

27 November 2000

SUBJECT: DETERMINATION ON THE SUITABILITY OF DREDGED MATERIAL EVALUATED FOR WEYERHAEUSER COMPANY SECTION 404 OF THE CLEAN WATER ACT (CWA) FOR OPEN-WATER DISPOSAL AT THE COMMENCEMENT BAY DISPOSAL SITE.

1. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) Agencies' (U.S. Army Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency) with jurisdiction on dredging and disposal on the suitability of the estimated 39,900 cubic yards of dredged material proposed for dredging from the head of Hylebos Waterway at the Weyerhaeuser Company area of the Hylebos Wood Debris Site (HWDS)¹. The suitable dredged material would be disposed at the unconfined open-water disposal site in Commencement Bay.
2. This determination of suitability is based on the acceptability of the sampling conducted on May 6-7, 1999 for initial (Round 1) seven dredged material management units (DMMU), and July 26-30, 1999 for three subsurface DMMUs (Round 2), and a third testing round accomplished during March 20-22, 2000. A summary of all relevant test data from the Weyerhaeuser Project area is contained in Data Summary Report submitted by the Wood Debris Group's contractor Pentec Environmental to the Dredged Material Management Office (DMMO)/DMMP agency representatives on November 6, 2000 for review by the DMMP agencies.
3. Relevant dates for regulatory tracking purposes are included in Table 1.

Table 1. Regulatory Tracking Dates

SAP Submittal date:	June 29, 1999
SAP Approval date:	July 23, 1999
Sampling date(s): Round 1	May 6-7, 1999
Round 2	July 26-30, 1999
Round 3 (bioassay resampling/retesting)	March 20-22, 2000
Round 4 (bioaccumulation/TBT porewater sampling)	May 2, 2000
Data report submittal date:	November 6, 2000
Recency Determination Dates: High (2 years)	May 2002

¹ A 22 September 2000 suitability determination documented the suitability of proposed dredged material from both the Manke Lumber and Louisiana-Pacific Companies dredging areas.

Sediment Chemical Testing:

4. The applicant elected to conduct some initial sampling during Round 1 between May 6-7, 1999, which was outside the DMMP review and approval process, and was accomplished at the applicant's risk². The Sampling and Analysis plan (SAP) was submitted to the DMMP agencies on June 29, 1999 and was approved by the DMMP agencies on July 23, 1999. Additional sampling (Round 2) was conducted between July 26-30, 1999, and generally followed the specifications in the approved SAP, as did the earlier sampling conducted in May. After reviewing the initial bioassay testing results from Rounds 1 and 2, the DMMP agencies determined that bioassay retesting of a subset of dredged material management units (DMMUs) would be required (enclosure 2). Subsequently, additional sampling was conducted between March 20-22, 2000 to conduct these bioassay retests. A fourth round of sampling was necessary (May 2, 2000) to collect sediments for bioaccumulation testing of three DMMUs (B-5, B-6, B-7) and TBT porewater testing for seven DMMUs. After reviewing the four rounds of testing data, the DMMP agencies determined that the analysis data collected from all field-testing rounds, was deemed sufficient and acceptable for decision making by the Agencies based on best professional judgement.
5. The DMMP-approved conceptual sampling and analysis plan for Weyerhaeuser Incorporated included a total dredging footprint within the larger Hylebos Wood Debris site area of an estimated 39,900 cubic yards (see Figure 1). Round 1 sampling conducted between May 6-7, 1999 collected seven uncomposited surface dredged material management units (DMMUs) with an impact-corer (Mudmole™). Three subsurface DMMUs (B-8, B-9, B-10) were sampled during Round 2 between July 26-30, 1999. To accomplish the DMMP approved bioassay retesting of 8 DMMUs from the Weyerhaeuser Incorporated dredging area additional sediment sampling was conducted (Round 3) between March 20-22, 2000. Seven DMMUs were resampled on May 2, 2000 (Round 4) for bioaccumulation testing and TBT porewater analyses. A total of ten DMMUs were evaluated collectively during Rounds 1, 2, 3 and 4 for unconfined open-water disposal consideration at the Weyerhaeuser Dock.
6. Appendix 1 provides a testing summary of the sediment conventional parameters including grain size and total organic carbon contents for all 10 DMMUs undergoing testing. The results for sediment analyzed for the 7 surface and 3 subsurface DMMUs indicated the sediments were variable ranging from a low of 38.8 percent fines to a high of 70.6 percent fines. Two of the ten DMMUs had total volatile solids (TVS) concentrations exceeding twenty-five percent on a dry weight basis (28.0 – 34.0 %), which was primarily attributed to the presence of woody debris in these sediment, and triggered biological testing on these two DMMUs.
7. The results of chemical analyses of the 10 DMMUs are summarized in Appendix 1 and indicated that 9 of 10 had detected/undetected chemicals exceeding PSDDA screening level (SL) guidelines. The most frequently noted detected chemicals were Tributyltin (6 DMMUs), total PCBs (6 DMMUs), Chrysene (6 DMMUs), Benzofluoranthene (3 DMMUs), Indeno(1,2,3,c,d)pyrene (2 DMMUs), Dibenzo(a,h)anthracene (2 DMMUs). Tiered testing was conducted and the results of the TVS and chemical testing triggered biological testing on 9 of the 10 DMMUs. The six DMMUs with TBT SL exceedances (Appendix 1), also had other chemicals exceeding SLs, which trigger bioassay testing. Pending the results of the bioassay testing these 6 DMMUs would also be subject to bioaccumulation

² The applicant's consultant was advised by the Dredged Material Management Office that any sampling/analyses conducted outside the DMMP review and approval process would be accomplished at the applicant's risk. The DMMP agencies acknowledged in a letter to applicant's agent on July 23, 1999 (enclosure 1), that the DMMP would consider these testing results along with the complete data testing submittal package evaluating the proposed dredged material as part of the suitability determination evaluation process using best professional judgement.

testing in the event they pass the acute bioassay tests. The results for the biological testing analyses are summarized below.

