CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD **November 19, 2007**

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATION AND MAINTENANCE DREDGED MATERIAL FROM GRAYS HARBOR, WASHINGTON ***(Public Notice CENWS OD-TS-NS-25)*** EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR OPEN-WATER DISPOSAL AT THE SOUTH JETTY OR POINT CHEHALIS DISPERSIVE SITES, OR AT SOUTH BEACH OR HALF MOON BAY BENEFICIAL USE SITES.

1. Introduction. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) on the suitability of material from Grays Harbor, Washington (Figure 1) for unconfined open-water disposal. The requirements for determining the suitability of this material are documented in "*Dredged Material Evaluation Procedures and Disposal Site Management Manual, Grays Harbor and Willapa Bay, Washington*" (DMMP 1995). As outlined in the GHDMEP, full sediment characterization of dredged material from the federal navigation channel is required on a rotating, biennial basis for the reaches of concern in the inner portions of Grays Harbor. Under this scenario, one third of the material dredged from the Crossover, North Channel, Hoquiam, Cow Point and South Aberdeen reaches of the Grays Harbor channel is characterized every two years, resulting in characterization of the entire inner portion every six years. In Grays Harbor, no contaminant testing is required for the outer reaches of the channel (Entrance, Bar, and South channels) per exclusionary criteria specified in Section 40 CFR 230.60 of the Clean Water Act. This exclusion is based on distance from known sources of contamination, generally coarse grain sizes and the high-energy environment of these outer channel areas.

For this project an estimated 2.5 million cubic yards (mcy) of maintenance material is proposed to be dredged annually from the federal navigation channel. Approximately 1.77 million cy of this material is in the inner reaches that are characterized. This characterization event begins the third six-year round of testing. Approximately 1/3 of the 1.77 million cy of material (~540,000 cy) underwent GHDMEP sampling and testing as part of this event and is summarized in this SDM. Disposal is anticipated to be at the Point Chehalis and South Jetty estuarine sites or at beneficial use sites nearshore or onshore of South Beach or Half Moon Bay.

Table 1. Project Details

SAP addendum received	September 27, 2006
SAP approved	October 12, 2006
Sampling dates	November 13-16, 2006
Final data report submitted	June 29, 2007
Dioxin report submitted	August 8, 2007
Recency Determination: Low Concern (6 years)	November 2012
Next sampling in rotation	November 2008
DAIS reference number	GRAYS-1-B-F-241

Table 2. Project Synopsis.

Time of proposed dredging	Annually, February through August, except during fish windows
Proposed disposal sites	Point Chehalis and South Jetty open water dispersive sites; Half Moon Bay and/or South Beach nearshore beneficial use sites, or HMB direct beach nourishment, as needed and approved.
Sediment ranking	Low
Project last dredged	Annually

Table 3. GH characterization planning

Year	Sampling Period	Reaches	DMMUs	Notes
2008	Spring	SA	2	
		AB	3	Still being dredged? If not, move DMMU.
		CP	4	
		SR, PC, ER, BR	Grain size distribution in outer harbor reaches required this year (every 6 years) to verify continued exclusion from testing	
2010	Spring	CP	3	
		HQ	1	
		NC	1	
		CX	4	

Reach abbreviations: South Aberdeen (SA); Aberdeen (AB); Cow Point (CP); Hoquiam (HQ); North Channel (NC); Crossover (CX); South Reach (SR); Point Chehalis (PC); Entrance Reach (ER); Bar Reach (BR)

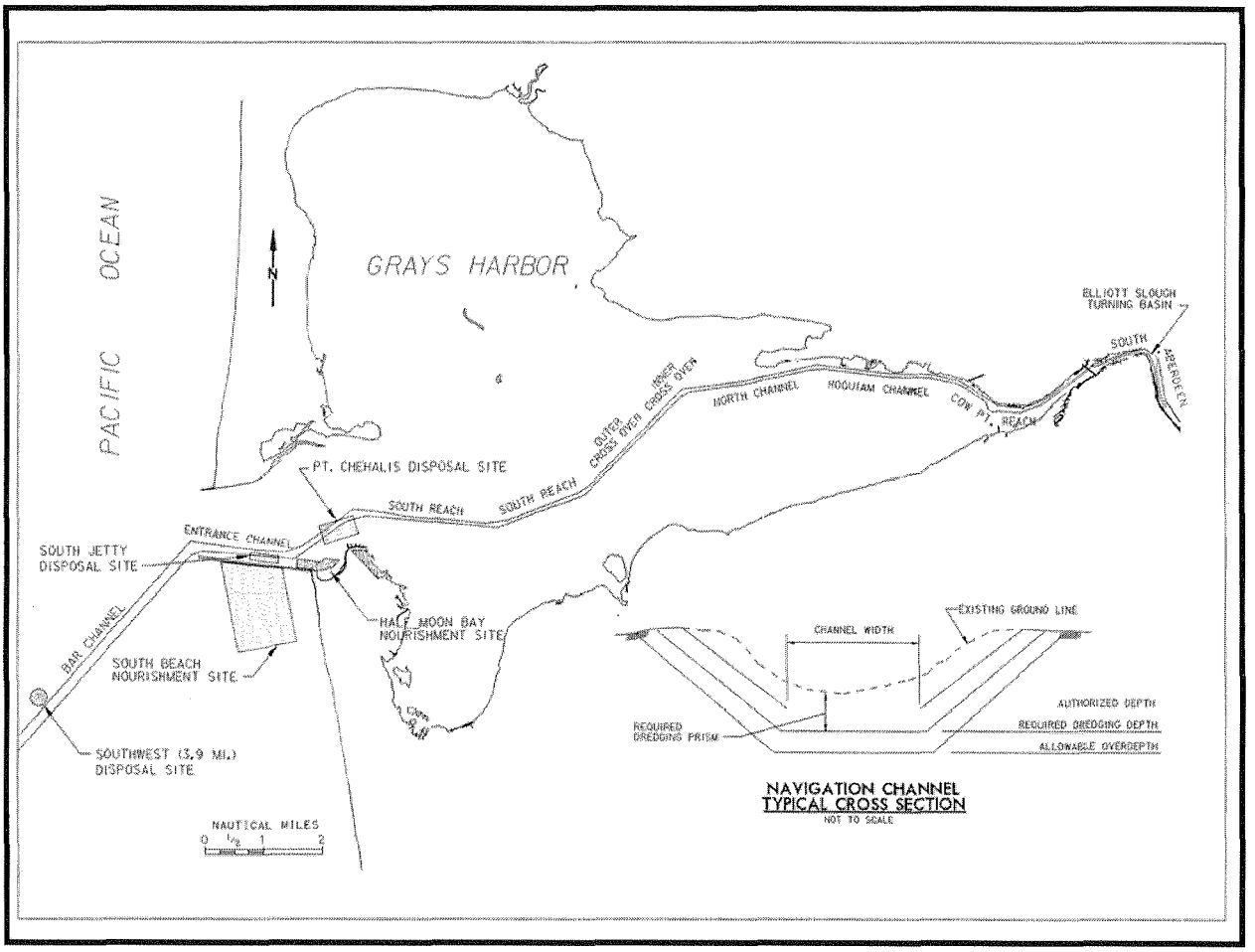

Figure 1. Grays Harbor navigation project. Samples taken for this characterization were from the Cow Point, Hoquiam, North Channel and Crossover reaches.

