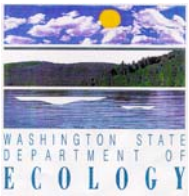
DREDGED MATERIAL MANAGEMENT PROGRAM BIENNIAL REPORT

Dredging Years 1996/1997

March 1998

PREPARED BY THE DMMP AGENCIES



DREDGED MATERIAL MANAGEMENT PROGRAM BIENNIAL REPORT

Dredging Years 1996/1997

Puget Sound Dredged Disposal Analysis

Grays Harbor/Willapa Bay Evaluation Procedures

Lower Columbia River Evaluation Framework (Washington)

CONTRIBUTING AUTHORS

Chapter 1

Stephanie Stirling, Corps of Engineers
David Kendall, Corps of Engineers
David Fox, Corps of Engineers

Chapter 2

Ted Benson, Washington Department of Natural Resources
David Kendall, Corps of Engineers

GEOGRAPHIC INFORMATION SYSTEM PRODUCTION
David Gustafson, Corps of Engineers

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AET	Apparent Effects Threshold
ARM	Annual Review Meeting
BT	Bioaccumulation Trigger
COC	Chemical of Concern
CWA	Clean Water Act
CY	Cubic Yard
DAIS	Dredged Analysis Information System
DMMO	Dredged Material Management Office
DMMU	Dredged Material Management Unit
DNR	Washington Department of Natural Resources
DY	Dredging Year
EPA	Environmental Protection Agency
EPTA	Evaluation Procedures Technical Appendix
FC	Full Characterization
GIS	Geographic Information System
HPA	Hydraulic Project Approval
HPAH	High-molecular-weight PAH
LPAH	Low-molecular-weight PAH
ML	Maximum Level
MPAR	Management Plan Assessment Report
MPR	Management Plan Report
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
O&M	Operations and Maintenance
PAH	Polynuclear Aromatic Hydrocarbon
PC	Partial Characterization
PCBs	Polychlorinated Biphenyls
PPB	Parts Per Billion
PPM	Parts Per Million
PSDDA	Puget Sound Dredged Disposal Analysis
PSEP	Puget Sound Estuary Program
PSVTS	Puget Sound Vessel Traffic Service
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SMS	Sediment Management Standards
SL	Screening Level
TOC	Total Organic Carbon
USACE	US Army Corps of Engineers
UCOWD	Unconfined Open Water Disposal
WDFW	Washington Department of Fish and Wildlife

PREFACE

This DMMP Biennial Report summarizes the application of sediment evaluation procedures to dredging projects for dredging years 1996 and 1997 (June 16, 1995 to June 15, 1997). The report also summarizes dredged material disposal activities and site monitoring for that period. Unlike previous reports, program modifications and status reports have not been included but will be made available on the Internet at URL http://www.nws.usace.army.mil.

Previous reports included dredging projects evaluated through the Puget Sound Dredged Disposal Analysis (PSDDA) process only. However, in June 1995, evaluation procedures for dredged material from Grays Harbor and Willapa Bay were adopted. This biennial report reflects the evaluation and disposal activities that took place in Grays Harbor and Willapa Bay under the new procedures.

In addition, during 1996 and 1997 an interagency team developed an evaluation framework for dredged material in the Lower Columbia River. These procedures are not yet final, and in the interim, the agencies are exercising best professional judgment in reviewing dredging projects on the Washington side of the Columbia River. These interim evaluation efforts for those projects under the jurisdiction of Washington agencies are documented in this biennial report. The reporting here includes only a portion of all dredging projects on the Lower Columbia River.

Dredged material management activities in these three regions are known collectively as the Dredged Material Management Program (DMMP). The DMMP agencies include the Army Corps of Engineers, Seattle District; the Environmental Protection Agency, Region 10, and the Washington Department of Ecology and Natural Resources.

CHAPTER 1

DREDGED MATERIAL MANAGEMENT PROGRAM (DMMP) EVALUATION ACTIVITIES

A. INTRODUCTION

This chapter summarizes the application of DMMP (Lake Washington, Puget Sound, Grays Harbor and Willapa Bay, Lower Columbia River) evaluation guidelines for Dredging Years 1996 and 1997. A dredging year includes all projects evaluated between June 16 of a given year and June 15 of the following year (DY96 = June 16, 1995 - June 15, 1996; DY97 = June 16, 1996 - June 15, 1997). Tables related to project-specific ranking, sampling, testing, and suitability determinations are presented in the first part of this chapter. The second half of the chapter presents an overall assessment of these activities and data. Where projects involved unusual circumstances or the application of best professional judgment by the agencies, more detailed descriptions are provided in Appendix A.

During DY96/97 there were twenty-eight projects at some stage of the DMMP process. Table 1-1 provides a complete summary of these projects/activities. Activities occurring in other dredging years are indicated by parentheses.

Of the projects listed in Tables 1-1a and 1-1b, seven had suitability determinations completed or applications withdrawn by June 15, 1996 and are considered DY96 projects for the purposes of this chapter. Nineteen projects had either suitability determinations completed or applications withdrawn by June 15, 1997. These are considered DY97 projects. DY96 and DY97 project locations in Puget Sound can be seen in Figures 1-1a and 1-1b respectively, projects located in Grays Harbor and Willapa Bay are shown in Figure 1-1c.

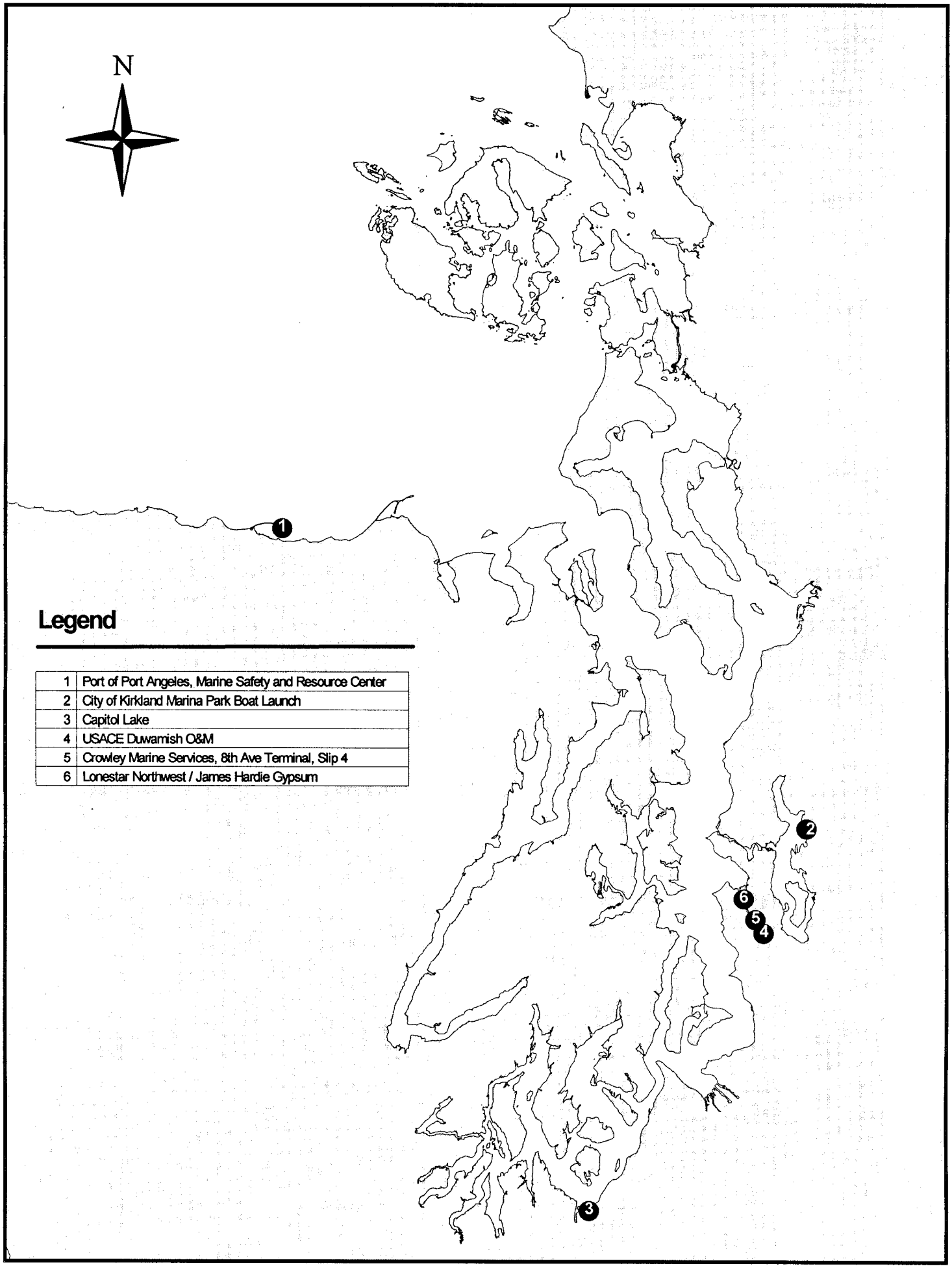


Figure 1-1a Dredging Year 1996 PSDDA Project Locations

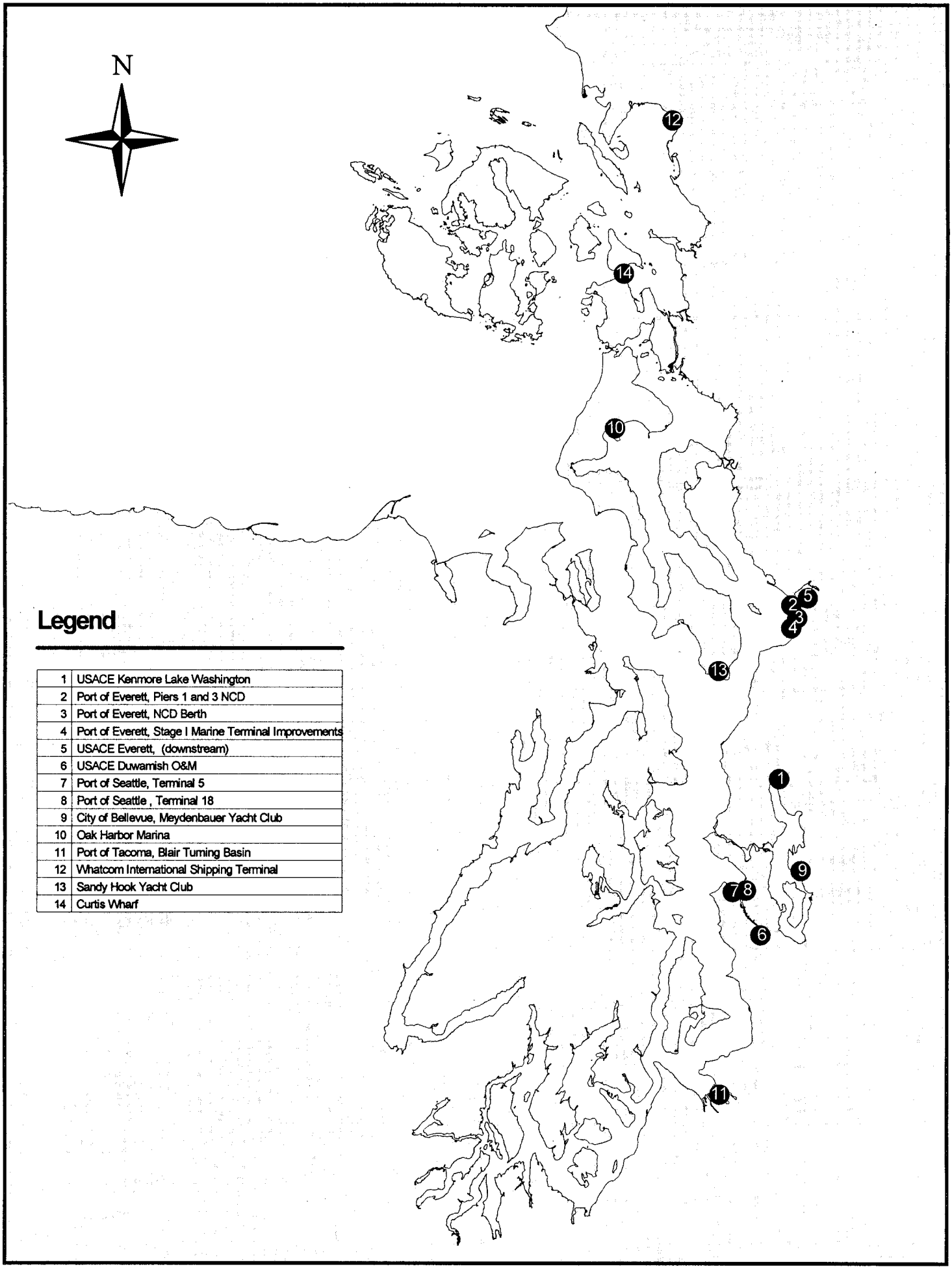


Figure 1-1b Dredging Year 1997 PSDDA Project Locations

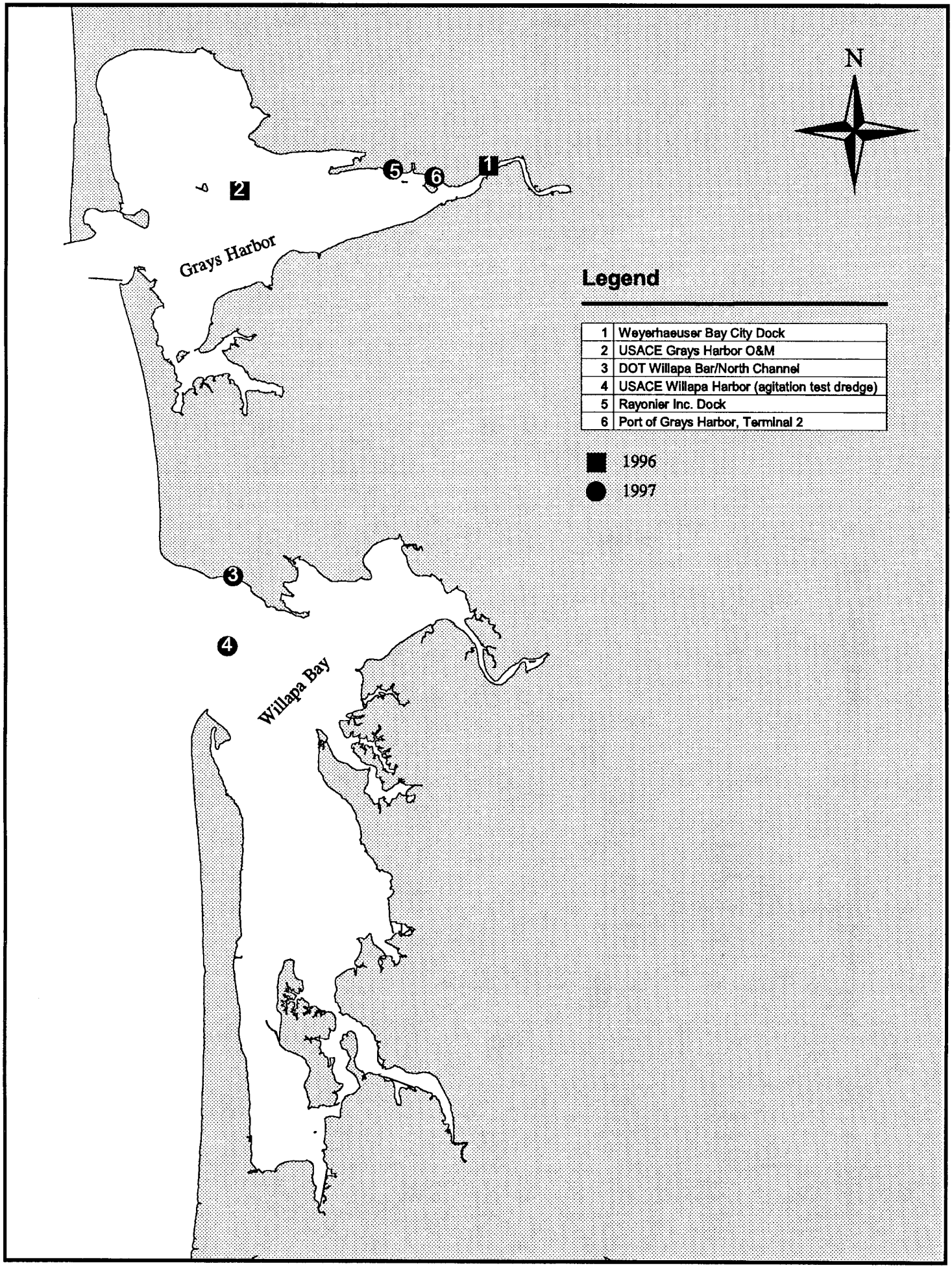


Fig. 1-1c Grays Harbor/Willapa Bay DMMP Projects

Table 1-1a. DY96 DMMP EVALUATION ACTIVITIES

PROJECT	Disposal Jurisdiction	Project Volume (cy)	Ranking Determination	Sampling Plan Review	Suitability Determination
Capitol Lake	PSDDA	180,000	96	96	application withdrawn
Crowley Marine Services 8th Avenue Terminal, Slip 4	PSDDA	13,000	96	96	96
High Cascade International	CR	20,000	96	96	96
City of Kirkland Marina Park Boat Launch	PSDDA	800	96	No test[1]	96
Lonestar Northwest / James Hardie Gypsum	PSDDA	9,000	(95)[2]	(95)	96
Port of Port Angeles, Marine Safety and Resource Center	PSDDA	30,000	96	96[3]	application withdrawn
Weyerhaeuser Bay City Dock	GH	14,000	(93)	frequency[4]	96
USACE Duwamish	PSDDA	98,000	(93)	96	96
USACE Grays Harbor	GH	2,120,000	(94)	96	96

CR = Columbia River
GH = Grays Harbor
NCD = Nearshore confined disposal
PSDDA = Puget Sound Dredged Disposal Analysis
WB = Willapa Bay

[1] No testing required under small project guidelines.
[2] Activities noted in parenthesis occurred outside DY96/97.
[3] Initial SAP reviewed by DMMP agencies, Permit application subsequently withdrawn.
[4] No testing required under frequency guidelines.

Table 1-1b. DY97 DMMP EVALUATION ACTIVITIES

PROJECT	Disposal Jurisdiction	Project Volume (cy)	Ranking Determination	Sampling Plan Review	Suitability Determination
City of Bellevue, Meydenbauer Bay	PSDDA	2500	96	96	97
Curtis Wharf	PSDDA	32,700	97	97	97
Department of Transportation, Willapa Bar/North Channel	WB	5,000,000	97	97	97
Oak Harbor Marina	PSDDA	27,000	96	96	97
Port of Everett, Piers 1 and 3	NCD	131,000	(93)	(95)	97[5]
Port of Everett, NCD Berth Approach	PSDDA	86,400	(93)	97	97
Port of Everett, Stage I Marine Terminal Improvement	PSDDA	239,000	(93)	No Test	97
Port of Grays Harbor, Terminal 2	GH	15,000	(93)	frequency[4]	97
Port of Seattle, Terminal 5	PSDDA	36,000	(94)	96	97
Port of Seattle, Terminal 18	PSDDA	546,430	96	96	97
Port of Tacoma, Blair Turning Basin	PSDDA	755,000	97	97	97
Rayonier Inc. Dock	GH	20,000	(92)	frequency[4]	97
Sandy Hook Yacht Club	Upland	42,000	(95)	(95)	97
Weyerhaeuser, Mt Coffin Access Channel, Longview, WA	CR	200,000	97	97	97
Whatcom International Shipping Terminal	PSDDA	8,700	97	97	application withdrawn
USACE Everett (downstream & settling basin)	PSDDA	300,437	(93)	97	97
USACE Duwamish	PSDDA	112,000	(93)	97	97
USACE Kenmore, Lake Washington	PSDDA	60,000	96	96	97
USACE Willapa Harbor (Agitation Test Dredge)	WB	250,000	97	97	97

[5] PSDDA open-water suitability assessment conducted in DY95 (see March 1996 Sediment Management Program Biennial Report).

B. DY96/97 PROJECTS

Ranking

Each of the DMMP projects discussed herein comes from one of three jurisdictional areas: Puget Sound (PSDDA), Grays Harbor/Willapa Bay and the Lower Columbia River. Each jurisdiction has specific guidance which explains requirements for evaluating dredging and disposal therein. Sampling and analysis requirements under the PSDDA program are fully explained in the 1988 Phase I Evaluation Procedures Technical Appendix (EPTA) and the 1997 PSDDA Users Manual. Sampling and analysis requirements in Grays Harbor and Willapa Bay are explained in the June 1995 Dredged Material Evaluation Procedures and Disposal Site Management Manual, Grays Harbor and Willapa Bay, Washington (Grays Harbor Manual). Draft sampling and analysis requirements for projects on the Lower Columbia River have been formulated for public interest review and future implementation as part of the Lower Columbia River Dredged Material Evaluation Framework. The ranking guidance contained in this framework is being implemented on an interim "best professional judgment" basis until guidance for the Lower Columbia River has been finalized.

The initial appraisal of a proposed dredging project requires a careful examination of all existing sediment quality data within the dredging area. The project ranking is based on a "reason to believe" that chemicals of concern may or may not be present in the project area. The agencies have established ranks for general areas within each jurisdiction (e.g., Elliott Bay/PSDDA) and activities (e.g., marinas) based on historical data or awareness of active sources of contamination. In the absence of project-specific data, representatives of the agencies apply an initial ranking based on guidance contained in the regional guidance documents.

All three jurisdictional areas allow for a reconsideration of the initial ranking if the historical data at the site are adequate, or the applicant conducts a partial characterization (PC) as described within each regional guidance document. If the PC chemistry data support a lower ranking, sampling and analysis requirements for surface and subsurface sediments may be reduced during the full characterization (FC). Tables 1-2a and 1-2b contain the initial and full characterization rankings of all DY96/97 projects. The "initial rank" was taken from the respective regional guidance documents. The "full characterization" rank was used to determine the sampling and analysis requirements for project sediments. No DY96 projects had ranking adjustments. Three of nineteen DY97 projects had ranking adjustments based on evaluations of existing data or PC data. The reranking allowed for reduced sampling requirements for the subsurface material from the Port of Seattle Terminal 18 project and significantly lower ranks for Port of Everett Stage I Marine Terminal Improvements and Port of Tacoma Blair Turning Basin projects.

Sampling and Analysis Plans

Approved sampling and analysis plans, based on the ranking which has been assigned to the proposed project, are required before applicants collect sediment samples for either a PC or FC. The applicant or dredging consultant receives guidance on sampling plan development from the Corps of Engineers Dredged Material Management Office (DMMO). Protocols for station positioning, decontamination, field sampling, sample compositing, chemical analysis, biological testing, QA/QC and data submittal are all included in the sampling and analysis plan. Once completed, DMMO coordinates review and approval of the plan with the DMMP agencies.