Biological Testing:

8. Standard bioassay testing was conducted on all nine DMMUs within the 56 day biological holding time. Appendix 2 summarizes the solid phase bioassay Quality Control (QC) performance guidelines and also summarizes the solid phase bioassay interpretative guidelines for nondispersive sites, which were used to evaluate the bioassay data discussed below. Appendix 3 summarizes the Round specific and batch specific bioassay toxicity testing outcomes (e.g., Appendix 3a: amphipod (*Ampelisca abdita*, *Rhepoxynius abronius*)(Rounds 1 – 3); Appendix 3b: echinoderm larval (*Dendraster excentricus*) (Round 2) and bivalve larval (*Mytilus galloprovincialis*)(Round 3); and Appendix 3c: *Neanthes arenaceodentata*-growth)(Rounds 1 and 2) for all twenty-two DMMUs. Reference sediment was collected from Carr Inlet to conduct DMMU specific test sediment comparisons for the three bioassay tests used during the three testing rounds (see Appendix 1, Appendix 3). Amphipod bioassays conducted during Round 1 testing with *Ampelisca abdita* failed to meet the negative control performance standard, but the single DMMU tested with *Rhepoxynius abronius* met both the negative control and reference performance standards. Amphipod testing during round 2 was problematic, based on performance standard failures for both reference and negative control sediments for both amphipod species (*Rhepoxynius abronius* and *Ampelisca abdita*), which resulted in a requirement to retest a subset of the DMMUs tested (see Appendices 1 and 3a). Round 3 amphipod resampling/retesting of 8 of 9 Round 1 DMMUs was conducted with *Ampelisca abdita*, and all Round 3 batches met both the negative control and reference sediment performance standards. Round 2 testing of Weyerhauser sediments was accomplished with the echinoderm (*Dendraster excentricus*), and the sediment larval bioassay meet both the negative control performance and reference performance standards. In general, the *Neanthes* growth bioassay met the DMMP performance standards for the negative control and reference sediments during Rounds 1 and 2. Summary bioassay results for each DMMU are depicted in Appendix I relative to the DMMP nondispersive interpretative guidelines. The bioassay results are discussed below for each of the bioassay tests conducted.

- a) **Amphipod Bioassay (*Ampelisca abdita*, *Rhepoxynius abronius*).** Amphipod bioassay testing was conducted during the three testing rounds for the 9 DMMUs as noted in Appendix 3a, Appendix I, Table 2. The testing resulted in 5 DMMUs among the three testing rounds exhibiting no-hit responses, 1 DMMU with 2-hit responses, and 3 DMMUs with a 1-hit response. DMMU B-3 had 1-hit responses from both the *Rhepoxynius abronius* and *Ampelisca abdita* bioassays during Round 1 and Round 1 retest.
- b) **Bivalve Larval Bioassay (*Dendraster excentricus*, *Mytilus galloprovincialis*).** Of the eight of the nine DMMU's³ tested, three passed the DMMP nondispersive guidelines for unconfined open-water disposal, and five exhibited a 2-hit responses (Appendix 3b, Appendix 1, Table 2). One of the three suitable DMMUs exceeded the 2-hit response guidelines, but when statistically compared to the appropriate reference sediment responses, were found to be "not statistically different" ($p < 0.1$), and thus are not scored as a "hit" for regulatory decision-making (e.g., "suitable").

³ The larval bioassay test was not rerun on DMMU B-3 in Round 2 because this DMMU exhibited Round-1 single-hit responses for both *Rhepoxynius abronius* and *Ampelisca abdita*.

- c) ***Neanthes* 20-day Growth Bioassay (*Neanthes arenaceodentata*).** The results of the *Neanthes* growth bioassay (Appendix 3c and Appendix I, Table 2) showed no hits among the nine DMMUs characterized, and all DMMU's tested passed the nondispersive site disposal guidelines.
- d) **DMMP Bioassay Determination.** Overall interpretation of the nine DMMU's tested by the DMMP bioassays demonstrated that five DMMUs exhibited bioassay responses that were suitable for unconfined open-water disposal (UOWD) and four exhibited responses that were unsuitable for UCOWD (Appendix 1, Table 2).
- e) **Bioaccumulation Trigger Exceedances.** Of the six DMMUs that had BT exceedances for TBT, three passed the DMMP bioassays interpretation guidelines for open-water-unconfined disposal during Rounds 1-3 bioassay testing. Therefore, these three DMMUs (B-5, B-6, B-7) were subject to bioaccumulation testing during Round 4.