2. Background. Dredging of the Grays Harbor navigation channel takes place annually to maintain the channel at the authorized depth. Characterization of this channel is not project specific, per the GHDMEP, but performed on a rotating basis. This approach characterizes the dredging volume over time (six years) rather than for a specific dredging event. The low rank of the area, and results from over a decade of sampling in the area, continue to support this approach.

The third six-year rotation of sampling and testing based on the GHDMEP began this year. In order to plan holistically for this entire round of sampling, a programmatic sampling and analysis plan was prepared (SAIC 2006). This PSAP looked at historic dredging volumes in various reaches of the navigation channel and devised a strategy for insuring that the sampling adequately represented those volumes. A SAP addendum is prepared each year to address sampling issues specific to the given sampling and testing event.

3. Sampling. Sediment sampling took place from November 13 to November 16, 2006, during Dredging Year 2007. Follow-up analysis (see below) was finished in August 2007. Because the dredging year, as defined by the DMMP, begins on 16 June, this characterization is now considered to be a DY 2008 project.

As in the past the area was ranked "low," and the material available for dredging was considered homogenous. The approved programmatic and 2007 addendum sampling and analysis plans were followed, and quality assurance/quality control guidelines specified by the GHDMEP sampling and testing guidelines were generally complied with.

The field sampling effort included collection of eight samples in each of nine dredged material management units (DMMUs) for a total of 72 sediment grab samples. Samples from each DMMU were composited for a single analysis per DMMU. Samples came from the Crossover, North Channel, Hoquiam and Cow Point reaches of the navigation channel. The sampling effort also included collection of reference sediment from the North Bay area of Grays Harbor in anticipation of performing confirmatory bioassays. Conventional parameters measured in these 9 DMMU samples are depicted in Table 4.

Table 4. Sediment conventional results.

	Reach	Crossover Reach				North Channel	Hoquiam Reach	Cow Point			Ref.
	DMMU	CX1	CX2	CX3	CX4	NC5	HQ6	CP7	CP8	CP9	GHS7
	# of samples in composite	8	8	8	8	8	8	8	8	8	3
	Volume (cubic yards)	56,201	60,047	57,718	26,807	58,073	58,021	58,097	58,310	56,922	n/a
GRAIN SIZE	% Gravel	0.2	2.4	0.4	0.2	0.2	0.4	0.0	1.1	0.9	0.0
	% Sand	46.4	53.2	45.0	33.0	47.1	12.3	7.1	17.2	8.4	23.7
	% Silt	40.9	32.6	42.0	49.6	40.7	65.3	72.3	62.9	66.0	55.0
	% Clay	12.7	11.7	12.5	17.3	11.0	22.3	20.5	19.0	24.5	21.2
	(clay+silt) % Fines	**53.6**	**44.3**	**54.5**	**66.9**	**51.7**	**87.6**	**92.8**	**81.9**	**90.5**	**76.2**
	Total Solids, %	58.0	58.8	59.6	51.7	54.7	41.4	42.5	44.3	40.1	47.7
	Volatile Solids, %	4.5	4.5	4.5	6.4	6.6	7.7	6.8	6.7	7.9	7.1
	Total Organic Carbon, %	0.57	0.64	0.55	0.80	0.97	0.93	0.91	0.95	0.95	0.94
	Total Sulfides, mg/kg	< 10	< 10	< 10	< 10	< 10	45.9	74.8	< 10	< 10	< 10
	Total Ammonia, mg N/kg	11.0	10.0	7.9	4.0	2.1	5.8	11.0	4.1	3.4	5.7

4. **Chemical Analysis QA/QC**. DMMP QA/QC requirements are shown in Table 5. All precision and accuracy goals were met by the analytical laboratory for this characterization.

Table 5. QA/QC requirements for chemical analysis in the DMMP program.

QA ELEMENT		WARNING LIMITS	ACTION LIMITS
Precision	Metals	None	20% RPD or COV
	Organics	35% COV	50% COV or a factor of 2 for duplicates
Matrix Spikes	Metals	None	75-125% recovery
	Organics:[1] ▪ Volatiles ▪ Semivolatiles and Pesticides	▪ 70-150% ▪ 50-150%	None (zero percent recovery may be cause for data rejection however)[2]
Reference Materials	Metals	None	95% CI if specified for a particular CRM; 80-120% recovery if not.
	Organics	None	95% CI for CRMs. No action limit for uncertified RMs.
Surrogate Spikes	Organics ▪ Volatiles ▪ Pesticides ▪ Semi-volatiles	▪ 85% minimum recovery ▪ 60% minimum recovery ▪ 50% minimum recovery	EPA CLP chemical-specific recovery limits

[1] Warning limits set at the CLP advisory limits for matrix spike duplicates for those chemicals covered under CLP.
[2] Rigorous control limits are not recommended due to possible matrix effects and interferences.

5. **Results of Chemical Analysis**. The Agencies' approved sampling and analysis plan was followed and quality assurance/quality control guidelines specified by PSEP and DMMP were generally complied with. Chemical analysis results (Table 6) demonstrated that all dredged material management units characterized showed no detected or non-detected chemical exceedances of DMMP screening levels. In addition to routine DMMP chemicals of concern analysis of special "chemicals of concern" are required for the Grays Harbor area. Guaiacols, resin acids and dioxins/furans were considered special COCs for this characterization. These additional chemicals are added due to the historical presence of wood treatment sites and associated discharges in the upper reaches of the Grays Harbor Navigation channel.

5.1. Resin acids and guaiacols. No guaiacols were detected in any sample. Of the four resin acids, pimaric acid was undetected in all samples, and abietic acid was detected in all samples, with a general increase in abietic acid levels progressing upstream. Levels of detected resin acids were much lower than levels generally associated with environmental or human health effects (Word *et al* 1990). It is important to note that the DMMP does not have interpretive criteria for guaiacols and resin acids. The samples chosen for confirmatory bioassays were chosen in part because they had some of the higher detections of these chemicals. Results for these compounds were comparable to previous years' data, showing no significant changes over time.

5.2. Dioxins and furans (PCDD/PCDF). Archived sediment from each DMMU was analyzed for PCDD/PCDF by Axys Analytical Services Ltd. using EPA Method 1613B. Results (Table 7) showed detected levels of PCDD/PCDF in all samples. Toxic Equivalency (with non-detects calculated as ½ reporting limit) ranged from 2.82 – 12.30 ng/kg dry wt., all below the 15 TEQ suitability level set for Grays Harbor (Table 8). Data reported were similar to previous years' findings for these compounds.

Table 6. Results of chemical analysis compared with DMMP guidelines.