Tables 1-3a and 1-3b contain data related to sampling plans approved for DY96/97 projects. Application of specific sampling and analysis requirements resulted in the number of field samples and dredged material management units (DMMUs) formulated for each of the projects. Descriptions of projects that required no testing or where best professional judgment was applied, are included in Appendix A.

Sampling

Tables 1-4a and 1-4b contain data related to sampling efforts during DY96/97. Two general requirements which exist within all three jurisdictions are to sample to the depth of dredging (including overdepth)[6], and to provide positioning data to a minimum precision of one-tenth of a second (approximately 2 meters). For the majority of the projects listed in the tables, the maximum sediment depths correspond to both the actual length of the deepest boring as well as to the maximum depth of the dredging prism including overdepth. In high-ranked areas there is an additional requirement to provide an archived sample from the one foot of sediment beyond the dredging prism. This additional depth is not reflected in the table. A variety of positioning techniques were used to provide the required precision. Great emphasis is placed on positioning in order to provide repeatability in sampling and to provide data which can be utilized in a geographic information system (GIS).

Chemical Testing

Chemical testing was conducted for six projects in DY96 and thirteen projectsin DY97. During DY96 one project (City of Kirkland Marina Park Boat Launch) did not require chemical testing based on PSDDA small project guidelines, and one project (Weyerhaeuser Bay City Dock) did not require testing under the Grays Harbor/Willapa Bay frequency guidelines. During DY97 two Grays Harbor projects (Port of Grays Harbor Terminal 2 and Rayonier Inc. Dock) met frequency guidelines and testing was not required. One DY96 and one DY97 project on the Lower Columbia River had limited testing for grain size and TOC only. Two DY97 Willapa Bay Projects (Corps test dredge

[6] This requirement is less stringent in areas with high shoaling rates, which have been previously characterized to the limits of the dredging prism. In these cases, sampling of the surface layer with a grab sampler is generally allowed.

of the Middle Channel and DOT project) also received limited testing for grain size only to ensure compliance with Section 103 exclusionary criteria and Section 404 reason to believe guidelines. In general, the QA/QC for projects undergoing testing was excellent and acceptable by the DMMP agencies for regulatory decision-making. A complete listing of PSDDA sediment guideline value exceedances for DY96/97 is included in Appendix C.

Biological Testing

Biological testing summaries can be found in Tables 1-5a and 1-5b. For those projects undergoing tiered testing only those DMMUs which had exceedances of SLs were subject to biological testing. Based on a reason-to-believe that at least one COC would exceed SL, and to save time in the testing process, several project proponents opted for concurrent biological testing.

DMMP regulatory use of the saline Microtox® test has been suspended since DY94 for regulatory decision-making. This suspension remains in force pending commitment of agency resources to effectively evaluate the continued use of this test. The saline Microtox test continues to be run for a limited number of federal maintenance dredging projects in conjunction with the solid-phase Microtox test to further evaluate alternative protocols.

Bioaccumulation testing was conducted on one DY96 project and one DY97 project. In both instances bioaccumulation testing employed two species, with the adult facultative deposit-feeding bivalve,*Macoma nasuta*, and the adult deposit-feeding polychaete, *Nepthys caecoides*, co-tested within the same aquarium. In DY96, sediment from one surface DMMU on the Crowley Marine Services 8th Avenue Terminal Project exceeded the bioaccumulation trigger for fluoranthene. In DY97, for the Port of Seattle's Terminal 18 project, 45 DMMU exceeded bioaccumulation triggers for PCBs, mercury, or TBT. Of those 45 DMMU, nine passed routine biological testing, and were subjected to bioaccumulation testing using an extended exposure of 44 days. The results of these tests are discussed in Appendix A.

Suitability Determinations

A suitability determination outlines the evaluation procedures used in the characterization of project sediments, summarizes chemical and biological testing data and associated QA/QC issues, and documents the interpretation of testing results. The suitability determination is a technical memorandum, drafted by the Corps' DMMO, and signed by DMMP representatives. The determination documents the suitability of proposed dredged sediments for open-water disposal at one of the eight Puget Sound sites, six Grays Harbor and Willapa Bay sites, or appropriate inwater sites in the Columbia River. It does not, however, constitute final project approval by the agencies. Comprehensive agency comments on the overall project are provided through the regulatory public notice and review process.

Tables 1-6a and 1-6b contains information taken from the suitability determinations for each of the projects which completed their DMMP review during DY96/97. For the seven projects receiving suitability determinations in DY96, three projects had one or more DMMUs that were found unsuitable for unconfined open-water disposal. In DY97, six of 19 projects receiving suitability determinations had one or more DMMU that were found unsuitable for unconfined open-water disposal. All projects with unsuitable material were from Puget Sound.

Cost Data

A limited number of projects reported cost data for DY96/97. For DY96 cost data was reported for the USACE Duwamish and Grays Harbor projects. For DY97, cost data was received for the Curtis Wharf, Oak Harbor Marina, Port of Tacoma Blair Turning Basin, Weyerhaeuser Mt. Coffin Channel and USACE Duwamish and USACE Everett projects. With less than a third of the projects reporting data, no cost comparison analysis with previous years can be performed.

Table 1-2a. DY96 PROJECT RANKING

PROJECT	DISPOSAL JURISDICTION	LOCATION	WATERBODY	INITIAL RANK	FULL CHARACTERIZATION RANK
Capitol Lake	PSDDA	Olympia	Capitol Lake	not ranked	LM
Crowley Marine Services 8th Avenue Terminal, Slip 4	PSDDA	Harbor Island Seattle	Duwamish River	H	H
High Cascade International	CR	Stevenson	Columbia River	not ranked	not ranked
City of Kirkland Marina Park Boat Launch	PSDDA	Kirkland	Lake Washington	M	M
Lonestar Northwest / James Hardie Gypsum	PSDDA	Harbor Island	Duwamish River	H	H
Port of Port Angeles, Marine Safety and Resource Center	PSDDA	Port Angeles	Strait of Juan de Fuca, Puget Sound	H	H
Weyerhaeuser Bay City Dock[7]	GH	Grays Harbor	Chehalis River	LM	LM
USACE Duwamish[8]	PSDDA	Seattle	Duwamish River	LM/H	LM/H
USACE Grays Harbor	GH	Grays Harbor	Chehalis River Grays Harbor	L	L

[7] No testing required based on frequency guidelines. Last tested in 1993.
[8] No testing required in LM ranked area (70,000 cy) based on frequency guidelines. Last tested in 1991.

Table 1-2b. DY97 PROJECT RANKING

PROJECT	DISPOSAL JURISDICTION	LOCATION	WATERBODY	INITIAL RANK	FULL CHARACTERIZATION RANK
City of Bellevue, Meydenbauer Bay	PSDDA	Bellevue	Lake Washington	H	H
Curtis Wharf	PSDDA	Anacortes	Guemes Channel	M	M
Oak Harbor Marina	PSDDA	Oak Harbor	Oak Harbor Bay	M	M
DOT, Willapa Bar/North Channel	WB	Tokeland	North Channel	L	L
Port of Everett, Piers 1 and 3	NCD[9]	Everett	East Waterway	H	H
Port of Everett, NCD Berth Approach	PSDDA	Everett	East Waterway	H	M
Port of Everett, Stage I Marine Terminal	PSDDA	Everett	East Waterway	H	LM, M
Port of Grays Harbor, Terminal 2[10]	GH	Aberdeen	Chehalis River	H	LM
Port of Seattle, Terminal 5	PSDDA	Seattle	West Waterway	LM	LM
Port of Seattle, Terminal 18	PSDDA	Harbor Island, Seattle	East Waterway	H	H, M
Port of Tacoma, Blair Turning Basin	PSDDA	Tacoma	Blair Waterway	M	L
Rayonier Inc. Dock[11]	GH	Hoquiam	Chehalis River	LM	LM
Sandy Hook Yacht Club	Upland	Sachet Head, Whidbey Island	Cultus Bay	LM	LM
Weyerhaeuser, Mt Coffin Access Channel, Longview, WA	CR	Longview	Mt. Coffin Access Channel	not ranked	not ranked
Whatcom International Shipping Terminal	PSDDA	Bellingham	Whatcom Waterway	H	H
USACE Everett (downstream)	PSDDA	Everett	Snohomish River	LM	LM
USACE Duwamish	PSDDA	Seattle	Duwamish River	LM, H	LM, H
USACE Kenmore, Lake Washington	PSDDA	Kenmore	Lake Washington	H	H
USACE Willapa Harbor (Agitation Test Dredge)	WB	Tokeland	Middle Channel	L	L

[9] NCD = nearshore confined disposal assessment (modified elutriate, sequential batch leach and column leach).
[10] No testing based on frequency guidelines. Last tested in 1995.
[11] No testing based on frequency guidelines. Last tested in 1993.

Table 1-3a. DY96 PROJECTS - APPROVED SAMPLING PLANS

PROJECT	Rank	Total Volume (cy)	Surface Volume (cy)	Number of Surface Samples	Number of Surface DMMUs	Subsurface Volume (cy)	Number of Subsurface Samples	Number of Subsurface DMMUs
Capitol Lake	LM	180,000	180,000	24	6	0	0	0
Crowley Marine Services 8th Avenue Terminal, Slip 4	H	13,000	13,000	8	4	0	0	0
High Cascade International	not ranked	20,000	20,000	2	2	-	-	-
Lonestar Northwest / James Hardie Gypsum	H	18,000	12,500	4	4	5,500	1	1
USACE Duwamish	H	28,000	28,000	7	7	0	0	0
USACE Grays Harbor	L	2,120,000	2,120,000	69	9	0	0	0

Table 1-3b. DY97 PROJECTS - APPROVED SAMPLING PLANS

PROJECT	Rank	Total Volume (cy)	Surface Volume (cy)	Number of Surface Samples	Number of Surface DMMUs	Subsurface Volume (cy)	Number of Subsurface Samples	Number of Subsurface DMMUs
City of Bellevue, Meydenbauer Bay	H	150	150	2	1	0	0	0
Curtis Wharf	M	32,700	17,000	4	1	15,700	4	1
Department of Transportation, Willapa Bar/North Channel	L	5,000,000	5,000,000	8	8	0	0	0
Oak Harbor Marina	M	27,000	27,000	7	2	0	0	0
Port of Everett, Piers 1 and 3[12]	H	131,000	114,000	3	not applicable	17,000	0	not applicable
Port of Everett, NCD Berth Approach	H	42,000[13]	42,000	9	4	0	0	0
Port of Seattle, Terminal 5	LM	36,000	36,000	8	2	0	0	0
Port of Seattle, Terminal 18	H, M	546,430	304,670	80	76	241,760	54	20
Port of Tacoma, Blair Turning Basin	L	126,203[14]	48,000	6	1	78,203	12	2
Sandy Hook Yacht Club	LM	42,000	42,000	10	10	0	0	0
Weyerhaeuser, Mt Coffin Access Channel, Longview, WA	not ranked	200,000	200,000	7	7	0	0	0
Whatcom International Shipping Term.	H	8,700	8,700	6	3	0	0	0
USACE Everett (downstream)	LM	300,437	188,717	24	6	111,720	17	3
USACE Duwamish	LM, H	112,000	112,000	6	4	0	0	0
USACE Kenmore, Lake Washington	H	60,000	60,000	15	15	0	0	0
USACE Willapa Harbor (Agitation Test Dredge)	L	250,000	250,000	5	5	0	0	0

[12] Worst-case testing done for NCD determination.
[13] An additional 44,000 cubic yards, the majority of which was native sediment, was not tested.
[14] An additional 628,787 cubic yards of native sediment was not tested.

TABLE 1-4a. DY96 PROJECT SAMPLING

PROJECT	GRAIN SIZE PERCENTAGES				SAMPLING EQUIPMENT	MAXIMUM SEDIMENT DEPTH (FT)	MEAN SEDIMENT DEPTH (FT)
	GRAVEL > 2 mm	SAND .063 - 2mm	SILT .004 - .063mm	CLAY < .004 mm			
Capitol Lake	<1-6	37-87	7-53	<1-10	hand held corer (Wildco 2424-A50)	3.0	3.0
Crowley Marine Services 8th Avenue Terminal, Slip 4	<1-7	44-85	11-40	13-51	hammer impact corer	4.5	3.7
High Cascade International	34-71	28-63	<1-3	<1-3	Van Veen grab	0.5	0.5
Lonestar Northwest / James Hardie Gypsum	<1-2	9-64	40-77	5-17	hydraulic impact corer	12	5.1
USACE Duwamish	0-2	22-39	50-69	8-11	Vibracorer	4	4
USACE Grays Harbor	0-1	21-64	25-62	10-18	Van Veen grab	0.5	0.5

TABLE 1-4b. DY97 PROJECT SAMPLING

PROJECT	GRAIN SIZE PERCENTAGES				SAMPLING EQUIPMENT	MAXIMUM SEDIMENT DEPTH (FT)	MEAN SEDIMENT DEPTH (FT)
	GRAVEL > 2 mm	SAND .063 - 2mm	SILT .004 - .063mm	CLAY < .004 mm			
Curtis Wharf	13-43	38-52	4-26	2-24	Vibracorer	14.5	9.4
Oak Harbor Marina	1-6	7-16	56-58	24-34	Gravity corer	8	6.1
DOT, Willapa Bar/ North Channel	0-1	99-100	0-<1	0	Van Veen grab	0.5	0.5
Port of Everett, NCD Berth Approach	39-51		49-61[15]		Pneumatic impact corer	9.8	8.1
Port of Seattle, Terminal 5	1-89	6-73	1-17	6-7	Vibracorer	8.4	5.2
Port of Seattle, Terminal 18	0-15	3-8	3-77	5-54	Pneumatic impact corer	15.3	4.4
Port of Tacoma, Blair Turning Basin	1-17	55-73	9-35	3-9	18", 24" split spoon sampler, hollow stem auger	14	4
Sandy Hook Yacht Club	0	96	2	2	Van Veen grab	0.5	0.5
Weyerhaeuser, Mt Coffin Access Channel	0	99	<1	<1	Van Veen grab	0.5	0.5
Whatcom International Shipping Terminal	4-7	20-32	35-48	13-36	Vibracorer	11	3.8
USACE Everett (downstream)	1-2	60-84	5-45	3-7	Vibracorer	16	5.9
USACE Duwamish	0-2	40-90	7-55	1-5	Vibracorer	13	4
USACE Kenmore, Lake Washington	0-21	29-78	16-65	1-17	Vibracorer	6.8	5.2
USACE Willapa Harbor (Agitation Test Dredge)	0-1	97-100	0-<1	0	Van Veen grab	0.5	0.5

[15] Only percent fines reported.

Table 1-5a. DY96 BIOLOGICAL TESTING DATA

PROJECT	Number of biological analyses	Number of analyses failing bioassays	Number undergoing concurrent testing	Number undergoing tiered testing	Bioassays Conducted			Control Sediment Location	Reference Sediment Location
					Amphipod	Sediment Larval	20-day Growth		
Crowley Marine Services 8th Ave. Terminal, Slip 4	4	3	0	4[16]	*Ra*	*De*	*Na*	West Beach	Carr Inlet
Lonestar Northwest / James Hardie Gypsum	4	3	4	0	*Aa*	*De*	*Na*	Narrow River, RI West Beach	Carr Inlet
USACE Duwamish	7	2	0	7	*Aa*	*Mg*	*Na*	Narrow River, RI West Beach	Carr Inlet
USACE Grays Harbor	2	0	2	0	*Aa*	*De*	*Na*	Narrow River, RI West Beach	North Bay

[16] One DMMU passing routine bioassay testing subjected to 28-day bioaccumulation testing (see Appendix A for summary of this testing).

Table 1-5b. DY97 BIOLOGICAL TESTING DATA

PROJECT	Number of biological analyses	Number of DMMU failing bioassays	Number undergoing concurrent testing	Number undergoing tiered testing	Bioassays Conducted			Control Sediment Location	Reference Sediment Location
					Amphipod	Sediment Larval	20-day Growth		
Port of Everett, NCD Berth Approach	4	1	0	4	*Aa*	*Mt*	*Na*	West Beach Narrow River, RI	Carr Inlet
Port of Seattle, Terminal 5	3	0	0	3	*Ra*	*Mg*	*Na*	West Beach	Sequim Bay
Port of Seattle, Terminal 18	96	48	96	9[17]	*Ee*	*Mg*	*Na*	Beaver Creek, OR	West Beach, Cape George, Sequim Bay
Port of Tacoma, Blair Turning Basin	1	0	0	1	*Ra*	*Sp*	*Na*	West Beach	Carr Inlet
USACE Duwamish	3	1	3	-	*Aa*	*De*	*Na*	Narraganset, RI West Beach	Carr Inlet
USACE Kenmore, Lake Washington	3	2	0	3	*Ee*	*De*	*Na*	West Beach	Carr Inlet

Aa = Ampelisca abdita
De = Dendraster excentricus
Ee = Eohaustorius estuarius
Mt = Mytilus trossulus
Mg = Mytilus galloprovincialus
Na = Neanthes arenaceodenta
Ra = Rhepoxynius abronius
Sp = Strongylocentrotus purpuratus

[17] Nine DMMU passing routine bioassay testing were subjected to 44-day bioaccumulation testing (See appendix A).

Table 1-6a. DY96 SUITABILITY DETERMINATIONS

PROJECT	RANK	Total Volume (cy)	No. of chemical analyses	No. of biological analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed DMMP Disposal Site
Crowley Marine Services 8th Avenue Terminal, Slip 4	H	13,000	4	4	3	9,750	1	3,250	Elliott Bay
High Cascade International	L	20,000	2[18]	0	0	0	2	20,000	Upland
City of Kirkland Marina Park Boat Launch	M	800	0	0	0	0	0	800	Elliott Bay
Lonestar Northwest / James Hardie Gypsum	H	18,000	5	4	3	9,375	2	8,625	Elliott Bay
Weyerhaeuser Bay City Dock[19]	LM	14,000	0	0	0	0	0	14,000	Pt. Chehalis South Jetty 3.9 mile Ocean
USACE Duwamish[20]	H	98,000	7	7	2	8,000	5	90,000	Elliott Bay
USACE Grays Harbor	L	2,120,000	9	2	0	0	9	2,120,000	Pt. Chehalis South Jetty 3.9 mile Ocean

[18] Grain-size analysis only.
[19] Frequency determination
[20] Approximately 70,000 cubic yards were found suitable under frequency guidelines.

Table 1-6b. DY97 SUITABILITY DETERMINATIONS

PROJECT	RANK	Total Volume (cy)	No. of chemical analyses	No. of biological analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed DMMP Disposal Site
City of Bellevue, Meydenbauer Bay	H	150	1	0	1	150	0	0	Upland
Curtis Wharf	M	32,700	2	0	0	0	2	32,700	Rosario Strait
Oak Harbor Marina	M	27,000	2	0	0	0	2	27,000	Rosario Strait / Port Gardner
DOT, Willapa Bar/North Channel	L	5,000,000	8[18]	0	0	0	8	5,000,000	Middle Channel, North Channel, Adjacent Beach
Port of Everett, Piers 1 and 3	H	131,000	1[21]	not applicable	not applicable	not applicable	not applicable	not applicable	NCD
Port of Everett, NCD Berth	M	86,400	4	4	1	10,200[22]	3	76,200[23]	Port Gardner, NCD
Port of Everett, Stage I Marine Terminal	LM, M	239,000	0	0	not applicable	20,000	not applicable	219,000	Port Gardner, beneficial use
Port of Grays Harbor, Terminal 2	LM	15,000	0	0	0	0	0	15,000	Pt. Chehalis, South Jetty
Port of Seattle, Terminal 5	LM	36,000	3	3	0	0	3	36,000	Elliott Bay
Port of Seattle, Terminal 18	H, M	546,430	96	96	50	268,810	46	277,620	Elliott Bay
Port of Tacoma, Blair Turning Basin	L	755,000	3	1	0	0	3	755,000	Commencement Bay
Rayonier Inc. Dock	LM	20,000[24]	0	0	0	0	0	20,000	Pt. Chehalis South Jetty
Sandy Hook Yacht Club	LM	42,000	10[18]	0	0	0	10	42,000	Upland

[21] Modified elutriate, sequential batch leach and column leach tests.
[22] Includes 4,200 cubic yards found unsuitable based on existing data.
[23] Includes 40,200 cubic yards, most of which was native sediment, found suitable for open-water disposal based on existing data.
[24] Frequency determination.

Table 1-6b. DY97 SUITABILITY DETERMINATIONS (Continued)

PROJECT	RANK	Total Volume (cy)	No. Of chemical analyses	No. of biological analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed DMMP Disposal Site
Weyerhaeuser, Mt Coffin Access Channel, Longview	not ranked	200,000	7[18]	0	0	0	7	200,000	River Mile 62 Columbia River
Whatcom International Shipping Terminal	H	8,700	3	not conducted	3	8,700	0	0	not yet determined
USACE Everett (downstream)	LM	300,437	9	0	0	0	9	300,437	Port Gardner, Jetty Island
USACE Duwamish[25]	LM, H	112,000	4	3	1	4,000	3	108,000	Elliott Bay
USACE Kenmore, Lake Washington	H	60,000	15	3	2	8,000	13	52,000	Elliott Bay
USACE Willapa Harbor (Agitation Test Dredge)	L	250,000	5[18]	0	0	0	5	250,000	Middle Channel

[25] Approximately 100,000 cubic yards from the LM-ranked turning basin received "safety-net" testing (3 samples composited for 1 chemical analysis).

C. SUMMARY AND ASSESSMENT OF DY96/97 DATA

Chemical Testing Table 1-7 summarizes the chemical testing results from DY96 and DY97. A total of 51 of the 61 DMMP screening levels were exceeded for at least one project. These included both detected exceedances (41 SLs) and detection limit exceedances (26 SLs). Eleven COCs had detected concentrations above the BT, while 18 COCs were detected above the ML.

Table 1-8 highlights those chemicals which had detected concentrations exceeding SL, BT and ML most frequently. Also included are those chemicals for which the detection limit exceeded SL the most frequently. From Table 1-8 it can be seen that the chemicals most often detected above SL, BT and ML included a single metal (lead), six individual PAHs, total LPAH, total HPAH, total DDT and total PCBs. Detection limit exceedances of SL were inconsequential as none of them would have triggered, on their own, the need to conduct biological testing.

