	71.6	CG	SB	1C45	63.7	CG	SB	2C18	54	CG	SB
1C17	87.4	SB	CG	1C46	40.1	CG	SB	2C19	76	SB	CG
1C18	41.3	CG	SB	1C47	31.6	WB	CG	2C20	82.9	SB	CG
1C19	72.6	SB	CG	1C48	53.3	CG	SB	2C21	83.3	SB	CG
1C20	83.5	SB	CG	1C49	77.6	SB	CG	2C22	48	CG	SB
1C21	86.1	SB	CG	1C50	75	SB	CG	2C23	72.6	SB	CG
1C22	82.4	SB	CG	1C51	76.3	SB	CG	2C24	59.3	CG	SB
1C23	51.6	CG	SB	1C53	79.3	SB	CG	3C01	41.4	CG	SB
1C24	85.3	SB	CG	1C54	89	SB	CG	3C02	51.3	CG	SB
1C25	82.5	SB	CG	1C55	70.3	CG	SB	3C03	31.7	WB	CG
1C26	74.6	SB	CG	1C56	61.3	CG	SB	3C04	77.2	SB	CG
1C27	85.6	SB	CG	1C57	37.5	CG	WB	3C05	53.3	CG	SB
1C28	48.3	CG	SB	2C01	39.3	CG	WB	3C06	43.3	CG	SB
1C29	36.5	CG	WB	2C02	67	CG	SB	3C07	52.4	CG	SB
1C30	41.3	CG	SB	2C03	63.9	CG	SB	4C01	84.5	SB	CG
1C31	88.5	SB	CG	2C04	75.1	SB	CG				

Phase 1 reference sediment fines content:

WB = 1.3% (historical average), CG = 65.3% (mean of 2 replicates), SB = 78.5% fines (mean of 2 replicates).

Dividing lines taken half way between WB and CG (33.3%) and halfway between CG and SB (71.9%) for primary reference comparisons.

CG is secondary reference for all WB and SB comparisons; secondary reference for CG sediments based on dividing line between WB and SB (39.9%).

Port of Seattle Terminal 18 (95-02133)
Ammonia Purging - Amphipod Bioassay

testing batch	purging time (days)	DMMU	initial porewater concentration (mg/l)	porewater concentration at time of testing (mg/l)	amphipod hits X = two-hit rule XX = one-hit rule
Phase 1 - 1a	0	1C47		4.3	
		1C41		5.2	
		1C46		4.6	
		1C35		8.1	
		2C19		10.5	
		2C03		9.0	
Phase 1 - 1b	20	2C18	243.6	8.5	XX
		2C20	62.7	8.3	X
		1C37	62.7	2.0	XX
		1C56	69.8	12.2	
		1C42	16.9	1.7	X
		1C48	26.9	2.8	
		1C49	44.4	7.1	X
		1C22	33.7	3.5	X
		1C20	46.2	4.9	X
		1C55	65.1	9.4	XX
		1C43	34.4	6.1	X
		2C24	145.4	16.2	X
Phase 1 - 2a	0	1C9		13.6	
		1C10		6.9	X
Phase 1 - 2b	18	1C7	92.4	5.1	X
		1C8	72.8	7.1	XX
		2C21	86.3	6.8	XX
		1C16	61.7	4.3	X
		1C26	35.8	5.7	X
		2C11	120.4	9.8	XX
		2C12	28.5	5.4	X
		1C11	24.7	2.6	
		4C1	30.9	4.8	XX
		1C27	70.3	6.0	XX
		1C12	27.2	2.9	X
		2C6	62.9	3.7	XX
		2C13	27.2	6.2	
		2C22	55.5	6.2	
		2C7	62.9	4.6	X
		2C8	56.8	3.7	XX
Phase 1 - 3a	0	1C23		5.3	
		2C2		13.7	X
		1C6		16.8	
		1C40		4.5	
		1C5		4.7	
		1C3		5.6	
		1C28		6.6	
		2C4		5.8	XX
		2C1		3.6	
Phase 1 - 3b	18	2C5	25.8	1.4	
		2C10	47.0	3.6	XX
		2C14	164.3	1.8	XX
		1C19	52.7	1.6	XX
		2C16	245.9	4.2	XX
		1C17	47.3	3.5	XX
		1C14	41.8	2.5	
		2C15	177.9	1.2	XX
		2C9	85.3	1.2	XX

Port of Seattle Terminal 18 (95-02133)
Ammonia Purging - Amphipod Bioassay

testing batch	purging time (days)	DMMU	initial porewater concentration (mg/l)	porewater concentration at time of testing (mg/l)	amphipod hits X = two-hit rule XX = one-hit rule
Phase 1 - 4a	0	1C13		9.1	XX
		1C15		10.5	
		1C30		10.5	X
		1C29		6.2	X
Phase 1 - 4b	14	1C36	51.3	5.3	XX
		1C44	60.7	6.7	X
		1C50	37.6	8.2	
		1C57	56.5	15.3	
		1C25	58.6	1.7	XX
		1C53	62.8	9.5	
		2C17	319.4	10.4	XX
		1C31	55.5	3.5	XX
		1C21	57.1	1.2	
		1C24	52.3	4.6	X
		1C18	23.0	1.2	
Phase 1 - 5a	0	3C4		6.3	XX
		3C7		18.8	
		3C1		12.4	
		3C2		7.0	X
		3C3		3.6	
		3C6		2.4	
		3C5		14.4	X
		1C34		4.1	X
		1C4		6.3	X
Phase 1 - 5b	18	1C32	84.9	3.4	XX
		1C33	84.9	2.8	XX
		1C51	65.3	2.8	XX
		1C54	141.2	10.3	X
		2C23	146.1	10.8	XX
		1C39	158.4	8.9	XX
		1C38	75.1	3.1	XX
		1C45	116.7	4.2	X
Phase 2 - A1a	0	2C1B		8.5	
Phase 2 - A1b	21	1C7B	99.3	9.2	X
		1C8B	107.9	16.2	
		1C35B	23.7	5.4	
		1C37B	83.1	0.9	X
		1C42B	71.7	11.6	X
		1C43B	67.1	7.8	
		1C48B	66.0	6.2	X
		1C48NB	68.3	9.7	
		1C48SB	36.3	9.4	
		1C49B	89.9	11.3	X
		1C55XSB	31.7	6.2	
		2C2B	28.3	3.5	
		2C6B	85.4	5.4	

Port of Seattle Terminal 18 (95-02133)
Amphipod Bioassay Interpretation

batch	treatment	mean % survival	meets performance standard?	DMMU > 20% over control?	reference comparison used	statistically different? (p = .05)	DMMU > 30% over reference?	hits
Phase 1 - 1a	control	98.8	Y					
	WB	96	Y					
	CG	86	Y					
	SB	83	Y					
	1C35	88		N				
	1C41	91		N				
	1C46	89		N				
	1C47	93		N				
	2C3	81		N				
	2C19	73		Y	SB	N		
Phase 1 - 1b	control	99.4	Y					
	WB	98	Y					
	CG	89	Y					
	SB	78	N					
	1C48	85		N				
	1C56	81		N				
	1C20	60		Y	CG	Y	N	X
	1C22	71		Y	CG	Y	N	X
	1C42	71		Y	WB	Y	N	X
	1C43	67		Y	CG	Y	N	X
	1C49	70		Y	CG	Y	N	X
	2C20	68		Y	CG	Y	N	X
	2C24	75		Y	CG	Y	N	X
	1C37	54		Y	CG	Y	Y	XX
	1C55	50		Y	CG	Y	Y	XX
	2C18	51		Y	CG	Y	Y	XX
Phase 1 - 2a	control	99.4	Y					
	WB	97	Y					
	CG	79	N					
	SB	87	Y					
	1C9	85		N				
	1C10	75		Y	SB	Y	N	X
Phase 1 - 2b	control	99.4	Y					
	WB	96	Y					
	CG	84	Y					
	SB	91	Y					
	1C11	83		N				
	2C13	93		N				
	2C22	92		N				
	1C7	64		Y	SB	Y	N	X
	1C12	78		Y	SB	Y	N	X
	1C16	70		Y	CG	Y	N	X
	1C26	77		Y	SB	Y	N	X
	2C7	70		Y	SB	Y	N	X
	2C12	67		Y	SB	Y	N	X
	1C8	54		Y	SB	Y	Y	XX
	1C27	43		Y	SB	Y	Y	XX
	2C6	54		Y	SB	Y	Y	XX
	2C8	56		Y	SB	Y	Y	XX
	2C11	45		Y	SB	Y	Y	XX