Table 5, DMMP Chemistry Results	SL	BT	ML	CX1		CX2		CX3*		CX4		NC5		HQ6		CP7		CP8		CP9	
Total Organic Carbon, %				0.57		0.64		0.55		0.80		0.97		0.93		0.91		0.95		0.95	
METALS (mg/kg dry)																					
Antimony	150	---	200	0.1	U	0.1	U	0.1		0.1	U	0.1	U	0.1	U	0.1		0.2	U	0.1	U
Arsenic	57	507	700	3.1		3.7		2.75		3.9		2.9		6.8		4.5		2.5		6.7	
Cadmium	5.1	11.3	14	0.005		0.01	U	0.505	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Chromium	---	267	---	5.74		4.3		7.25		12		2.7		6.3		5.8		16		17	
Copper	390	1,027	1,300	25		24		28		35		37		39		66		62		64	
Lead	450	975	1,200	4.5		6.4		4.5		5.4		5.4		4.8		6.8		6.4		7.1	
Mercury	0.41	1.5	2.3	0.048		0.037		0.039		0.046		0.066		0.08		0.047		0.047		0.085	
Nickel	140	370	370	18		18		19		21		20		17		31		27		26	
Selenium	---	3.0	---	0.61		1.1	U	0.975	U	1.2	U	1	U	1.4	U	1.5	U	1.6	U	1.3	U
Silver	6.1	6.1	8.4	0.036		0.03		0.04		0.06		0.06		0.13		0.08		0.1		0.13	
Zinc	410	2,783	3,800	51		53		55		61		56		50		86		76		77	
LPAH (ug/kg dry)																					
2-Methylnaphthalene	670	---	1,900	3.3	U	2.6	J	2.7	J	2.6	J	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Acenaphthene	500	---	2,000	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U
Acenaphthylene	560	---	1,300	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U
Anthracene	960	---	13,000	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U
Fluorene	540	---	3,600	4.7	U	4.7	U	4.7	U	4.7	U	4.7	U	4.7	U	4.7	U	4.7	U	4.7	U
Naphthalene	2,100	---	2,400	3.6	U	3.6	U	3.3	J	3.6	J	4.2	J	4.6	J	3.6	U	3.1	J	4.2	J
Phenanthrene	1,500	---	21,000	3.6	U	3.5	J	6.6	J	3.4	J	3.6	U	3.9	J	3.6	U	3.5	J	3.8	J
Total LPAH	**5,200**	**---**	**29,000**	**4.7**	**U**	**6.1**	**J**	**12.6**	**J**	**9.6**	**J**	**4.2**	**J**	**8.5**	**J**	**4.7**	**U**	**6.6**	**J**	**8.0**	**J**
HPAH (ug/kg dry)																					
Benzo(a)anthracene	1,300	---	5,100	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U
Benzo(a)pyrene	1,600	---	3,600	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U
Benzo(g,h,i)perylene	670	---	3,200	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U
Benzofluoranthenes (b+j+k)	3,200	---	9,900	6.9	U	6.9	U	6.9	U	6.9	U	6.9	U	6.9	U	6.9	U	6.9	U	6.9	U
Chrysene	1,400	---	21,000	3.9	U	3.9	U	2.8	J	3.9	U	3.6	J	3.9	U	5.2	J	9.4	J	3.9	U
Dibenzo(a,h)anthracene	230	---	1,900	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
Fluoranthene	1,700	4,600	30,000	6	U	6	U	8.8	J	6	U	11	J	6	U	6	U	6	U	6	U

Table 5, DMMP Chemistry Results	SL	BT	ML	CX1		CX2		CX3*		CX4		NC5		HQ6		CP7		CP8		CP9	
Indeno(1,2,3-c,d)pyrene	600	---	4,400	5.2	U	5.2	U	5.2	U	5.2	U	5.2	U	5.2	U	5.2	U	5.2	U	5.2	U
Pyrene	2,600	11,980	16,000	3.3	J	3.6	U	8.3	J	4.1	J	10	J	5.3	J	5.5	J	3.9	J	4.2	J
Total HPAH	**12,000**	**---**	**69,000**	**3.3**	**J**	**6.9**	**U**	**19.9**	**J**	**4.1**	**J**	**24.6**	**J**	**5.3**	**J**	**10.7**	**J**	**13.3**	**J**	**4.2**	**J**
CHLORINATED HYDROCARBONS (ug/kg dry)																					
1,2,4-Trichlorobenzene	31	---	64	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U	0.59	U
1,2-Dichlorobenzene	35	---	110	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U
1,3-Dichlorobenzene	170	---	---	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U	0.33	U
1,4-Dichlorobenzene	110	---	120	0.49	U	0.49	U	0.49	U	0.49	U	0.49	U	0.49	U	0.49	U	0.49	U	1.1	J
Hexachlorobenzene	22	168	230	5.8	U	5.8	U	5.8	U	5.8	U	5.8	U	5.8	U	5.8	U	5.8	U	5.8	U
PHTHALATES (ug/kg dry)																					
Bis(2-ethylhexyl)phthalate	1,300	---	8,300	13	J	6.1	J	13.3	J	9.6	J	16	J	10	J	10	J	11	J	7.5	J
Butyl benzyl phthalate	63	---	970	3	U	2.9	U	5.75	U	3.3	U	3.3	U	4.1	U	4	U	3.6	U	4.1	U
Di-n-butyl phthalate	1,400	---	5,100	5.9	J	5.3	J	5.6	J	6.6	J	8.3	J	7.1	U	7.1	U	6.4	J	7.1	U
Di-n-octyl phthalate	6,200	---	6,200	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Diethyl phthalate	200	---	1,200	9.6	U	9.6	U	9.6	U	9.6	U	9.6	U	9.6	U	9.6	U	9.6	U	9.6	U
Dimethyl phthalate	71	---	1,400	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
PHENOLS (ug/kg dry)																					
2 Methylphenol	63	---	77	9.3	U	9.3	U	9.3	U	9.4	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U
2,4-Dimethylphenol	29	---	210	15	U	15	U	15	U	15	U	15	U	15	U	15	U	15	U	15	U
4 Methylphenol	670	---	3,600	32		39	J	6.3	J	6.8	J	20	J	8	U	8	U	8	U	8	U
Pentachlorophenol	400	504	690	24	U	24	U	24	U	24	U	24	U	24	U	24	U	24	U	24	U
Phenol	420	---	1,200	11	J	14	J	11	J	15	J	16	J	16	J	14	J	16	J	14	J
MISCELLANEOUS EXTRACTABLES (ug/kg dry)																					
Benzoic acid	650	---	760	270	U	270	U	270	U	270	U	270	U	270	U	270	U	270	U	270	U
Benzyl alcohol	57	---	870	11	U	11	U	11	U	11	U	11	U	11	U	11	U	11	U	11	U
Dibenzofuran	540	---	1,700	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Hexachlorobutadiene	29	---	270	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U
Hexachloroethane	1,400	---	14,000	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
N-Nitrosodiphenylamine	28	---	130	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
VOLATILE ORGANICS (ug/kg dry)																					
Ethylbenzene	10	---	50	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U	0.13	U
Tetrachloroethene	57	---	210	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U

Table 5, DMMP Chemistry Results	SL	BT	ML	CX1		CX2		CX3*		CX4		NC5		HQ6		CP7		CP8		CP9	
Total Xylene (m,p,o)	40	---	160	0.242	U	0.31	U	0.34	U	0.46	U	0.44	U	0.58	U	0.49	U	0.38	U	0.43	U
Trichloroethene	160	---	1,600	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
PESTICIDES AND PCBs (ug/kg dry)																					
Aldrin	10	---	---	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U	0.41	U
Total Chlordane (5 isomers)	10	37	---	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U
Dieldrin	10	---	---	0.8	U	0.8	U	0.8	U	0.8	U	0.8	U	0.8	U	0.8	U	0.8	U	0.8	U
Heptachlor	10	---	---	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U	0.6	U
Lindane	10	---	---	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Total DDT	6.9	50	69	0.79	U	0.79	U	0.39	J P	0.22	J P	0.67	J P	0.79	U	0.95	J	0.79	U	0.90	JP
Total PCBs	130	---	3,100	20	U	20	U	20	U	20	U	20	U	22	U	22	U	20	U	22	U
Total PCBs (mg/kg OC)	---	38	---	3.5	U	3.1	U	3.6	U	2.5	U	2.1	U	2.4	U	2.4	U	2.1	U	2.3	U
RESIN ACIDS AND GUAIACOLS (ug/kg dry)																					
3,4,5-Trichloroguaiacol				150	U	150	U	150	U	150	U	150	U	150	U	150	U	150	U	150	U
Tetrachloroguaiacol				99	U	99	U	99	U	99	U	99	U	99	U	99	U	11	U	100	U
Pimaric Acid				97	U	97	U	97	U	98	U	96	U	98	U	98	U	99	U	99	U
Isopimaric Acid				97	U	97	U	97	U	98	U	130	M	160	M	150	M	190	M	220	M
Dehydroabietic Acid				120		97	U	97	U	130		240		270		230		280		240	
Abietic Acid				180		160		340		360		610		800		760		770		800	

Notes:

SL = screening level
BT = bioaccumulation trigger
ML = maximum level
* reported values for C3 are a mean of sample and duplicate values
J = estimated concentration
U = undetected
M = Estimated value for an analyte detected and confirmed by analyst but with low spectral parameter matches.
OC = organic carbon
Shaded DMMU (NC5 and HQ6) were used for confirmatory bioassays.