TABLE 1-7. DY96/97 CHEMICAL TESTING SUMMARY FOR DMMP PROJECTS

CHEMICAL OF CONCERN	# of Projects D>SL	# of DMMU D>SL	# of Projects D>BT	# of DMMU D>BT	# of Projects D>ML	# of DMMU D>ML	# of Projects U>SL	# of DMMU U>SL	# of Projects U>BT	# of DMMU U>BT	# of Projects U>ML	# of DMMU U>ML
METALS AND ORGANOMETALLICS												
Antimony	1	1										
Cadmium (1)	3	49										
Copper (1)	3	41										
Lead (1)	5	56										
Mercury	3	76	1	4	1	1						
Silver	1	32	1	4	1	3	1	2				
Zinc (1)	4	44										
Tributyltin (2)	3	5	1	3								
LPAH												
2-Methylnaphthalene (1)	3	29			1	12	1	6				
Acenaphthene (1)	4	39			1	4	1	5				
Acenaphthylene (1)	1	1					1	19				
Anthracene (1)	5	52			1	2						
Fluorene (1)	5	55			2	5	1	1				
Naphthalene (1)	1	13										
Phenanthrene (1)	5	43			1	2						
Total LPAH (1)	5	49			2	6						
HPAH												
Benzo(a)anthracene (1)	3	29										
Benzo(a)pyrene	3	10										
Benzofluoranthenes (1)	3	30										
Chrysene (1)	3	28										
Dibenzo(a,h)anthracene (1)	3	3					1	8				
Fluoranthene	4	48	3	3	3	3						
Indeno(1,2,3-c,d)pyrene (1)	9	89										
Pyrene (1)	7	84			1	1						
Total HPAH (1)	9	85										

total projects with chemical testing = 15, total DMMUs = 159

D = Detected U = Undetected SL = Screening Level BT = Bioaccumulation Trigger
(1) No BT exists (2) No ML exists (3) No BT or ML exists

TABLE 1.7 (CONTINUED) - DY96/97 CHEMICAL TESTING SUMMARY FOR DMMP PROJECTS

CHEMICAL OF CONCERN	# of Projects D>SL	# of DMMU D>SL	# of Projects D>BT	# of DMMU D>BT	# of Projects D>ML	# of DMMU D>ML	# of Projects U>SL	# of DMMU U>SL	# of Projects U>BT	# of DMMU U>BT	# of Projects U>ML	# of DMMU U>ML
CHLORINATED HYDROCARBONS												
1,2-Dichlorobenzene	1	1	1	1								
1,2,4-Trichlorobenzene (1)	1	3					3	26				
1,4-Dichlorobenzene					1	1						
Hexachlorobenzene							1	33				
Hexachlorobutadiene	1	1					1	34				
PHTHALATES												
Bis(2-ethylhexyl) Phthalate (2)	1	9										
Diethyl Phthalate (3)							1	8				
Dimethyl Phthalate (2)							1	2				
Ethylbenzene	1	4	1	3	1	2						
Xylenes	1	11			1	2						
PHENOLS												
2 Methylphenol (1)							1	31			1	4
2,4-Dimethyl phenol (1)							1	17			1	7
4 Methylphenol (1)	1	4					1	8				
Pentachlorophenol							1	28				
Phenol	2	20					1	2				
MISCELLANEOUS EXTRACTABLES												
Benzoic Acid (1)	1	3			1	3	1	7			1	2
Benzyl Alcohol (1)	2	2			1	1	2	27			1	8
Dibenzofuran (1)	4	29			1	1	1	12				
N-Nitrosodiphenylamine							1	26				
PESTICIDES AND PCBs												
Aldrin (2)	1	23	1	3			2	6				
Alpha chlordane(2)	1	16	1	1			1	15	1	7		
Dieldrin (2)	1	40	1	13								
Heptachlor (2)							1	8				
Gamma-HCH (Lindane) (2)							1	8				
Total DDT	6	61	1	18	1	16	1	13				
Total PCBs	5	72	2	3	1	11	1	4				

total projects = 15, total DMMUs = 159

D = Detected U = Undetected SL = Screening Level BT = Bioaccumulation Trigger ML = Maximum Level
(1) No BT exists (2) No ML exists (3) No BT or ML exists

TABLE 1-8. MULTIPLE EXCEEDANCES OF DMMP GUIDELINE VALUES

CHEMICAL	CHEMICALS EXCEEDING SL IN AT LEAST ONE-THIRD OF THE PROJECTS	CHEMICALS EXCEEDING BT IN AT LEAST TWO PROJECTS	CHEMICALS EXCEEDING ML IN AT LEAST TWO PROJECTS	CHEMICALS WITH DETECTION LIMITS EXCEEDING SL IN AT LEAST TWO PROJECTS
Lead	X			
Anthracene	X			
Fluorene	X		X	
Phenanthrene	X			
Total LPAH	X		X	
Fluoranthene		X	X	
Indeno(1,2,3-c,d)pyrene	X			
Pyrene	X			
Total HPAH	X			
1,2,4-Trichlorobenzene				X
Benzyl Alcohol				X
Aldrin				X
Total DDT	X			
Total PCBs	X	X		

Biological Testing. Biological testing was conducted for 127 DMMUs at nine of the fifteen projects which underwent chemical testing during DY96/97. Table 1-9 shows the number of times each of the three bioassays was conducted and the number of hits for each.

TABLE 1-9 - DY96/97 BIOASSAY "HITS"[1]

BIOASSAY	Number of DMMUs Tested	Number of Hits Under the "Two-Hit Rule"	Number of Hits Under the "Single-Hit Rule"
Amphipod	127	33	35
Sediment Larval	127	24	33
Neanthes Biomass	127	6	27

[1]Nondispersive interpretation

As can be seen from this tabulation, the amphipod test exhibited the most hits, with 68 hits out of 127 bioassays. The majority of these hits (60 of 68) occurred for a single project, Port of Seattle Terminal 18. The larval bioassay resulted in 57 hits in five projects. The *Neanthes* biomass test resulted in 33 hits, with all but two hits occurring for Terminal 18.

Regulatory Processing

For the majority of dredging projects, DMMP sediment sampling and testing are among the regulatory requirements under Section 404 of the Clean Water Act or Section 103 of the Marine Protection, Research and Sanctuaries Act. For those dredging projects requiring sampling and testing, the regulatory process consists of a sequence of steps which must be taken before obtaining a permit. The majority of permit actions involve 404 jurisdiction, but the steps are similar for 103 actions. These are as follows:

(1) Submit application for permit.

(2) Prepare sampling and analysis plan (SAP) for characterization of proposed dredged material.

(3) Receive approval of SAP from DMMP agencies.

(4) Perform sampling and chemical/biological analysis.

(5) Submit testing results.

(6) Receive suitability determination for open-water disposal from DMMP agencies.

(7) Complete application details required to issue public notice.

(8) Corps prepares and issues public notice.

(9) Corps transmits review comments to applicant after 30-day public comment period.

(10) Applicant provides Corps with responses to public comments.

(11) Corps completes public interest review, 404(b)1 evaluation, NEPA documentation and issues permit.

The average time requirements for steps 3 through 11 are included in Figures 1-5a and 1-5b, which were constructed using data from processing activities occurring in DY96/97 (this included public interest reviews and permitting actions for several dredging projects which received suitability determinations during DY94/95). Steps 1 and 2, while part of the regulatory process, are completely within control of the permit applicant and were not included in the analysis of processing time.

Permit Application. An application for a Corps of Engineers Section 10/404 permit for dredging and dredged material disposal must be submitted before any DMMP processing may take place. An application number and Regulatory Branch Project

Manager are assigned at this time and the Dredged Material Management Office begins review of information relevant to the proposed dredging.

Sampling and Analysis Plan Development A sediment sampling and analysis plan must be developed and submitted to the DMMP agencies for review prior to commencement of field sampling. The time required for SAP development is highly variable and almost completely within control of the dredging applicant. In many cases a permit application is submitted at the same time as a draft SAP, while in other cases a permit application is submitted long before development of a SAP begins. Therefore, the time required for SAP development is difficult to quantify and was not included in Figures 1-5a and 1-5b.

Sampling and Analysis Plan Approval Once a sediment SAP has been submitted, the DMMO coordinates review with the other DMMP agencies: EPA, DNR and Ecology. An approval letter is sent which includes DMMP agency comments and recommended modifications of the SAP. Once these comments and modifications have been acknowledged by the applicant, via telephone, letter or e-mail, sampling and analysis may proceed. It is the goal of the DMMO to complete the review of SAPs within three weeks. During DY 96/97 the average time from the submittal of the final SAP for a project to SAP approval was 19 days.

Sampling and Analysis During this phase, field sampling and chemical/ biological analysis are completed following the protocols established in the approved SAP. Data are compiled and submitted in a hard copy report. These data are entered into the Dredged Analysis Information System by a Corps contractor. Sampling, testing and reporting consume a substantial portion of the DMMP Process time budget, averaging 199 days during DY96/97. There was a high degree of variability in this phase, with projects ranging from 44 to 357 days. Factors influencing the time required for this phase include weather, sampling difficulties, laboratory capacity and turn-around, QA problems arising during chemical and biological testing, and report compilation time.

Data Review. Once a full set of chemical/biological testing data is submitted along with the sampling report, the DMMO conducts a data review with the other DMMP agencies. The result of this review is the signing, by DMMP agency representatives, of a Memorandum for Record documenting the determination reached on the suitability/ unsuitability of each of the dredged material management units defined in the approved SAP. The goal of the DMMO is to complete this review within three weeks of data submittal. In DY96/97, the average time required was 17 days.

Complete Permit Application Once the suitability determination has been signed, the DMMO informs the Corps Regulatory Branch project manager and preparations are made to issue a public notice. However, if project details have not been fully developed by this time, or if project plans are modified subsequent to the suitability determination, new drawings or other information may be required of the applicant prior to the preparation of the public notice. In other cases, a shorelines development permit may not

have yet been obtained by the applicant and a decision may be made to wait to go out to public notice until the local shoreline jurisdiction has issued a permit. During DY96/DY97 the average time required for the applicant to complete their permit application was 48 days. Again, there was a high degree of variability in this phase, with projects ranging from 0 to 239 days.

Prepare and Issue Public Notice. By regulation, the Regulatory Branch must issue a public notice within fifteen days of the completion of the permit application. The average time required for DY96/DY97 projects was 12 days.

Public Comment Period and Transmittal of Review Comments. A DMMP project typically undergoes a 30-day public comment period. Comments received during this period are collated by the Corps and transmitted to the applicant for response. For DY96/97 projects, the average time required for the public comment period and transmittal of review comments was 42 days.

Applicant Responds to Review Comments. The permit applicant is responsible for providing written responses to review comments and supporting data to the Corps before the Regulatory Branch project manager can complete a public interest review. The average time required for this step in DY96/97 was 14 days.

Corps Completes Public Interest Review and Makes Permit Decision. The public interest review, including a Section 404(b)(1) alternatives analysis and NEPA evaluation, is completed and documented after the permit applicant provides responses to review comments. The Corps project manager prepares a permit decision upon completion of the public interest review.

This stage of the process may be very time consuming. Dredging and DMMP processing are often only part of complex projects. Other elements may be involved, such as wetland fills or eelgrass bed impacts. Resolution of controversial issues such as these may consume substantial amounts of time. The time required to complete this phase was highly variable in DY96/97, ranging from 7 to 139 days, with a mean time of 72 days. To improve regulatory response time, the Department of Ecology recommends that applicants seek a hydraulic project approval (HPA) from the Department of Fish and Wildlife, and resolve other problems as early as possible in the permit process.

Dredged Material Evaluation. The DMMP dredged material evaluation process, as depicted in Figure 1-5b, includes final sampling and analysis plan review and approval, field sampling and analysis, data review and completion of the suitability determination. The average time required for the DMMP dredged material evaluation process was 250 days (range = 68 to 396) in DY96/97, with the majority of that time taken up by sampling, testing, and data report preparation by the applicant. Note that Figure 1-5b shows the average time required for each of the three phases of the dredged material evaluation process, the sum of which does not equal the mean time for the entire process.

Time Elapsing for Each Regulatory Stage:

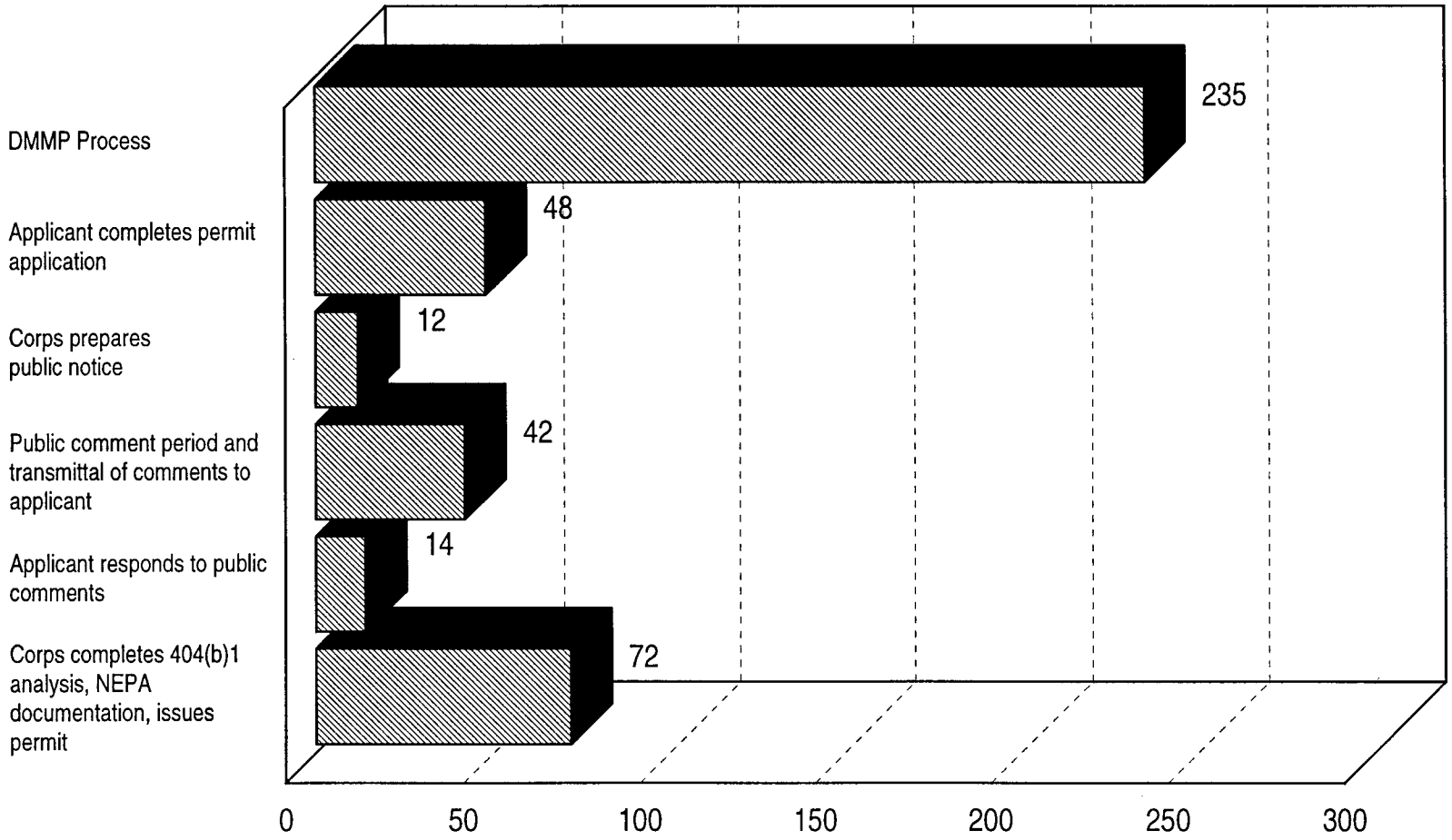
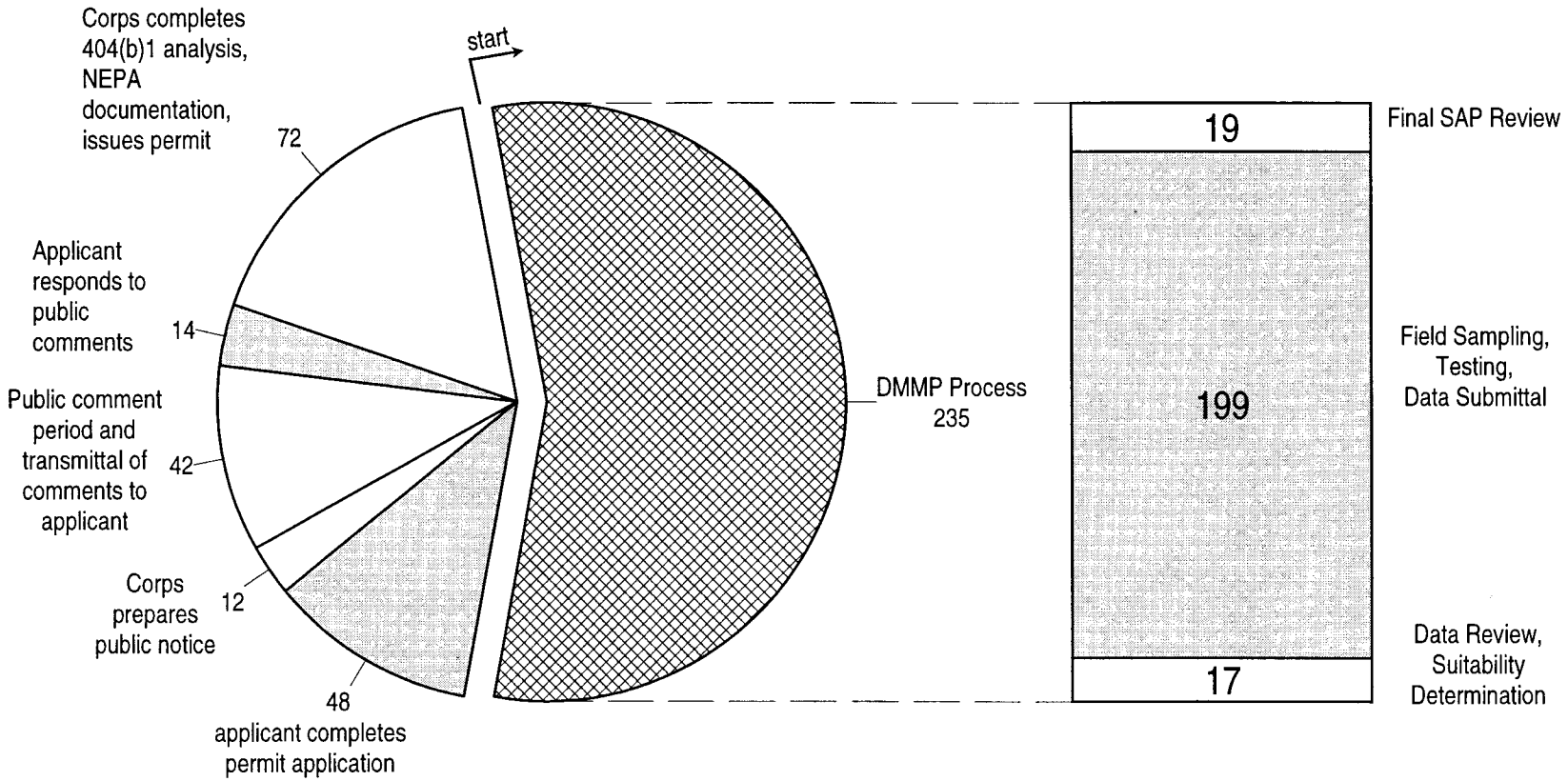


FIGURE 1-5a. Regulatory Processing Time

Means for DY96/DY97 Projects (days)

FIGURE 1-5b. DMMP PROCESSING TIME

Means for DY96/DY97 Projects (days)



Note: solid gray areas are under control of dredging applicant

CHAPTER 2

DISPOSAL SITE USE AND MONITORING

A. DISPOSAL ACTIVITY AND SITE USE

The Washington Department of Natural Resources (DNR) issues site-use authorizations to project proponents who wish to dispose of dredged material at PSDDA, Grays Harbor/Willapa Bay and Columbia River open-water disposal sites. These authorizations are issued for sediments which are 1) suitable for open-water disposal as determined by the DMMP evaluation process; and 2) associated with dredging projects which have received all required regulatory permits (e.g., CWA 404/401 permits). This section of the report describes the PSDDA and Grays Harbor disposal activities for DY 1996 and 1997. Disposal site activity summaries for the Columbia River are not included in this report, but will be included in future Biennial Reports. Disposal activities are discussed by year and by individual disposal site.

Dredging Year 1996 (June 16, 1995 - June 15, 1996)

In DY96, a total of 935,056 cubic yards was disposed at six PSDDA sites, whereas a total of 1,998,047 cubic yards was disposed at two Grays Harbor sites and one beneficial use site in Half Moon Bay (Tables 2-1 and 2-2). Of the PSDDA sites, Commencement Bay, Rosario Strait and Port Gardner received the majority of the material, with totals of 460,684 cy, 205,500 cy, and 121,246 cy respectively. In Grays Harbor, the South Jetty estuarine site received the bulk of the material with 1,674,267 cy. Figures 2-1 and 2-2 illustrate the pattern of site use in DY96 for both PSDDA sites and Grays Harbor sites, respectively. Table 2-2 provides a project by project summary of the disposal activity for both PSDDA and Grays Harbor sites.

Table 2-1. Open-water Disposal Summary DY96

Disposal Site	Disposal Jurisdiction	# of Projects	Total Volume (cubic yards)
Commencement Bay	PSDDA	1	460,684
Elliott Bay	PSDDA	3	95,302
Port Gardner	PSDDA	1	121,246
Rosario Straits	PSDDA	2	205,500
Bellingham Bay	PSDDA	1	44,800
Port Angeles	PSDDA	1	22,344
Point Chehalis	Grays Harbor	4	370,203
South Jetty	Grays Harbor	1	1,674,267
Half Moon Bay (beneficial uses)	Grays Harbor	1	274,780
All Sites within Jurisdiction Combined:	PSDDA	9	935,056
	Grays Harbor	4	2,319,250

Table 2-2. Summary of DY96 Disposal Projects

Site	Proponent	Dredging Contractor	Disposal Volumes, cy	# Barge Loads	Off Site	Disposal Dates
CB	Port of Tacoma West Blair .	Fletcher General	460,684	330	no	11/02/95 to 03/14/96
EB	City of Bremerton Warren Ave. Outfall	A. H. Powers	2,500	3	no	06/23/95 to 07/20/95
EB	Sinclair Inlet Marina	Manson Construction	2,745	6	no	07/17/95 to 07/22/95
EB	USACE, Duwamish O&M	J.E. McAmis	90,057[1]	55	no	02/14/96 to 03/30/96
PG	Port of Everett Pier I South	A. H. Powers	121,246	69	no	07/24/95 to 10/02/95
BB	USACE / POB (local sponsor), Squalicum Waterway O&M	J.E. McAmis	44,800	27	no	09/30/95 to 10/20/95
RS	Port of Bellingham (POB)/Bellingham Cold Storage	J.E. McAmis	39,000	26	no	09/30/95 to 01/28/96
RS	USACE / POB (local sponsor), Squalicum Waterway	J.E. McAmis	166,500	111	no	09/30/95 to 01/28/96
PA	Holnam Inc./ Ideal Cement	American Construction	22,344	19	no	02/02/96 to 02/22/96
PC	Weyerhaeuser Bay	Great Lakes	6,000	2	no	06/16/95

[1] Includes 14,820 cubic yards of material that was placed within the southwest corner of the site to cap material from a previous Corps/Waterways Experiment Station experimental disposal of 114,000 cubic meters of PCB contaminated material during the late 1970s (Pavlou et. al. 1977).