Port of Seattle Terminal 18 (95-02133)
Amphipod Bioassay Interpretation

batch	treatment	mean % survival	meets performance standard?	DMMU > 20% over control?	reference comparison used	statistically different? (p = .05)	DMMU > 30% over reference?	hits
	2C21	57		Y	SB	Y	Y	XX
	4C1	46		Y	SB	Y	Y	XX
Phase 1 - 3a	control	100	Y					
	WB	94	Y					
	CG	87	Y					
	SB	97	Y					
	1C3	81		N				
	1C5	90		N				
	1C6	92		N				
	1C23	82		N				
	1C28	86		N				
	1C40	84		N				
	2C1	92		N				
	2C2	61		Y	CG	Y	N	X
	2C4	66		Y	SB	Y	Y	XX
Phase 1 - 3b	control	99.4	Y					
	WB	100	Y					
	CG	96	Y					
	SB	92	Y					
	1C14	89		N				
	2C5	66		Y	SB	N		
	1C17	60		Y	SB	Y	Y	XX
	1C19	61		Y	SB	Y	Y	XX
	2C9	58		Y	SB	Y	Y	XX
	2C10	61		Y	SB	Y	Y	XX
	2C14	30		Y	SB	Y	Y	XX
	2C15	38		Y	SB	Y	Y	XX
	2C16	26		Y	SB	Y	Y	XX
Phase 1 - 4a	control	98.8	Y					
	WB	98	Y					
	CG	68	N					
	SB	94	Y					
	1C15	86		N				
	1C29	77		Y	WB	Y	N	X
	1C30	69		Y	SB	Y	N	X
	1C13	67		Y	WB	Y	Y	XX
Phase 1 - 4b	control	92	Y					
	WB	99	Y					
	CG	92	Y					
	SB	93	Y					
	1C18	95		N				
	1C21	87		N				
	1C50	73		N				
	1C53	85		N				
	1C57	92.5		N				
	1C24	64		Y	SB	Y	N	X
	1C44	68		Y	SB	Y	N	X
	1C25	49		Y	SB	Y	Y	XX
	1C31	55		Y	SB	Y	Y	XX
	1C36	56		Y	CG	Y	Y	XX

Port of Seattle Terminal 18 (95-02133)
Amphipod Bioassay Interpretation

batch	treatment	mean % survival	meets performance standard?	DMMU > 20% over control?	reference comparison used	statistically different? (p = .05)	DMMU > 30% over reference?	hits
	2C17	31		Y	WB	Y	Y	XX
Phase 1 - 5a	control	98.1	Y					
	WB	99	Y					
	CG	69	N					
	SB	79	Y					
	3C1	79		N				
	3C3	96		N				
	3C6	69		Y	SB	N		
	3C7	78		Y	SB	N		
	1C4	72		Y	WB	Y	N	X
	3C2-	63		Y	SB	Y	N	X
	3C5	65		Y	SB	Y	N	X
	1C34	67		Y	WB/SB	Y/N	Y/N	X
	3C4	47		Y	SB	Y	Y	XX
Phase 1 - 5b	control	99.4	Y					
	WB	96	Y					
	CG	93	Y					
	SB	99	Y					
	1C45	65		Y	CG	Y	N	X
	1C54	72		Y	SB	Y	N	X
	1C32	31		Y	SB	Y	Y	XX
	1C33	39		Y	SB	Y	Y	XX
	1C38	46		Y	SB	Y	Y	XX
	1C39	39		Y	SB	Y	Y	XX
	1C51	68		Y	SB	Y	Y	XX
	2C23	57		Y	SB	Y	Y	XX
Phase 2 - A1a	control	99.4	Y					
	WB	98	Y					
	CG	92	Y					
	SB	98	Y					
	2C1B	95		N				
Phase 2 - A1b	control	99.4	Y					
	WB	96	Y					
	CG	96	Y					
	SB	98	Y					
	1C48SB	95		N				
	1C48NB	95		N				
	1C43B	96		N				
	1C55XSB	96		N				
	1C8B	83		N				
	2C2B	95		N				
	2C6B	90		N				
	1C48B	70		Y	CG	Y	N	X
	1C49B	74		Y	CG	Y	N	X
	1C37B	76		Y	SB	Y	N	X
	1C42B	75		Y	CG	Y	N	X
	1C7B	69		Y	SB	Y	N	X

Port of Seattle Terminal 18 (95-02133)
Sediment Larval Bioassay Interpretation

batch	treatment	mean % combined mortality & abnormality	meets performance standard?	DMMU > 20% over control?	reference comparison used	statistically different? (p = .10)	DMMU > 30% over reference?	hits
Phase 1 - 1	control	17.2	Y					
	WB	2.4	Y					
	CG	0	Y					
	SB	0	Y					
	2C19	0		N				
	1C26	1.2		N				
	1C46	0		N				
	1C20	11		N				
	1C22	4.9		N				
	1C47	0		N				
	4C1	16.5		N				
	1C10	11.9		N				
	1C11	15.2		N				
	2C6	2		N				
	1C48	17		N				
	1C56	4.4		N				
	1C35	10.1		N				
	2C3	13.3		N				
	1C41	9.9		N				
	1C49	21.7		Y	SB	Y	N	X
	1C16	22.7		Y	CG	Y	N	X
	1C7	28.9		Y	SB	Y	N	X
	1C8	23.6		Y	SB	Y	N	X
	2C18	89.6		Y	CG	Y	Y	XX
	2C20	30.9		Y	SB	Y	Y	XX
	1C42	56.6		Y	WB	Y	Y	XX
	1C55	69.1		Y	CG	Y	Y	XX
	2C11	88.4		Y	SB	Y	Y	XX
	2C12	30.2		Y	SB	Y	Y	XX
	2C8	40.7		Y	SB	Y	Y	XX
	2C7	66.9		Y	SB	Y	Y	XX
	1C43	44.5		Y	CG	Y	Y	XX
	1C37	86.3		Y	SB	Y	Y	XX
	2C24	50.3		Y	CG	Y	Y	XX
Phase 1 - 2	control	9	Y					
	WB	0	Y					
	CG	2.9	Y					
	SB	10.5	Y					
	2C13	5.7		N				
	2C22	0		N				
	3C7	0		N				
	3C4	16.5		N				
	3C5	12.6		N				
	3C6	3.7		N				
	3C3	0		N				
	1C34	2.9		N				
	1C50	11.2		N				
	1C53	15.6		N				
	1C21	16		N				
	1C4	5.9		N				
	1C23	0		N				

Port of Seattle Terminal 18 (95-02133)
Sediment Larval Bioassay Interpretation

batch	treatment	mean % combined mortality & abnormality	meets performance standard?	DMMU > 20% over control?	reference comparison used	statistically different? (p = .10)	DMMU > 30% over reference?	hits
	1C5	10.1		N				
	1C29	0.4		N				
	1C6	0		N				
	1C3	10.5		N				
	1C15	0.3		N				
	1C24	22.9		Y	SB	N		
	1C25	24.2		Y	SB	N		
	1C12	21.8		Y	SB	Y	N	X
	1C32	31.9		Y	SB	Y	N	X
	1C38	28.1		Y	SB	Y	N	X
	1C27	51.9		Y	SB	Y	Y	XX
	2C16	100		Y	SB	Y	Y	XX
	2C14	98.9		Y	SB	Y	Y	XX
	2C15	99.8		Y	SB	Y	Y	XX
	2C9	47.9		Y	SB	Y	Y	XX
Phase 1 - 3	control	12.5	Y					
	WB	4.1	Y					
	CG	10	Y					
	SB	20.4	Y					
	2C21	16.3		N				
	2C5	17.5		N				
	1C40	13.7		N				
	2C1	3.1		N				
	1C14	17.2		N				
	1C28	6.9		N				
	1C57	19.5		N				
	1C13	14.1		N				
	1C30	15.2		N				
	1C18	4.7		N				
	3C1	16.1		N				
	2C4	26.6		Y	SB	N		
	1C19	25.5		Y	SB	N		
	1C51	24.4		Y	SB	N		
	2C2	26		Y	CG	Y	N	X
	1C9	21.6		Y	CG	Y	N	X
	1C17	38.4		Y	SB	Y	N	X
	2C10	47.7		Y	SB	Y	N	X
	1C44	30.7		Y	SB	Y	N	X
	1C54	37.7		Y	SB	Y	N	X
	3C2	22		Y	CG	Y	N	X
	1C31	59.9		Y	SB	Y	Y	XX
	1C36	49.9		Y	CG	Y	Y	XX
	2C17	100		Y	WB	Y	Y	XX
	2C23	100		Y	SB	Y	Y	XX
	1C39	98		Y	SB	Y	Y	XX
	1C45	99.8		Y	CG	Y	Y	XX
	1C33	90.4		Y	SB	Y	Y	XX
Phase 2 - 1	control	25.1	Y					
	WB	5.1	Y					
	CG	0	Y					
	SB	4	Y					