Table 2. Bioassay interpretation summary³

Amphipod bioassay: (<i>Rhepoxynius abronius</i> & <i>Ampelisca abdita</i>)	Pass	Two-Hit	One-Hit	Total:
Weyerhaeuser Dock DMMUs	5	1	3	9
Sediment Larval Bioassay: (<i>Dendraster excentricus</i>)	Pass	Two-Hit	One-Hit	Total:
Weyerhaeuser Dock DMMUs	3	5	0	8
<i>Neanthes</i> Growth Bioassay: (<i>Neanthes arenaceodentata</i>)	Pass	Two-Hit	One-Hit	Total:
Weyerhaeuser Dock DMMUs	9	0	0	9
DMMP Bioassay Determination:	Number of Suitable DMMUs		Number of Unsuitable DMMUs	
Weyerhaeuser Dock DMMUs	5		4	

Bioaccumulation Testing

9. The sediment analytical chemical results for the 3 DMMUs that underwent bioaccumulation testing for TBT are presented in Appendix 3d and 4a. The results of these sediment analyses indicated that there was often a large disparity between the initial and resampled/retested analytical results for porewater-TBT. When the initial result exceeded the retested result, the ratio of the two was used to adjust the bioaccumulation tissue concentrations to reflect a "worst case" analytical result.
10. Bioaccumulation testing was performed with *Macoma nasuta*, a facultative deposit feeding/suspension feeding bivalve and *Nephtys caecoides*, a burrowing facultative deposit feeding/carnivorous polychaete. The two species were tested together in the same 8-gallon aquaria. The protocol used followed the recent DMMP protocol clarification (Kendall, 2000), which extended the standard bioaccumulation test duration from 28 days to 45 days. Five replicate 8-gallon aquaria were run for the negative control/reference sediments, and for each of the three tested DMMUs.

Tissue Chemistry:

11. Tissue concentrations of chemicals-of-concern from the 45-day exposures were compared statistically to the appropriate reference sediment, based on grain size similarity comparisons. As noted in paragraph 9 above, the calculated ratios of Phase I (initial)/Phase II (retest) sediment chemistry Appendix 4a were used to adjust the observed tissue concentrations (Appendix 4b) Statistical comparisons of test DMMUs and reference tissue concentrations for the final interpretation "worst case" analyses were based on the adjusted tissue concentrations. The summary tissue chemistry interpretation for each of the measured chemicals is provided in Appendix 4b for each of the 3 DMMUs tested.

Bioaccumulation Interpretation:

12. The DMMP agencies agreed that comparing statistical differences from reference is a necessary, but not sufficient condition to determine a DMMU unsuitable for open-water disposal. For those DMMUs that were statistically greater than reference, a more in depth evaluation was required to determine the significance of the bioaccumulation that had occurred. This evaluation focused on **a) Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food; b) PSDDA target tissue concentration values for chemicals of concern to human health, and c) ecological residue-effects data from the literature.**
13. There is no FDA guidelines for Tributyltin (TBT).
14. A target tissue trigger level (TTL), of 3 ppm dry weight of TBT in tissue (0.6 ppm wet weight) was used to evaluate the Weyerhaeuser Dock tissue concentrations. This tissue concentration is protective for growth and reproduction endpoints in polychaetes, crustaceans, bivalves, and most gastropods. However, it might not protect the most sensitive species of meso- and neogastropods against imposex-related sterility. Considering that meso- and neogastropods are rare in Elliott Bay (Appendix D in EVS, 1999) and are thus presumed to be rare in Commencement Bay as well, the DMMP agencies have decided to extrapolate the use of the **TBT trigger level (3 ppm dry weight)** derived for the West Waterway on an interim basis to interpret bioaccumulation data relative to disposal at the Commencement Bay disposal site.
15. To summarize, the DMMP agencies will use the following TTLs to interpret the bioaccumulation test data for the proposed Weyerhaeuser Dock dredging area:

TBT: 3.0 ppm dry weight (dw) as TBT

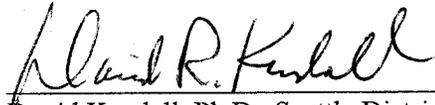
16. The agencies used best professional judgement in developing the interpretation guidelines to meet PSDDA disposal site management objectives; achievement of other sediment management objectives will require additional evaluation. The use of this guideline is subject to change for future PSDDA/DMMP projects as additional bioaccumulation data become available.
17. Each of the three DMMU's was compared to these interpretation guidelines using a one-tailed one-sample t-test (see Appendix 4b). An alpha level (the probability of making a Type I error, rejecting the null hypothesis of no difference between test and reference responses when, in fact, they are not different) of 0.1 was selected for these statistical comparisons by the DMMP agencies to reflect the higher within sample variability, and to increase the power of the test to discriminate between reference and test responses. All three DMMU's were found to be statistically less than the TBT target tissue level (TTL) and thus passed the bioaccumulation test.

Suitability Determination

10. The agencies concluded based on these testing results that six of the ten DMMUs evaluated from the Weyerhaeuser Company Dock representing 25,700 cubic yards of dredged material were found to be suitable for unconfined open-water disposal at the Commencement bay disposal site. Moreover, these testing results confirmed that four DMMUs (B-1, B-2, B-3, and B-8) comprising 14,200 cubic yards of dredged material were found to be unsuitable for UCOWD at the proposed Weyerhaeuser Company Dock dredging area (see Appendix 1 for a complete inventory of suitable and unsuitable DMMUs).
11. This memorandum documents the suitability of the dredged material within the proposed Weyerhaeuser Company dock dredging area at the head of Hylebos Waterway for disposal at the Commencement Bay non-dispersive open-water disposal site. However, this suitability determination does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under Section 404(b)(1) of the Clean Water Act.