	City Dock					
PC	Rayonier Inc.	Great Lakes	19,800	6	no	06/20/95
PC	Port of Grays Harbor Terminal 2	Great Lakes	48,684	14	no	06/18/95 to 06/20/95
PC	USACE, Grays Harbor O&M	Great Lakes	295,719	43	no	09/01/96 to 09/09/96
SJ	USACE, Grays Harbor O&M	Great Lakes	1,634,517	586	no	04/30/96 to 08/31/96
SJ	USACE, Grays Harbor O&M	USACE Hopper Dredge "YAQUINA"	6,375	~24	no	05/07/96 to 05/11/96
SJ	USACE, Grays Harbor O&M	USACE Hopper Dredge "YAQUINA"	33,375	~40	no	05/04/96 to 05/30/96
HMB	USACE, Grays Harbor O&M	USACE Hopper Dredge "YAQUINA"	274,780	~330	no	05/04/96 to 05/30/96

Legend: EB = Elliott Bay; PG = Port Gardner; CB = Commencement Bay; PA = Port Angeles; BB = Bellingham Bay; RS = Rosario Strait; PC = Point Chehalis; SJ = South Jetty; HMB = Half Moon Bay

Dredging Year 1997 (June 16, 1996 - June 15, 1997)

In DY97, a relatively small total volume of 121,513 cy was disposed at two PSDDA disposal sites, whereas a total volume of 1,933,241 cy was disposed at the two Grays Harbor estuarine disposal sites and at one beneficial use site in Half Moon Bay (Table 2-3). Of the PSDDA sites, only Elliott Bay and Port Gardner were used, receiving volumes of 18,982 cy and 102,531 cy, respectively. In Grays Harbor, both the South Jetty site and the Point Chehalis site had relatively heavy use with 959,249 cy and 665,388 cy respectively. Figures 2-3 and 2-4 illustrate the pattern of site use in DY97 for both PSDDA sites and Grays Harbor sites, respectively. Table 2-4 provides a project-by-project summary of the disposal activity at both PSDDA and Grays Harbor sites.

Table 2-3. Openwater Disposal Activity Summary DY97

Disposal Site	Disposal Jurisdiction	# of Projects	Total Volume (cubic yards)
Elliott Bay	PSDDA	5	18,982
Port Gardner	PSDDA	1	102,531
Point Chehalis	Grays Harbor	5	665,388
South Jetty	Grays Harbor	1	959,249
Half Moon Bay (beneficial uses)	Grays Harbor	1	308,604
All Sites within Jurisdiction Combined:	PSDDA	6	121,513
	Grays Harbor	5	1,933,241

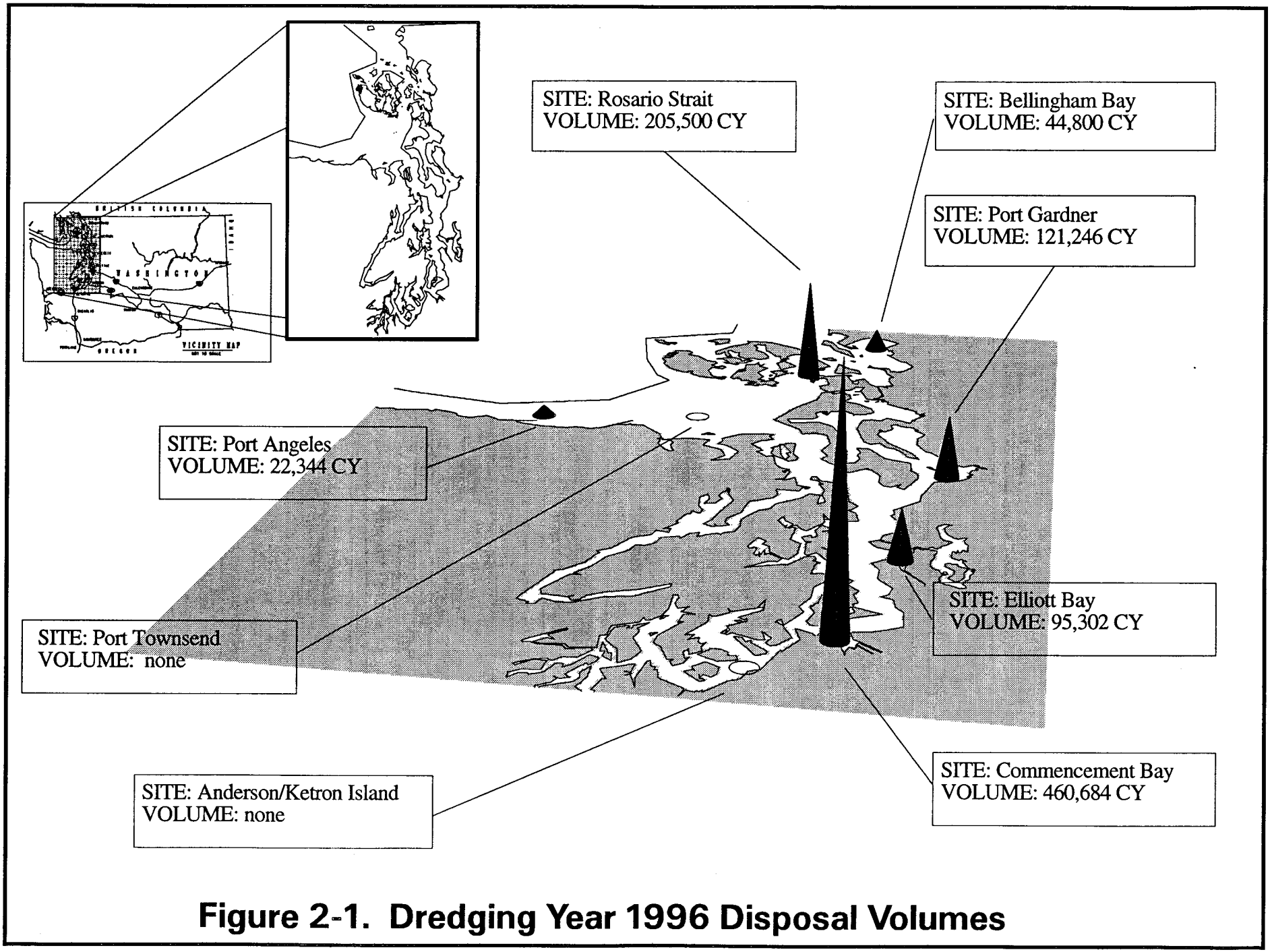


Figure 2-1. Dredging Year 1996 Disposal Volumes

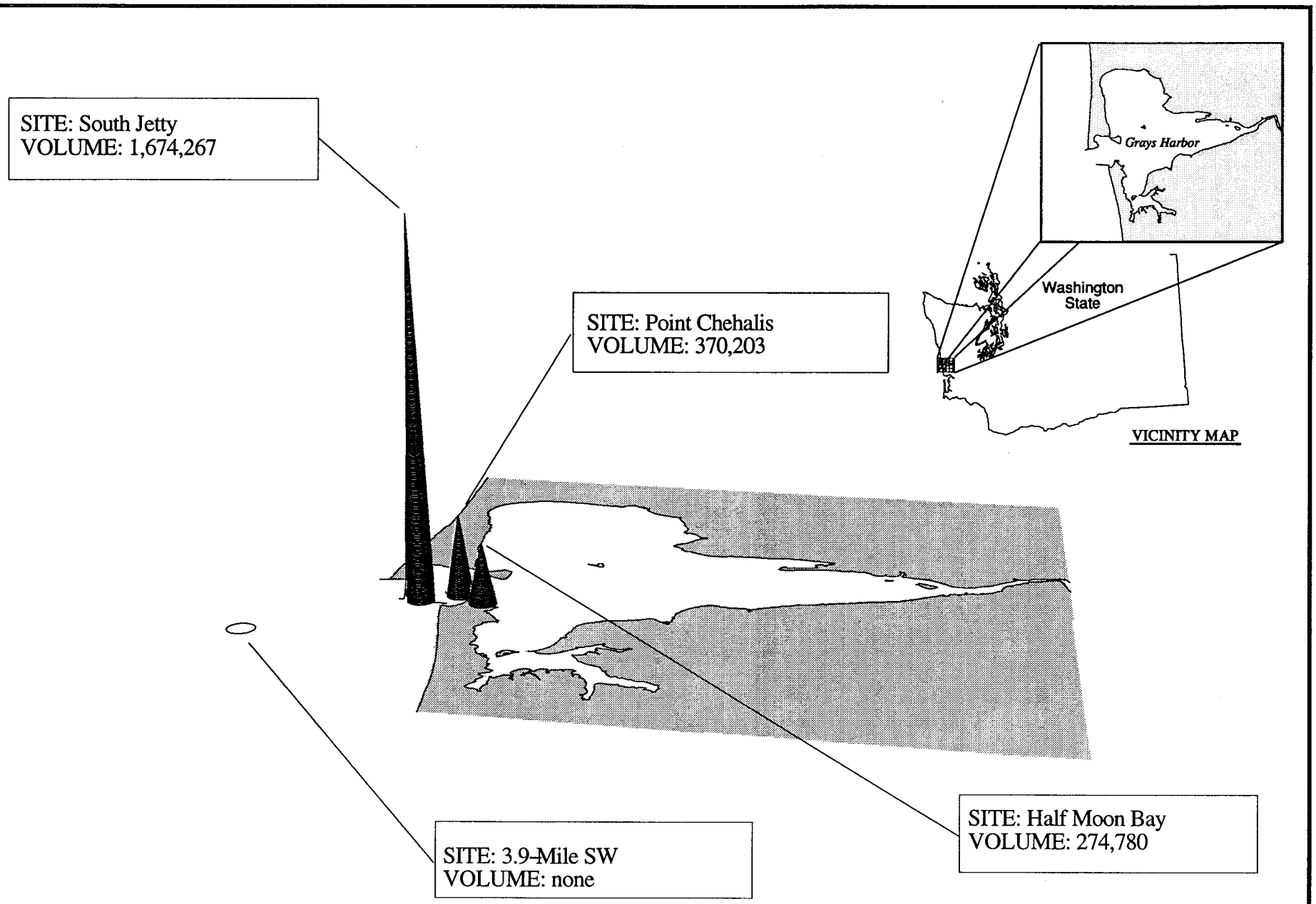


Figure 2-2. Dredging Year 1996 Disposal Volumes for Grays Harbor

Table 2-4. Summary of DY97 Disposal Projects

Site	Proponent	Dredging Contractor	Disposal Volumes, cy	# Barge Loads	Off Site	Disposal Dates
EB	Lone Star NW Kaiser Dock	A.H. Powers	12,070	7	no	06/24/96 to 07/02/96
EB	City of Kirkland Marina Park Boat Launch	A.H. Powers	800	1	no	10/25/96
EB	Crowley Marine Services	American Construction	2,400	2	no	12/27/96 to 12/28/96
EB	Port of Seattle	A.H. Powers	3,493	4	no	03/10/97 to 03/12/97
EB	Sinclair Inlet Marina	Island Tug and Barge	219	1	no	02/11/97
PG	Port of Everett Marine Terminal	A. H. Powers	102,531	92	no	11/11/96 to 03/12/97
PC	Weyerhaeuser, Bay City Dock	Great Lakes Dredge	14,000	4	no	08/18/96 to 02/25/97
PC	Port of Grays Harbor, T2	American Construction	38,500	12	no	07/01/96 to 07/16/96
PC	Rayonier, Inc.	Foss Engineering	20,000	6	no	02/22/97 to 02/23/97
PC	Port of Grays Harbor, T2	Great Lakes	14,173	6	no	02/24/97 to 02/25/97
PC	USACE Grays Harbor O&M	Manson Construction	218,666	215	no	04/23/97 to 5/8/97
PC	USACE Grays Harbor O&M	Manson Construction	360,049	139	no	04/15/97 to 06/13/97
SJ	USACE Grays Harbor O&M	Manson Construction	959,249	370	no	03/11/97 to 08/19/97
HMB	USACE Grays Harbor O&M	Manson Construction	172,923	126	no	04/07/97 to 05/07/97
HMB	USACE Grays Harbor O&M	USACE Hopper Dredge "YAQUINA"	135,686	~159	no	05/20/97 to 05/31/97

Legend:
EB = Elliott Bay; PC = Point Chehalis; SJ = South Jetty Site; HMB = Half Moon Bay

Summary of Disposal Activity by Jurisdiction and Site

PSDDA

Bellingham Bay. The Bellingham Bay open-water disposal site received 44,800 cy of dredged material from 1 project in DY96 (Table 2-1). This project was the Port of Bellingham/Corps of Engineers maintenance dredging in Squalicum Waterway. The work was accomplished by clamshell dredge, and all disposals occurred on site.

During DY97, there were no disposals at the Bellingham Bay site.

Port Gardner. During DY96, the Port Gardner disposal site received 121,246 cy of material from one project, the Port of Everett's Pier 1 South development project (Table 2-1). Although

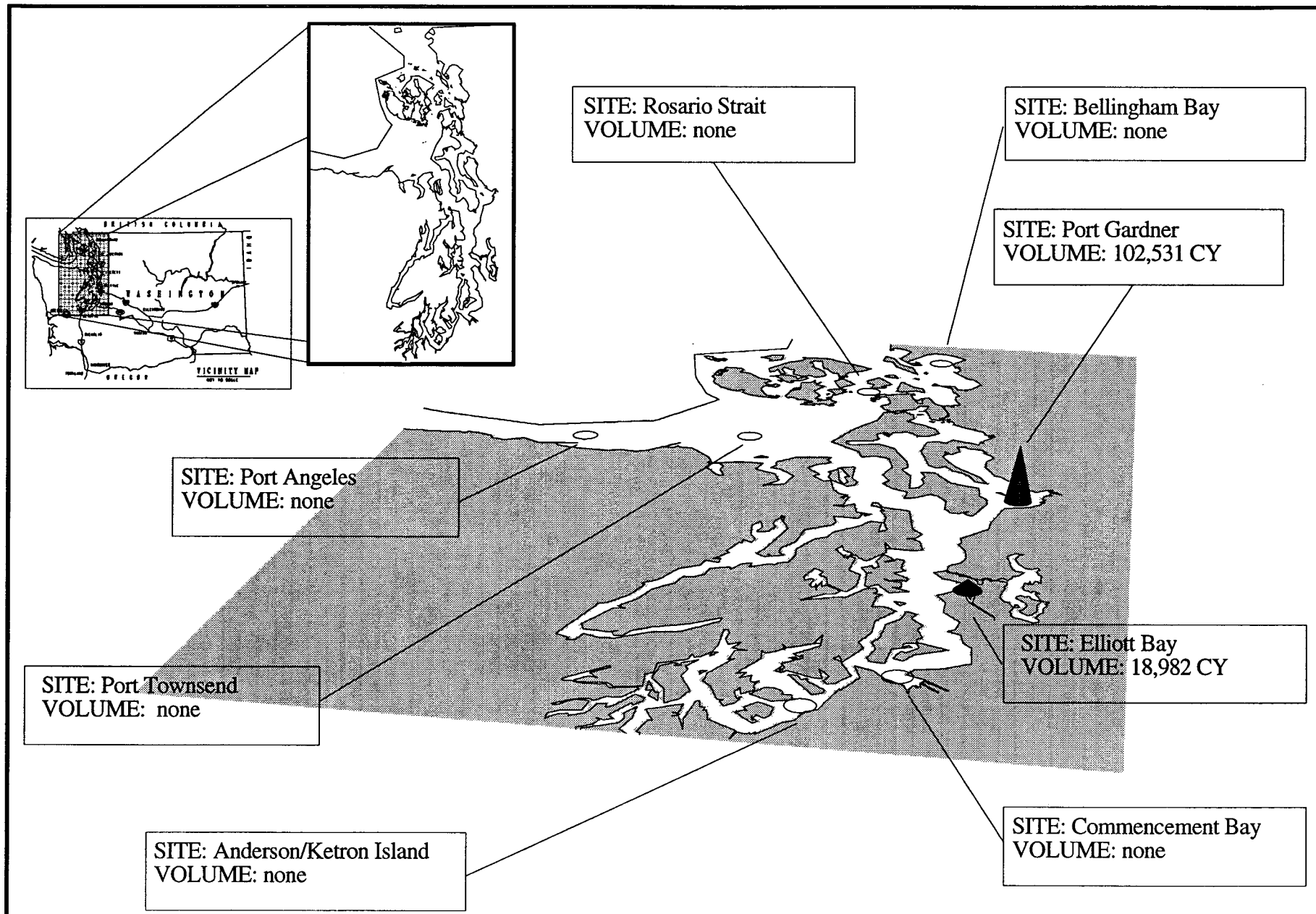


Figure 2-3. Dredging Year 1997 Disposal Volumes

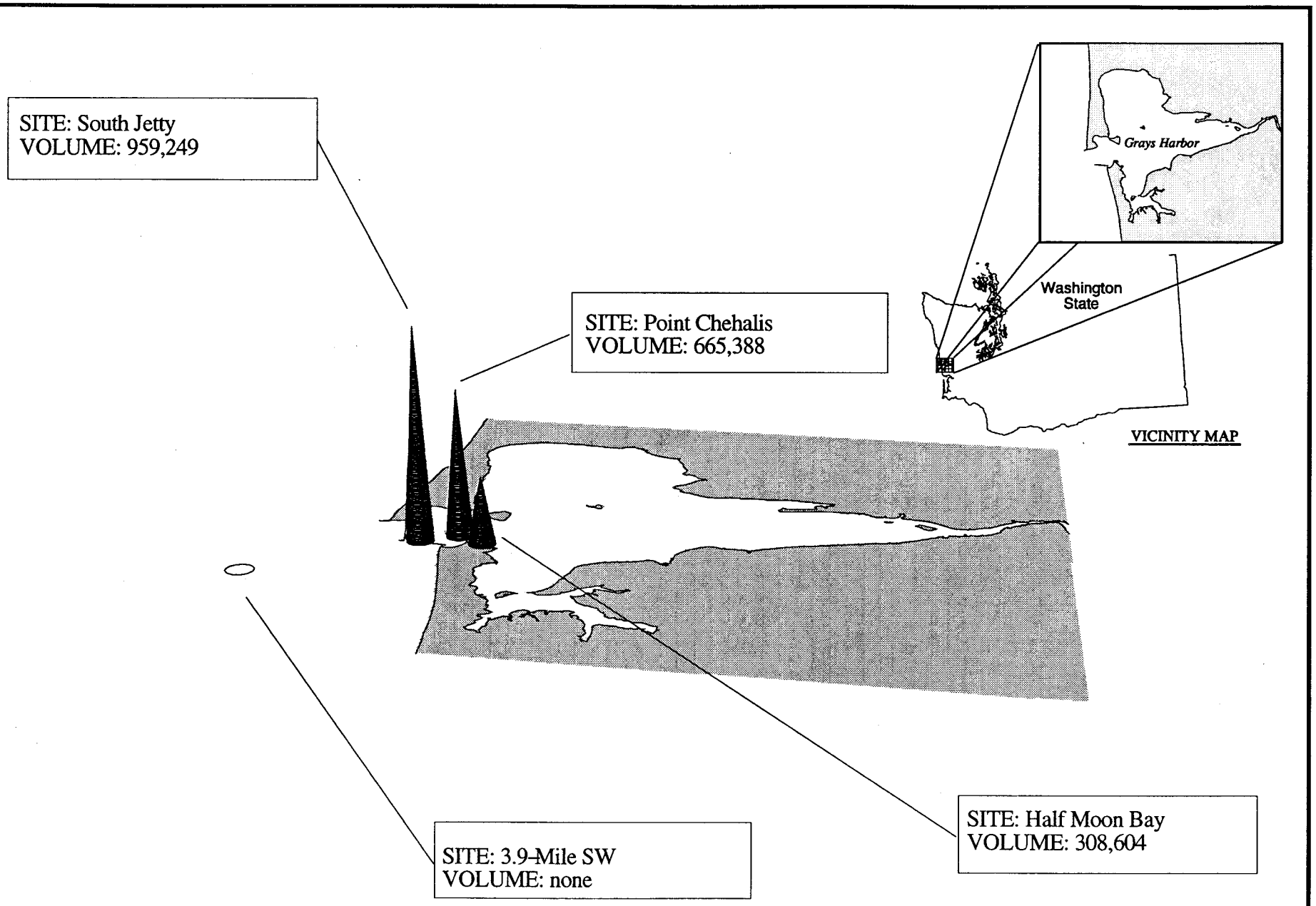


Figure 2-4. Dredging Year 1997 Disposal Volumes for Grays Harbor

all disposal occurred in the disposal area, the Port of Everett was assessed penalties for disposals in excess of the authorized volume of 105,000 cubic yards. All dredging was done by clamshell dredge.

In DY97, the Port Gardner site received 102,531 cy of material dredged from the Port of Everett's Stage 1 Marine Terminal Development project (Table 2-3). All dredging was done by clamshell dredge, and all disposals occurred within the target area.

Rosario Strait. During DY96, 205,500 cy of dredged material was disposed at the Rosario Strait disposal site, from two different, although related, projects (Table 2-1). These were the Corps of Engineers maintenance dredging of Squalicum Waterway and the dredging at Bellingham Cold Storage. All dredging was done by clamshell, and all disposals were on-site.

There were no disposals at the Rosario Strait site in DY97.

Elliott Bay. The Elliott Bay disposal site had a total of 95,302 cy of dredged material disposed during DY96 (Table 2-1). This was from 3 different projects: 2,500 cy from the City of Bremerton Warren Avenue stormwater outfall project, 2,745 cy from Sinclair Inlet Marina, and 90,057 from the Corps of Engineers Duwamish maintenance dredging project. All dredging was done by clamshell, and all disposals occurred on site.

During DY97, five projects disposed a total of 23,082 cy of clamshell dredged material at the Elliott Bay site (Table 2-3). These 5 projects were: 12,070 cy from Lonestar Northwest; 2,400 cy from the Crowley Marine Services; 878 cy from the City of Kirkland's Marina Park project; 3,493 cy from the Port of Seattle's Terminal 5 deepening; and 219 cy from Sinclair Inlet Marina.

Grays Harbor/Willapa Bay

Point Chehalis. During DY96, Point Chehalis received 370,203 cubic yards from four projects (Table 2-1). The four projects were the Weyerhaeuser project of 6,000 cy, the Rayonier project of 19,800 cy, the Port of Grays Harbor project of 48,684 cy, and the Corps of Engineers project of 295,719 cy. There were no offsite disposals.

During DY97, there was a total of 665,388 cy of dredged material disposed at the Point Chehalis site, from six projects (Tables 2-3 and 2-4). Again, there were no offsite disposals.