Port of Seattle Terminal 18 (95-02133)
Sediment Larval Bioassay Interpretation

batch	treatment	mean % combined mortality & abnormality	meets performance standard?	DMMU > 20% over control?	reference comparison used	statistically different? (p = .10)	DMMU > 30% over reference?	hits
	1C42B	7.2		N				
	1C43B	0		N				
	1C48B	0		N				
	1C48NB	12.3		N				
	1C48SB	14.2		N				
	1C49B	8.3		N				
	1C55XSB	6.9		N				
	2C1B	3.1		N				
	2C2B	3.1		N				
	1C8B	31.6		Y	SB	Y	N	X
	2C6B	21.9		Y	SB	Y	N	X
	1C7B	56.9		Y	SB	Y	Y	XX
	1C37B	50.1		Y	SB	Y	Y	XX

Port of Seattle Terminal 18 (95-02133)
Neanthes biomass test interpretation

batch	treatment	mean % survival	meets performance standard?	mean individual dry wt (mg)	DMMU < 80% of control?	reference comparison used	statistically different? (p = .05)	DMMU < 70% of reference?	DMMU < 50% of reference?	hits
Phase 1 - 1	control	95	Y	9.0						
	WB	96	Y	11.7						
	CG	100	Y	12.2						
	SB	92	Y	12.6						
	1C20	88		12.8	N					
	1C22	100		13.6	N					
	1C35	100		12.4	N					
	1C41	100		15.8	N					
	1C42	96		11.9	N					
	1C43	92		12.8	N					
	1C46	96		14.3	N					
	1C47	96		12.8	N					
	1C48	100		14.2	N					
	1C49	100		11.0	N					
	1C55	92		11.4	N					
	1C56	96		9.2	N					
	2C3	96		14.6	N					
	2C19	100		15.4	N					
	2C20	88		11.1	N					
	2C24	88		6.2	Y	CG	Y	Y	N	X
	1C37	92		5.3	Y	SB	Y	Y	Y	XX
	2C18	0		zero survival						XX
Phase 1 - 2	control	100	Y	9.2						
	WB	96	Y	10.2						
	CG	100	Y	12.4						
	SB	100	Y	12.3						
	1C9	100		12.2	N					
	1C10	100		10.7	N					
	1C11	96		9.4	N					
	1C12	96		8.0	N					
	1C26	100		11.6	N					
	2C12	96		7.8	N					
	2C13	100		11.6	N					
	2C22	100		8.1	N					
	4C1	100		8.6	N					
	1C16	92		6.3	Y	CG	Y	Y	N	X
	1C7	72		5.8	Y	SB	Y	Y	Y	XX
	1C8	84		5.4	Y	SB	Y	Y	Y	XX
	1C27	32		2.2	Y	SB	Y	Y	Y	XX
	2C6	100		5.0	Y	SB	Y	Y	Y	XX
	2C7	100		3.5	Y	SB	Y	Y	Y	XX
	2C8	92		4.0	Y	SB	Y	Y	Y	XX
	2C11	28		0.8	Y	SB	Y	Y	Y	XX
	2C21	96		5.0	Y	SB	Y	Y	Y	XX
Phase 1 - 3	control	97.5	Y	10.6	N					
	WB	96	Y	11.2	N					
	CG	92	Y	14.2	N					
	SB	92	Y	14.2	N					
	1C3	92		10.5	N					
	1C5	96		12.1	N					
	1C6	100		13.9	N					
	1C14	96		13.2	N					
	1C17	100		10.6	N					
	1C19	96		9.5	N					
	1C23	100		13.3	N					
	1C28	100		13.5	N					
	1C40	100		14.6	N					
	2C1	88		13.2	N					
	2C2	92		13.5	N					
	2C4	92		11.7	N					
	2C5	96		11.6	N					
	2C10	100		7.2	Y	SB	Y	Y	N	X
	2C9	80		2.6	Y	SB	Y	Y	Y	XX

Attachment 12

Port of Seattle Terminal 18 (95-02133)
Neanthes biomass test interpretation

batch	treatment	mean % survival	meets performance standard?	mean individual dry wt (mg)	DMMU < 80% of control?	reference comparison used	statistically different? (p = .05)	DMMU < 70% of reference?	DMMU < 50% of reference?	hits
	2C14	0		zero survival	N/A	N/A	N/A	N/A	N/A	XX
	2C15	0		zero survival	N/A	N/A	N/A	N/A	N/A	XX
	2C16	0		zero survival	N/A	N/A	N/A	N/A	N/A	XX
Phase 1 - 4	control	100	Y	8.4						
	WB	100	Y	10.4						
	CG	100	Y	11.6						
	SB	100	Y	10.2						
	1C13	96		12.9	N					
	1C15	100		10.7	N					
	1C18	100		12.4	N					
	1C21	100		9.5	N					
	1C24	100		9.5	N					
	1C25	96		7.2	N					
	1C29	100		12.1	N					
	1C30	96		10.9	N					
	1C31	96		7.0	N					
	1C36	96		9.7	N					
	1C44	96		9.1	N					
	1C50	100		7.8	N					
	1C53	96		8.1	N					
	1C57	100		11.5	N					
	2C17	0		zero survival	N/A	N/A	N/A	N/A	N/A	XX
Phase 1 - 5	control	100	Y	9.1						
	WB	100	Y	10.4						
	CG	100	Y	11.8						
	SB	100	Y	11.4						
	1C4	100		10.2	N					
	1C34	100		10.7	N					
	3C1	100		13.8	N					
	3C2	100		12.1	N					
	3C3	96		13.6	N					
	3C4	100		11.2	N					
	3C5	100		11.2	N					
	3C6	100		14.1	N					
	3C7	96		10.0	N					
	1C51	92		6.4	Y	SB	Y	Y	N	X
	1C32	52		1.4	Y	SB	Y	Y	Y	XX
	1C33	80		2.3	Y	SB	Y	Y	Y	XX
	1C38	88		2.9	Y	SB	Y	Y	Y	XX
	1C39	44		1.2	Y	SB	Y	Y	Y	XX
	1C45	68		2.0	Y	CG	Y	Y	Y	XX
	1C54	36		1.4	Y	SB	Y	Y	Y	XX
	2C23	0		zero survival	N/A	N/A	N/A	N/A	N/A	XX
Phase 2 -1	control	97.5	Y	12.9						
	WB	100	Y	13.0						
	CG	100	Y	12.2						
	SB	100	Y	12.6						
	1C43B	100		14.3	N					
	1C48B	100		14.8	N					
	1C48SB	100		13.3	N					
	1C48NB	96		11.6	N					
	1C55XSB	100		14.1	N					
	2C1B	100		17.5	N					
	2C2B	100		12.5	N					
	1C42B	100		10.2	Y	CG	Y	N		
	1C49B	100		6.2	Y	CG	Y	Y	N	X
	1C7B	20		7.3	Y	SB	Y	Y	Y	XX
	1C8B	76		2.0	Y	SB	Y	Y	Y	XX
	1C37B	8		1.1	Y	SB	Y	Y	Y	XX
	2C6B	80		3.3	Y	SB	Y	Y	Y	XX

Attachment 12

Port of Seattle Terminal 18 (95-02133)
Phase 2 Bioassay Reference Comparisons

DMMU	% fines	reference
1C07B	93.9	SB
1C08B	91.5	SB
1C37B	97.3	SB
1C42B	62.5	CG
1C43B	27	WB
1C48B	49.1	CG
1C48NB	46.3	CG
1C48SB	57.4	CG
1C49B	59.3	CG
1C55XSB	31.1	CG
2C01B	41.9	CG
2C02B	44.7	CG
2C06B	91.7	SB

Phase 2 reference sediment fines content:
WB = 4.5%, CG = 50.7%, SB = 85.2% fines.
Dividing lines taken half way between WB and CG (27.6%) and halfway between CG and SB (68.0%).

