

MEMORANDUM FOR RECORD

SUBJECT: DETERMINATION ON THE SUITABILITY OF DREDGED MATERIAL TESTED UNDER PSDDA GUIDELINES FOR MAINTENANCE DREDGING OF THE CROWLEY MARINE SERVICES 8TH AVENUE TERMINAL FACILITY'S SLIP 4 ON THE UPPER DUWAMISH RIVER (OYB 2-95-00537) FOR PLACEMENT AT THE ELLIOTT BAY NONDISPERSIVE OPEN WATER SITE

1. The following summary represents the suitability determination for material characterized for maintenance dredging from the Crowley Marine Services 8th Avenue Terminal Facility's Slip 4 on the lower Duwamish River (see site location map). The initial sampling and analyses were conducted during July, 1995. This characterization effort reflects information on analyses gathered for and reviewed by the PSDDA agencies' (Corps, Departments of Ecology and Natural Resources, and the Environmental Protection Agency). The technical decision is based on a careful review of the sediment characterization results documented in March 19, 1996 Data Report entitled: "Proposed Dredging of Slip No. 4, Duwamish River, Seattle, Washington". A determination of suitability has been made for the 13,000 cubic yards of dredged material proposed for maintenance dredging from Slip 4 on the lower Duwamish River. This final determination is made relative to suitability for unconfined open-water disposal (UCOWD) at the PSDDA Elliott Bay nondispersive site. Relevant dates for regulatory tracking purposes are included in Table 1.

Table 1. Regulatory Tracking Dates

SAP Approval date	June 21, 1995
Sampling date(s):	July 1995
Data report submittal date	March 19, 1996
Recency Determination Dates: High Concern DMMU (2 years)	July 1997

2. The Slip 4 proposed dredging area was initially constructed in 1981 and was dredged to - 15.2 ft MLLW. This material was disposed at the DNR 4-Mile Rock Disposal Site in Elliott Bay. No subsequent maintenance dredging has occurred since that time. Sediment characterization sampling occurred in July, 1995. Characterization from this high ranked area included the collection of three samples for each of the four DMMUs. Three samples were composited for each of the DMMU rather than one as usually called for in high concern areas, to provide better spatial coverage and resolution of the material proposed for dredging. Conventional parameters representative of the four composited dredged material management units (DMMU) analyzed are depicted in Table 2.

3. The sampling and testing plan was approved by PSDDA agencies on June 21, 1995. The PSDDA agencies subsequently requested TBT analyses, as a general PSDDA policy sampling and analysis requirement relative to the lower Duwamish River (enclosure 1). The sampling and analysis plan was followed, and quality assurance/quality control guidelines specified by PSEP and the PSDDA program were generally complied with. A sequential, tiered testing regime was followed after sample collections. Chemical analysis results depicted in Table 3 demonstrated that all four dredged material management units characterized contained screening level exceedances of chemicals of concern, principally HPAH's and PCB's, which were found in all DMMU. DMMU-S1 had 21 chemicals exceeding PSDDA chemical guidelines (i.e., metals, LPAHs, HPAHs, PCB) including one chemical, fluoranthene, which exceeded both the maximum level (1.35 x ML) and the bioaccumulation trigger for this chemical. The PCB bioaccumulation trigger was exceeded in DMMU-S4. Normal bioassay testing was initiated on the four DMMU, before proceeding with bioaccumulation testing on DMMU-S1 (fluoranthene) and DMMU-S4 (total PCBs), and the outcomes of biological testing are discussed below.

4. PSDDA biological testing performance guidelines for control and reference sediments are depicted in Table 4a for each of the PSDDA bioassays. Interpretative guidelines for nondispersive sites are summarized in Table 4b. The testing outcome summary for the four DMMU undergoing biological testing are depicted in Table 5. In general, the control and reference performance standards were met for all bioassays. Positive control LC50 (CdCl_2 expressed as Cd) responses indicated that both amphipod (*Rhepoxynius abronius*) and juvenile polychaete growth (*Neanthes arenaceodenta*) bioassays exhibited LC50's within observed DAIS limits. The *Neanthes* LC50's exceeded the laboratory performance limits, which were about half of the observed values from the PSDDA program data (DAIS). and were considered acceptable for regulatory decisionmaking. Positive control responses observed for the sediment larval bioassay utilizing the echinoderm *Dendraster excentricus*, were within the observed DAIS values (see Table 5).