South Jetty. South Jetty was the site of disposals totaling 1,674,267 cy during DY96. The entire volume was from the Corps of Engineers maintenance dredging of Grays Harbor (Table 2-1). The disposals were, however, from three projects, of 1,634,517 cy, 6,375 cy, and 33,375 cy. The last two volumes were disposed from the hopper dredge YAQUINA.

In DY97, there was one project disposing of material at the South Jetty, a Corps of Engineers project of 959,249 cy.

B. PSDDA Disposal Site Monitoring

Overview.

Environmental monitoring is the primary tool in the management plan of the PSDDA non-dispersive disposal sites. The objective of disposal site monitoring is to determine whether the disposed dredged material is producing unanticipated adverse effects at the sites. Environmental monitoring can include physical, chemical, and biological assessment of the sediments and biological resources in and adjacent to the disposal sites. The PSDDA monitoring program is designed to compare the post-disposal monitoring results to "baseline" values. Baseline values of key environmental parameters, such as sediment chemistry, toxicity, and biological community structure, were determined for each PSDDA site and at various benchmark stations prior to the first use of the sites (PTI, 1988, 1989).

A post-disposal site monitoring survey is designed to answer three major questions:

1. Is the dredged material deposited on site?

2. Is the deposited dredged material producing chemical and/or biological conditions on site beyond the "minor adverse effects" levels allowed by the PSDDA site management plans?

3. Is the dredged material causing any adverse impacts to biological resources beyond the disposal site boundaries?

Full PSDDA monitoring is designed to address all three questions whereas partial PSDDA monitoring only addresses questions 1 and 2.

DNR and the Corps are responsible for the physical (Corps) and chemical/biological (DNR) monitoring of the PSDDA non-dispersive disposal sites. This environmental monitoring is conducted, at irregular intervals, based on the "pattern" of disposal site use since the previous monitoring event. This pattern encompasses several important elements, such as volume and characteristics of the material disposed at a given site, the nature and recency of previous site monitoring data, and site-specific environmental concerns. Each spring, DMMP technical staff review the previous year's disposal activity and reach consensus on which site(s), if any, will be monitored and at what intensity.

The following sections summarize the partial survey at the Commencement Bay site, which was conducted during the spring of 1996.

DY96 - Commencement Bay - Partial Monitoring

Site Use and Monitoring History. A baseline (pre-disposal) survey of the Commencement Bay disposal site was conducted by the Department of Ecology in 1988 (PTI, 1988). A cumulative disposal volume from 1989 through 1995 of 325,953 cubic yards triggered a full monitoring survey in June 1995. The results of that survey were summarized in the 1996 Biennial Report. During the year following this monitoring event, an additional 460,684 cubic yards were disposed at the Commencement Bay site triggering the partial monitoring event in June 1996.

1996 Partial Monitoring Results. Three types of samples were collected during this monitoring survey: physical mapping (sediment vertical profile imagery), sediment chemistry, and sediment toxicity (bioassays). The major findings of this survey follow, organized according to the two major monitoring questions addressed by the survey.

1) Does the dredged material stay on-site?

A total of 174 images were collected at 66 stations during the sediment vertical profile survey (SVPS). Stations sampled during 1996 were similar to those sampled in 1995, with nine additional stations in 1996 to more fully delineate the dredged material footprint. The dredged material footprint was roughly triangular in shape, with the major axis oriented northwest to southeast, and the southeastern edge of the deposit extending beyond the site boundary and tracing the edge of the disposal site perimeter (Figure 2-5). Dredged material thicknesses measured within the disposal zone were greater than prism penetration, suggesting that the majority of the dredged material was placed on target. The thickness of the deposit of dredged material decreases with distance from the disposal zone, forming a thin 1-5 cm triangular apron as shown in Figure 2-5. The SVPS imagery confirmed that virtually all the recently deposited dredged material was confined within the disposal site perimeter (all dredged material measured at perimeter line was 0.5 cm or less in thickness), and therefore met the site management objective (no dredged material thicknesses greater than 3 cm at perimeter line). All measured SVPS parameters, including optical signature, grain size distribution, RPD (redox-potential-discontinuity), and OSI (organism-sediment-index) were all in general agreement as to the distribution and orientation of the dredged material.

Results of the thirteen sediment chemistry samples/analyses conducted within the dredged material footprint at one onsite and at twelve perimeter stations (there were three field replicate stations at each of the four perimeter stations) are summarized as follows. Metals were all below State Sediment Management Standards (SMS) and PSDDA screening level (SL) guidelines except lead, which slightly exceeded SL (e.g., highest concentration measured at 70 ppm) in one of three replicate samples at two of the four perimeter stations. However, the mean lead concentration at all four perimeter stations was below the SL. Few organic compounds were detected within the thirteen samples and all were all quantitated below the SMS and PSDDA SLs,

except phenol, which had a single exceedance of the SL (e.g., concentration measured at 190 ppm dry weight compared with PSDDA SL of 120 ppm) at one of the four perimeter stations. Two undetected chemicals (2-methylphenol and 1,2,4-trichlorobenzene) had detection limits that slightly exceeded the PSDDA SL, but not the SMS.[2]

Of the few detected organic chemicals, two low molecular weight polycyclic aromatic hydrocarbons (LPAHs), phenanthrene and 2-methylnaphthalene were detected in all 12 perimeter samples but not in the onsite station. A third LPAH, naphthalene, was detected in one of the twelve perimeter station samples. Five high molecular weight polycyclic aromatic hydrocarbons (HPAHs) were detected in perimeter station samples: fluoranthene (12 of 13 samples), pyrene (10 of 13 samples), chrysene (10 of 13 samples), benzo(b)fluoranthene (9 of 13 samples), benzo(a)anthracene (3 of 13 samples). Phenol and bis (2-ethylhexyl)phthalate were detected in most of the perimeter station samples. Aldrin was the only pesticide detected (1 of 13 samples).

In summary, the SVPS results indicated that the dredged material remained on site, as did the perimeter chemistry results (no exceedances of the State SMS sediment quality standards off-site).

2) Is the dredged material causing biological effects beyond the "minor adverse effects" allowed at the disposal site?

Onsite chemistry measurements indicated that there were no exceedances of the PSDDA MLs or state SMS at the one onsite station. Therefore, the chemical site management objective was not exceeded (all chemicals less than maximum levels).

The suite of PSDDA bioassays evaluated biological conditions at the one on-site location. All four bioassays passed the nondispersive site interpretive guidelines. Therefore, the biological effects management guideline ("minor adverse effects") for nondispersive sites was not exceeded.

Time Trend Analysis. Following the 1995 Commencement Bay monitoring survey, the PSDDA agencies decided to use the 1995 Commencement Bay data as baseline values for future monitoring comparisons in Commencement Bay. The rationale for this decision was documented in a 1997 PSDDA clarification paper presented at the Sediment Management Annual Review Meeting (Kendall and Benson, 1997). The results of a new time trend analysis approach implemented via this clarification paper are summarized below.

Technical Discussion. The DMMP agencies applied a new time trend statistical procedure to the 1996 Commencement Bay monitoring data to determine if changes observed in perimeter site chemistry were significant over time. The model applied is called the "Chemical Tracking System" (CTS), and is described in detail in SAIC (1996a). Briefly, the CTS evaluates the changes in site chemistry for each chemical, or for a guild of chemicals (e.g., metals, LPAHs), as a slope expressing the trend in concentrations over time. Underlying the approach is the assumption that if there is mass movement of dredged material, multiple chemicals will be involved and there will be a common trend among the chemical concentrations. The mean slope

[2] However, these values do not exceed 1998 SLs for phenol, 2-methylphenol and 1,2,4-trichlorobezene

of concentration versus time for several chemicals gives a more accurate estimate of change than use of the slopes of individual chemicals.

The CTS model was incorporated into an Excel spreadsheet, and run for Commencement Bay perimeter stations using the baseline (1988), 1995, and 1996 monitoring data (SAIC, 1996b). A brief discussion of the CTS outcome relative to time-trend analysis is included below.

All chemicals of concern (COCs). Table 2-5 presents the maximum likelihood estimations for each perimeter station; first as a global estimate for all COCs and then by individual groups. The analyses were based on the Puget Sound conventionals, metals, LPAHs and HPAHs, bis(2-ethylhexyl)phthalate and phenol. The remaining COCs were reported as unmeasured or undetected in the 1988, 1995, and 1996 surveys.

The global maximum likelihood results indicate that a significant ($p=0.05$) decrease occurred at one perimeter station (CBP01), but that there have been no significant changes in COCs at the remaining perimeter stations since 1988. For CBP01, there was a highly significant ($p<0.001$) mean decrease of 7.5% per year, largely caused by the decreases in LPAH and HPAH at all the perimeter stations. While metals showed significant increases, the overall trend at CBP01 was downward. Results of these analyses are discussed below based upon the major chemical groups.

Metals. As a group, the time trend analysis for three of the perimeter stations (CBP03, CBP07, and CBP11) did not demonstrate a significant change in metal concentrations over time. However, at one perimeter station (CBP01), examination of the slopes and p-values for arsenic, copper, mercury, silver and zinc showed significant positive increases since 1988. At all perimeter stations there were significant ($p<0.01$) increases in lead concentration.

PAHs. Time trend analysis suggests that there is a decreasing trend in perimeter PAH concentrations at CBP01, but LPAH changes at the other three perimeter stations were not significantly different from zero. For the LPAHs at CBP01 there were significant decreases in concentrations for five of the seven measured LPAHs since 1988; as much as 26% for acenapthene and anthracene. Even when comparing 1995 and 1996 CBP01 data, there are decreases in measured concentrations for all LPAHs. HPAHs show the same trend; a significant decrease at CBP01, but no significant changes at the other three perimeter stations.

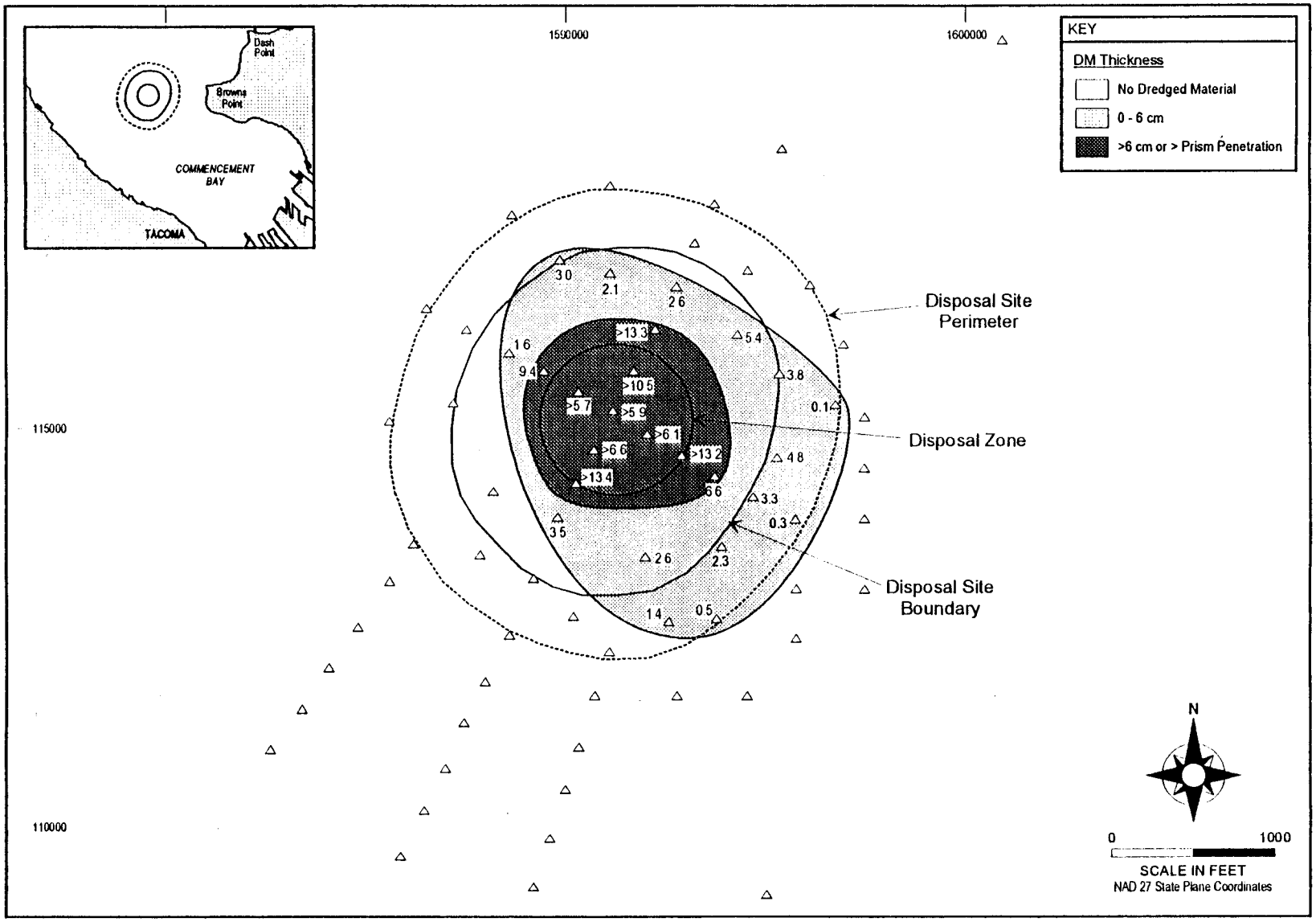


Figure 2-5. Dredged Material footprint measured at the Commencement Bay disposal site in 1996. Thickness is measured in centimeters.

Table 2-5. Sample Maximum Likelihood output for Commencement Bay perimeter stations. Results are presented as both global results, and by major chemical groups.

	SLOPE AND SIGNIFICANCE (Log 10)						***PERCENT CHANGE PER YEAR***		
	Mean	**S.E.**	**95% LCL**	**95% UCL**	**P-Value**		**Mean**	**95% LCL**	**95% UCL**
CBP01									
Global	-0.03385	0.00920	-0.05262	-0.01509	0.00088		-7.50	-11.41	-3.41
Conventionals	0.02569	0.00681	0.00817	0.04321	0.01302		6.09	1.90	10.46
Metals	0.02591	0.00410	0.01588	0.03593	0.00073		6.15	3.72	8.63
LPAH	-0.10661	0.01085	-0.14114	-0.07208	0.00224		-21.77	-27.75	-15.29
HPAH	-0.09456	0.02892	-0.16533	-0.02379	0.01705		-19.57	-31.66	-5.33
CBP03									
Global	-0.01737	0.01118	-0.04021	0.00547	0.13092		-3.92	-8.84	1.27
Conventionals	-0.02185	0.01757	-0.06484	0.02114	0.26000		-4.91	-13.87	4.99
Metals	-0.00690	0.00762	-0.02555	0.01174	0.39983		-1.58	-5.71	2.74
LPAH	-0.00334	0.01502	-0.06795	0.06127	0.84475		-0.77	-14.48	15.15
HPAH	-0.05841	0.03257	-0.14215	0.02532	0.13290		-12.58	-27.91	6.00
CBP07									
Global	-0.01556	0.00896	-0.03391	0.00280	0.09355		-3.52	-7.51	0.65
Conventionals	-0.03028	0.02185	-0.08376	0.02319	0.21511		-6.74	-17.54	5.48
Metals	-0.01564	0.00758	-0.03419	0.00292	0.08487		-3.54	-7.57	0.68
LPAH	0.03701	0.00894	-0.07655	0.15057	0.15084		8.90	-16.16	41.44
HPAH	-0.02557	0.01993	-0.07680	0.02566	0.25572		-5.72	-16.21	6.09
CBP11									
Global	-0.01984	0.01225	-0.04494	0.00526	0.11666		-4.47	-9.83	1.22
Conventionals	0.01874	0.01373	-0.01373	0.05122	0.21453		4.41	-3.11	12.52
Metals	-0.00850	0.01231	-0.03862	0.02163	0.51581		-1.94	-8.51	5.11
LPAH	-0.01914	0.01115	-0.16077	0.12249	0.33572		-4.31	-30.94	32.58
HPAH	-0.08118	0.03838	-0.17983	0.01747	0.08801		-17.05	-33.90	4.10

As a measure of decreases in PAHs at the perimeter stations, Table 2-6 compares mean total LPAH and HPAH concentrations in 1995 and 1996. In all cases, the 1996 perimeter PAH concentrations are less than those reported in 1995.

Table 2-6. Comparison of 1995 and 1996 total LPAH and HPAH concentrations at the perimeter stations. All values reported as µg/kg DW.

	CBP01		CBP03		CBP07		CBP11	
Year	**LPAH**	**HPAH**	**LPAH**	**HPAH**	**LPAH**	**HPAH**	**LPAH**	**HPAH**
1996	91	208	81	123	79	174	23	36
1995	297	2105	180	583	98	440	108	515

Summary: DMMP disposal site use and monitoring since program implementation

The cumulative dredged material volumes disposed at each PSDDA site and each Grays Harbor site since program implementation are depicted in Table 2-7 and Figures 2-6 and 2-7. All eight PSDDA sites have been used, and the two estuarine sites in Grays Harbor have been utilized. There was no disposal in DY96 and DY97 at the Willapa Bay disposal sites. Nine year summaries of site use for the PSDDA sites show that site capacities appear to be sufficient to last at least fifty years for most sites (Figure 2-6, Table 2-8). Over the nine years of PSDDA implementation (1989-1997) 4,441,924 cubic yards total have been placed at all eight open-water sites, averaging 551,241 cubic yards per year.

Table 2-7. Cumulative Site Use Summary.

Disposal Site	Dredging Years Used	Cumulative Volumes Disposed (cubic yards)
PSDDA	**(1989 - 1997)**	
Anderson/Ketron (ND)	93, 95	18,874
Commencement Bay (ND)	89, 91, 95, 96	769,089
Elliott Bay (ND)	90, 91, 92, 93, 94, 95, 96, 97	733,631
Port Gardner (ND)	90, 91, 93, 94, 95, 96, 97	1,722,871
Rosario Strait (D)	91, 92, 93, 94, 95, 96	1,074,790
Bellingham Bay (ND)	93, 96	77,683
Port Townsend (D)	93	22,642
Port Angeles (D)	96	22,344
Total cumulative volume		4,441,924
GRAYS HARBOR	**(1996 - 1997)**	
Point Chehalis (D)	96, 97	1,035,591
South Jetty (D)	96, 97	2,633,516
Half Moon Bay (beneficial use site)	96, 97	583,384
3.9 Mile Ocean (D)	not used	
Total cumulative volume		4,252,491

Legend: ND = nondispersive; D = dispersive

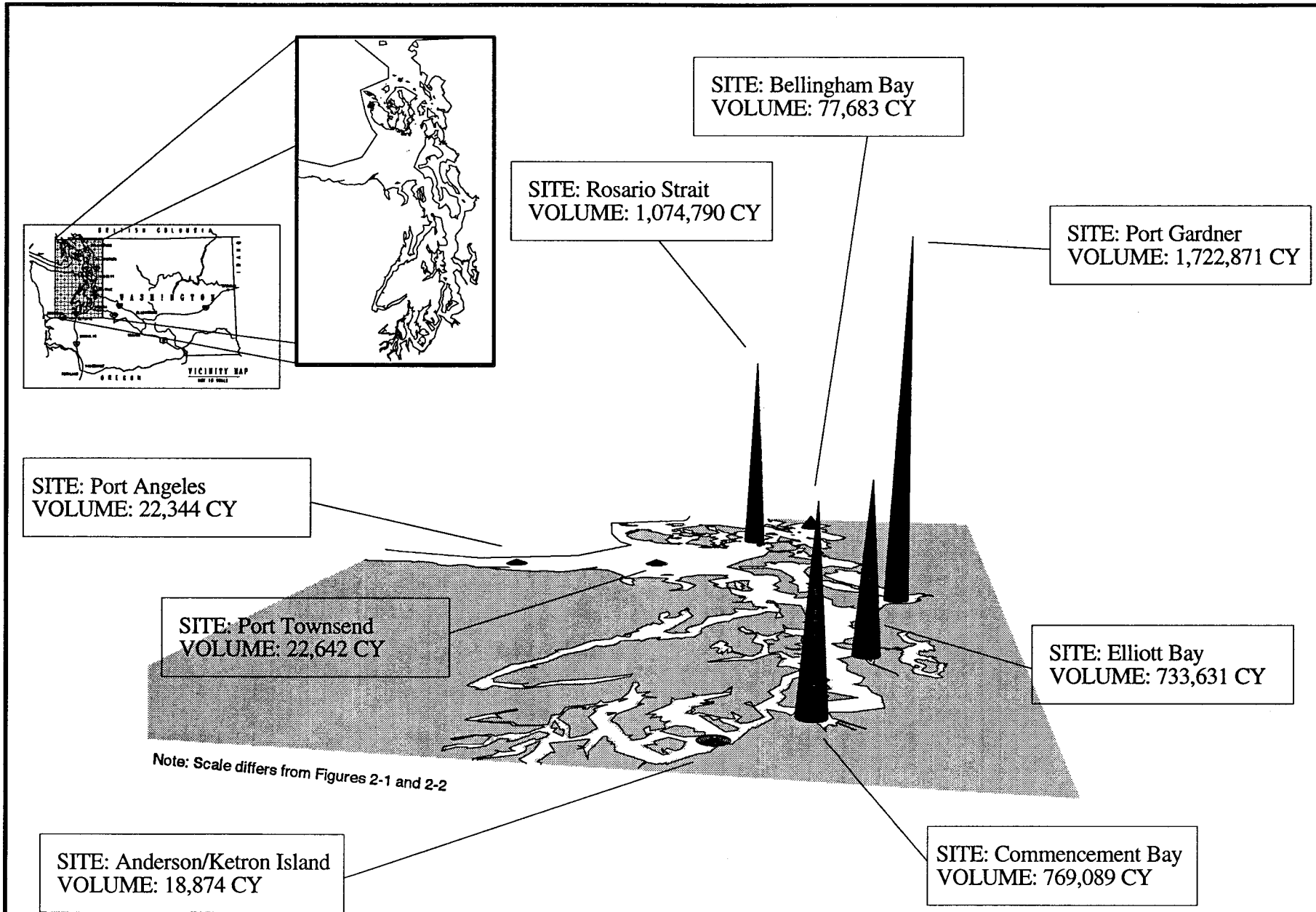


Figure 2-6. PSDDA Cumulative Disposal Volumes in Puget Sound Dredging Years 1989-1997

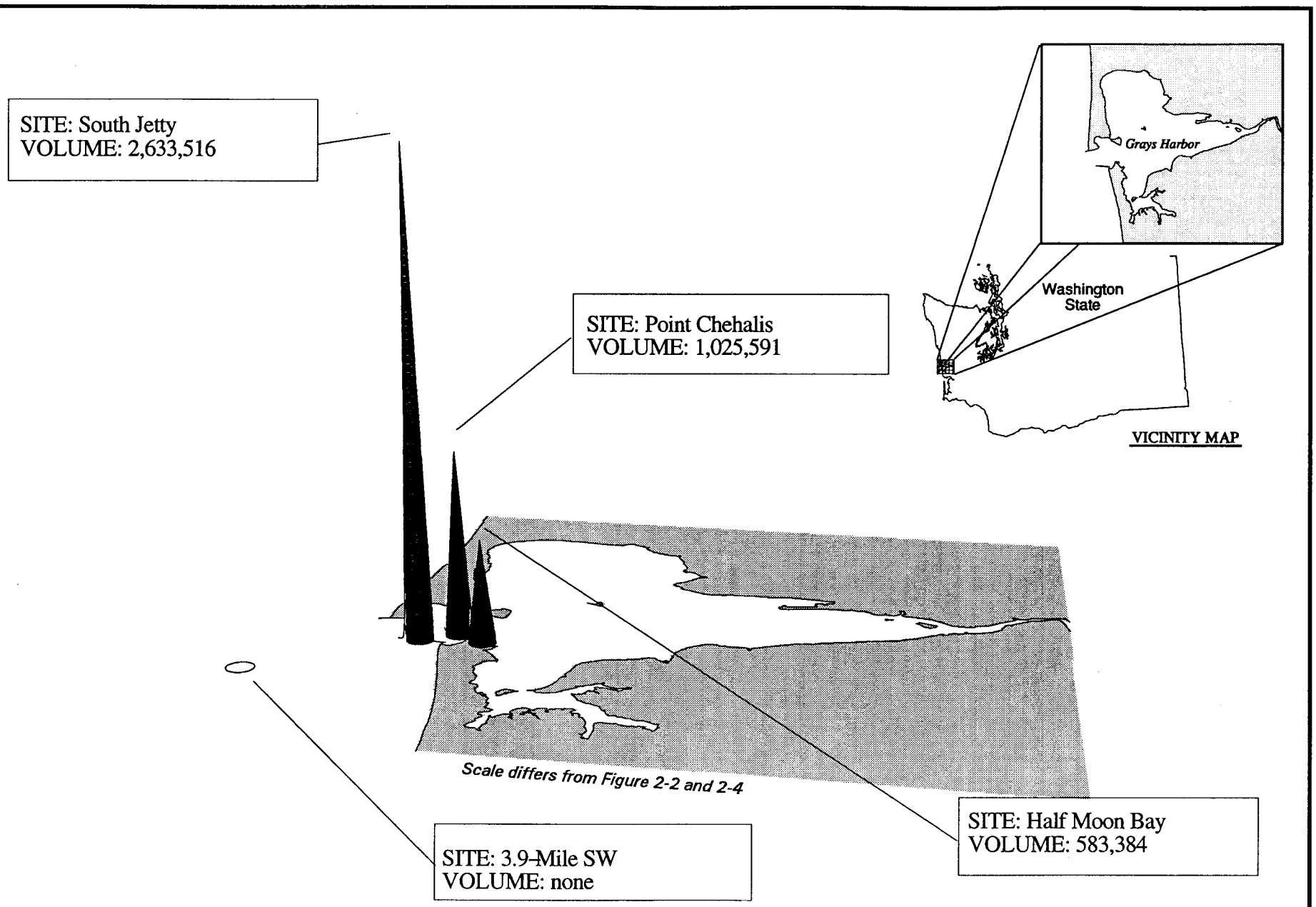


Figure 2-7. Cumulative Disposal Volumes for Grays Harbor (1996-1997)

Table 2-8. Nine Year PSDDA Site Use Summary.