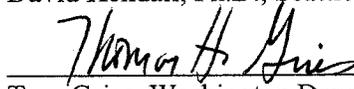
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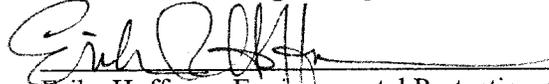
David Kendall, Ph.D., Seattle District Corps of Engineers

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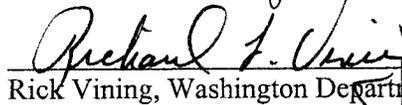
Tom Gries, Washington Department of Ecology

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Erika Hoffman, Environmental Protection Agency

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Rick Vining, Washington Department of Ecology

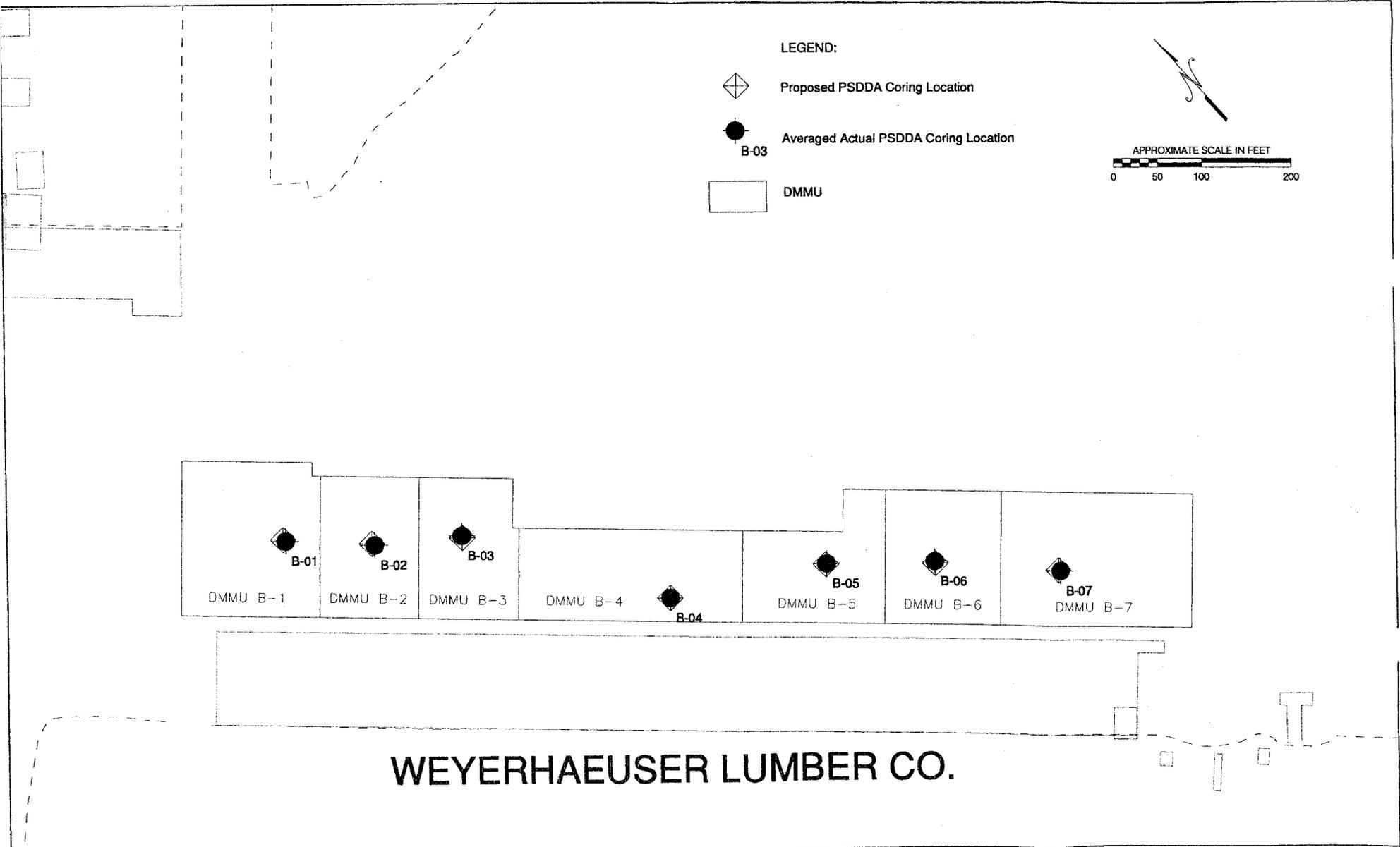
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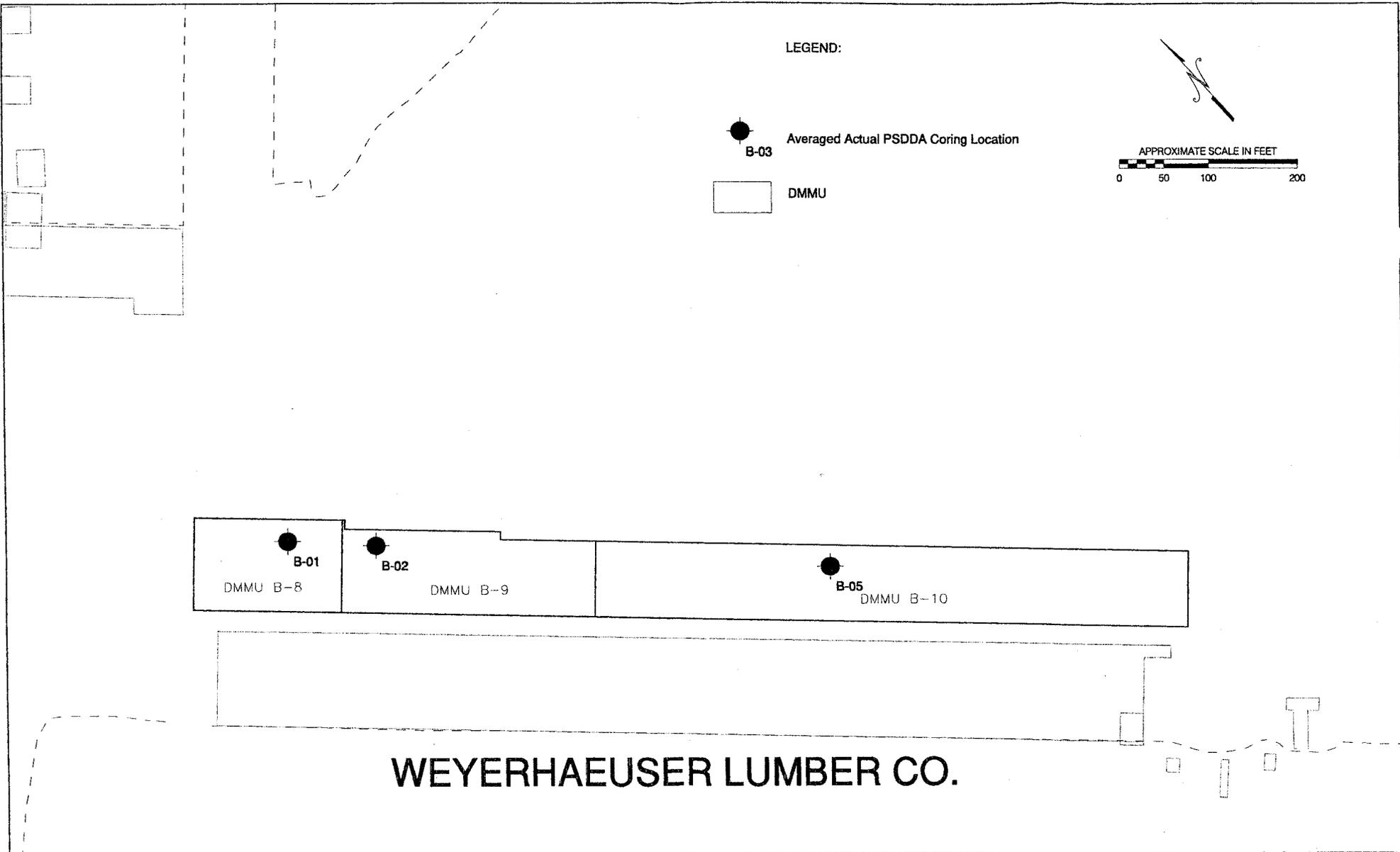
Copies Furnished:

Corps Regulatory Branch Project Manager
Erika Hoffman, EPA
Ted Benson, DNR
Tom Gries, Ecology
Rick Vining, Ecology
DMMO File



Weyerhaeuser Company PSDDA Characterization
Tacoma, Washington
for Floyd & Snider Inc.

Figure 1
Proposed and averaged PSDDA core sample locations
and surface DMMUs at the Weyerhaeuser Company facility.



WEYERHAEUSER LUMBER CO.

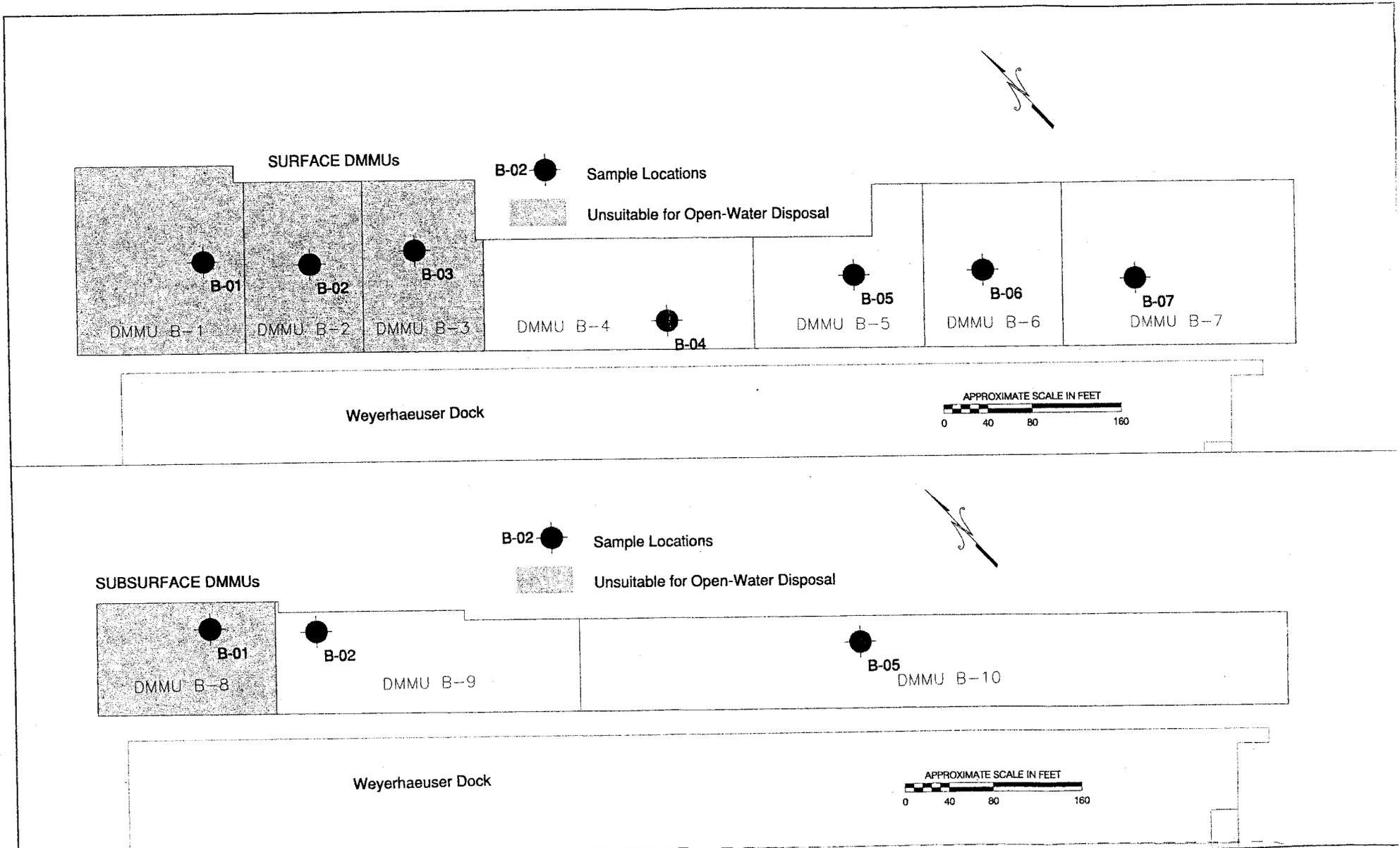


Figure 3

DMMU layout and suitability determinations at the Weyerhaeuser Company facility.