Port of Seattle Terminal 18 (95-02133)
Bioaccumulation Interpretation

			Macoma												Nephtys											
Treatment	Reference Comparison		Total DDT (ug/kg)	statistically different from reference?	statistically below guideline?	Total PCB (ug/kg)	statistically different from reference?	statistically below guideline?	Total Hg (ug/kg)	statistically different from reference?	statistically below guideline?	TBT (ug/kg as TBT)	statistically different from reference?	statistically below guideline?	Total DDT (ug/kg)	statistically different from reference?	statistically below guideline?	Total PCB (ug/kg)	statistically different from reference?	statistically below guideline?	Total Hg (ug/kg)	statistically different from reference?	statistically below guideline?	TBT (ug/kg as TBT)	statistically different from reference?	statistically below guideline?
		Guideline:	3000			2000			1000			2000			3000			2000			1000			2000		
SB			0.4			7.6			107			2.2			2.4			64			267			0.6		
WB			0.3			6.8			116			1.4			2.1			57			60			0.4		
CG			0.6			9.1			116			1.3			4.6			123			62			0.4		
1C03	WB		14.3	Y	Y	244	Y	Y							17.7	Y	Y	419	Y	Y						
1C04	CG					125	Y	Y				2280	Y	N				232	Y	Y				2070	Y	N
1C05	WB					141	Y	Y				650	Y	Y				167	Y	Y				127	Y	Y
1C14	CG					182	Y	Y										285	Y	Y						
1C20	SB					151	Y	Y										297	Y	Y						
1C48	CG					238	Y	Y										272	Y	Y						
1C51	SB								154	Y	Y										40	N	Y			
2C03	CG					63	Y	Y										81	N	Y						
2C13	CG					205	Y	Y										297	Y	Y						

Port of Seattle Terminal 18 (95-02133)
Sediment Chemistry Comparison - Phase 1 vs. Phase 2

Chemical Name	1C03 Phase 1 Conc. VQ	1C03 Phase 2 Conc. VQ	1C04 Phase 1 Conc. LQ	1C04 Phase 2 Conc. VQ	1C05 Phase 1 Conc. LQ	1C05 Phase 2 Conc. VQ	1C14 Phase 1 Conc. VQ	1C14 Phase 2 Conc. VQ	1C20 Phase 1 Conc. VQ	1C20 Phase 2 Conc. VQ	1C48 Phase 1 Conc. VQ	1C48 Phase 2 Conc. VQ	1C51 Phase 1 Conc. VQ	1C51 Phase 2 Conc. VQ	2C03 Phase 1 Conc. VQ	2C03 Phase 2 Conc. VQ	2C13 Phase 1 Conc. VQ	2C13 Phase 2 Conc. LQ
Mercury (mg/kg)													1.66	1.26				
TBT (ug/l as TBT) - porewater			0.207	0.356 J	0.209	0.124 J												
Aldrin (ug/kg)	16 UD	2.6											20 D	0.78 U				
Alpha chlordane (ug/kg)	44 UD	13											22 UD	2.1 U				
Dieldrin (ug/kg)	34 D	6.7											24 D	12				
Lindane (ug/kg)	16 UD	0.57 U											8.2 UD	0.78 U				
Heptachlor (ug/kg)	16 UD	0.57 UJ											8.2 UD	0.78 UJ				
p,p'-DDD (ug/kg)	25 D	11											33 D	49 J				
p,p'-DDE (ug/kg)	46 D	0.77 U											17 D	12				
p,p'-DDT (ug/kg)	54 UD	1.9 U											27 UD	2.6 UJ				
Total DDD,DDE and DDT	71 D	11											50 D	61 D				
Aroclor 1016 (ug/kg)	270 UD	9.6 UD	100 UD	10 UD	48 UD	10 D	52 UD	11 U	68 UD	63 UD	220 UD	120 UD			53 UD	11 U	53 UD	61 UD
Aroclor 1221 (ug/kg)	1100 UD	38 UD	400 UD	41 UD	190 UD	41 UD	52 UD	43 U	270 UD	250 UD	870 UD	470 UD			210 UD	42 U	210 UD	240 UD
Aroclor 1232 (ug/kg)	270 UD	9.6 UD	100 UD	10 UD	48 UD	10 UD	52 UD	11 U	68 UD	63 UD	220 UD	120 UD			53 UD	11 U	53 UD	61 UD
Aroclor 1242 (ug/kg)	270 UD	18 J	100 UD	24 J	48 UD	24 J	270 D	62	450 D	180 D	220 UD	120 UD			53 UD	21	53 UD	450 D
Aroclor 1248 (ug/kg)	270 UD	9.6 UD	100 UD	10 UD	48 UD	10 UD	52 UD	11 U	68 UD	63 UD	220 UD	120 UD			53 UD	11 U	53 UD	61 UD
Aroclor 1254 (ug/kg)	270 UD	9.6 UD	100 UD	10 UD	48 UD	10 UD	52 UD	11 U	68 UD	63 UD	220 UD	120 UD			53 UD	11 U	53 UD	61 UD
Aroclor 1260 (ug/kg)	4900 D	3000 D	1100 D	520 D	840 D	510 D	500 D	210	930 D	440 D	1200 D	1300 D			830 D	140	760 D	670 D
PCBs, total (ug/kg)	4900 D	3018 D	1100 D	544 D	840 D	544 D	770	272	1380 D	620 D	1200	1300 D			830 D	161	760	1120 D
PCBs, total (ug/kg oc)	376.9 D	215.6 D	78.6 D	32.0 D	90.3 D	41.8 D	42.8	22.7	60.0 D	32.6 D	75.0	41.9 D			51.9 D	11.5	40.0	46.7 D
Fines Content (%)	26.2	28.6	36.2	31.2	23.2	35	44.3	52.2	83.5	73	53.3	66.4	76.3	75.5	63.9	65.4	51.3	60
Total Organic Carbon (%)	1.3	1.4	1.4	1.7	0.93	1.3	1.8	1.2	2.3	1.9	1.6	3.1	3.5	3.4	1.6	1.4	1.9	2.4

Port of Seattle Terminal 18 (95-02133)
Phase 1/Phase 2 Chemistry Ratios

	DMMU								
	1C03	1C04	1C05	1C14	1C20	1C48	1C51	2C03	2C13
Mercury:							1.32		
Tributyltin:		0.58	1.69						
Total DDT:	6.45								
Total PCBs:	1.62	2.02	1.54	2.83	2.23	0.92		5.16	0.68

Example 1: Phase 1 porewater TBT for 1C04 = 0.207 ug/l
Phase 2 porewater TBT for 1C04 = 0.356 ug/l
Phase 1/Phase 2 ratio = 0.58

Example 2: Phase 1 porewater TBT for 1C05 = 0.209 ug/l
Phase 2 porewater TBT for 1C05 = 0.124 ug/l
Phase 1/Phase 2 ratio = 1.69

Port of Seattle Terminal 18 (95-02133)
Bioaccumulation Interpretation - "Worst-Case Scenario"

			Macoma												Nephtys											
Treatment	Reference Comparison		Total DDT (ug/kg)	statistically different from reference?	statistically below guideline?	Total PCB (ug/kg)	statistically different from reference?	statistically below guideline?	Total Hg (ug/kg)	statistically different from reference?	statistically below guideline?	TBT (ug/kg as TBT)	statistically different from reference?	statistically below guideline?	Total DDT (ug/kg)	statistically different from reference?	statistically below guideline?	Total PCB (ug/kg)	statistically different from reference?	statistically below guideline?	Total Hg (ug/kg)	statistically different from reference?	statistically below guideline?	TBT (ug/kg as TBT)	statistically different from reference?	statistically below guideline?
		Guideline:	3000			2000			1000			2000			3000			2000			1000			2000		
SB			0.4			7.6			107			2.2			2.4			64			267			0.6		
WB			0.3			6.8			116			1.4			2.1			57			60			0.4		
CG			0.6			9.1			116			1.3			4.6			123			60			0.4		
1C03	WB		92	Y	Y	395	Y	Y							114	Y	Y	678	Y	Y						
1C04	CG					253	Y	Y				2280	Y	N				469	Y	Y				2070	Y	N
1C05	WB					217	Y	Y				1099	Y	Y				257	Y	Y				215	Y	Y
1C14	CG					514	Y	Y										807	Y	Y						
1C20	SB					336	Y	Y										661	Y	Y						
1C48	CG					238	Y	Y										272	Y	Y						
1C51	SB								203	Y	Y										53	N	Y			
2C03	CG					324	Y	Y										418	Y	Y						
2C13	CG					205	Y	Y										297	Y	Y						