5. Bioassay results are depicted in Table 5 for the three required bioassays. The analysis results for *Neanthes* growth bioassays and the echinoderm larval bioassay met PSDDA nondispersive disposal guidelines. Results for the amphipod bioassay indicated that DMMU-S3 and DMMU-S4 exhibited single hit bioassay failures, whereas DMMU-S2 exhibited a double hit exceedance of nondispersive guidelines. Because there was no corroborating hits from the other two bioassays for DMMU-S2, this DMMU passed PSDDA nondispersive disposal guidelines. DMMU-S1 passed PSDDA bioassay interpretive guidelines, and therefore, underwent bioaccumulation testing to assess fluoranthene. Because DMMU-S4 failed bioassay guidelines no bioaccumulation testing for PCBs was initiated. The bioaccumulation testing outcome is summarized below.

6. The 28-day bioaccumulation testing results summary is depicted in Tables 6a-6c. The 28-day bioaccumulation test was conducted at Battelle Northwest Laboratory, Sequim, Wahington. The protocol followed and approved by the PSDDA agencies consisted of initiating testing with the adult bivalve, *Macoma nasuta* and the adult Polychaete, *Nephtys caecoides*. Both species were placed together in the same aquaria and exposed to sediments from DMMU-S1 over a 28-day exposure period. The 8-liter aquaria utilized a flow through seawater system. Because there was insufficient sediment from DMMU-1 archived for potential bioaccumulation testing, resampling of the three stations initially sampled and

composited for DMMU-S1 was required. Reanalysis of the resampled composite sample DMMU-S1 occurred at the same time as tissue analyses, and demonstrated a five fold decrease compared with the initial fluoranthene concentration measured (Table 6a). The PSDDA agencies determined that these bioaccumulation results are suitable for regulatory decisionmaking. The results demonstrated significant bioaccumulation of fluoranthene by both species as depicted in Tables 6b and 6c and discussed below. To provide for an environmentally conservative evaluation and to adjust for the discrepancy in the initial sediment versus resampled fluoranthene concentrations, tissue concentrations were multiplied by 5.3 to provide a correction for the human health and ecological health evaluation summarized below:

Bioaccumulation Testing Evaluation Summary for DMMU-S1 relative to Fluoranthene.

Sediment/Tissue Ratios:

Initial Sediment = 8,500 ppb (dry); Resampled sediment = 1,600 ppb (dry)

Macoma Tissue = 427.4 ppb (dry)

Nephtys Tissue = 167.5 ppb (dry)

Ratio: *Macoma* Tissue / Resampled Sediment = 0.267 (26.7%)

Ratio: *Nephtys* Tissue / Resampled Sediment = 0.105 (10.5%)

Thus, no apparent potential for bioconcentration (biomagnification) relative to sediments.

Human Health Evaluation: Tissue Comparison to PSDDA Tissue Criteria (MPR II, Table A-9) for Fluoranthene:

Tissue (*Macoma*) = 0.0684 ppm (wet) / PSDDA Criterion = 8,400 ppm (wet) = 8.14×10^{-6}
adjusting tissue for Initial/Resampled Sediment: Tissue (*Macoma*) = 0.0684 ppm (wet) x 5.3
= 0.3625 ppm (wet) = 4.316×10^{-5}

Tissue (*Nephtys*) = 0.0285 ppm (wet) / PSDDA Criterion = 8,400 ppm (wet) = 3.39×10^{-6}
Adjusting tissue for Initial/Resampled Sediment: Tissue (*Nephtys*) = 0.0285 x 5.3 = 0.151 ppm
(wet)/8,400 ppm(wet) = 1.80×10^{-5}

Conclusion: No demonstrated human health concern

Ecological Health Evaluation: Tissue bioaccumulation statistical comparison of test sediment tissue exposures with reference sediment tissue exposures demonstrated significant bioaccumulation relative to reference.