Table 7. Summary of PCDD/PCDF Data.

	CX1		CX2		CX3*		CX4		NC5		HQ6		CP7		CP8		CP9	
	ng/kg dry weight																	
Dioxins																		
2,3,7,8-TCDD	0.829	J	0.836	J	1.145		1.74		2.32		3.85		3.91		3.8		4.3	
1,2,3,7,8-PeCDD	1.07	J	1.06	J	1.395	J	2.26	J	2.66	J	4.64	J	4.87	J	4.95	J	5.1	J
1,2,3,4,7,8-HxCDD	0.405	J	0.379	J	0.5095	J	0.692	J	0.627	J	1.16	J	1.23	J	0.999	J	1.14	J
1,2,3,6,7,8-HxCDD	1.41	J	1.36	J	1.665	J	2.55	J	2.4	J	4.01	J	4.6	J	3.65	J	3.93	J
1,2,3,7,8,9-HxCDD	3.25	J	2.97	J	4.11	J	6.36		7.92		13.1		14.3		12.8		16.1	
1,2,3,4,6,7,8-HpCDD	15		14.3		17.45		26.6		23.2		39.5		54.1		34.1		34.1	
OCDD	90.1		84.9		108		167		145		237		350		195		185	
Furans																		
2,3,7,8-TCDF	0.614	J	0.543	KJ	0.647	J	0.828	J	0.362	J	0.666	J	0.792	J	0.468	J	0.504	
1,2,3,7,8-PeCDF	0.119	KJ	0.145	J	0.1595	KJ	0.177	J	0.131	J	0.156	J	0.271	J	0.146	KJ	0.204	J
2,3,4,7,8-PeCDF	0.228	J	0.24	J	0.2865	J	0.278	J	0.23	J	0.266	J	0.415	J	0.264	KJ	0.298	J
1,2,3,4,7,8-HxCDF	0.336	J	0.33	J	0.385	J	0.622	J	0.398	J	0.58	J	0.723	J	0.501	J	0.697	J
1,2,3,6,7,8-HxCDF	0.248	J	0.235	KJ	0.2755	J	0.393	J	0.3	J	0.398	J	0.44	J	0.293	J	0.455	J
1,2,3,7,8,9-HxCDF	0.12	U	0.117	U	0.1175	U	0.122	U	0.0914	U	0.119	U	0.124	U	0.117	U	0.117	U
2,3,4,6,7,8-HxCDF	0.219	KJ	0.209	J	0.2485	J	0.374	J	0.239	J	0.375	J	0.393	J	0.271	J	0.316	J
1,2,3,4,6,7,8-HpCDF	7.1		6.56		7.935		12.3		8.06		11.9		12.8		8.58		8.19	
1,2,3,6,7,8,9-HpCDF	0.242	J	0.236	J	0.2745	J	0.437	J	0.274	J	0.493	J	0.542	J	0.379	J	0.401	J
OCDF	7.84	J	7.4	J	9.03	J	15.5		11.1		19.9		21		15.9		16.4	

Table 8. Summary of Toxicity Equivalence Factors for PCDDs/PCDFs.

	TEF	CX1	CX2	CX3	CX4	NC5	HQ6	CP7	CP8	CP9	CX1	CX2	CX3	CX4	NC5	HQ6	CP7	CP8	CP9
		ND=1/2 RL TEQ									ND=0 TEQ								
Dioxins																			
2,3,7,8-TCDD	1	0.83	0.84	1.15	1.74	2.32	3.85	3.91	3.80	4.30	0.83	0.84	1.15	1.74	2.32	3.85	3.91	3.80	4.30
1,2,3,7,8-PeCDD	1	1.07	1.06	1.40	2.26	2.66	4.64	4.87	4.95	5.10	1.07	1.06	1.40	2.26	2.66	4.64	4.87	4.95	5.10
1,2,3,4,7,8-HxCDD	0.1	0.04	0.04	0.05	0.07	0.06	0.12	0.12	0.10	0.11	0.04	0.04	0.05	0.07	0.06	0.12	0.12	0.10	0.11
1,2,3,6,7,8-HxCDD	0.1	0.14	0.14	0.17	0.26	0.24	0.40	0.46	0.37	0.39	0.14	0.14	0.17	0.26	0.24	0.40	0.46	0.37	0.39
1,2,3,7,8,9-HxCDD	0.1	0.33	0.30	0.41	0.64	0.79	1.31	1.43	1.28	1.61	0.33	0.30	0.41	0.64	0.79	1.31	1.43	1.28	1.61
1,2,3,4,6,7,8-HpCDD	0.01	0.15	0.14	0.17	0.27	0.23	0.40	0.54	0.34	0.34	0.15	0.14	0.17	0.27	0.23	0.40	0.54	0.34	0.34
OCDD	0.0003	0.03	0.03	0.03	0.05	0.04	0.07	0.11	0.06	0.06	0.03	0.03	0.03	0.05	0.04	0.07	0.11	0.06	0.06
Furans																			
2,3,7,8-TCDF	0.1	0.06	0.05	0.06	0.08	0.04	0.07	0.08	0.05	0.05	0.06	0.05	0.06	0.08	0.04	0.07	0.08	0.05	0.05
1,2,3,7,8-PeCDF	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01
2,3,4,7,8-PeCDF	0.3	0.07	0.07	0.09	0.08	0.07	0.08	0.12	0.08	0.09	0.07	0.07	0.09	0.08	0.07	0.08	0.12	0.08	0.09
1,2,3,4,7,8-HxCDF	0.1	0.03	0.03	0.04	0.06	0.04	0.06	0.07	0.05	0.07	0.03	0.03	0.04	0.06	0.04	0.06	0.07	0.05	0.07
1,2,3,6,7,8-HxCDF	0.1	0.02	0.02	0.03	0.04	0.03	0.04	0.04	0.03	0.05	0.02	0.02	0.03	0.04	0.03	0.04	0.04	0.03	0.05
1,2,3,7,8,9-HxCDF	0.1	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0	0	0	0	0	0	0	0	0
2,3,4,6,7,8-HxCDF	0.1	0.02	0.02	0.02	0.04	0.02	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.04	0.02	0.04	0.04	0.03	0.03
1,2,3,4,6,7,8-HpCDF	0.01	0.07	0.07	0.08	0.12	0.08	0.12	0.13	0.09	0.08	0.07	0.07	0.08	0.12	0.08	0.12	0.13	0.09	0.08
1,2,3,6,7,8,9-HpCDF	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
OCDF	0.0003	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Totals		**2.88**	**2.82**	**3.71**	**5.72**	**6.64**	**11.21**	**11.95**	**11.23**	**12.30**	**2.87**	**2.81**	**3.71**	**5.72**	**6.64**	**11.20**	**11.95**	**11.23**	**12.30**

Table 9. Results of chemical analysis compared with SMS guidelines.