Nondispersive Disposal Site	Cumulative Volumes (CY)	Average Volume (CY/YR)	15-Year Predictions MPR Phase I/II (CY)	Percent of 15-Year Prediction	Estimated Time to Exceed Site Capacity[3] (Years)
Port Gardner (1989-1997)	1,722,871	191,430	8,243,000	20.9	47
Elliott Bay (1989-1997)	733,631	81,515	10,525,000	7.0	>50
Bellingham Bay (1990-1997)	77,683	9,710	1,181,500	6.6	>50
Commencement Bay (1989-1997)	769,089	85,454	3,929,000	19.6	>50
Anderson/Ketron Island (1990-1997)	18,874	2,359	785,000	2.4	>50
SUBTOTALS:	3,322,148	370,468	24,763,500	11.3	N/A
Dispersive Disposal Site	**Cumulative Volumes (CY)**	**Average Volume per Year (CY/YR)**	**15-Year Predictions MPR Phase I/II (CY)**	**Percent of 15-Year Prediction**	**Estimated Time to Exceed Site Capacity[4] (Years)**
Rosario Strait (1990-1997)	1,074,790	134,349	1,801,000	59.7	N/A
Port Townsend (1990-1997)	22,642	2,830	687,000	3.3	N/A
Port Angeles (1990-1997)	22,344	2,793	285,000	7.8	N/A
SUBTOTALS:	1,119,776	139,972	2,773,000	40.4	N/A
GRAND TOTALS:	4,441,924	555,241	27,536,500	16.1	N/A

Table 2-9 lists the completed and scheduled DMMP disposal site monitoring events at the PSDDA nondispersive and dispersive sites. To date, the DMMP agencies have conducted seven post-disposal monitoring surveys at nondispersive sites - 2 full, 2 partial, 2 tiered-full and one tiered-partial monitoring events. Four of five nondispersive sites have been surveyed. The only nondispersive site not yet monitored is the Ketron/Anderson Island site, which has received relatively little use to date.

[3] Site capacity estimated in Phase II Disposal Site Selection Technical Appendix for nondispersive sites is approximately 9,000,000 cubic yards.

[4] Actual site capacity for dispersive sites is not limited, assuming complete dispersal of dredged material off site.

Table 2-9. PSDDA Disposal Site Monitoring Surveys.

Year	Disposal Site	Type of Survey
1990	Port Gardner	Full
1990	Elliott Bay	Partial
1992	Elliott Bay	Full
1993	Bellingham Bay	Partial
1994	Port Gardner	Tiered-Full
1995	Commencement Bay	Tiered-Full
1996	Commencement Bay	Tiered-Partial

Based on PSDDA site monitoring data collected to date (including physical mapping, on and offsite sediment chemistry, sediment toxicity, offsite infaunal bioaccumulation, and offsite benthic community structure data), dredged material disposal is not causing adverse impacts at or adjacent to any of the nondispersive sites. PSDDA evaluation procedures appear to adequately protect the environmental conditions at the disposal sites.

The overall goal of the PSDDA site monitoring program is to insure that the PSDDA prescribed disposal site conditions are maintained and verify that PSDDA dredged material evaluation procedures adequately protect the environment. Monitoring surveys provide positive feedback to verify the adequacy of the PSDDA dredged material management process. Annual review meetings provide a forum to report on these post-disposal survey findings conducted during any given dredging year, and any adjustments to the management plan.

The PSDDA Management Plan Reports (MPR, 1988, 1989) recognize that intensive post-disposal monitoring surveys would be required early in program implementation to gather data on the adequacy of the evaluation procedures to meet the site management objectives. Seven monitoring events to date have not detected unexpected adverse impacts at any of the four nondispersive sites that have been monitored. In accordance with the management plan, following the 1997 SMARM, the DMMP agencies reduced the frequency and scope of monitoring based on past documented compliance with the site management objectives. These modifications to the management plan formally incorporated tiered-full monitoring into the management plan, and initiate monitoring when cumulative volumes approach or exceed 300,000 cubic yards since the last monitoring event. The DMMP agencies will continue to assess the perimeter chemistry evaluation approach adopted and implemented following the 1997 SMARM.

References

DSSTA, 1988. Puget Sound Dredged Disposal Analysis (PSDDA) Phase I (Central Puget Sound) Disposal Site Selection Technical Appendix. Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

DSSTA, 1989. Puget Sound Dredged Disposal Analysis (PSDDA) Phase II (North and South Puget Sound) Disposal Site Selection Technical Appendix. Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

EPTA, 1988. Evaluation Procedures Technical Appendix. Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

FEIS, 1988. Puget Sound Dredged Disposal Analysis (PSDDA) Phase I (Central Puget Sound) Final Environmental Impact Assessment. Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

FEIS, 1989. Puget Sound Dredged Disposal Analysis (PSDDA) Phase II (North and South Puget Sound) Final Environmental Impact Assessment. Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

Kendall, D. and T. Benson. 1997. Disposal site monitoring chemical valuation guidelines reassessment and proposed changes to nondispersive site management plans. A DMMP Clarification Paper presented at the May 7, 1997 Sediment Management Annual Review Meeting.

MPR, 1988. Puget Sound Dredged Disposal Analysis (PSDDA) Management Plan Report, Unconfined Open-Water Disposal of Dredged Material, Phase I (Central Puget Sound). Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

MPR, 1989. Puget Sound Dredged Disposal Analysis (PSDDA) Management Plan Report, Unconfined Open-Water Disposal of Dredged Material, Phase II (North and South Puget Sound). Prepared by the Corps of Engineers in cooperation with the Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

MPTA, 1988. Puget Sound Dredged Disposal Analysis (PSDDA) Management Plan Technical Appendix. Prepared by the Corps of Engineers in cooperation with the

Environmental Protection Agency, Region 10, and the Washington State Departments of Ecology and Natural Resources.

Pavlou, S.P., R.N. Dexter, W. Hom, A.J. Hafferty, and K.A. Krogslund. Aquatic disposal field investigations Duwamish Waterway disposal site Puget Sound, Washington; Appendix E: Release and distribution of polychlorinated biphenyl's induced by open-water dredged disposal activities. Prepared for the Dredged Material Research Program, Office, Chief of Engineers, U.S. Army Washington, DC (Technical Report: D-77-24).

PTI, 1988. Puget Sound Dredged Disposal Analysis: Baseline Survey of Phase I Disposal Sites. Prepared for Washington Department of Ecology. PTI Environmental Services, Bellevue, WA.

PTI, 1989. Puget Sound Dredged Disposal Analysis: Baseline Survey of Phase II Disposal Sites. Prepared for Washington Department of Ecology. PTI Environmental Services, Bellevue, WA.

SAIC 1991. PSDDA 1991 Monitoring Program: Port Gardner benchmark station observations. Tissue chemistry of invertebrates from Port Gardner and Bellingham Bay, and bioaccumulation guidelines assessment. Draft report. Prepared by SAIC, Bothell, WA. for the Washington State Department of Natural Resources and the PSDDA agencies.

SAIC, 1993 PSDDA perimeter chemistry trigger approach assessment. Prepared by SAIC, Bothell, WA. for the Washington State Department of Natural Resources and the PSDDA agencies.

SAIC, 1995. 1995 full monitoring at the Commencement Bay PSDDA disposal site. Prepared by SAIC, Bothell, WA. for the Washington State Department of Natural Resources and the PSDDA agencies.

SAIC, 1996a. A new statistical protocol for evaluating PSDDA perimeter site chemistry. Prepared by SAIC, Bothell, WA. and Mountain Whisper Light Statistical Consulting, Seattle, WA. for the Washington State Department of Natural Resources and the PSDDA agencies.

SAIC, 1996b. Partial monitoring at the Commencement Bay PSDDA disposal site. Prepared by SAIC, Bothell, WA and Herrera Environmental Consultants, Seattle, WA. for the Washington State Department of Natural Resources and the PSDDA agencies.

APPENDIX A

The following discussion includes those projects requiring explanation beyond the summaries provided in Chapter 1 for ranking, sampling plan development, chemical testing, biological testing, or those for which the DMMP agencies used best professional judgment as part of the decision-making process.

Dredging Year 1996

High Cascade International. This project is located at Stevenson, Washington, on the lower Columbia River. A Tier I evaluation under the draft Inland Testing Manual was undertaken, reviewing known sources and site history to determine the potential for contaminants in the area. Section 404 of the Clean Water Act provides that in areas of high current, with a high proportion of sand, and lacking sources of contamination, material does not require chemical characterization prior to disposal in an aquatic environment. To confirm that the material to be dredged consisted of sand, grain size analysis was performed. The material was determined to be predominantly sand, and in an area generally free from sources of contamination, and therefore suitable for aquatic disposal.

Dredging Year 1997

City of Bellevue, Meydenbauer Bay Yacht Club. The City of Bellevue proposed to dredge approximately 2500 cubic yards of sediment from the Meydenbauer Yacht Club in Lake Washington. This area was ranked high due to the presence of stormwater outfalls in an urban environment. Samples were taken in two locations and composited for one analysis. The chemical analysis showed five exceedances of Dredging Year 1996 maximum levels. The applicants chose not to pursue biological testing, and the application for open-water disposal was withdrawn. A later application to dredge a small portion of the material (150 cubic yards) and place it upland in a confined facility was approved.

Crowley Marine Services, 8th Avenue Terminal Facilities Slip 4. Sediment characterization of the 13,000 cubic yards of proposed maintenance material at Slip 4 consisted of the collection of three samples from each of the four surface 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.

Chemical analysis results demonstrated that all four dredged material management units characterized contained screening level exceedances of chemicals of concern, principally

HPAHs and PCBs, which were found in all DMMUs. One DMMU (S1) had multiple SL exceedance and one chemical, fluoranthene, which exceeded both the maximum level and the bioaccumulation trigger. A second bioaccumulation trigger for PCBs was exceeded in a second DMMU (S4). Normal bioassay testing was initiated on all four DMMUs, before proceeding with bioaccumulation testing for the two DMMUs with BT exceedances.

The DMMU (S1) with the fluoranthene BT exceedance passed PSDDA bioassay interpretive guidelines, and subsequently underwent 28-day bioaccumulation testing to assess fluoranthene human health and ecological risks. The remaining DMMU (S4) with the BT exceedance for PCBs failed the bioassay guidelines and no further biological testing was initiated.

The 28-day bioaccumulation test was conducted at Battelle Northwest Laboratory, Sequim, Washington. The protocol followed and approved by the PSDDA agencies consisted of testing with the adult bivalve,*Macoma nasuta* and the adult polychaete, *Nepthys caecoides.* The species were co-tested 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 occurred at the same time as tissue analyses, and demonstrated a five-fold decrease in fluoranthene compared with the initial concentration measured. The PSDDA agencies determined that these bioaccumulation results were suitable for regulatory decisionmaking. The results demonstrated significant bioaccumulation of fluoranthene by both species. 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) = 68.4 ppb (wet) = 84% moisture/16% solids
Nepthys Tissue = 167.5 ppb (dry) = 28.5 ppb (wet) = 83% moisture/17% solids
Ratio: *Macoma* Tissue: 427.4 / Resampled Sediment: 1,600 = 0.267 (26.7%)
Ratio: *Nepthys* Tissue: 167.5 / Resampled Sediment: 1,600 = 0.105 (10.5%)
Thus, no apparent potential for bioconcentration (biomagnification) is apparent 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 x 10^{-06}

adjusting tissue for Initial/Resampled Sediment: Tissue (*Macoma*) = 0.0684 ppm (wet) x 5.3 = 0.3625 ppm (wet) = 4.316 x 10^{-05}

Tissue **(*Nepthys*)**= 0.0285 ppm (wet) / PSDDA Criterion=8,400 ppm (wet) = 3.39 x 10^{-06}
Adjusting tissue for Initial/Resampled Sediment: Tissue (*Nepthys*) = 0.0285 x 5.3 = 0.151 ppm (wet)/8,400 ppm(wet) = 1.80 x 10^{-05}

Conclusion: These results do not demonstrate a human health concern.

Ecological Health Evaluation: Statistical comparisons (t-test) of observed tissue burdens (28-day exposures) from tested DMMU sediment (S1) exposures and reference sediment tissue exposures demonstrated a significant bioaccumulation potential in the tested DMMU-S1 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 (*Nepthys*) = 2.5 ppb (@ ½ detection limit - wet weight);
Test sediment (DMMU-S1) mean (*Nepthys*) = 28.5 ppb (wet)
Ratio *Nepthys*: Test/Reference tissue = 11.4
Ratio *Nepthys*: Test tissue x 5.3 (Initial/Resampled difference) = 151 ppb (wet)/Reference tissue = 60.4 fold increase after adjustment

Conclusion: This comparison demonstrates a significant tissue accumulation and potential ecological health concern. Therefore, DMMU-S1 was determined to be not suitable for unconfined open-water disposal.

Port of Everett Marine Terminal Improvements Project

Stage I of the Port of Everett Marine Terminal Improvements Project included dredging of 422,000 cubic yards of sediment. Of this volume, 183,000 cubic yards were covered by an earlier suitability determination. Subsequent to that determination, the Port of Everett revised its design requirements and requested a suitability determination for an additional 239,000 cubic yards of material.

The additional proposed volume included three fractions. The largest fraction consisted of native material, which lay beneath the original project volume. Second, a portion of the revised footprint fell just outside the DMMUs addressed in the previous determination. Finally, a pocket of wood debris was identified within the project footprint during geotechnical sampling.

As a result of a partial characterization conducted in 1992, the DMMP agencies determined that native sediment underlying the proposed dredging project was suitable for open-water disposal with no additional testing required. This determination logically extended to the additional volume of native sediment proposed for dredging in the revised design. The sediment falling outside the original project footprint was found suitable for open-water disposal based on evidence available from previous sediment and groundwater analyses. The woody debris was tested and found to be chemically similar to surrounding sediments. However, because this material was predominantly wood waste, the DMMP agencies determined that it was unsuitable for open-water disposal.

Port of Seattle Terminal 18

Tributyltin testing. The DMMP evaluation guidelines for tributyltin (TBT) were in a state of flux during this project. At the time of SAP development, PSDDA required bulk sediment testing for TBT in areas of concern such as East Waterway. The SL and BT at the time were 30 and 219 ug/kg TBT (as tin) respectively. However, an interagency workgroup was in the process of developing guidance for use by EPA Region 10 in the evaluation of TBT at Superfund sites. Based on this work, the DMMP agencies proposed revised guidelines which included pore water 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 triggers bioaccumulation testing. Because the Port of Seattle had already conducted bulk sediment testing for TBT, a compromise was reached between the Port and DMMP agencies which called for calculation of theoretical pore water concentrations using a relationship developed by the National Marine Fisheries Service. The Port of Seattle agreed to conduct pore water testing on archived sediment for those DMMUs with calculated interstitial TBT concentrations exceeding 0.15 ug/l (as TBT). Fifteen DMMUs were extracted for pore water and tested for TBT. Only two of the fifteen DMMUs exceeded 0.15 ug/l (as TBT) and required bioaccumulation testing. One of these two DMMUs exceeded the tissue residue limit established for TBT and was found unsuitable for open-water disposal.

Amphipod bioassay. For the amphipod test, the DMMP 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. The Port of Seattle elected to use *Eohaustorius estuarius* collected from Beaver Creek, Oregon. This strategy for TBT testing was later overcome by events as the DMMP agencies shifted focus to pore water analysis and bioaccumulation testing.

The Port of Seattle expressed concern regarding potential ammonia toxicity in the amphipod test and proposed reducing ammonia concentrations to nontoxic levels prior to testing using a purging protocol recommended by EPA and the Corps of Engineers. The DMMP agencies agreed to this procedure. A threshold of 15 mg/l (pore water) was used

to determine which DMMUs required ammonia adjustment. 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.

Bioaccumulation testing. 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 DMMP bioaccumulation test duration is 28 days. However, 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 DMMP agencies agreed that statistical difference from reference was 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.

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. The following tissue residue limits were established:

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 DMMP projects as additional bioaccumulation data become available.

The dredger's option. For DMMUs with multiple ML exceedances, or with a single chemical exceeding an ML by a factor of two, the "dredger's option" can be invoked. 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 DMMP agencies on a case-by-case basis.

The Port of Seattle invoked the dredger's option on two DMMUs. The first had a single chemical, benzyl alcohol, which exceeded the ML by greater than a factor of two. This DMMU caused no adverse effects in any of the PSDDA bioassays, either acute or sublethal. In addition, benzyl alcohol is not a bioaccumulative chemical of concern, thus posing no adverse ecological or human health effects due to long-term uptake or trophic transfer. There was no reason to believe that this DMMU poses an undue environmental risk, therefore the DMMP agencies determined that this DMMU was suitable for open-water disposal.

The second DMMU for which the dredger's option was invoked had ML exceedances for PCBs and DDT. While no adverse effects were found in any of the PSDDA bioassays, the DMMP agencies were concerned with the possibility of trophic transfer, biomagnification and potential adverse effects on birds or marine mammals. The Port of Seattle agreed to conduct an ecological risk assessment specific to disposal of PCB-contaminated sediment at the Elliott Bay site. However, the agencies and the Port did not come to agreement concerning assumptions underlying the modeling effort and the risk assessment was not completed. Therefore, this DMMU was found unsuitable for open-water disposal.

USACE Everett Downstream Channel and Settling Basin

A single SL exceedance occurred, with one DMMU having diethyl phthalate detected just marginally above the SL. A screening level exceedance normally triggers the requirement to run bioassays. But because phthalates are common laboratory contaminants, the PSDDA agencies do not require biological testing based solely on a phthalate exceedance of SL [EPTA, 1988, see pages II-100, II-123, II-209]. Therefore, no bioassays were performed. However, to verify or refute the diethylphthalate exceedance, Seattle District performed three additional analyses on frozen archived sediment. Diethylphthalate was undetected in all three analyses at a level below the SL.

Port of Tacoma, Blair Turning Basin. The initial project ranking for this area was moderate, base on guidance provided in the Management Plan Report, Phase II. The project was down-ranked two levels to low, based on previous testing data, lack on in-water or upland source of contamination, and the probability that most of the material was native sediment. All material tested for this project was found suitable for open-water disposal.

Weyerhaeuser, Mt. Coffin Channel. Weyerhaeuser Inc. proposed to dredge approximately 200,000 cubic yards from the Mt. Coffin Channel in the Columbia River, with flow-lane disposal in the Columbia River near River Mile 62. This project underwent evaluation under the Section 404 guidelines, similar to the process described for the High Cascade International project described previously. Seven samples were taken of material from the dredge prism, and grain size analysis was performed. The material was all medium to coarse sand. All samples were at least 99 percent sand. Based on this

information, and the absence of sources of contamination in the vicinity of dredging, the material was determined to be suitable for in-water disposal.