Example 1: the mean Macoma TBT tissue concentration for 1C04 = 2280 ug/kg (see Attachment 14)
the Phase 1/Phase 2 ratio = 0.58 (see Attachment 16)
therefore, the Phase 2 sediment actually used for the bioaccumulation test represents the "worst case"

Example 2: mean Macoma TBT tissue concentration for 1C05 = 650 ug/kg
Phase 1/Phase 2 ratio = 1.69
therefore, the "worst-case" tissue concentration is 650 X 1.69 = 1099 ug/kg

PSDDA Agency Re-evaluation
of Risk-based Target Tissue Concentrations
for Human Health

1) Excerpt from the PSDDA Evaluation Procedures Technical Appendix - Phase 1 (June 1988), section 8.4.2, Target Tissue Concentration Calculation Models:

> To calculate target tissue concentration of chemicals that might pose a human health problem if the tissue was ingested, the following models were used:
>
> For chemicals posing a carcinogen risk: $C = (R)(W)/(B)(I)$
>
> where:
>
> C = target tissue concentration
> R = reference risk level
> W = reference human weight
> B = potency factor for the chemical in question
> I = average seafood ingestion rate per human.
>
> For noncarcinogens posing a human health risk: $C = (RFD)(W)/I$
>
> where:
>
> C = target tissue concentration
> RFD = reference Risk Dose (Acceptable Daily Intake) Values
> W = reference human weight
> I = average seafood ingestion rate per human.

2) Excerpt from the PSDDA Evaluation Procedures Technical Appendix - Phase 1 (June 1988), section 8.4.3, Seafood Ingestion Rate Estimate:

> Seafood ingestion rates that estimate the amount of fish caught and eaten that could have been exposed to dredged material at the unconfined, open-water, disposal sites were calculated based on the following assumptions and available data. The ingestion estimates are calculated for bottom fish caught by recreational anglers only:
>
> o Baseline seafood consumption rates for seafood caught in urban bays by recreational anglers were based on the data of Landolt *et al.* (1985). According to their report, the average daily fish ingestion rate for seafood from the urban bays is 11 g/day (table 62d, p. 65 in Landolt *et al.* 1985).

o The above value was adjusted to reflect the percentage of seafood caught that was represented by flatfish (which are the primary finfish that would be exposed to the open-water dredged material mound). According to Landolt et al. 1985, bottom flatfish represent 2.5 percent (by weight) of the total amount caught. Therefore the amount of seafood eaten that is composed of flatfish - 11 g/day x (2.5 percent) = 0.28 g/day.

o The food ingestion rate was further adjusted to reflect the amount of consumed flatfish that could have been exposed to dredged material at the disposal mound. This was accomplished by estimating the percent of the individual home range of bottom fish that was covered by the disposal site. This value is then applied to the daily ingestion rate to provide an estimate of the dietary contribution of fish eaten that might have been exposed to the disposal mound.

Studies on the nonrandom occurrence and stable percent incidence of fish liver tumors and tagging-recapture studies indicate that flatfish exhibit a home range in which juveniles and adults spend most of their lives within a given area. Bottom fish have also been shown to exhibit seasonal migrations perpendicular to the shoreline in an area approximately bounded by the 600-foot depth contour (Tetra Tech 1986; Bargmann, G., 1986, personal communication). The longshore extent of the home range is not known, but it has been approximated by the distance between West Point and Terminal 90/91 (approximately 3.2 mi). It is important to note that estimating the areal extent of a fish's home range is a very uncertain exercise and such estimates should be understood to be very rough.

Based on these data and assumptions, the final steps leading to the estimated seafood ingestion rate were:

1. Home range area estimate = 2,334 ac

2. Disposal site area estimate = 395 ac (Elliott Bay site; the largest Phase I site)

3) Potency factors (B) and Reference Doses (RfD) are chemical specific and were taken from Tetra Tech 1986 (Tables C-1 and C-2) and Tetra Tech 1988 (Health Risk Assessment of Chemical Contamination in Seafood - Table ES-3):

B_{PCBs} = 7.7 mg/kg-day (note: this value has since been changed to 2.0)

B_{DDT} = 0.34 mg/kg-day

RfD_{Hg} (chronic) = 3×10^{-4} mg/kg-day

4) Other relevant reference doses were provided by EPA:

RfD_{Hg} (developmental) = 1×10^{-4} mg/kg-day

RfD_{Hg} (EPA fish advisory) = 6×10^{-5} mg/kg-day

RfD_{TBT} = 3×10^{-5} mg/kg-day (as TBT oxide)

5) Other input parameters:

W = 70 kg is the weight currently used by EPA and Ecology for risk assessment

R = 10^{-5} is within the current acceptable range

Note: for noncarcinogens, the hazard quotient is assumed equal to 1 and does not appear in the risk-based formula

6) Calculation of risk-based tissue concentrations:

$$C_{tissue}^{PCBs} = \frac{(10^{-5})(70kg)}{7.7\frac{kg-day}{mg}\left[\left(\frac{395ac}{2{,}334ac}\right)\right]\left(\frac{11g}{day}(0.025)\right)\left(\frac{kg}{1000g}\right)} = 2.0 \text{ mg/kg ww}$$

$$C_{tissue}^{DDT} = \frac{(10^{-5})(70kg)}{0.34\frac{kg-day}{mg}\left[\left(\frac{395ac}{2{,}334ac}\right)\right]\left(\frac{11g}{day}(0.025)\right)\left(\frac{kg}{1000g}\right)} = 44 \text{ mg/kg ww}$$

$$C_{tissue}^{Hg(chronic)} = \frac{3x10^{-4}\frac{mg}{kg-day}(70kg)}{\left[\left(\frac{395ac}{2{,}334ac}\right)\right]\left(\frac{11g}{day}(0.025)\right)\left(\frac{kg}{1000g}\right)} = 450 \text{ mg/kg ww}$$

$$C_{tissue}^{Hg(developmental)} = \frac{1x10^{-4}\frac{mg}{kg-day}(70kg)}{\left[\left(\frac{395ac}{2{,}334ac}\right)\right]\left(\frac{11g}{day}(0.025)\right)\left(\frac{kg}{1000g}\right)} = 150 \text{ mg/kg ww}$$

$$C_{tissue}^{Hg\,(\text{EPA fish advisory})} = \frac{6x10^{-5}\,\dfrac{mg}{kg-day}(70kg)}{\left[\left(\dfrac{395ac}{2{,}334ac}\right)\right]\left(\dfrac{11g}{day}(0.025)\right)\left(\dfrac{kg}{1000g}\right)} = 90 \text{ mg/kg ww}$$

$$C_{tissue}^{TBTO} = \frac{3x10^{-5}\,\dfrac{mg}{kg-day}(70kg)}{\left[\left(\dfrac{395ac}{2{,}334ac}\right)\right]\left(\dfrac{11g}{day}(0.025)\right)\left(\dfrac{kg}{1000g}\right)} = 45 \text{ mg/kg ww (as TBTO)}$$

= 43 mg/kg ww (as TBT)

PCB concentrations in tissue that may cause adverse effects or changes in response

RESPONSE	MACROINVERTEBRATES	FISH
Lethality	>25 mg/kg	>100 mg/kg
Growth	>25 mg/kg	>50 mg/kg
Reproduction	>25 mg/kg	>100 mg/kg (female); >50 mg/kg (progeny)
Behavior		
Disease	nd	mg/kg range
Cellular changes	Low mg/kg	High μg/kg to low mg/kg
Biochemical changes	nd	High μg/kg to low mg/kg