Reference sediment tissue mean (*Macoma*) = 2.5 ppb (@ ½ detection limit -wet weight); Test sediment (DMMU-S1) mean (*Macoma*) = 68.4 ppb (wet)

Ratio *Macoma*: Test/Reference tissue = 27.4

Ratio *Macoma*: Test tissue 68.4 ppb (wet) x 5.3 (Initial/Resampled difference) = 362.5 ppb (wet)/Reference tissue = 145 fold increase after adjustment

Reference sediment tissue mean (*Nephtys*) = 2.5 ppb (@ ½ detection limit - wet weight); Test sediment (DMMU-S1) mean (*Nephtys*) = 28.5 ppb (wet)
Ratio *Nephtys*: Test/Reference tissue = 11.4
Ratio *Nephtys*: Test tissue x 5.3 (Initial/Resampled difference) = 151 ppb (wet)/Reference tissue = 60.4 fold increase after adjustment

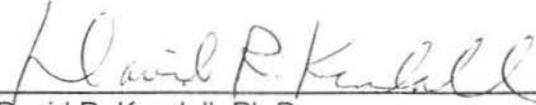
Conclusion: Comparison does demonstrate a significant tissue accumulation and potential ecological health concern. Therefore, DMMU-S1 is determined to be **not suitable for unconfined open-water disposal**.

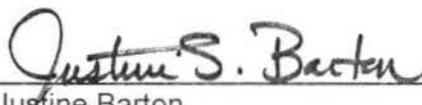
7. The Agencies concluded based on the above discussion and summary of sediment chemical and biological testing results for the Crowley Marine Services 8th Avenue, Slip 4 project, indicated that 3,250 cubic yards is suitable for disposal at a PSDDA nondispersive site, whereas 9,750 cubic yards (represented by DMMU's S1, S3, and S4) are not suitable for unconfined open-water disposal.

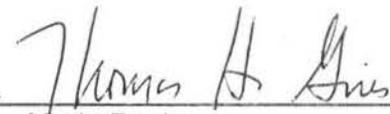
8. This memorandum documents the suitability of proposed dredged sediments for disposal at a PSDDA open-water disposal site. This determination of suitability does not preclude the consideration of this material for an appropriate beneficial use. It does not constitute final agency approval of the project. During the public comment period 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.

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Concur:

5-29-96 
Date David R. Kendall, Ph.D
Seattle District Corps of Engineers

5-29-96 
Date Justine Barton
Environmental Protection Agency
Region 10

5/25/96 
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Date Ted Benson
Washington Department of Natural Resources

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DMMO File

Table 2. Summary of DMMU Sediment Conventional Parameters and suitability for UCOWD.

Conventional Parameters	DMMU S1	DMMU S2	DMMU S3	DMMU S4	Reference
DMMU Volume (cubic yards)	3,250	3,250	3,250	3,250	NA
Grain Size (%):					
Gravel	3.54	6.46	2.7	0.81	0.35
Sand	44.1	60.5	59.9	85.1	57.3
Silt	39.9	24.1	26.8	11	36.6
Clay	10.9	8.3	9.1	2.3	4.2
Fines	50.8	32.4	35.9	13.3	40.8
Total Solids (%)	73.8	72	69.4	73.366.8	
Total Volatile Solids (%)	4.9	3.81	4	1.7	1.7
Total Organic Carbon (%)	2	2.4	2.7	0.81	0.35
Bulk Ammonia (mg/Kg)	24 J	7.7 J	38 J	17 J	22 J
Total Sulfides (mg/Kg)	910 J	1,100 J	93 J	2.6 J	15 J

Legend: UCOWD = unconfined open-water disposal; J = estimate

Table 3. DMMU with screening level guideline exceedances.