Table 8, SMS Chemistry Results	SQS	CSL	CX1		CX2		CX3*		CX4		NC5		HQ6		CP7		CP8		CP9	
Total Organic Carbon (%)			0.57		0.64		0.55		0.80		0.97		0.93		0.91		0.95		0.95	
METALS (mg/kg dry)																				
Arsenic	57	93	3.1		3.7		2.75		3.9		2.9		6.8		4.5		2.5		6.7	
Cadmium	5.1	6.7	0.0054		0.01	U	0.505	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Chromium	260	270	5.74		4.3		7.25		12		2.7		6.3		5.8		16		17	
Copper	390	390	25		24		28		35		37		39		66		62		64	
Lead	450	530	4.5		6.4		4.5		5.4		5.4		4.8		6.8		6.4		7.1	
Mercury	0.41	0.59	0.0484		0.037		0.039		0.046		0.066		0.08		0.047		0.047		0.085	
Silver	6.1	6.1	0.036		0.03		0.04		0.06		0.06		0.13		0.08		0.1		0.13	
Zinc	410	960	51		53		55		61		56		50		86		76		77	
LPAH (mg/kg OC)																				
2-Methylnaphthalene	38	64	0.58	U	0.41	J	0.49	J	0.33	J	0.34	U	0.35	U	0.36	U	0.35	U	0.35	U
Acenaphthene	16	57	0.49	U	0.44	U	0.51	U	0.35	U	0.29	U	0.30	U	0.31	U	0.29	U	0.29	U
Acenaphthylene	66	66	0.68	U	0.61	U	0.70	U	0.49	U	0.40	U	0.42	U	0.43	U	0.41	U	0.41	U
Anthracene	220	1200	0.68	U	0.61	U	0.70	U	0.49	U	0.40	U	0.42	U	0.43	U	0.41	U	0.41	U
Fluorene	23	79	0.82	U	0.73	U	0.85	U	0.59	U	0.48	U	0.51	U	0.52	U	0.49	U	0.49	U
Naphthalene	99	170	0.63	U	0.56	U	0.60	J	0.45	J	0.43	J	0.49	J	0.40	U	0.33	J	0.44	J
Phenanthrene	100	480	0.63	U	0.55	J	1.19	J	0.43	J	0.37	U	0.42	J	0.40	U	0.37	J	0.40	J
Total LPAH	370	780	0.82	U	0.95	J	2.28	J	1.20	J	0.43	J	0.91	J	0.52	U	0.69	J	0.84	J
HPAH (mg/kg OC)																				
Benzo(a)anthracene	110	270	0.68	U	0.61	U	0.70	U	0.49	U	0.40	U	0.42	U	0.43	U	0.41	U	0.41	U
Benzo(a)pyrene	99	210	0.77	U	0.69	U	0.80	U	0.55	U	0.45	U	0.47	U	0.48	U	0.46	U	0.46	U
Benzo(g,h,i)perylene	34	88	1.11	U	0.98	U	1.14	U	0.79	U	0.65	U	0.68	U	0.69	U	0.66	U	0.66	U
Benzofluoranthenes	230	450	1.21	U	1.08	U	1.25	U	0.86	U	0.71	U	0.74	U	0.76	U	0.73	U	0.73	U
Chrysene	110	460	0.68	U	0.61	U	0.51	J	0.49	U	0.37	J	0.42	U	0.57	J	0.99	J	0.41	U
Dibenzo(a,h)anthracene	12	33	1.05	U	0.94	U	1.08	U	0.75	U	0.62	U	0.65	U	0.66	U	0.63	U	0.63	U
Fluoranthene	160	1200	1.05	U	0.94	U	1.59	J	0.75	U	1.13	J	0.65	U	0.66	U	0.63	U	0.63	U
Indeno(1,2,3-c,d)pyrene	34	88	0.91	U	0.81	U	0.94	U	0.65	U	0.54	U	0.56	U	0.57	U	0.55	U	0.55	U
Pyrene	1000	1400	0.58	J	0.56	U	1.50	J	0.51	J	1.03	J	0.57	J	0.60	J	0.41	J	0.44	J
Total HPAH	960	5300	0.58	J	1.08	U	3.60	J	0.51	J	2.54	J	0.57	J	1.18	J	1.40	J	0.44	J

Table 8, SMS Chemistry Results	SQS	CSL	CX1		CX2		CX3*		CX4		NC5		HQ6		CP7		CP8		CP9	
CHLORINATED HYDROCARBONS (mg/kg OC)																				
1,2,4-Trichlorobenzene	0.81	1.8	0.10	U	0.09	U	0.11	U	0.07	U	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U
1,2-Dichlorobenzene	2.3	2.3	0.05	U	0.05	U	0.06	U	0.04	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
1,4-Dichlorobenzene	3.1	9	0.09	U	0.08	U	0.09	U	0.06	U	0.05	U	0.05	U	0.05	U	0.05	U	0.12	J
Hexachlorobenzene	0.38	2.3	**1.02**	**U**	**0.91**	**U**	**1.05**	**U**	**0.73**	**U**	**0.60**	**U**	**0.62**	**U**	**0.64**	**U**	**0.61**	**U**	**0.61**	**U**
PHTHALATES (mg/kg OC)																				
Bis(2-ethylhexyl)phthalate	47	78	2.28	J	0.95	J	2.39	J	1.20	J	1.65	J	1.08	J	1.10	J	1.16	J	0.79	J
Butyl benzyl phthalate	4.9	64	0.53	U	0.45	U	1.04	U	0.41	U	0.34	U	0.44	U	0.44	U	0.38	U	0.43	U
Di-n-butyl phthalate	220	1700	1.04	J	0.83	J	1.01	J	0.83	J	0.86	J	0.76	U	0.78	U	0.67	J	0.75	U
Di-n-octyl phthalate	58	4500	0.58	U	0.52	U	0.60	U	0.41	U	0.34	U	0.35	U	0.36	U	0.35	U	0.35	U
Diethyl phthalate	61	110	1.68	U	1.50	U	1.73	U	1.20	U	0.99	U	1.03	U	1.05	U	1.01	U	1.01	U
Dimethyl phthalate	53	53	0.88	U	0.78	U	0.90	U	0.63	U	0.52	U	0.54	U	0.55	U	0.53	U	0.53	U
PHENOLS (ug/kg dry)																				
2 Methylphenol	63	63	9.3	U	9.3	U	9.3	U	9.4	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U
2,4-Dimethylphenol	29	29	15	U	15	U	15	U	15	U	15	U	15	U	15	U	15	U	15	U
4 Methylphenol	670	670	32		39	J	6.3	J	6.8	J	20	J	8	U	8	U	8	U	8	U
Pentachlorophenol	360	690	24	U	24	U	24	U	24	U	24	U	24	U	24	U	24	U	24	U
Phenol	420	1200	11	J	14	J	11	J	15	J	16	J	16	J	14	J	16	J	14	J
MISCELLANEOUS EXTRACTABLES																				
Benzoic acid (ug/kg dry)	650	650	270	U	270	U	270	U	270	U	270	U	270	U	270	U	270	U	270	U
Benzyl alcohol (ug/kg dry)	57	73	11	U	11	U	11	U	11	U	11	U	11	U	11	U	11	U	11	U
Dibenzofuran (mg/kg OC)	15	58	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Hexachlorobutadiene (mg/kg OC)	3.9	6.2	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U
N-Nitrosodiphenylamine (mg/kg OC)	11	11	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
PCBs (mg/kg OC)																				
Total Aroclors	12	65	0.62	U	0.49	U	0.65	U	0.31	U	0.21	U	0.25	U	0.27	U	0.22	U	0.24	U