SOURCE: Niimi (1996)
NOTE: nd - no data

Correlations between body burdens of PCBs and toxicological effects

RESPONSE/ ORGANISM	OBSERVATIONS	REFERENCE
Crustacea	7-day LC_{50} for shrimp reported for Aroclor 1254 at 9 μg/L; animals had 60 mg/kg of PCBs	Nimmo et al. (1974)
Crustacea	Shell growth in oyster inhibited 19-100% by Aroclor 1254 at 1-100 μg/L after 96 hours; oysters had >8 mg/kg of PCBs	Duke et al. (1970)
Crustacea	Lethal threshold for *Gammarus* reported for Aroclor 1254 at 5 μg/L during 20-day study; dead shrimp had 16 mg/kg PCBs while those surviving had 33 mg/kg	Duke et al. (1970)
Crustacea	16-day LC_{50} for shrimp reported for Aroclor 1254 at 12 μg/L; animals had 45 mg/kg of PCBs	Nimmo et al. (1974)
Crustacea	5% of crabs died when exposed to Aroclor 1254 at 5 μg/L during 20-day study; surviving crabs had about 18-27 mg/kg of PCBs	Duke et al. (1970)
Mollusc	Growth in oyster reduced by Aroclor 1254 at 5 μg/L exposed for 168 days, but not by those exposed to 1 μg/L for 210 days; PCB concentrations in those affected estimated to be 50 mg/kg	Nimmo et al. (1975)
Crustacea	Reproduction in *Gammarus pseudolimnaeus* inhibited by Aroclor 1242 at 9-234 μg/L exposed for 60 days; animals had >320 mg/kg of PCBs, those exposed to 3 μg/L and reproduced had 76 mg/kg of PCBs	Nebeker and Puglisi (1974)
Crustacea	Survival, growth, and reproduction in *Hyallela azteca* not affected by Aroclor 1242 at 3-30 μg/L exposed for 70 days; but affected animals exposed to $\leq$ 100 mg/L; toxic effects observed in animals with 30-100 mg/kg PCBs	Borgmann et al. (1990)
Echinoderm	Testosterone, but not progesterone, levels in ovaries and testes of starfish increased 2- to 3-fold after exposure to > 26 mg/kg of PCBs in lipid of food fed for 84 days; PCB concentrations in gonads were 9 mg/kg of lipid	den Besten et al. (1991)
Mollusc	Connective tissue structure of oyster altered by Aroclor 1254 at 5 μg/L exposed for 180 days but recovered when exposed to clean water; PCB concentration in affected animals estimated to be 50 mg/kg	Nimmo et al. (1975)
Arthropod	*Daphnia magna* were exposed to 0.1 μg/L and 1.0 μg/L of PCBs for 21 days; no effects in survival or reproduction were seen, although there was a slight difference in biomass; body burdens were 0.4 - 2.8 mg/kg wet weight for individual congeners (52, 77, 101, 118, 138, 153, 180) at 0.1 μg/L and 4-26.6 mg/kg ww at 1.0 μg/L	Dillon et al. (1990)
Mollusc	*Crassostrea virginica* were exposed to Aroclor 1254 in seawater for 24 weeks; 425 mg/kg wet weight was the whole body burden; effects were reported as significantly reduced growth rate and tissue alterations	Lowe et al. (1972)
Crustacea	Hepatopancreas structure of shrimp altered by Aroclor 1254 at 3 μg/L exposed for 30 days; PCB concentrations estimated to be 3 mg/kg	Nimmo et al. (1975)
Amphipod	Toxic effects were observed at tissue levels of PCBs between 30 and 180 µg/L on a wet weight basis for *Hyallella azteca*. There were no effects on survival, growth, or reproduction after addition of 30 µg/L during ten week chronic toxicity test.	Borgmann et al. (1990)

SOURCE: Niimi (1996)

with an average whole-body concentration of DDT of 0.023 ppm ww. The gulls and cormorants were fed queenfish with an average whole-body concentration of DDT ranging from 3.8 to 5.0 ppm ww.

To protect the California brown pelican, the State of California has established a limit of 0.15 ppm ww of DDT in fish. Blus (1996) estimates the lower critical dietary level of DDE at about 0.1 ppm, on the basis of 31x biomagnification from fish to pelican eggs. However, because the chief prey fish also contained DDT at one-half the concentration of DDE, the 0.1 ppm level probably should be raised slightly to account for metabolism from DDT to DDE.

In experiments with animals on dietary dosages of DDT, DDD, and DDE, residues in tissues, particularly the brain, have proven to be diagnostic of lethality. Beyer et al. (1996) states that when used in field investigations, this technique makes possible the interpretation of lethality when DDT equivalents (using a weighting system that equates 1 ppm of DDT with 5 ppm DDD or 15 ppm DDE) are as low as 10 in brains; however, most birds or mammals that die from DDT have DDT equivalents >20. Few dead wild birds have been found with lethal levels of DDE or DDD in their brains. The brown pelican is the most sensitive, with eggshell thinning and reduced productivity occurring at 3 ppm of DDE in the egg and total reproductive failure when residues exceed 3.7 ppm (Beyer et al., 1996). In contrast, adverse effects on the reproductive success of peregrine falcons first occur when DDE residues in the egg are about 10-fold higher, 30 ppm. In addition, the black-crowned night heron exhibits a gradual decline in productivity with DDE concentrations > 25 ppm.

Within Terminal 18 sediments DDD comprises the majority of total DDT concentrations for all DMMUs. Concentrations of p,p'-DDT were not detected in any of the sediment samples for Terminal 18. Since DDD and DDE are less toxic than DDT based on the literature cited in the previous discussion, we recommend that the allowable total DDT tissue residue concentration be based on the toxic effects of DDD and DDE. From the data presented the action level for aquatic species would be 3 ppm, based on isolated tissues of croakers and cutthroat trout. Lower action levels, such as those imposed by the State of California, were developed to protect a sensitive species (brown pelican). Such an action level would be inappropriate for use in the PSDDA program, because of the acceptance of Level II effects at PSDDA disposal sites. Level II effects include acute toxicity in some species, and some chronic effects on other species. The sediment being evaluated would be disposed of at the Elliott Bay PSDDA disposal site. Water depth at this site is 300 feet; its location does not present a risk to birds similar to the brown pelican. Therefore, these data indicate that effects observed concentrations are less than the FDA action limit of 5 ppm. These data support the conclusion that if total DDT tissue concentrations in test organisms are less than 3 ppm ww, the test sediments are suitable for unconfined, open-water disposal based both on concerns for human health and ecological risks.

DDT

Limited information has been found relating DDT tissue concentrations to potential for risk to aquatic organisms. Of the few studies found on aquatic organisms, two are presented: Childress (1971) and Allison et al. (1964), who reported that 3 to 5 ppm ww in gonads or liver for croakers and cutthroat trout may induce sterility and other reproductive effects.

Most of the available data focus on birds. SCCWRP (1977) reported that 16 seagulls and 5 cormorants died at the California zoo in 1976. DDT was found in these birds at concentrations ranging from 90 to 500 ppm ww (tissue samples were from three gulls and 1 cormorant). Pelicans at the zoo which exhibited the same symptoms as the seagulls and cormorants had tissue concentrations of DDT ranging from 11 to 110 ppm ww. There were no mortalities among the pelicans, which were fed a diet consisting of surf smelt

Environmental Services for Industry and Government
Seattle, U.S.A.
Vancouver, Canada

EVS ENVIRONMENT CONSULTANTS

July 15, 1996
Project No.: 2/203-09.5

David Fox
OP-TS
U.S. Army Corps of Engineers
Seattle District
4735 E. Marginal Way S.
Seattle, WA 98134

Re: Bioaccumulation Interpretation Guidelines

Dear David:

On behalf of the Port of Seattle we are submitting Bioaccumulation Interpretation Guidelines as requested in the interagency meeting on June 20, 1996. We trust you will find the information helpful and that we will be able to reach some conclusions during our meeting on July 16.