Parameters	Chemical Guidelines			DMMU S1 (3,250 cy)	DMMU S2 (3,250 cy)	DMMU S3 (3,250 cy)	DMMU S4 (3,250 cy)
	SL	BT	ML				
Metals (ppm)							
Cadmium	0.96		9.6	1.4			
Copper	81		810	94			
Lead	66		660	132			
Zinc	160		1,600	279			
Organics (ppb)							
Total LPAH	610		6,100	4,570			658
Acenaphthene	63		630	200			
Fluorene	64		640	220			
Phenanthrene	320		3,200	3,000			400
Anthracene	130		1,300	1,100			
Total HPAH	1,800		51,000	31,510	4,940	2,011	3,072
Fluoranthene	630	4,600	6,300	8,500	800		660
Pyrene	430		7,300	6,200	1,000		630
Benzo(a)anthracene	450		4,500	3,600	480		
Chrysene	670		6,700	4,000			
Total Benzofluoranthenes	800		8,000	4,500	960		
Benzo(a)pyrene	680	4,964	6,800	2,300			
Indeno(123cd)pyrene	69		5,200	980	260	120	150
Dibenzo(ah)anthracene	120		1,200	450			
Benzo(ghi)perylene	540		5,400	980			
Dibenzofuran	54		540	69			
Total PCBs (ppm, TOC normalized)	130	(38)	2500	320 (16)	860 (35.8)	640 (23.7)	980 (42.6)

Table 4a. Solid Phase Bioassay Performance Standards.

PARAMETER	AMPHIPOD BIOASSAY	SEDIMENT LARVAL BIOASSAY	NEANTHES 20-DAY GROWTH TEST	SALINE MICROTOX TEST
Negative control performance	Mortality \leq 10 %	CMA _A \leq 30 %	Mortality \leq 10 % (\geq 0.72 mg-ind-day) ³	None
Reference sediment performance	Reference mortality minus control mortality \leq 20 %	NCMA ² \leq 35 % Seawater Control	Mean individual growth ⁴ \leq 80 % of control	Blank-corrected light decrease \leq 20%

¹ Combined mortality and abnormality.

² Normalized combined mortality and abnormality relative to Seawater control_(final)

³ Proposed control growth guideline (1995 SMARM)

⁴ Expressed as mg-individual-day (dry weight)

Table 4b. Solid Phase Bioassay Interpretive Guidelines for Nondispersive sites.

BIOASSAY	NONDISPERSIVE INTERPRETATION GUIDELINES ¹	
	2-HIT	1-HIT
Amphipod (% Mortality)	Test mortality > 20% over Control mortality; Test mortality < 30% over Reference mortality, and statistically significant ²	Test mortality > 20% over Control mortality; Test mortality > 30% over Reference mortality, and statistically significant ²
Sediment Larval (% Combined Mort+Abnor)	Test CMA > 20% over Control CMA; Test CMA < 30% over Reference CMA, and statistically significant ²	Test CMA > 20% over Control CMA; Test CMA > 30% over Reference CMA, and statistically significant ²
<i>Neanthes</i> -20-day Growth (mg-individual-day)	Test growth < 80% or > 120% of Control growth; Test growth < 70 of Reference growth, and statistically significant ²	Test growth < 80% or >120% of Control growth; Test growth < 50% of Reference growth, and statistically significant ²
Saline Microtox (% light Δ)	Test light Δ > 20% over Control light Δ ; Test light \leq 20% (absolute) over Reference light Δ , and statistically significant ²	NA

1/ Test response \leq 20% of Control response (test \geq 80% or < 120% of control growth endpoint for *Neanthes* Bioassay) = No Hit.

2/ Statistically significant (t-test, $p < 0.05$).

Table 5. Solid Phase Bioassay Results Summary for four DMMU undergoing testing.