**Appendix 1. Weyerhaeuser Company Dock Dredging Project:
PSDDA Evaluation Summary**

CHEMICAL NAME	Units	SL	BT	Rank: ML	B-1		B-2		B-3		B-4		B-5		B-6		B-7		B-8		B-9		B-10		DMMU	
					H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ	H Conc.	VQ
Tributyltin ion (porewater)	ug/L	0.15	0.15	--	0.18		1.1						0.67		0.33		0.17		0.43							6
Acenaphthene	ug/kg	500		2,000																				570	1	
Phenanthrene	ug/kg	1,500		21,000																				3,200	1	
Total HPAH	ug/kg	12,000		69,000																				16,240	1	
Fluoranthene	ug/kg	1,700	4,600	30,000																				3,400	1	
Pyrene	ug/kg	2,600		16,000																				3,100	1	
Benzo(a)anthracene	ug/kg	1,300		5,100																				1,700	1	
Chrysene	ug/kg	1,400		21,000	1,600		1,500								1,700				1,900		1,900			1,900	6	
Benzo(a)fluoranthene	ug/kg	3,200		9,900	3,300		3,700												3,300						3	
Indeno(1,2,3-c,d)pyrene	ug/kg	600		4,400			680																	750	2	
Dibenzo(a,h)anthracene	ug/kg	230		1,900									250											390	2	
Hexachlorobenzene (HCB)	ug/kg	22	168	230	40	u	120	u	39	u			59	u	59	u				59	u		57	u	7	
2,4-Dimethylphenol	ug/kg	29		210					39	u			39	u	39	u								38	u	4
Pentachlorophenol	ug/kg	400	504	690			580																		1	
Benzyl alcohol	ug/kg	57		870			120	u					59	u	59	u					59	u	57	u	5	
Hexachlorobutadiene	ug/kg	29	212	270	40	u	120	u	39	u			59	u	59	u					59	u	57	u	7	
N-Nitrosodiphenylamine	ug/kg	28	130	130	55	j	120	u	39	u			59	u	59	u					59	u	57	u	7	
Total DDT	ug/kg	6.9	50	69	9.7	u	11	u	13.5	j			14	u						9.8	u	9.9	u		6	
Total PCBs	ug/kg	130		3,100	210		220						250							240		220			5	
Total PCBs (TOC-normalized)	mg/kg		38		3.2		3.5						5.2							6.0		7.3				
Total Solids	%				35.1		37.1		51.8		75.6		39.8		60.0		61.0		53.1		50.0		66.7			
Total Volatile Solids	%				34.0		28.0		14.0		2.0		25.0		5.0		10.0		12.0		14.0		3.0			
Total Organic Carbon	%				6.5		6.3		3.3		0.4		4.8		1.5		1.6		4.0		3.0		0.8			
Total Ammonia	mg/kg				46.0		65.0		32.0		13.0		28.0		25.0		12.0		41.0		46.0		15.0			
Total Sulfides	mg/kg				3,800		9,000		4,600		11		5,800		1,200		580		3,700		5,200		680			
Gravel (percent)	%				9.6		3.7		4.2		6.4		7.0		1.2		1.8		2.1		0.9		0.9			
Sand (percent)	%				25.0		30.0		43.9		54.9		22.5		40.6		46.8		53.6		38.3		34.2			
Silt (percent)	%				40.2		39.8		36.6		27.8		45.8		41.6		36.8		28.3		42.6		52.9			
Clay (percent)	%				25.0		26.4		15.3		11.0		24.8		16.6		14.5		16.2		18.1		12.0			
Fines (percent silt + clay)	%				65.2		66.2		51.9		38.8		70.6		58.2		51.3		44.5		60.7		64.9			
Fines (Round-3 retested amphipod)	%				59.3		65.8						69.1		58.1		31.3		35.8		33.2		34.0			
Reference match (silt+clay): Rounds 1 & 2	%				65.4		66.3		63.1				70.6		58.1		51.3		44.4		61.3		65.0			
Reference match (silt+clay): Round 3	%				57.4		75.5		45.6				75.5		57.4		38.4		38.4		38.4		38.4			
<i>Rhepoxynius abronius</i> (round 1) hits:								1-H																		
<i>Ampelisca abdita</i> (round 1 retest) hits:								1-H																		
<i>Ampelisca abdita</i> (round 3) hits:					2-H		1-H						NH		NH		NH		1-H		NH		NH			
<i>Dendroaster excentricus</i> (round 2) hits:					2-H		2-H						NSD		NH		NH		2-H		2-H		2-H			
<i>Neanthes arenaceodentata</i> (round 1 and 2) hits:					NH		NH		NSD				NH		NH		NH		NH		NH		NH			
Bioassay Pass/Fail:					Fail		Fail		Fail		NA		Pass		Pass		Pass		Pass		Fail		Pass		Pass	
BTs exceeded:					yes		yes		no		no		yes		yes		yes		yes		yes		no		no	
Bioaccumulation conducted:					no		no						yes		yes		yes		yes		no					
Bioaccumulation Pass/Fail:					no		no		no		no		Pass		Pass		Pass		Pass		no		no		no	
ML Rule exceeded:					Fail		Fail		Fail		Pass		Fail		Pass		Pass									
PSDDA Determination:					Fail		Fail		Fail		Pass		Fail		Pass		Pass									
DMMU Volume:	cy				3,900		3,400		3,700		3,700		3,700		3,700		3,800		3,200		4,900		5,900			
DMMU ID:					B-1		B-2		B-3		B-4		B-5		B-6		B-7		B-8		B-9		B-10			
Failed:					3,900		3,400		3,700												3,200					
Passed:													3,700		3,700		3,700		3,800				4,900		5,900	