Sincerely,

D. Michael Johns
Project Manager

cc: Doug Hotchkiss/Port of Seattle
Justine Barton/EPA
Karen Keeley/EPA
Ted Benson/DNR
Tom Gries/Ecology
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Attachment 19A

Total mercury concentrations in tissues of fish exhibiting symptoms of methylmercury toxicity

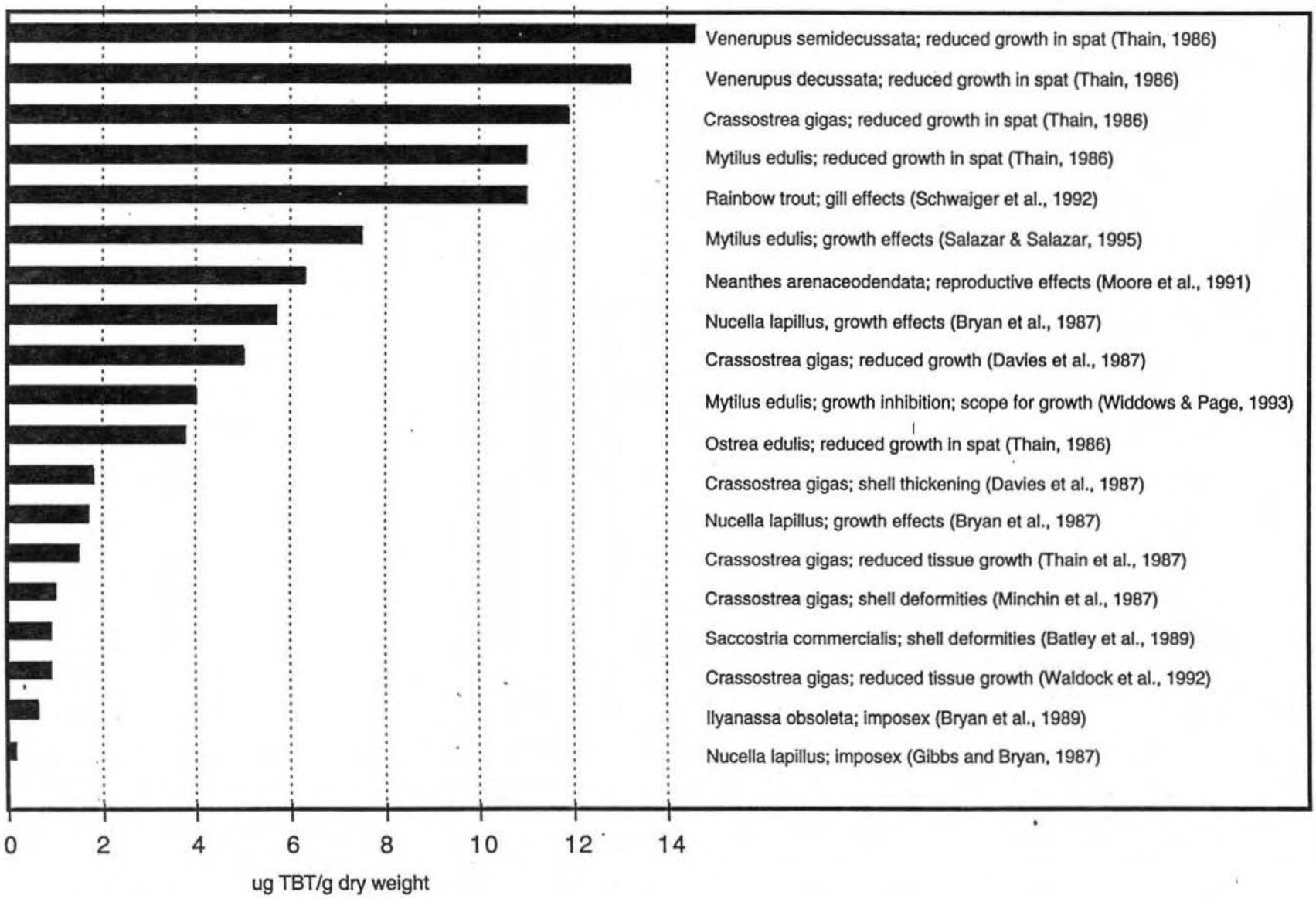
Species	Location or Mode and Duration of Exposure	Hg Concentration (ppm wet weight)				Toxic effect(s)[a]	Reference
		Brain	Liver	Muscle	Whole Body		
Laboratory Studies							
Walleye	Diet (42 - 63 days)	3 - 6	6 - 14	5 - 8		Onset of mortality Fish emaciated (-) locomotor activity (-) coordination (-) appetite	Scherer et al. (1975)
	Diet (240 - 314 days)	15 - 40	18 - 50	15 - 45		(+) mortality	Scherer et al. (1975)
Rainbow trout	Diet (105 days)			12 - 23		(-) growth	Wobeser (1975b)
Rainbow trout	Diet (84 days)				30 - 35	Darkened skin Lethargic behavior	Rodgers and Beamish (1982)
	Diet (84 days)				10 - 30	(-) appetite (-) growth	Rodgers and Beamish (1982)
Rainbow trout	Diet (270 days)	16 - 30	26 - 68	20 - 28	19	(-) appetite (-) activity (-) visual acuity (-) growth Darkened skin Loss of equilibrium	Matida et al. (1971)
Rainbow trout	Water (4 µg/L)[b] (30 - 98 days)	7 - 32	32 - 114	9 - 52		Death, preceded by (-) appetite and (-) activity	Niimi and Kissoon (1994)

Species	Location or Mode and Duration of Exposure	Hg Concentration (ppm wet weight)				Toxic Effect(s)[a]	Reference
		Brain	Liver	Muscle	Whole Body		
Rainbow trout	Water (9 µg/L)[b] (12 - 33 days)				4 - 27	Death, preceded by (-) appetite and (-) activity	Niimi and Kissoon (1994)
Rainbow trout		10 - 20	1 - 5	1.4 - 10.9			Niimi (1994)
Brook trout	Water (2.9 µg/L)[b] (273 days)	42	58	24	24	Mortality, preceded by loss of appetite, muscle spasms, and deformities	McKim et al. (1976)
	Water (0.93 µg/L)[b] (273 days)	17	24	10	5 - 7	(+) mortality (-) growth Sluggish behavior Deformities	McKim et al. (1976)
	Water (0.29 µg/L)[b] (273 days)	5	8	5	3	None observed	McKim et al. (1976)
Field Studies							
Nibea schlegeli	Minamata Bay			8 - 15		Fish enfeebled	Kitamura (1968)
Latcolabrax japonicus	Minamata Bay			17		Fish enfeebled	Kitamura (1968)
Sparus macrocephalus	Minamata Bay			24		Fish enfeebled	Kitamura (1968)
Scomberomorus niphonicus	Minamata Bay		15	9		Fish enfeebled	Kitamura (1968)
Striped mullet (*Mugil cephalus*)	Minamata Bay			11		Fish enfeebled	Kitamura (1968)
Cardinalfish (*Apogon* sp.)	Minamata Bay			19		Fish enfeebled	Kitamura (1968)

Species	Location or Mode and Duration of Exposure	Hg Concentration (ppm wet weight)				Toxic Effect(s)[a]	Reference
		Brain	Liver	Muscle	Whole Body		
Northern pike	Clay Lake, Ontario			6 - 16		Fish emaciated, with biochemical symptoms of starvation and (-) immunity	Lockhart et al. (1972)

SOURCE: Wiener and Spry 1996

[a] An increase is indicated by (+); a decrease is indicated by (-).
[b] Concentration of mercury in water, administered as methylmercuric chloride.