Dredged Material Management Units (DMMU)	Amphipod Mortality, % (<i>Rhepoxynius abronius</i>)	Sediment Larval Test (Sanddollar: <i>Dendraster excentricus</i>)		20-day <i>Neanthes</i> growth, mg-ind-day (% reference) mortality %	DMMU Suitability
		Mort+Abnor %	Abnormality %		ND
Control	4	2.1	1.0	init. wgt = 0.598 mg-individual 0.9 mg-ind-day mortality = 0%	NA
Carr Reference (40.8% fines)	15	25.9	1.0	0.82 mg-ind-day mortality = 0%	NA
DMMU S1 (50.8% fines)	25	25.2	4.6	0.84 (102%) mortality = 4%	No ¹
DMMU S2 (32.4% fines)	29 ^{dh}	27.7	5.3	0.75 (91.5%) mortality = 0%	yes
DMMU S3 (35.9% fines)	48 ^{sh}	13.7	1.9	0.85 (103.6%) mortality = 0%	No
DMMU S4 (13.3% fines)	50 ^{sh}	19.3	3.9	0.75 (91.5%) mortality = 0%	No
Positive Control TEST (LC50)	CdCl ₂ 0.40 mg/L Cd	Cd Cl ₂ 8.78 mg/L Cd		CdCl ₂ 11.6 mg/L Cd	
DAIS (Mean ± SD)	(DAIS: Cd 0.49 ± 0.42 mg/L)	(DAIS: 10.1 ± 6.5 mg/L Cd for <i>Dendraster</i>)		(DAIS: 12.5 ± 5.4 mg/L Cd)	

Legend: ND = Nondispersive site suitability; SD = Standard Deviation; * = Statistically significant (t-Test; p<0.05), DH = Double Hit failure (requires two bioassay hits for DMMU to be unsuitable for nondispersive site disposal); SH = Single Hit failure under PSDDA disposal guidelines for nondispersive sites.

1/ Passed nondispersive site disposal guidelines for bioassays, not suitable UCOWD based on 28-day bioaccumulation testing results depicted in Table 6 and discussed in paragraph 6 of SDM.

Table 6a. Comparison of initial and resampled sediment fluoranthene chemistry results for DMMU-1.

Initial Result $\mu\text{g}/\text{kg}$ (dry)	Resampled Result $\mu\text{g}/\text{kg}$ (dry)	Ratio: Initial / Resampled
8,500	1,600	5.3

Table 6b. Fluoranthene bioaccumulation testing summary (*Macoma nasuta*) for DMMU-S1.

Replicate #	Background $\mu\text{g}/\text{kg}$ (wet)	Reference $\mu\text{g}/\text{kg}$ (wet)	DMMU-S1 $\mu\text{g}/\text{kg}$ (wet)	DMMU-S1 $\mu\text{g}/\text{kg}$ (dry) ¹
1	6	5u (2.5)	61	381
2	5u (2.5)	5u (2.5)	92	575
3	5u (2.5)	5u (2.5)	52	325
4	5u (2.5)	5u (2.5)	73	456
5	5u (2.5)	5u (2.5)	64	400
Mean	3.2	5u (2.5)	68.4	427.4
Stnd Dev. (n-1)	1.56	0 (0)	15.2	94.9