Values in **Bold** are non-detects that exceed SQS when OC normalized. See text for details.
SQS = sediment quality guideline; CSL = cleanup action level
* reported values for C3 are a mean of sample and duplicate values
J = estimated concentration
U = undetected
OC = organic carbon

6. Comparison with SMS Guidelines. Chemical results were carbon normalized if necessary, and compared with Washington State Sediment Management Standards (Table 8) to determine if the sediments were suitable for beneficial uses under both DMMP and state guidelines. Levels of all detected compounds were below SMS guidelines. Non-detected levels of one chemical, hexachlorabenzene, exceeded SMS guidelines when carbon-normalized. Due to the low carbon percentage in these samples, the expected difficulty in the laboratory for obtaining low MDLs of hexachlorobenzene, and the fact that two samples underwent, and passed, confirmatory bioassay testing, the DMMP used Best Professional Judgment (BPJ) to disregard the OC normalized non-detections of hexachlorobenzene. All sediments were thus found suitable for beneficial use under SMS guidelines. However, SMS does not include guidelines for dioxins. Thus, the DMMP has modified the beneficial use finding, based on best professional judgment, in the Suitability section below (Section 8.)

7. Biological Testing. The standard suite of three bioassay tests (amphipod toxicity, larval mortality/abnormality, and polychaete growth) was performed on sediments chosen for confirmatory testing. The DMMP selected DMMUs 5 (from North Channel) and 6 (from Hoquiam Reach) for bioassay testing based on: 1) Location--no recent bioassay tests for these reaches; 2) Grain size—the chosen DMMU represented two different grain size characteristics; and 3) chemical results—the chosen DMMU both had resin acids detected in the higher range of detections for this characterization. Grays Harbor disposal sites are dispersive sites, which under DMMP guidelines require slightly more conservative bioassay data interpretation than with non-dispersive sites due to the inability to monitor disposed material over time. Both DMMU test sediments passed all three bioassays, interpreted with dispersive site guidelines, under both the 1-hit and 2-hit rules (Table 11).

Negative control and reference sediments were within DMMP performance criteria for all both the larval and amphipod tests (Table 10). For the *Neanthes* growth test, the mortality performance standard was met for both the control and reference, as was the mean individual growth (MIG) rate performance standard for the reference sediment. The MIG performance standard was not met for the negative control. Since the MIG results for both the test and reference sediments outperformed the negative control, the DMMP considered the tests valid and did not request a retest.

Table 10. Bioassay performance summary

Bioassay	Negative Control Performance Standard	Positive Control Performance (PSEP Guidelines)	Reference Sediment Performance Standard
Amphipod toxicity (*E. estuarius*)	**10%** mortality ≤ 10%; pass	$CdCl_2$, 96 hr EC50, **10.4 mg/L Cd** Lab control limits: 4.76 - 11.1 mg/L Cd pass	**28%** ref. mortality – 10% control mortality ≤ 20%; pass
Larval development (*M. galloprovincialis*)	**3%** CMA ≤ 30%; pass	$CuCl_2$, normality, **6.88 µg/L Cu** 5.15 - 15.8 µg/L Cu pass	**-0.2%** NCMA ≤ 35%; pass
Polychaete growth (*N. arenaceodentata*)	**0%** mortality ≤ 10% pass	$CdCl_2$, 96 hr EC50, **14.1 mg/L Cd** 4.58 - 22.9 mg/L Cd pass	**4%** mortality ≤ 20% **169%** ref MIG ≥ 80% control MIG pass

Bolded values are test results. Non-bolded values are performance standards.
CMA = Combined mortality and abnormality; MIG – mean individual growth (mg/day/worm); NCMA = Normalized combined mortality and abnormality (normalized to seawater control)

Table 11. Bioassay results summary. Data is interpreted using dispersive site guidelines.

STATION	% fines	% clay	Amphipod *(E. estuarius)* Mortality (%)		Sediment Larval *(M. galloprovincialis)* NCMA (%)		20-day *Neanthes* Growth					DMMP Pass/Fail (dispersive guidelines)
							Mortality (%)	MIG (mg/ind/day)		MIG % of control	MIG % of reference	
			mean	sd	mean	sd		mean	sd			
Control	--	--	10.0	5.0	97.0	6.5	0	0.333	0.233	--	--	n//a
Reference	76.2	21.2	28.0	10.4	97.1	10.0	4	0.562	0.112	169%	--	n/a
NC5	51.7	11.0	8.0	8.4	95.8	5.6	4	0.586	0.047	176%	104%	Pass
HQ6	87.6	87.6	15.0	10.0	96.5	7.2	4	0.543	0.068	163%	97%	Pass

8. Suitability. This memo documents the suitability of all proposed dredged sediments in the Grays Harbor navigation channel for open water disposal. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the chemical and biological testing and the discussions above, the DMMP agencies concluded that the **total dredging volume remains suitable** for open water disposal. Open water disposal may be at the South Jetty or Point Chehalis estuarine disposal site.

Based on agency best professional judgment regarding acceptable dioxin concentrations in beneficial use material, only material from the Outer Reaches (exclusionary) may be used at an approved beneficial use (nearshore or onshore) site. Material from Inner Reaches may be used for beneficial use only after comparison of dioxin concentrations in the source and receiving areas. Specifically, if dioxin concentrations in each DMMU proposed for beneficial use are equal to or less than that in a representative sampling of the sediments from the receiving area(s), that dredged material will be acceptable for beneficial use at that approved location. This suitability determination does not constitute final agency approval of the project.

9. References.

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Concur:

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Date

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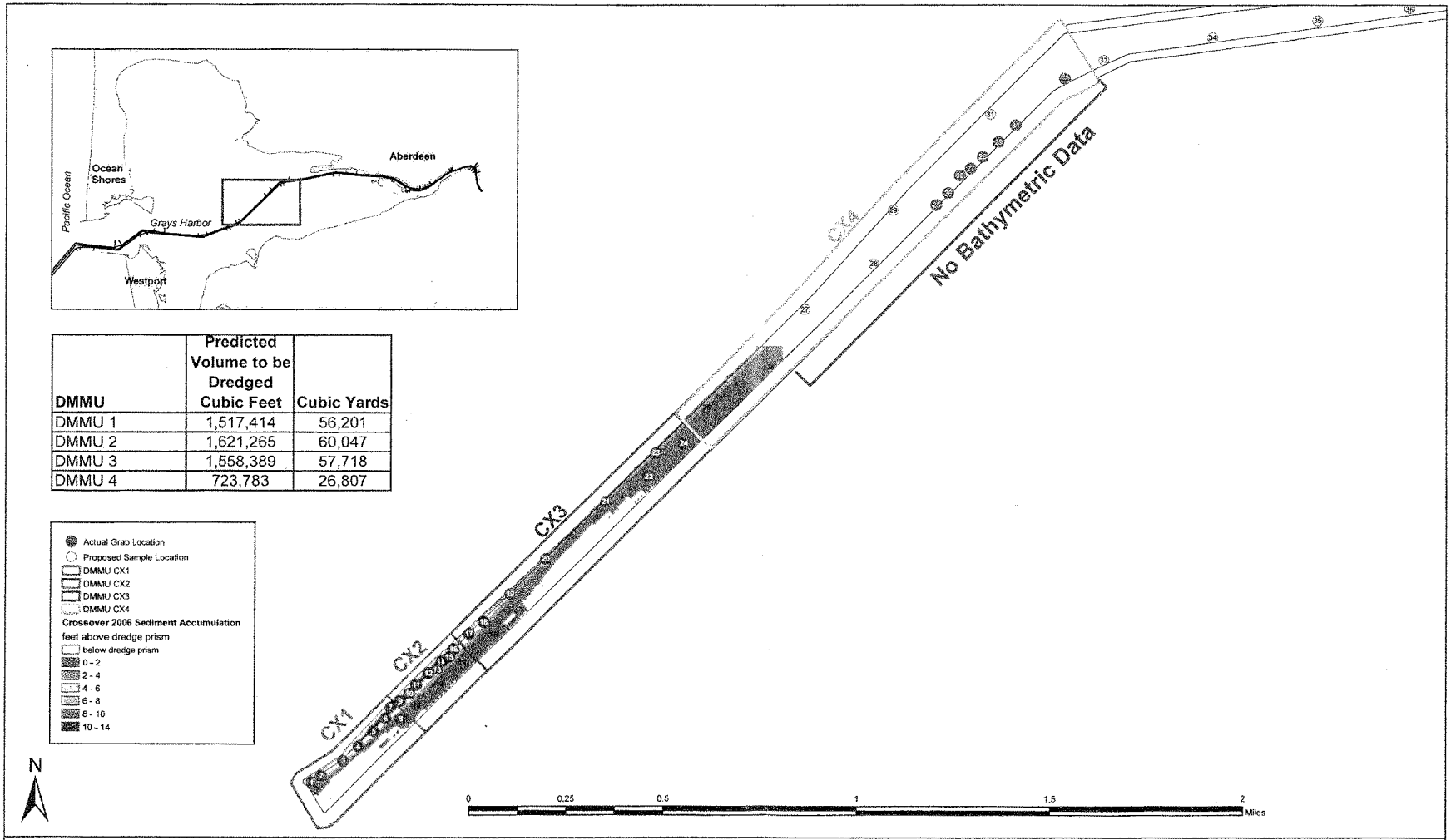
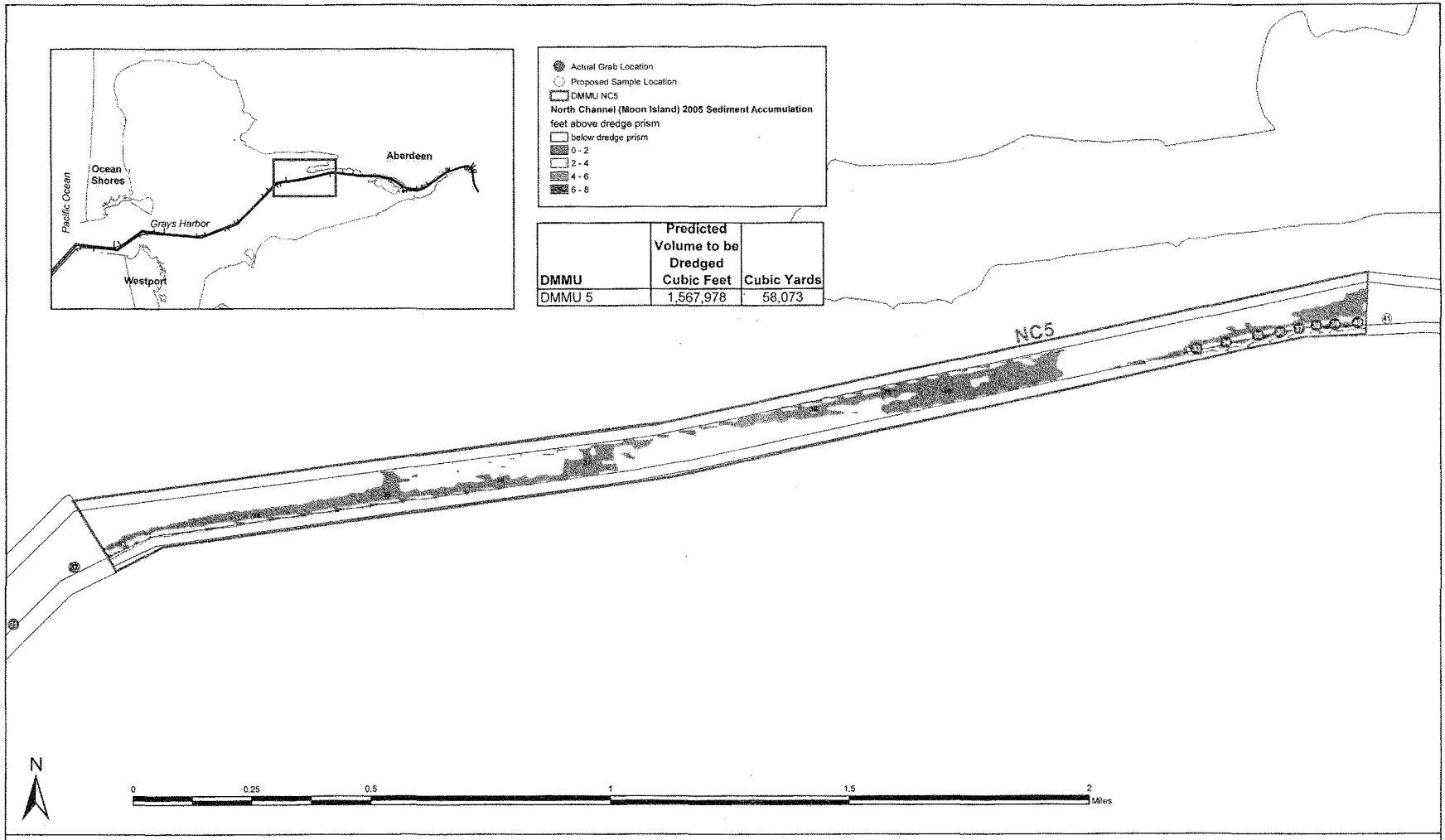
Quinault Tribe
DMMO file

DMMU	Predicted Volume to be Dredged Cubic Feet	Cubic Yards
DMMU 1	1,517,414	56,201
DMMU 2	1,621,265	60,047
DMMU 3	1,558,389	57,718
DMMU 4	723,783	26,807



This analysis based on 2006 bathymetric data. Dredge prism is based on 38' required dredge depth, plus 2' allowable overdepth. A 1V:5H slope is included in analysis and volume calculations.