APPENDIX B - DY92/93 GUIDELINE VALUES (CHEMISTRY)

CHEMICAL	SL	BT	ML	(SL+ML)/2
METALS (ppm dry wgt):				
Antimony	20	146	200	110
Arsenic	57	507.1	700	378.5
Cadmium	0.96		9.6	5.3
Copper	81		810	445.5
Lead	66		660	363
Mercury	0.21	1.5	2.1	1.2
Nickel	140	1,022		
Silver	1.2	4.6	6.1	3.7
Zinc	160		1,600	880
ORGANOMETALICS (ug/l porewater):				
Tributyltin		0.15		
ORGANIC CHEMICALS (ppb dry wgt):				
LPAH				
2-Methylnaphthalene	67		670	368.5
Acenaphthene	63		630	346.5
Acenaphthylene	64		640	352
Anthracene	130		1,300	715
Fluorene	64		640	352
Naphthalene	210		2,100	1,155
Phenanthrene	320		3,200	1,760
Total LPAH	610		6,100	3,355
HPAH				
Benzo(a)anthracene	450		4,500	2,475
Benzo(a)pyrene	680	4,964	6,800	3,740
Benzo(g,h,i)perylene	540		5,400	2,970
Benzofluoranthenes	800		8,000	4,400
Chrysene	670		6,700	3,685
Dibenzo(a,h)anthracene	120		1,200	660
Fluoranthene	630	4,600	6,300	3,465
Indeno(1,2,3-c,d)pyrene	69		5,200	2,634.5
Pyrene	430		7,300	3,865
Total HPAH	1,800		51,000	26,400
CHLORINATED HYDROCARBONS				
1,2,4-Trichlorobenzene	13		64	38.5
1,2-Dichlorobenzene	19	37	350	184.5
1,3-Dichlorobenzene	170	1,241		
1,4-Dichlorobenzene	26	190	260	143
Hexachlorobenzene	23	168	230	126.5

APPENDIX B - DY92/93 GUIDELINE VALUES (CHEMISTRY)

CHEMICAL	SL	BT	ML	(SL+ML)/2
PHTHALATES				
Bis(2-ethylhexyl) phthalate	3,100	13,870		
Butyl benzyl phthalate	470			
Di-n-butyl phthalate	1,400	10,220		
Di-n-octyl phthalate	6,200			
Diethyl Phthalate	97			
Dimethyl Phthalate	160	1,168		
PHENOLS				
2-Methylphenol	20		72	46
2-4-Dimethylphenol	29		50	39.5
4-Methylphenol	120		1,200	660
Pentachlorophenol	100	504	690	395.0
Phenol	120	876	1,200	660
MISCELLANEOUS EXTRACTABLES				
Benzoic Acid	400		690	545
Benzyl Alcohol	25		73	49
Dibenzofuran	54		540	297
Hexachlorobutadiene	29	212	290	159.5
Hexachloroethane	1,400	10,220	14,000	
N-Nitrosodiphenylamine	28	161	220	124
VOLATILE ORGANICS				
Ethylbenzene	10	27	50	30
Tetrachloroethene	14	102	210	112
Total Xylene	12		160	86
Trichloroethene	160	1,168	1,600	880
PESTICIDES and PCBs				
Aldrin	10	37		
Chlordane	10	37		
Dieldrin	10	37		
Heptachlor	10	37		
Lindane	10	37		
Total DDT	6.9	50	69	38
Total PCBs	130	38*	2,500	1,315

* Value in ppm normalized to Total Organic Carbon

APPENDIX B - DY96/97 DMMP EVALUATION GUIDELINES (BIOASSAYS)

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

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

APPENDIX C - LEGEND

S	=	reported concentration exceeds screening level (SL)
B	=	reported concentration exceeds bioaccumulation trigger (BT)
M	=	reported concentration exceeds maximum level (ML)
BM	=	reported concentration exceeds BT and ML
u	=	detection limit exceeds SL
b	=	analyte detected in corresponding blank
d	=	quantitation performed on a diluted sample
e	=	estimate
j	=	detected between the SDL and the CRDL
L	=	the highest reported concentration was below SL
LM	=	the highest reported concentration was between SL and (SL + ML)/2
M	=	the highest reported concentration was between (SL + ML)/2 and ML
H	=	the highest reported concentration exceeded ML
H*	=	the sediment rank is based on biological testing results
X	=	a hit under the two-hit rule, or denotes “yes”
XX	=	a hit under the single-hit rule
X(X)	=	a hit under the two-hit rule for nondispersive sites; a hit under the single-hit rule for dispersive sites
QC	=	bioassay results were set aside due to QA/QC problems
P	=	test sediment passed PSDDA guidelines for open-water unconfined disposal
F	=	test sediment failed PSDDA guidelines for open-water unconfined disposal
P(F)	=	passes nondispersive guidelines; fails dispersive guidelines
F(C)	=	DMMU found unsuitable for open-water disposal in the absence of bioaccumulation and/or Tier IV testing data
---	=	this test was not done

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																														
	1C03		1C04			1C05		1C06			1C07		1C08		1C09	1C10		1C11			1C12			1C13			1C14			1C15		
METALS & ORGANOMETALICS																															
Antimony																															
Cadmium	S																	S			S					S					
Copper																		S			S										
Lead																		S			S			S			S				
Mercury											S		S					S			S			S			S				
Silver																		S	u		S										
Zinc																		S			S										
Tributyltin			B	j		B																									
LPAH																															
2-Methylnaphthalene								S	d		S																				
Acenaphthene			S					S	d		S		S																		
Acenaphthylene																															
Anthracene								S	d		S					S								S			S	d			
Fluorene			S					S	d		S		S			S															
Naphthalene								S	d																						
Phenanthrene			S					S	d		S		S			S											S	d			
Total LPAH								S	d		S		S			S											S	d			
HPAH																															
Benz(a)anthracene																S											S	d			
Benzo(a)pyrene																S															
Benzo(b+k)fluoranthenes																S															
Benzo(g,h,i)perylene																															
Chrysene																S	d										S	d			
Dibenz(a,h)anthracene																															
Fluoranthene											S		S			S	d							S			S	d			
Indeno(1,2,3-c,d)pyrene	S		S			S		S	d		S		S			S					S	d		S			S	d			
Pyrene	S	d	S			S	d	S	d		S		S		S	S	d	S	d		S	d		S	d		S	d		S	d	S
Total HPAH	S		S			S		S	d		S		S		S	S	d	S			S	d		S	d		S	d		S	d	S
CHLORINATED HYDROCARBONS																															
1,2-Dichlorobenzene																															
1,2,4-Trichlorobenzene																					S	ud									
1,4-Dichlorobenzene																															
Hexachlorobenzene								S	ud												S	ud					S	ud			
Hexachlorobutadiene								S	ud												S	ud					S	ud			

(Continued on facing page)

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																													
	1C03		1C04		1C05		1C06		1C07		1C08		1C09		1C10		1C11		1C12		1C13		1C14		1C15	
PHTHALATES																										
Bis(2-ethylhexyl)phthalate																										
Diethyl phthalate																										
Dimethyl phthalate																										
PHENOLS																										
2-Methylphenol							S	ud											S	ud			S	ud		
2,4-Dimethylphenol																										
4-Methylphenol																										
Pentachlorophenol																			S	ud						
Phenol																										
MISCELLANEOUS EXTRACTABLES																										
Benzoic acid																										
Benzyl alcohol							M	d											S	ud						
Dibenzofuran							S	d	S		S				S											
N-nitrosodiphenylamine																			S	ud						
VOLATILE ORGANICS																										
Ethylbenzene																										
Xylenes																										
PESTICIDES AND PCBs																										
Aldrin	S	ud	S	d																						
Alpha chlordane	B	ud	S	ud															S	d						
Dieldrin	S	d	S	d													S	d	S	d			S	d		
Gamma-HCH (Lindane)	S	ud																								
Heptachlor	S	ud																								
Total DDT	BM	d	S	ud	S	ud	S	ud							S	ud	S	d	S	d	S	d	S	d		
Total PCBs	BM	d	B	d	B	d	S								S	d	S	d	B	d	B	d	B	d		
BIOASSAYS																										
Amphipod			X						X		XX				X				X		XX					
Neanthes Biomass									XX		XX															
Sediment Larval									X		X		X						X							
Bioassay Pass/Fail:	P		P		P		P		F		F		P		P		P		F		F		P		P	
BTs exceeded:	X		X		X														X		X		X			
Bioaccumulation Test Conducte	X		X		X																					
Bioaccumulation Pass/Fail:	P		F		P																		P			
ML rule exceeded:	X						X																			
OVERALL PASS/FAIL	F(C)		F		P		P		F		F		P		P		P		F		F		P		P	
HIGHEST RANKING	H		H*		LM		H		H*		H*		LM		LM		LM		H*		H*		LM		LM	

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																													
	1C16		1C17		1C18		1C19		1C20		1C21		1C22		1C23		1C24		1C25		1C26		1C27		1C28	
METALS & ORGANOMETALICS																														
Antimony																														
Cadmium	S		S				S		S		S	j	S				S	j	S	j			S							
Copper	S		S	j			S	j	S				S				S		S				S							
Lead	S		S				S		S		S		S				S		S				S							
Mercury	S		S		S		S		S		S		S		S		S		S		S		S							
Silver	S		S	j			S	j	S										S				S							
Zinc	S		S				S		S				S				S		S				S							
Tributyltin																														
LPAH																														
2-Methylnaphthalene			S	ud			S	d			S	ud					S	ud	S	ud			S	j						
Acenaphthene	S	d	S	ud			S	d			S	ud					S	ud	S	ud			S							
Acenaphthylene			S	ud							S	ud					S	ud	S	ud										
Anthracene	S	d	S	d			S	d	S	d							S	d	S	d			S							
Fluorene	S	d	S	d			S	d	S	d	S	ud					S	d	S	d			S							
Naphthalene							S	d																						
Phenanthrene	S	d					S	d															S							
Total LPAH	S	d					S	d											S	d			S							
HPAH																														
Benz(a)anthracene	S	d					S	d											S	d										
Benzo(a)pyrene																														
Benzo(b+k)fluoranthenes							S	d											S	d										
Benzo(g,h,i)perylene																														
Chrysene	S	d					S	d											S	d										
Dibenz(a,h)anthracene																			S	ud										
Fluoranthene	S	d	S	d			S	d	S	d							S	d	S	d			S							
Indeno(1,2,3-c,d)pyrene	S	d	S	d			S	d	S	d	S	d	S		S		S	d	S	d					S					
Pyrene	S	d	S	d	S		S	d	S	d	S	d	S		S	d	S	d	S	d			S		S					
Total HPAH	S	d	S	d			S	d	S	d	S	d	S		S		S	d	S	d			S		S					
CHLORINATED HYDROCARBONS																														
1,2-Dichlorobenzene																														
1,2,4-Trichlorobenzene	S	ud	S	ud			S	ud	S	ud	S	ud					S	ud	S	ud										
1,4-Dichlorobenzene																														
Hexachlorobenzene	S	ud	S	ud			S	ud	S	ud	S	ud					S	ud	S	ud										
Hexachlorobutadiene	S	ud	S	ud			S	ud	S	ud	S	ud					S	ud	S	ud										

(Continued on facing page)

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																																							
	1C16			1C17			1C18			1C19			1C20			1C21			1C22			1C23			1C24			1C25			1C26			1C27			1C28		
PHTHALATES																																								
Bis(2-ethylhexyl)phthalate																																								
Diethyl phthalate																											S	ud												
Dimethyl phthalate																																								
PHENOLS																																								
2-Methylphenol	S	ud		S	ud					S	ud		S	ud		S	ud									S	ud		S	ud										
2,4-Dimethylphenol				S	uj											S	uj									S	ud		M	uj										
4-Methylphenol																											S	ud												
Pentachlorophenol	S	ud		S	ud					S	ud		S	ud		S	ud									S	ud		S	ud										
Phenol										S	d		S	d													S	ud												
MISCELLANEOUS EXTRACTABLE																																								
Benzoic acid				S	ud																						S	uj												
Benzyl alcohol	S	ud		S	ud					S	ud		S	ud		S	ud									S	ud		M	ud										
Dibenzofuran				S	ud					S	d					S	ud									S	ud		S	ud				S						
N-nitrosodiphenylamine	S	ud		S	ud					S	ud		S	ud		S	ud									S	ud		S	ud										
VOLATILE ORGANICS																																								
Ethylbenzene																																								
Xylenes																																								
PESTICIDES AND PCBs																																								
Aldrin										S	d		S	d													S	d					S	d						
Alpha chlordane				S	ud					S	d		S	d													S	ud	S	d		S	d						
Dieldrin	S	d		S	d					S	d		S	j					S	d					S	d		S	d				S	d						
Gamma-HCH (Lindane)																																								
Heptachlor																																								
Total DDT	S	d		S						S			S	d		S	d		S	d					S	d		BM	d		S	d		BM	d				
Total PCBs	B	d		B	d					B	d		B	d		S	d		S	d		S	d		S	d		B	d		S			B	d				
BIOASSAYS																																								
Amphipod	X			XX						XX			X						X						X			XX			X			XX					
Neanthes Biomass	X																																	XX						
Sediment Larval	X			X																														XX						
Bioassay Pass/Fail:	F			F			P			F			P			P			P			P			P			F			P			F			P		
BTs exceeded:	X			X						X			X														X						X						
Bioaccumulation Test Conducte																																								
Bioaccumulation Pass/Fail:													P																												
ML rule exceeded:																											X													
OVERALL PASS/FAIL	F			F			P			F			P			P			P			P			P			F			P			F			P		
HIGHEST RANKING	H*			H*			LM			H*			M			LM			LM			LM			LM			H			LM			H			LM		

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project: Port of Seattle, Terminal 18

	1C29	1C30	1C31	1C32	1C33	1C34	1C35	1C36	1C37	1C38	1C39	1C40	1C41
METALS & ORGANOMETALICS													
Antimony													
Cadmium		S j	S j	S j	S j			S j	S j	S j	S j		
Copper		S	S	S	S			S	S	S	S		
Lead		S	S	S	S			S	S	S	S		
Mercury		S	S	S	S	S		S	S	S	BM		
Silver		S	S	B j	S				S	S	S		
Zinc		S	S	S	S			S	S	S	S		
Tributyltin													
LPAH													
2-Methylnaphthalene			S d	M d	M d			S ud	S	M d	M d		
Acenaphthene	S d	S d	S d	S d	M d	S d		M d	S	S d	S d		
Acenaphthylene			S ud	S ud	S ud			S ud		S ud	S ud		
Anthracene	S d	S d	S d	S d	S d	S d	S	S d	S	S d	S d		
Fluorene	S d	S d	S d	S d	M d	S d		S d	S	S d	S d		
Naphthalene				S d	S d						S d		
Phenanthrene		S d	S d	S d	S d			S d	S	S d	S d		
Total LPAH	S d	S d	S d	S d	S d	S d	S	S d	S	S d	S d		
HPAH													
Benz(a)anthracene	S d	S d	S d	S d	S d			S d	S	S d			
Benzo(a)pyrene	S d					S d	S	S d					
Benzo(b+k)fluoranthenes	S d	S d	S d	S d	S d	S d	S	S d	S	S d			
Benzo(g,h,i)perylene													
Chrysene	S d	S d	S d	S d	S d		S	S d	S	S d			
Dibenz(a,h)anthracene			S ud	S ud	S ud						S ud		
Fluoranthene	S d	S d	S d	S d	S d			S d	S d	S d	S d		
Indeno(1,2,3-c,d)pyrene	S d	S d	S d	S d	S d	S d	S	S d	S	S d	S d	S	S
Pyrene	S d	S d	S d	S d	S d	S d	S d	S d	S d	S d	S d	S	S d
Total HPAH	S d	S d	S d	S d	S d	S d	S d	S d	S d	S d	S d	S	S d
CHLORINATED HYDROCARBONS													
1,2-Dichlorobenzene													
1,2,4-Trichlorobenzene			S ud	S ud	S ud			S ud		S ud	S d		
1,4-Dichlorobenzene													
Hexachlorobenzene	S ud	S ud	S ud	S ud	S ud	S ud		S ud		S ud	S ud		
Hexachlorobutadiene	S ud	S ud	S ud	S ud	S ud	S ud		S ud		S ud	S ud		

(Continued on facing page)

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																																			
	1C29				1C30				1C31				1C32				1C33				1C34				1C35				1C36				1C37				1C38			
PHTHALATES																																				
Bis(2-ethylhexyl)phthalate									S	d			S	d			S	d															S	d		
Diethyl phthalate									S	ud			S	ud			S	ud																	S	ud
Dimethyl phthalate																																				
PHENOLS																																				
2-Methylphenol					S	ud			M	ud			S	ud			M	ud			S	ud					S	ud					S	ud	S	ud
2,4-Dimethylphenol									M	ud							M	ud									S	ud					S	ud	M	ud
4-Methylphenol									S	ud			S	ud			S	ud																	S	ud
Pentachlorophenol									S	ud			S	ud			S	ud			S	ud					S	ud					S	ud	S	ud
Phenol									S	ud			S	d			S	d													S		S	d	S	d
MISCELLANEOUS EXTRACTABLE																																				
Benzoic acid													S	ud							S	ud														
Benzyl alcohol									M	ud			M	ud			M	ud									S	ud					S	ud	M	ud
Dibenzofuran	S	d			S	d			S	ud			S	ud			S	d									S	d			S		S	d	S	ud
N-nitrosodiphenylamine									S	ud			S	ud			S	ud									S	ud					S	ud	S	ud
VOLATILE ORGANICS																																				
Ethylbenzene																	S																			
Xylenes													S				S																S		S	
PESTICIDES AND PCBs																																				
Aldrin													S	d			S	D									S	d			S	d	S	d	S	d
Alpha chlordane									S	d			S	ud			S	ud									S	d			S	d	S	d	S	d
Dieldrin									B	d			B	d			B	D									S	d			B	d	B	d	B	d
Gamma-HCH (Lindane)																																				
Heptachlor																																				
Total DDT	S	d			S	d			M	d			BM	d			BM	d			S	d			S	d	S	d			BM	d	BM	d	BM	d			S	ud
Total PCBs	S	d			S	d			B	d			B	d			BM	d			S	d			S	d	B	d			B	d	B	d	BM	d			S	ud
BIOASSAYS																																				
Amphipod	X				X				XX				XX				XX				X						XX				XX				XX			
Neanthes Biomass													XX				XX														XX				XX			
Sediment Larval									XX				X				XX										XX				XX				XX			
Bioassay Pass/Fail:	P				P				F				F				F				P				P		F				F				F			
BTs exceeded:									X				X				X										X				X				X			
Bioaccumulation Test Conducte																																				
Bioaccumulation Pass/Fail:																																				
ML rule exceeded:									X				X				X														X				X			
OVERALL PASS/FAIL	P				P				F				F				F				P				P		F				F				F		P		P	
HIGHEST RANKING	LM				M				H				H				H				LM				LM		H				H				H		LM		LM	

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project: Port of Seattle, Terminal 18

	1C42		1C43		1C44		1C45		1C46		1C47		1C48		1C49		1C50		1C51		1C53		1C54		1C55	
METALS & ORGANOMETALICS																										
Antimony																										
Cadmium			S	j	S	j	S	j					S		S				S	j					S	
Copper			S		S		S				S		S		S				S							
Lead	S		S		S		S						S		S				S						S	
Mercury	S		S		S		S						S		S		S		B		S		S		S	
Silver			S		S	u	S								S				S							
Zinc			S		S		S						S		S				S							
Tributyltin																										
LPAH																										
2-Methylnaphthalene	S	d	S	ud	S	d	M	d											S	d			S			
Acenaphthene	M	d	S	ud	S	d	S	d											S	d					M	
Acenaphthylene	S	d	S	ud			S	ud																		
Anthracene	M	d	S	d	S	d	S	d					S		S				S	d					S	
Fluorene	M	d	S	d	S	d	S	d							S				S	d					S	
Naphthalene	S	d					S	d																		
Phenanthrene	M	d	S	d	S	d	S	d											S	d					S	d
Total LPAH	M	d	S	d	S	d	S	d											S	d					S	d
HPAH																										
Benz(a)anthracene	S	d	S	d			S	d											S	d					S	
Benzo(a)pyrene	S	d																								
Benzo(b+k)fluoranthenes	S	d	S	d			S	d											S	d					S	
Benzo(g,h,i)perylene	S	d																								
Chrysene	S	d	S	d															S	d					S	
Dibenz(a,h)anthracene	S	d																								
Fluoranthene	BM	d	S	d	S	d	S	d					S		S				S	d					S	d
Indeno(1,2,3-c,d)pyrene	S	d	S	d	S	d	S	d	S		S		S		S				S	d					S	
Pyrene	M	d	S	d	S	d	S	d	S		S		S	d	S	d			S	d	S		S		S	d
Total HPAH	S	d	S	d	S	d	S	d			S		S	d	S	d			S	d					S	d
CHLORINATED HYDROCARBONS																										
1,2-Dichlorobenzene																										
1,2,4-Trichlorobenzene			S	ud	S	ud	S	ud											S	ud						
1,4-Dichlorobenzene																										
Hexachlorobenzene	S	ud	S	ud	S	ud	S	ud											S	ud						
Hexachlorobutadiene	S	ud	S	ud	S	ud	S	ud											S	ud						

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APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																																							
	1C42		1C43		1C44		1C45		1C46		1C47		1C48		1C49		1C50		1C51		1C53		1C54		1C55																
PHTHALATES																																								
Bis(2-ethylhexyl)phthalate							S	d																																
Diethyl phthalate																																								
Dimethyl phthalate																																								
PHENOLS																																								
2-Methylphenol			S	ud	S	ud	S	ud											S	ud																			
2,4-Dimethylphenol			S	uj			S	ud																																
4-Methylphenol																																								
Pentachlorophenol			S	uj	S	ud	S	ud											S	ud																			
Phenol			S	d	S	d									S																									
MISCELLANEOUS EXTRACTABLE																																								
Benzoic acid																																								
Benzyl alcohol			S	ud	S	ud	S	ud											S	ud																			
Dibenzofuran	M	d	S	ud			S	ud											S	d					S														
N-nitrosodiphenylamine			S	ud	S	ud	S	ud											S	ud																			
VOLATILE ORGANICS																																								
Ethylbenzene																																								
Xylenes																																								
PESTICIDES AND PCBs																																								
Aldrin			S	d	S	d	S	ud	S	d					S	d			S	d																			
Alpha chlordane					S	ud	B	ud											S	ud																			
Dieldrin			S	d	S	d	B	d					S	d	S	d			S	d																			
Gamma-HCH (Lindane)							S	ud																																
Heptachlor							S	ud																																
Total DDT	S	d	S	d	B	d	BM	d	S	ud	S	ud	S	d	S	d	S	d	S	d	S	d	S		S	ud													
Total PCBs	S	d	B	d	BM	d	BM	d	S	ud	S	d	B	d	B	d	S	d	S	d	S	d	S	d	S	d													
BIOASSAYS																																								
Amphipod	X		X		X		X								X				XX				X		XX														
Neanthes Biomass							XX												X				XX																
Sediment Larval	XX		XX		X		XX								X								X		XX														
Bioassay Pass/Fail:	F		F		F		F		P		P		P		F		P		F		P		F		F														
BTs exceeded:	X		X		X		X						X		X				X																				
Bioaccumulation Test Conduct																																								
Bioaccumulation Pass/Fail:													P						P																				
ML rule exceeded:	X						X																																
OVERALL PASS/FAIL	F		F		F		F		P		P		P		F		P		F		P		F		Phase 2														
HIGHEST RANKING	H		H*		H		H		LM		LM		LM		H*		LM		H*		LM		H*		H														