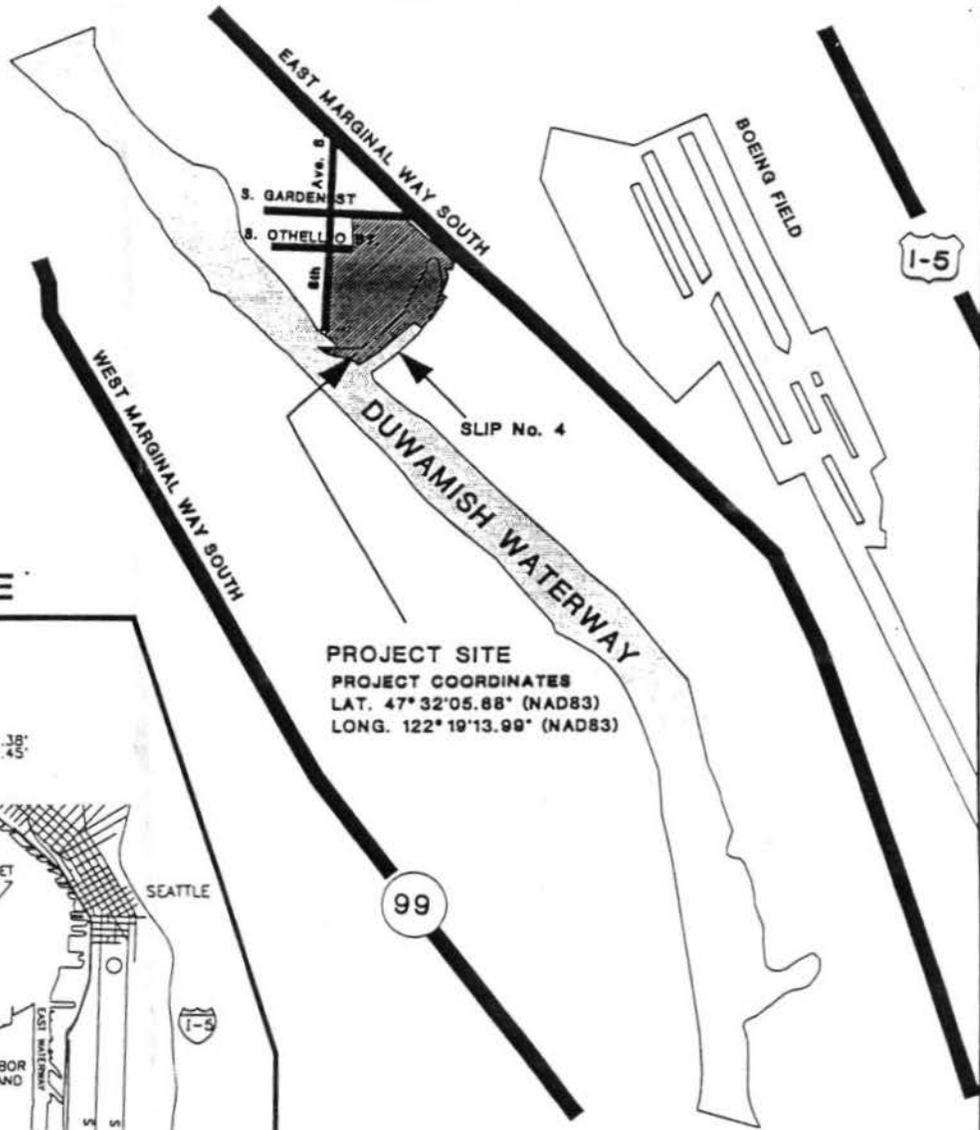
¹/ Percent moisture = 84%, 16% solids; Values undetected are expressed as ½ detection limit in parenthesis.

Table 6c. Fluoranthene bioaccumulation testing summary (*Nephtys caecoides*) for DMMU-S1.

Replicate #	Background $\mu\text{g}/\text{kg}$ (wet)	Reference $\mu\text{g}/\text{kg}$ (wet)	DMMU-S1 $\mu\text{g}/\text{kg}$ (wet)	DMMU-S1 $\mu\text{g}/\text{kg}$ (dry) ¹
1	5u (2.5)	5u (2.5)	48	282
2	5u (2.5)	5u (2.5)	33	194
3	5u (2.5)	5u (2.5)	35	206
4	5u (2.5)	5u (2.5)	5u (2.5)	14.7
5	5u (2.5)	5u (2.5)	24	141
Mean	5u (2.5)	5u (2.5)	28.5	167.5
Stnd Dev. (n-1)	0 (0)	0 (0)	16.9	99.2

¹/ Percent moisture = 83%, 17% solids; Values undetected are expressed as ½ detection limit in parenthesis.

LOCATION MAP



DISPOSAL SITE

ELLIOTT BAY DISPOSAL SITE

TYPE: Nondispersive
 AREA: 415 Acres DEPTH: 300-360 ft.
 SITE DIMENSIONS: 6200 ft. by 4000 ft. Ovoid
 DISPOSAL ZONE: 1800 ft. Diameter
 TARGET AREA: 1200 ft. Diameter
 BARGE POSITIONING METHOD: VTS
 NAD27 LOCATION: Lat 47° 35.97' Long 122° 21.38'
 NAD83 LOCATION: Lat 47° 35.96' Long 122° 21.45'

PROJECT SITE
 PROJECT COORDINATES
 LAT. 47° 32' 05.88" (NAD83)
 LONG. 122° 19' 13.99" (NAD83)