SOURCE: Beaverson et al. 1996

Summary of measured effects and associated tissue TBT concentrations

Attachment 19A

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1 - Dry weight concentration converted to wet weight concentration using water content given in citation, or by assuming 80% water content (Dillon 1984) if no water content given in citation
2 - Field survey, co-occurrence of multiple contaminants with listed contaminant
3 - Laboratory toxicity test, single contaminant
4 - Laboratory toxicity test, co-occurrence of multiple contaminants with listed contaminant
5 - Estimated tissue residue concentration
6 - Outdoor microcosm or artificial stream test, single contaminant
7 - Outdoor microcosm or artificial stream test, co-occurrence of multiple contaminants with listed contaminant

Chemical	(mg/kg ww)	Tissue type	Observations
Aroclor 1242	2.7	whole body	rainbow trout fry LD75
Aroclor 1242	2.7	whole body	rainbow trout fry ED60-75
Aroclor 1254	0.39	whole body	rainbow trout fry LD10-28
Aroclor 1242	<514	whole body	fathead minnow NOEC reproduction
Aroclor 1254	<130	whole body	fathead minnow NOEC reproduction
Aroclor 1254	654	whole body	*Oncorhynchus kisutch* LD100
Aroclor 1254	425	whole body	*Crassostrea virginica* NOEC
Aroclor 1016	77	whole body	Cyprinodon fry NOEC survival
Aroclor 1242	30-180	whole body	*Hyalella* reduced survival
Total PCBs	<1100	liver	English sole NOEC gonad development
Total PCBs	<540	gonad	English sole NOEC gonad development

Attachment 19C

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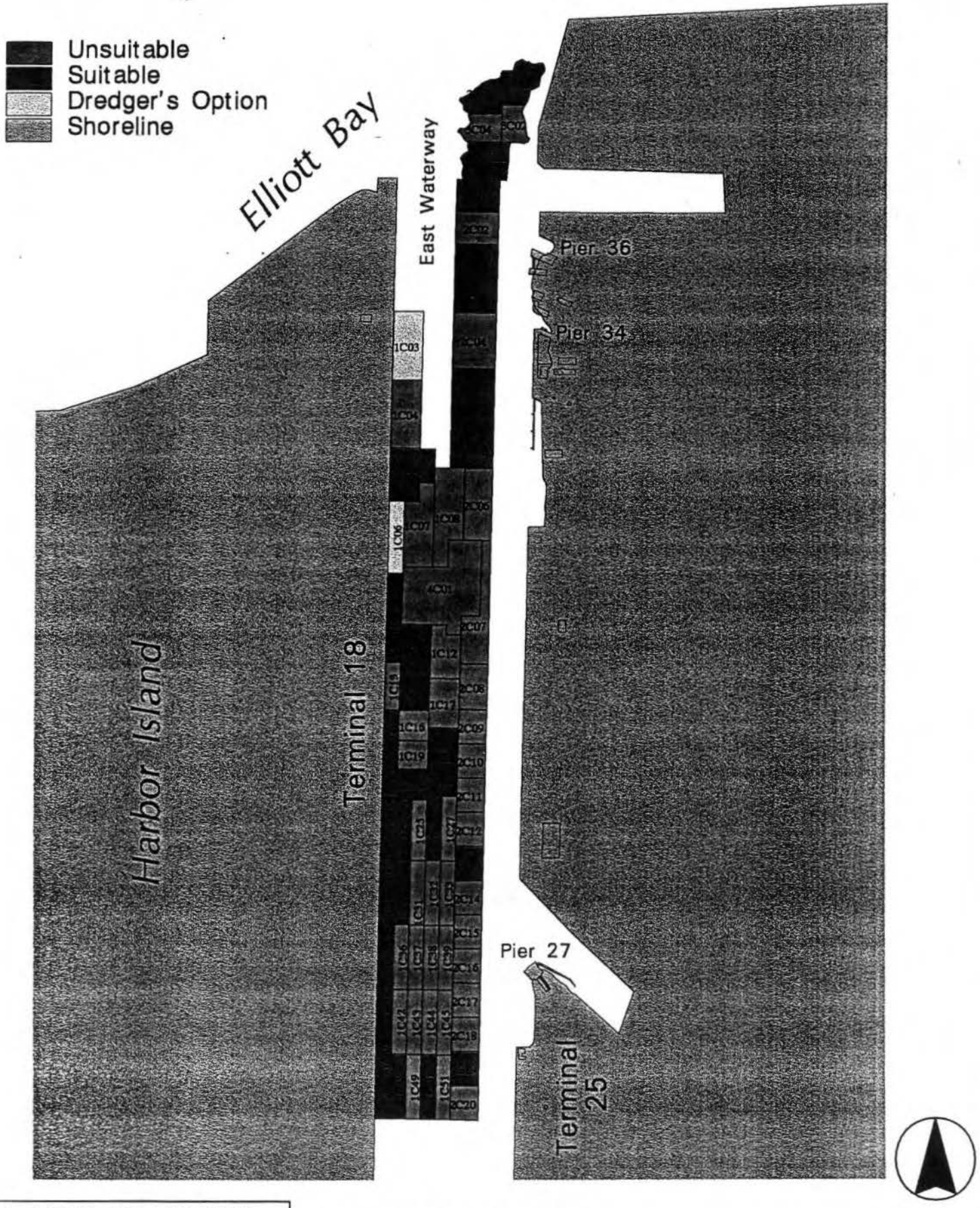
Attachment 19B

Attachment 20 - PSDDA Surface Suitability Determination



Port of Seattle T18 - (95-02133)

Corps of Engineers, Seattle District
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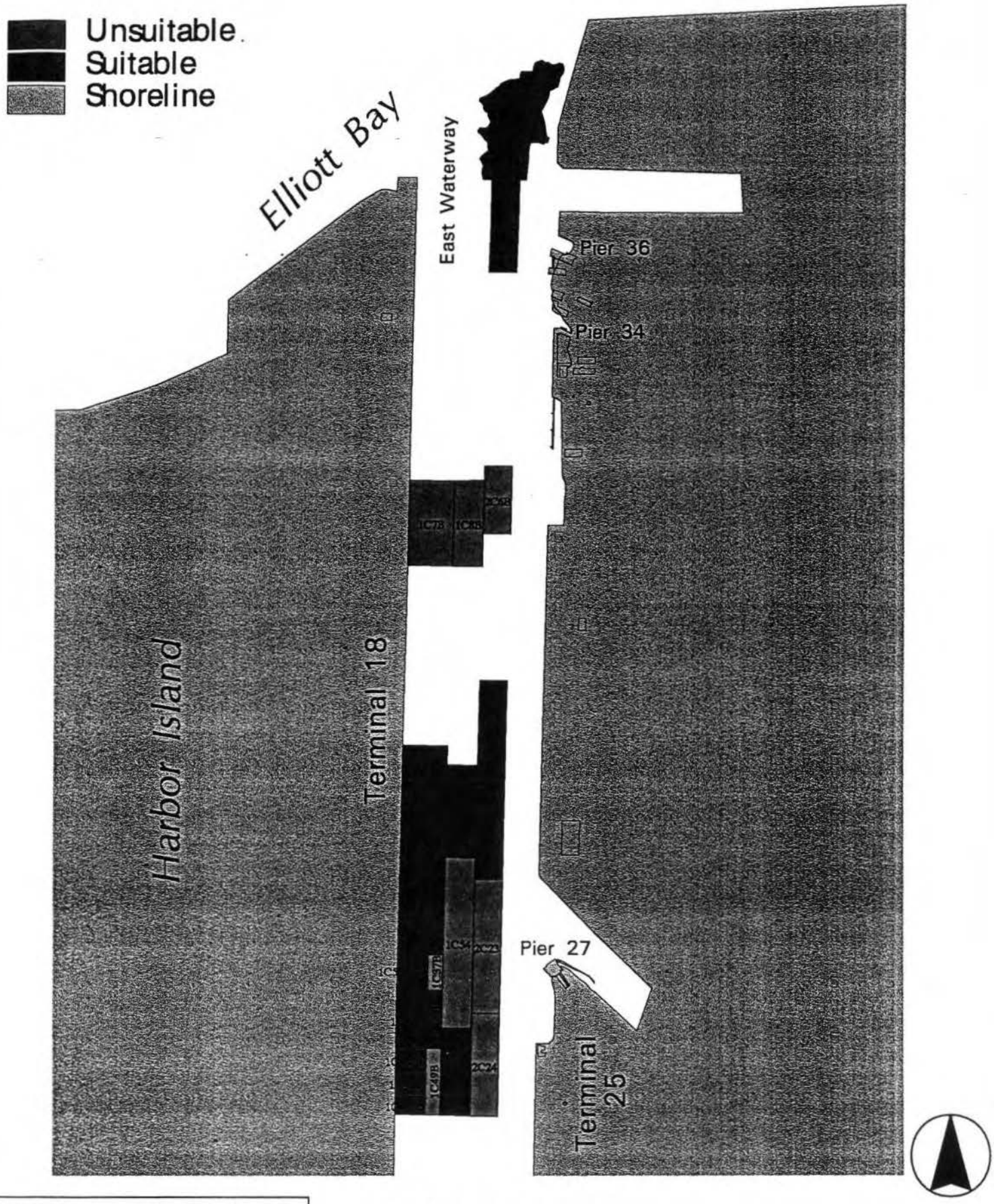
Attachment 21 - PSDDA Subsurface Suitability Determination



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