Legend:

- NA = Not Analyzed (bioassays)
- NSD = Not Significantly Different (No Hit)
- NH = No Hit (nondispersive guidelines)
- 2H = two hit failure (nondispersive guidelines)
- 1H = one hit failure (nondispersive guidelines)

P = Pass (Suitable for UCOWD)

F = Failure (Unsuitable for UCOWD)

UCOWD = Unconfined open-water disposal

VQ = Validation Qualifier

U = Undetected

J = Positively identified; approximate concentration of the analyte in sample.

ML = Maximum Level (upper chemical guideline)

ML + BT = ML + BT exceedance

BT = Bioaccumulation Trigger

14,200 cy: Unsuitable
 25,700 cy: Suitable
 39,900 cy: Total

Appendix 2. PSDDA EVALUATION GUIDELINES (BIOASSAYS)

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

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

Appendix 3a.

Results of amphipod sediment bioassay (percent mortality endpoint) conducted in May 1999 (Round 1) and March 2000 (Round 3).

Test	Test Species	Sample ID No.	Percent Fines	Location/DMMU	Replicate (Percent Mortality)						Mean	Nondispersive Disposal Site Interpretation Guidelines	
					1	2	3	4	5	M _T -M _C >20% and M _T vs M _R SD (p = 0.05) and M _T -M _R >30%		2-hit rule M _T -M _C >20% and M _T vs M _R SD (p = 0.05)	
Round 1	<i>Rhepoxynius</i>			Control	5	5	0	0	0	2			
		CR-23 ↙	312005212	45.6	Reference	10	10	20	10	0	10		
			312005200	63.1	B-3	80	10	30	35	70	45	X	
Round 1 retest	<i>Ampelisca</i>			Control	10	10	15	5	20	12*			
			312005212	45.6	Reference	15	5	15	10	5	10		
			312005200	63.1	B-3	60	55	50	25	40	46	X	
Round 3	<i>Ampelisca</i>			Control	5	5	0	5	0	3			
			312005596	75.5	Reference	10	0	5	5	10	6		
			312005552	69.1	B-5	10	0	10	10	0	6		
			312005555	65.8	B-2	70	35	35	45	55	48	X	
		CR 20/23 ↙	312005597	57.4	Reference	5	15	0	0	5	5		X
			312005557	59.3	B-1	35	35	40	25	30	33		
			312005551	58.1	B-6	35	15	25	20	10	21		
		CR 23W/25 ↙	312005598	38.4	Reference	0	0	5	0	0	1		
			312005550	31.3	B-7	5	10	15	15	15	12		
			312005553	34.0	B-10	5	10	10	0	0	5		
	312005556	33.2	B-9	15	0	5	0	5	5				
	312005558	35.8	B-8	35	25	35	60	50	41	X			

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* Control or reference sediment failed to meet performance criteria.

SD: Statistically different

M: Percent mortality

Subscripts: R = reference sediment, C = negative control, T = test sediment

X: Bioassay exceeds the criteria

Appendix 3b.

Table 8 Results of sediment larval bioassays (normality endpoint) conducted in August 1999 (Round 2).

Test	Test Species	Sample ID No.	Percent Fines	Location/ DMMU	Replicate					Mean	Nondispersive Disposal Site	
					1	2	3	4	5		1-hit rule $N_T/N_C < 0.80$ and N_T/N_C vs N_R/N_C SD ($p = 0.10$) and $N_R/N_C - N_T/N_C > 0.30$	2-hit rule $N_T/N_C < 0.80$ and N_T/N_C vs N_R/N_C SD ($p = 0.10$)
Round 2 (Initial Count - 250 embryos)	<i>Dendraster</i>	312005383	seawater	Control	204	243	188	225	251	222.20		
			78.1	Reference (CR-20)	188	200	182	191	225	197.20		
			78.1	Reference (CR-20)	118	186	213	198	157	174.40		NSD
			70.6	B-5	197	137	173	159	182	169.60		X
			66.3	B-2	108	99	127	153	151	127.60		X
			65.4	B-1	143	111	149	117	182	140.40		X
			65	B-10	178	112	177	110	143	144.00		
			55.5	Reference (CR-23)	216	170	202	212	179	195.80		
			55.5	Reference (CR-23)	213	180	203	167	199	192.40		X
			61.3	B-9	119	151	113	193	168	148.80		
			58.1	B-6	170	221	201	129	203	184.80		
			51.3	B-7	155	203	149	190	207	180.80		X
			44.4	B-8	167	154	113	142	101	135.40		

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SD: Statistically different

NSD: Not statistically different

N: Counts of normal larvae

Subscripts: R = reference sediment, C = negative control, T = test sediment

Appendix 3c.

Table 7 Results of juvenile polychaete sediment bioassays (mean individual growth rate endpoint) conducted in May 1999 (Round 1) and August 1999 (Round 2).