PREFERRED DISPOSAL COORDINATES

Lat 47° 35.92' Long 122° 21.35' NAD27
 Lat 47° 35.91' Long 122° 21.45' NAD83

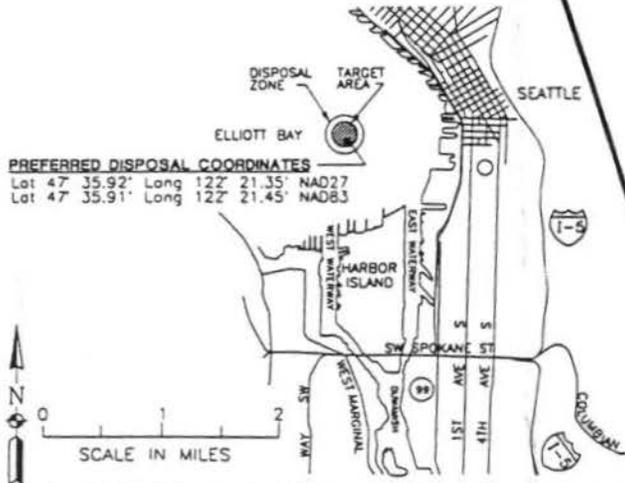


FIGURE 1
LOCATION MAP &
DISPOSAL SITE

8th Avenue Terminal Company
 7400 8th Ave. S.
 Seattle, WA 98108

PROPOSED DREDGING

IN: Slip No. 4, Duwamish Waterway

AT: Seattle

COUNTY OF: King STATE: WA

APPLICATION BY:
 8th Avenue Terminal Company

SHEET 1 of 3 DATE: 02/02/96

PURPOSE: Provide adequate depth for moorage and movement of barges.
DATUM: MLLW = 0.0'

ADJACENT PROPERTY OWNERS:

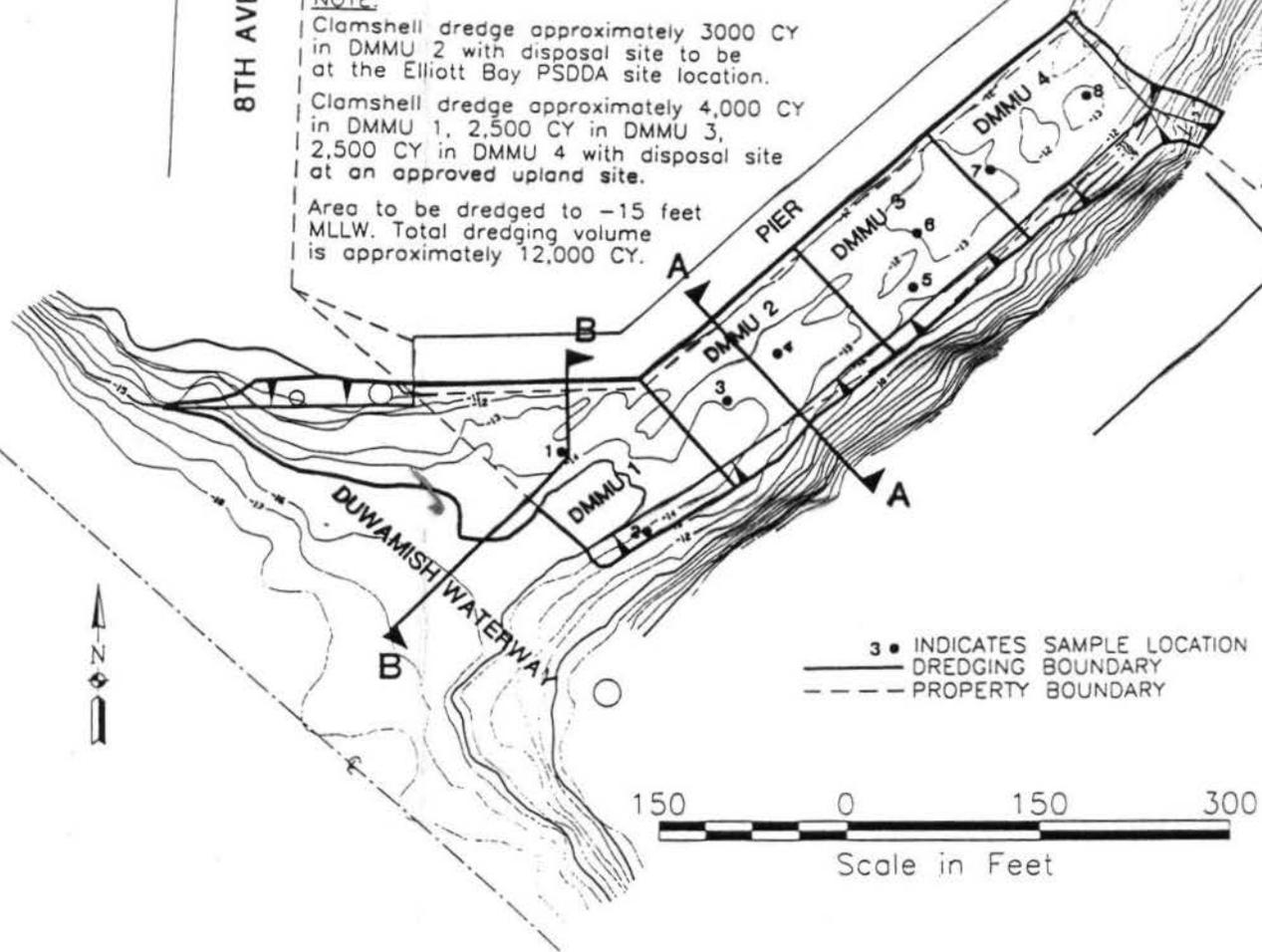
- 1) Morkey Machinery Co., Inc.
 7266 8th Ave. S.
 Seattle, WA 98108
- 2) Puget Sound Freight Lines
 3720 Airport Way S.
 Seattle, WA 98108
- 3) Boeing Aircraft Co., Inc.
 7755 E. Marginal Way S.
 Seattle, WA 98108
- 4) Evergreen Marine Leasing
 First Interstate Bank
 P.O. Box 160-MS-247
 Seattle, WA 98108