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																					
	1C56		1C57		2C01	2C02		2C03		2C04		2C05	2C06		2C07	2C08	2C09		2C10		2C11	
METALS & ORGANOMETALICS																						
Antimony																						
Cadmium													S	j	S	S	S		S		S	
Copper															S	S	S	j	S	j	S	
Lead						S							S		S	S	S		S		S	
Mercury	S		S			S		S		S		S	S		S	S	S		S		S	
Silver															S	S	S	j	S	j	S	
Zinc													S		S	S	S		S		S	
Tributyltin																						
LPAH																						
2-Methylnaphthalene															S	S	S	d	S	d	M	
Acenaphthene															S	S	S	d	S	d	S	
Acenaphthylene																	S	ud	S	ud		
Anthracene												S			S	S	S	d	S	d	S	
Fluorene												S	S		S	S	S	d	S	d	S	
Naphthalene																					S	
Phenanthrene															S	S	S	d	S	d	S	d
Total LPAH						S	j								S	S	S	d	S	d	S	d
HPAH																						
Benz(a)anthracene															S						S	
Benzo(a)pyrene																						
Benzo(b+k)fluoranthenes															S						S	
Benzo(g,h,i)perylene																						
Chrysene															S						S	
Dibenz(a,h)anthracene																						
Fluoranthene															S	S	S	d	S	d	S	d
Indeno(1,2,3-c,d)pyrene						S		S		S	d	S	S		S	S	S	d			S	
Pyrene						S	d	S		S	d	S	S		S	S	S	d	S	d	S	d
Total HPAH						S	d	S		S	d	S	S		S	S	S	d	S	d	S	d
CHLORINATED HYDROCARBONS																						
1,2-Dichlorobenzene																						
1,2,4-Trichlorobenzene																	S	ud	S	ud		
1,4-Dichlorobenzene																						
Hexachlorobenzene										S	ud						S	ud	S	ud		
Hexachlorobutadiene										S	ud						S	ud	S	ud		

(Continued on facing page)

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																					
	1C56		1C57		2C01	2C02		2C03		2C04		2C05	2C06		2C07		2C08		2C09		2C10		2C11	
PHTHALATES																								
Bis(2-ethylhexyl)phthalate																								
Diethyl phthalate																								
Dimethyl phthalate																								
PHENOLS																								
2-Methylphenol										S	ud								S	ud	S	ud		
2,4-Dimethylphenol																			S	uj	S	uj		
4-Methylphenol																								
Pentachlorophenol										S	ud								S	ud	S	ud		
Phenol																					S	d	S	
MISCELLANEOUS EXTRACTABLE																								
Benzoic acid																								
Benzyl alcohol										S	ud								S	ud	S	ud		
Dibenzofuran															S				S	ud	S	ud	S	
N-nitrosodiphenylamine																			S	ud	S	ud		
VOLATILE ORGANICS																								
Ethylbenzene																								
Xylenes																							S	
PESTICIDES AND PCBs																								
Aldrin								S	d														S	d
Alpha chlordane															S	d			S	d			S	d
Dieldrin															S	d	S	d	S	d	S	d	S	d
Gamma-HCH (Lindane)																								
Heptachlor																								
Total DDT	S	ud				S	d	S	d	S	d		S	ud	S	d	S	d	S	d	S	d	B	d
Total PCBs	B	d						B	d	S	d				B	d	B	d	B	d	B	d	B	d
BIOASSAYS																								
Amphipod						X				XX			XX		X		XX		XX		XX		XX	
Neanthes Biomass													XX		XX		XX		XX		X		XX	
Sediment Larval						X									XX		XX		XX		X		XX	
Bioassay Pass/Fail:	P		P		P	F		P		F		P	F		F		F		F		F		F	
BTs exceeded:	X							X							X		X		X		X		X	
Bioaccumulation Test Conducte																								
Bioaccumulation Pass/Fail:								P																
ML rule exceeded:																								
OVERALL PASS/FAIL	Phase 2		P		P	F		P		F		P	F		F		F		F		F		F	
HIGHEST RANKING	LM		LM		L	H*		M		H*		LM	H*		H*		H*		H*		H*		H*	

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project: Port of Seattle, Terminal 18

	2C12	2C13	2C14	2C15	2C16	2C17	2C18	2C19	2C20	2C21	2C22	2C23	2C24
METALS & ORGANOMETALICS													
Antimony													
Cadmium	S		S	S	S	S j	S j		S j			S j	
Copper			S j	S j	S j	S	S					S	
Lead	S		S	S	S	S	S		S			S	
Mercury	S	S	S	S	S	B	B	S	S	S	S	S	S
Silver	S		BM j	BM j	BM j	S	S		S			S j	
Zinc	S		S	S	S	S	S					S	
Tributyltin													
LPAH													
2-Methylnaphthalene			M d	M d	M d	M d	M d					M	
Acenaphthene			S d	S d	S d	S d	S d		S			S	
Acenaphthylene			S ud	S ud	S ud	S ud	S ud						
Anthracene			S d	S d	S d	S d	S d		S				
Fluorene	S		M d	M d	S d	S d	S d		S	S		S	
Naphthalene			S d	S d	S d	S d	S d						
Phenanthrene			S d	S d	S d	M d	S d		S			S	
Total LPAH			M d	M d	M d	M d	S d		S j			S	
HPAH													
Benz(a)anthracene			S d	S d	S d	S d	S d						
Benzo(a)pyrene						S d							
Benzo(b+k)fluoranthenes			S d	S d	S d	S d	S d						
Benzo(g,h,i)perylene						S d							
Chrysene			S d	S d	S d	S d	S d						
Dibenz(a,h)anthracene			S ud	S ud	S ud								
Fluoranthene	S		S d	S d	S d	S d	S d		S				
Indeno(1,2,3-c,d)pyrene	S	S	S d	S d	S d	S d	S d		S	S		S	
Pyrene	S		S d	S d	S d	S d	S d		S			S	
Total HPAH	S		S d	S d	S d	S d	S d		S			S	
CHLORINATED HYDROCARBONS													
1,2-Dichlorobenzene						B							
1,2,4-Trichlorobenzene			S ud	S d	S ud	S d	S ud						
1,4-Dichlorobenzene					S	BM							
Hexachlorobenzene			S ud	S ud	S ud	S ud	S ud						
Hexachlorobutadiene			S ud	S ud	S ud	S ud	S ud						

(Continued on facing page)

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18																													
	2C12		2C13		2C14		2C15		2C16		2C17		2C18		2C19		2C20		2C21		2C22		2C23		2C24					
PHTHALATES																														
Bis(2-ethylhexyl)phthalate					S	d	S	d	S	d	S	d																		
Diethyl phthalate					S	ud	S	ud	S	ud																				
Dimethyl phthalate					S	ud			S	ud																				
PHENOLS																														
2-Methylphenol					M	ud	S	ud	M	ud	S	ud	S	ud																
2,4-Dimethylphenol					M	uj	M	uj	M	uj	S	uj	S	uj																
4-Methylphenol					S	ud	S	ud	S	ud																				
Pentachlorophenol					S	ud	S	ud	S	ud	S	ud	S	uj																
Phenol					S	d	S	d	S	d	S	d	S	d									S							
MISCELLANEOUS EXTRACTABLE																														
Benzoic acid					M	ud	S	ud	M	ud																				
Benzyl alcohol					M	ud	M	ud	M	ud	S	ud	S	ud																
Dibenzofuran					S	d	S	d	S	d	S	d	S	d									S							
N-nitrosodiphenylamine					S	ud	S	ud	S	ud	S	ud	S	ud																
VOLATILE ORGANICS																														
Ethylbenzene					B		S		BM		BM																			
Xylenes	S				S		S		M		M		S																	
PESTICIDES AND PCBs																														
Aldrin					S	ud	B	d	S	ud	B	d	B	d			S	d					S	ud						
Alpha chlordane	S	d			B	ud	B	ud	B	ud	B	d	B	ud									B	ud						
Dieldrin	S	d			B	d	B	d	B	d	B	d	B	d			S	d					B	d						
Gamma-HCH (Lindane)					S	ud	S	ud	S	ud	S	ud	S	ud									S	ud						
Heptachlor					S	ud	S	ud	S	ud	S	ud	S	ud									S	ud						
Total DDT	S	d	S	ud	BM		BM		BM	d	BM	d	BM	d	S	ud	S	d					BM	d	S	ud				
Total PCBs	B	d	B	d	BM	d	BM	d	BM	d	BM	d	BM	d	S	ud	B	d			S	ud	BM	d	S	d				
BIOASSAYS																														
Amphipod	X				XX		XX		XX		XX		XX				X		XX				XX		X					
Neanthes Biomass					XX		XX		XX		XX		XX						XX				XX		X					
Sediment Larval	XX				XX		XX		XX		XX		XX				XX						XX		XX					
Bioassay Pass/Fail:	F		P		F		F		F		F		F		P		F		F		P		F		F					
BTs exceeded:	X		X		X		X		X		X		X				X						X							
Bioaccumulation Test Conduct																														
Bioaccumulation Pass/Fail:			P																											
ML rule exceeded:					X		X		X		X		X										X							
OVERALL PASS/FAIL	F		P		F		F		F		F		F		P		F		phase 2		P		F		F					
HIGHEST RANKING	H*		LM		H		H		H		H		H		LM		H*		LM		LM		H		H*					

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project: Port of Seattle, Terminal 18

	3C01	3C02	3C03	3C04	3C05	3C06	3C07	4C01	1C07B	1C08B	1C37B	1C42B	1C43B
METALS & ORGANOMETALICS													
Antimony													
Cadmium								S			S		
Copper								S					
Lead					S			S			S		
Mercury	S	S	S	S	S			S	S	S	S		
Silver								S					
Zinc								S			S		
Tributyltin										B j			
LPAH													
2-Methylnaphthalene	S d								S				
Acenaphthene									S				
Acenaphthylene													
Anthracene	M d				S			S d	S				
Fluorene	S d							S d	S	S	S		
Naphthalene													
Phenanthrene	S d								S d	S			
Total LPAH	S d				S				S	S			
HPAH													
Benz(a)anthracene									S				
Benzo(a)pyrene									S				
Benzo(b+k)fluoranthenes								S d	S				
Benzo(g,h,i)perylene													
Chrysene									S				
Dibenz(a,h)anthracene													
Fluoranthene								S d	S d				
Indeno(1,2,3-c,d)pyrene	S d	S		S	S			S d	S		S		
Pyrene	S d	S		S	S d			S d	S d		S		
Total HPAH		S			S d			S d	S d		S		
CHLORINATED HYDROCARBONS													
1,2-Dichlorobenzene													
1,2,4-Trichlorobenzene								S ud					
1,4-Dichlorobenzene													
Hexachlorobenzene								S ud					
Hexachlorobutadiene	S ud							S ud					

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APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project: Port of Seattle, Terminal 18

	3C01	3C02	3C03	3C04	3C05	3C06	3C07	4C01	1C07B	1C08B	1C37B	1C42B	1C43B
PHTHALATES													
Bis(2-ethylhexyl)phthalate													
Diethyl phthalate													
Dimethyl phthalate													
PHENOLS													
2-Methylphenol								S ud					
2,4-Dimethylphenol													
4-Methylphenol													
Pentachlorophenol								S ud					
Phenol													
MISCELLANEOUS EXTRACTABLES													
Benzoic acid													
Benzyl alcohol								S ud					
Dibenzofuran	S d							S ud	S				
N-nitrosodiphenylamine								S ud					
VOLATILE ORGANICS													
Ethylbenzene													
Xylenes													
PESTICIDES AND PCBs													
Aldrin								S d					
Alpha chlordane								S ud					
Dieldrin								S d					
Gamma-HCH (Lindane)													
Heptachlor													
Total DDT					S d			S d			S		
Total PCBs								B d			B		
BIOASSAYS													
Amphipod		X		XX	X			XX	X		X	X	
Neanthes Biomass									XX	XX	XX		
Sediment Larval		X							XX	X	XX		
Bioassay Pass/Fail:	P	F	P	F	P	P	P	F	F	F	F	P	P
BTs exceeded:								X		X	X		
Bioaccum. Test Conducted:													
Bioaccumulation Pass/Fail:													
ML rule exceeded:													
OVERALL PASS/FAIL	P	F	P	F	P	P	P	F	F	F	F	P	P
HIGHEST RANKING	H	H*	LM	H*	LM	L	L	H*	H*	H*	H*	L	L

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18								Kaiser Dock Upgrade				
	1C48B	1C48NB	1C48SB	1C49B	1C55XSB	2C01B	2C02B	2C06B	S1	S2	S3	S4	S5
METALS & ORGANOMETALICS													
Antimony											S		
Cadmium													
Copper								S	S		S		
Lead									S	S	S		
Mercury		S						S					
Silver													
Zinc									S	S	S		
Tributyltin													
LPAH													
2-Methylnaphthalene													
Acenaphthene					S								
Acenaphthylene													
Anthracene													
Fluorene													
Naphthalene													
Phenanthrene													
Total LPAH													
HPAH													
Benz(a)anthracene													
Benzo(a)pyrene													
Benzo(b+k)fluoranthenes													
Benzo(g,h,i)perylene													
Chrysene													
Dibenz(a,h)anthracene													
Fluoranthene											S		
Indeno(1,2,3-c,d)pyrene		S			S				S	S	S		
Pyrene					S						S		
Total HPAH					S					S	S		
CHLORINATED HYDROCARBONS													
1,2-Dichlorobenzene													
1,2,4-Trichlorobenzene													
1,4-Dichlorobenzene													
Hexachlorobenzene													
Hexachlorobutadiene													

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APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Port of Seattle, Terminal 18								Kaiser Dock Upgrade				
	1C48B	1C48NB	1C48SB	1C49B	1C55XSB	2C01B	2C02B	2C06B	S1	S2	S3	S4	S5
PHTHALATES													
Bis(2-ethylhexyl)phthalate													
Diethyl phthalate													
Dimethyl phthalate													
PHENOLS													
2-Methylphenol													
2,4-Dimethylphenol													
4-Methylphenol													
Pentachlorophenol													
Phenol													
MISCELLANEOUS EXTRACTABLE													
Benzoic acid													
Benzyl alcohol													
Dibenzofuran													
N-nitrosodiphenylamine													
VOLATILE ORGANICS													
Ethylbenzene													
Xylenes													
PESTICIDES AND PCBs													
Aldrin													
Alpha chlordane					S j								
Dieldrin													
Gamma-HCH (Lindane)													
Heptachlor													
Total DDT					S								
Total PCBs					S				S	S			
BIOASSAYS													
Amphipod	X			X					XX	XX	X		---
Neanthes Biomass				X				XX					---
Sediment Larval								X	XX	XX	XX		---
Bioassay Pass/Fail:	P	P	P	F	P	P	P	F	F	F	F	P	NA
BTs exceeded:													
Bioaccum. Test Conducted:													
Bioaccumulation Pass/Fail:													
ML rule exceeded:													
OVERALL PASS/FAIL	P	P	P	F	P	P	P	F	F	F	F	P	P
HIGHEST RANKING	L	LM	L	H*	LM	L	L	H*	H*	H*	H*	L	L

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Capitol Lake			Crowley Marine Services				Port of Seattle T5		Port of Everett NCD Berth Approach			
	C3	C4	C5	C1	C2	C3	C4	C1	C2	C1	C2	C3	C4
METALS & ORGANOMETALICS													
Antimony													
Cadmium				S						S	S	S	S
Copper				S									
Lead				S						S j	S j	S j	S j
Mercury								S					
Silver													
Zinc				S									
Tributyltin								S	S				
LPAH													
2-Methylnaphthalene											S		
Acenaphthene				S									
Acenaphthylene													
Anthracene				S						S	S		
Fluorene				S						S	S		
Naphthalene													
Phenanthrene				S			S				S		
Total LPAH				S			S			S	S		
HPAH													
Benz(a)anthracene				S	S								
Benzo(a)pyrene				S									
Benzo(b+k)fluoranthenes				S	S								
Benzo(g,h,i)perylene				S									
Chrysene				S									
Dibenz(a,h)anthracene				S									
Fluoranthene				BM	S		S						
Indeno(1,2,3-c,d)pyrene				S	S	S	S	S					S
Pyrene				S	S		S	S					
Total HPAH				S	S	S	S	S					S
CHLORINATED HYDROCARBONS													
1,2-Dichlorobenzene													
1,2,4-Trichlorobenzene								S u	S u		S uj		
1,4-Dichlorobenzene													
Hexachlorobenzene													
Hexachlorobutadiene										S j			

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APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Capitol Lake			Crowley Marine Services				Port of Seattle T5		Port of Everett NCD Berth Approach			
	C3	C4	C5	C1	C2	C3	C4	C1	C2	C1	C2	C3	C4
PHTHALATES													
Bis(2-ethylhexyl)phthalate													
Diethyl phthalate													
Dimethyl phthalate													
PHENOLS													
2-Methylphenol													
2,4-Dimethylphenol													
4-Methylphenol										S	S	S	S
Pentachlorophenol													
Phenol	S		S										
MISCELLANEOUS EXTRACTABLE													
Benzoic acid	M	M	M										
Benzyl alcohol	S												
Dibenzofuran				S						S	S		
N-nitrosodiphenylamine													
VOLATILE ORGANICS													
Ethylbenzene													
Xylenes													
PESTICIDES AND PCBs													
Aldrin							S uj						
Alpha chlordane													
Dieldrin													
Gamma-HCH (Lindane)													
Heptachlor													
Total DDT								S					S j
Total PCBs				S	S	S	B	S					
BIOASSAYS													
Amphipod					X	XX	XX						
Neanthes Biomass													
Sediment Larval										X	X	X	XX
Bioassay Pass/Fail:				P	P	F	F	P	P	P	P	P	F
BTs exceeded:				X			X						
Bioaccum. Test Conducted:				X									
Bioaccumulation Pass/Fail:				F									
ML rule exceeded:	X	X	X										
OVERALL PASS/FAIL	AW	AW	AW	F	P	F	F	P	P	P	P	P	F
HIGHEST RANKING	H	H	H	H*	LM	H*	H*	LM	LM	LM	M	LM	H*

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	USACE Duwamish, DY 1996							USACE Duwamish 1997			USACE Kenmore		
	S1	S2	S3	S4	S5	S6	S7	S1	S2	S3	S1	S4	S10
METALS & ORGANOMETALICS													
Antimony													
Cadmium													
Copper													
Lead													
Mercury			S										
Silver													
Zinc													
Tributyltin		S		S								S	
LPAH													
2-Methylnaphthalene													
Acenaphthene											S		
Acenaphthylene													
Anthracene											S		
Fluorene											S		
Naphthalene													
Phenanthrene											S		
Total LPAH											S		
HPAH													
Benz(a)anthracene													
Benzo(a)pyrene													
Benzo(b+k)fluoranthenes													
Benzo(g,h,i)perylene													
Chrysene													
Dibenz(a,h)anthracene													
Fluoranthene													
Indeno(1,2,3-c,d)pyrene		S	S	S	S	S	S	S					
Pyrene		S											
Total HPAH		S		S	S		S				S		
CHLORINATED HYDROCARBONS													
1,2-Dichlorobenzene													
1,2,4-Trichlorobenzene													
1,4-Dichlorobenzene													
Hexachlorobenzene													
Hexachlorobutadiene													

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APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	USACE Duwamish, DY 1996							USACE Duwamish 1997			USACE Kenmore		
	S1	S2	S3	S4	S5	S6	S7	S1	S2	S3	S1	S4	S10
PHTHALATES													
Bis(2-ethylhexyl)phthalate													
Diethyl phthalate													
Dimethyl phthalate													
PHENOLS													
2-Methylphenol													
2,4-Dimethylphenol													
4-Methylphenol													
Pentachlorophenol													
Phenol													
MISCELLANEOUS EXTRACTABLE													
Benzoic acid													
Benzyl alcohol													
Dibenzofuran													
N-nitrosodiphenylamine													
VOLATILE ORGANICS													
Ethylbenzene													
Xylenes													
PESTICIDES AND PCBs													
Aldrin													
Alpha chlordane													
Dieldrin													
Gamma-HCH (Lindane)													
Heptachlor													
Total DDT						S							S
Total PCBs	S												
BIOASSAYS													
Amphipod									X	XX			
Neanthes Biomass												XX	X
Sediment Larval	X	X	X	X	XX	X	XX					XX	XX
Bioassay Pass/Fail:	P	P	P	P	F	P	F	P	P	F	P	F	F
BTs exceeded:													
Bioaccum. Test Conducted:													
Bioaccumulation Pass/Fail:													
ML rule exceeded:													
OVERALL PASS/FAIL	P	P	P	P	F	P	F	P	P	F	P	F	F
HIGHEST RANKING	LM	LM	LM	LM	H*	LM	H*	LM	L	H*	LM	H*	H*

APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Meydenbauer	Blair Turning Basin
	C1	C3
METALS & ORGANOMETALICS		
Antimony		
Cadmium		
Copper		
Lead	S	
Mercury		
Silver		
Zinc	S	
Tributyltin		
LPAH		
2-Methylnaphthalene	S	
Acenaphthene	M	
Acenaphthylene		
Anthracene	S	
Fluorene	M	
Naphthalene		
Phenanthrene	M	
Total LPAH	M	
HPAH		
Benz(a)anthracene	S	
Benzo(a)pyrene	S	
Benzo(b+k)fluoranthenes	S	
Benzo(g,h,i)perylene	S	
Chrysene	S	
Dibenz(a,h)anthracene	S	
Fluoranthene	BM	
Indeno(1,2,3-c,d)pyrene	S	S
Pyrene	S	S
Total HPAH	S	S
CHLORINATED HYDROCARBONS		
1,2-Dichlorobenzene		
1,2,4-Trichlorobenzene		
1,4-Dichlorobenzene		
Hexachlorobenzene		
Hexachlorobutadiene		

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APPENDIX C - DY96/97 EVALUATION GUIDELINE EXCEEDANCES

Project:	Meydenbauer	Blair Turning Basin
	C1	C3
PHTHALATES		
Bis(2-ethylhexyl)phthalate		
Diethyl phthalate		
Dimethyl phthalate		
PHENOLS		
2-Methylphenol		
2,4-Dimethylphenol		
4-Methylphenol		
Pentachlorophenol		
Phenol		
MISCELLANEOUS EXTRACTABLE		
Benzoic acid		
Benzyl alcohol		
Dibenzofuran	S	
N-nitrosodiphenylamine		
VOLATILE ORGANICS		
Ethylbenzene		
Xylenes		
PESTICIDES AND PCBs		
Aldrin		
Alpha chlordane		
Dieldrin		
Gamma-HCH (Lindane)		
Heptachlor		
Total DDT		S
Total PCBs		
BIOASSAYS		
Amphipod	---	
Neanthes Biomass	---	
Sediment Larval	---	
Bioassay Pass/Fail:	NA	P
BTs exceeded:	X	
Bioaccum. Test Conducted:		
Bioaccumulation Pass/Fail:		
ML rule exceeded:	X	
OVERALL PASS/FAIL	F(C)	P
HIGHEST RANKING	H	LM