Test	Test Species	Sample ID No.	Percent Fines	Location/ DMMU	Replicate (Mean Individual Growth Rate [mg/ind/d])					Nondispersive Disposal Site Interpretation Guidelines		
					1	2	3	4	5	Mean	1-hit rule MIG _T /MIG _C < 0.80 and MIG _T vs MIG _R SD (p = 0.05) and MIG _T /MIG _R < 0.50	2-hit rule MIG _T /MIG _C < 0.80 and MIG _T vs MIG _R SD (p = 0.05) and MIG _T /MIG _R < 0.70
Round 1	<i>Neanthes</i>			Control	1.17	1.02	0.92	1.03	1.03	1.03		
		312005212	45.6	Reference	1.06	1.08	0.91	0.70	0.97	0.94		
		312005200	63.1	B-3	0.77	0.63	0.59	0.76	1.16	0.78		NSD
Round 2	<i>Neanthes</i>			Control	0.80	1.16	1.06	0.71	0.87	0.92		
		312005383	78.1	Reference (CR-20)	1.47	1.69	0.91	1.21	1.17	1.29		
		312005355	65.4	B-1	0.68	0.49	0.82	0.75	0.99	0.75		
		312005370	66.3	B-2	0.92	0.74	1.17	0.99	1.28	1.02		
		312005377	70.6	B-5	0.71	0.81	1.08	0.72	0.82	0.83		
		312005378	65	B-10	0.76	1.10	0.98	1.02	0.86	0.94		
		312005382	55.5	Reference (CR-23)	0.82	0.60	0.61	0.77	0.89	0.74		
		312005356	44.4	B-8	0.97	1.41	1.07	0.96	0.87	1.06		
		312005371	61.3	B-9	0.88	0.86	1.18	0.69	1.01	0.92		
		312005375	51.3	B-7	1.10	1.03	1.08	0.89	0.90	1.00		
312005376	58.1	B-6	1.00	0.91	0.91	0.90	1.08	0.96				

SD: Statistically different

NSD: Not statistically different

MIG: Mean individual growth rate (mg/individual/day)

Subscripts: R = reference sediment, C = negative control, T = test sediment

Appendix 3d.

Table 9 Results of 45-day bioaccumulation testing for TBT conducted May 23, 2000, through July 7, 2000.

DMMU/ Treatment	TBT	TBT	Ratio (I/R)	<i>Macoma nasuta</i>			<i>Nephtys caecoides</i>				
	Porewater Initial (µg/L)	Porewater Retest (µg/L)		TBT Tissue (ppm dw)	Percent Survival	Percent Moisture	Percent Lipid	TBT Tissue (ppm dw)	Percent Survival	Percent Moisture	Percent Lipid
B-5 (312005601)	0.67	0.23	2.9	0.1245	85.6	84	14	0.0281	74.4	85	11
B-6 (312005602)	0.33	0.16	2.1	0.1764	88.8	84	12	0.0376	71.2	86	13
B-7 (312005603)	0.17	0.073M	2.3	0.1074	88.0	84	12	0.0252	73.2	84	13
<i>Macoma</i> Control/Reference	NA	NA	NA	0.0044	84.0	84	11	0.0009	97.6	84	11
<i>Nephtys</i> Control	NA	NA	NA	0.0044	NA	85	14	0.0010	93.2	85	11
Background	NA	NA	NA	0.0045	NA	83	13	0.0009	NA	83	13

Appendix 4a. Ratio of Initial Sediment porewater-TBT Concentrations to Retested Sediments for the Bioaccumulation Test.

CHEMICAL NAME	Units	B-5	B-5	Initial/Retest	B-6	B-6	Initial/Retest	B-7	B-7	Initial/Retest
		Initial	Retest	ratio:	Initial	Retest	ratio:	Initial	Retest	ratio:
TBT (porewater)	ug/L	0.67	0.23	2.91	0.33	0.16	2.06	0.17	0.073	2.33

Appendix 4b. Worst Case Bioaccumulation Testing Summary (Adjusted Values).

			DMMU B-5									
			<i>Macoma nasuta</i>					<i>Nephtys caecoides</i>				
CHEMICAL NAME	Units	Guideline	DMMU tissue (Initial)	DMMU tissue (adjusted)	Reference	Statistically different from reference	Statistically below guideline	DMMU tissue (Initial)	DMMU tissue (adjusted)	Reference	Statistically different from reference	Statistically below guideline
TBT ion (as TBT)	ug/kg-dw	3,000	125	363	4.4	yes	yes	28.1	81.9	0.9	yes	yes
			DMMU B-6									
			<i>Macoma nasuta</i>					<i>Nephtys caecoides</i>				
CHEMICAL NAME	Units	Guideline	DMMU tissue (Initial)	DMMU tissue (adjusted)	Reference	Statistically different from reference	Statistically below guideline	DMMU tissue (Initial)	DMMU tissue (adjusted)	Reference	Statistically different from reference	Statistically below guideline
TBT ion (as TBT)	ug/kg-dw	3,000	176	364	4.4	yes	yes	37.6	78	0.9	yes	yes
			DMMU B-7									
			<i>Macoma nasuta</i>					<i>Nephtys caecoides</i>				
CHEMICAL NAME	Units	Guideline	DMMU tissue (Initial)	DMMU tissue (adjusted)	Reference	Statistically different from reference	Statistically below guideline	DMMU tissue (Initial)	DMMU tissue (adjusted)	Reference	Statistically different from reference	Statistically below guideline
TBT ion (as TBT)	ug/kg-dw	3,000	107	250	4.4	yes	yes	25.2	59	0.9	yes	yes