reference: 95-4-00537

8TH AVE. S.

8th AVENUE TERMINAL COMPANY

NOTE:
 Clamshell dredge approximately 3000 CY in DMMU 2 with disposal site to be at the Elliott Bay PSDDA site location.
 Clamshell dredge approximately 4,000 CY in DMMU 1, 2,500 CY in DMMU 3, 2,500 CY in DMMU 4 with disposal site at an approved upland site.
 Area to be dredged to -15 feet MLLW. Total dredging volume is approximately 12,000 CY.



● 3 INDICATES SAMPLE LOCATION
 — DREDGING BOUNDARY
 - - - PROPERTY BOUNDARY



NOTE: Positional accuracy of property lines and pier lines may be ±5 ft due to the fact that the property survey could not be tied to WA State Plane coordinates.

General Notes:

- 1) Horizontal Datum = WA SP NAD83
- 2) Slip No. 4 Bathymetric Survey by DOWL Engineers 10/13/95 and 10/16/95.
- 3) Duwamish Waterway Bathymetric Survey by Chris Ransom & Assoc., Aug. 1994.
- 4) Property Boundaries/Pier features taken from DODDS Engineers, Inc. drawing Proj. No 89003 Dated Nov. 1992.

PURPOSE: Provide adequate depth for moorage and movement of barges.
DATUM: MLLW = 0.0'

ADJACENT PROPERTY OWNERS:

- 1) Markey Machinery Co, Inc.
7266 8th Ave S.
Seattle, WA 98108
- 2) Puget Sound Freight Lines
3720 Airport Way S.
Seattle, WA 98108
- 3) Boeing Aircraft Co., Inc.
7755 E. Marginal Way S.
Seattle, WA 98108
- 4) Evergreen Marine Leasing
First Interstate Bank
P.O. Box 160-MS-247
Seattle, WA 98108

**FIGURE 2
 PLAN VIEW
 PROPOSED DREDGING**

8th Avenue Terminal Company
 7400 8th Ave. S.
 Seattle, WA 98108

PROPOSED DREDGING

IN: Slip No. 4, Duwamish Waterway
 AT: Seattle
 COUNTY OF: King STATE: WA
 APPLICATION BY:
 8th Avenue Terminal Company
 SHEET 2 of 3 DATE: 02/02/96

Reference: 95-4-00537