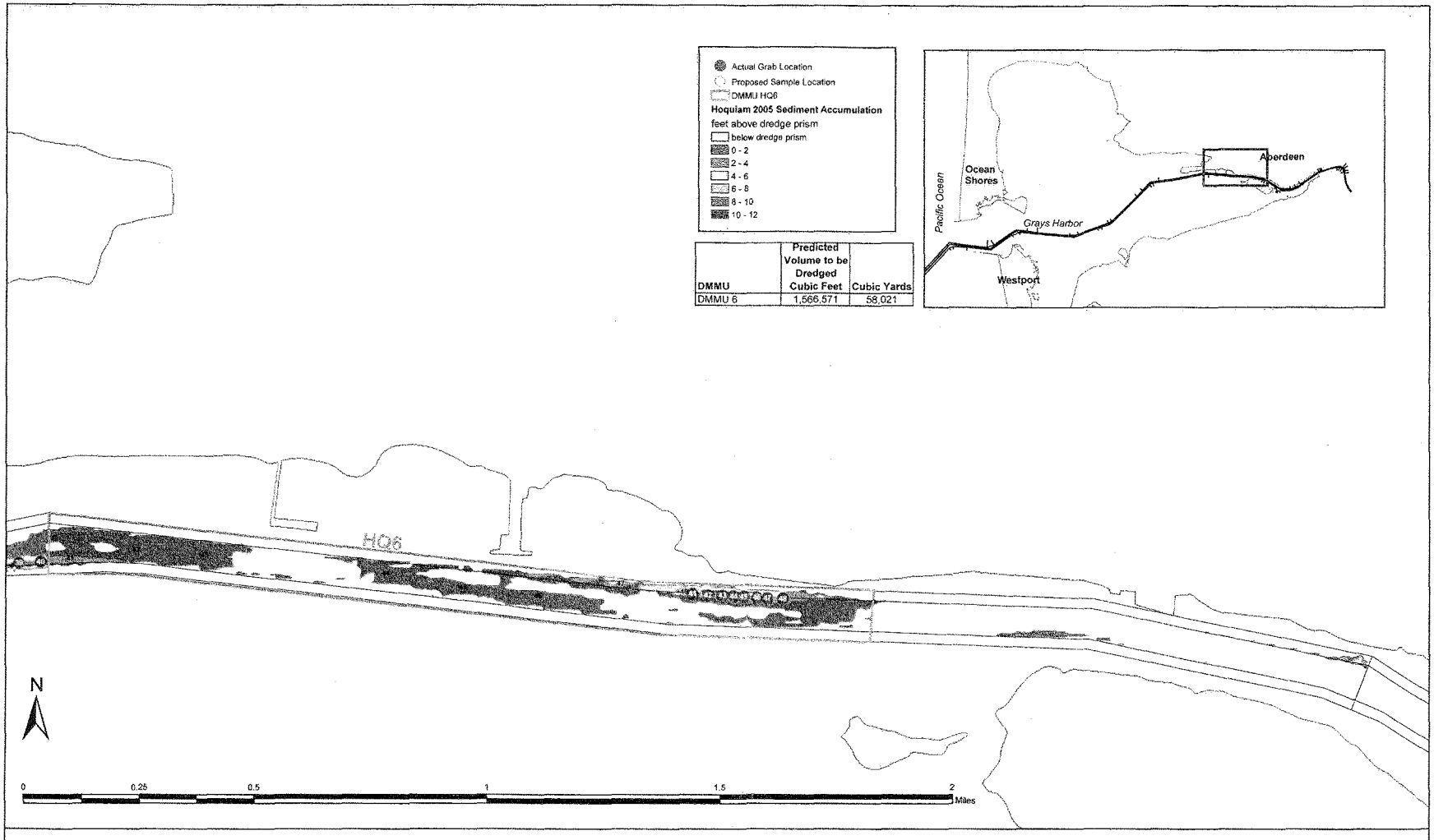
Figure 3-1. DMMUs, Estimated Dredge Volumes, and Actual Sampling Locations in Crossover Reach, Based on Real-time Bathymetry



DMMU	Predicted Volume to be Dredged Cubic Feet	Cubic Yards
DMMU 5	1,567,978	58,073

This analysis based on 2005 bathymetric data. Dredge prism is based on 38' required dredge depth, plus 2' allowable overdepth. A 1V:3H slope is included in analysis and volume calculations.

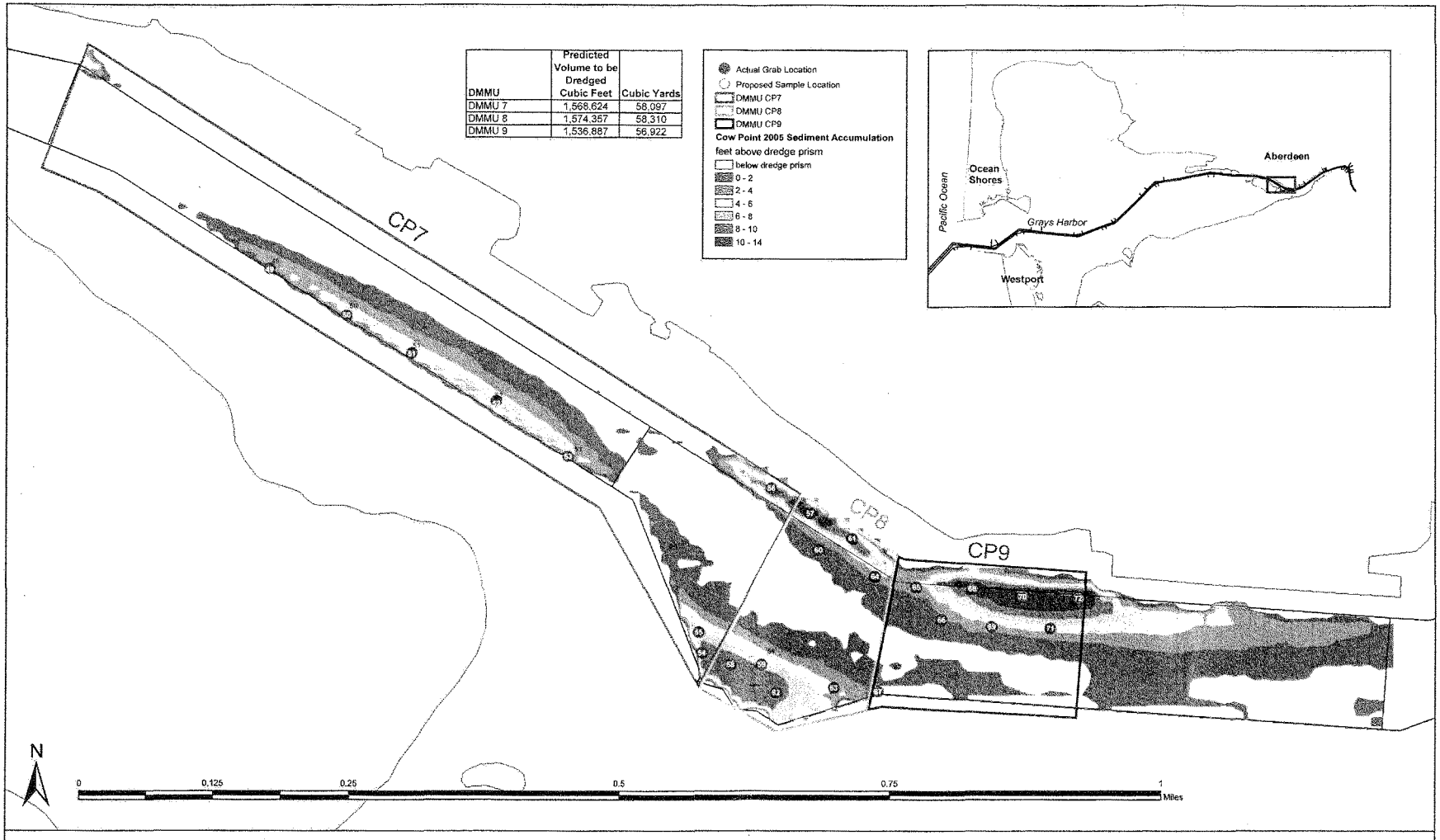
Figure 3-2. DMMUs, Estimated Dredge Volumes, and Actual Sampling Locations in North Channel (Moon Island) Reach, Based on Real-time Bathymetry



DMMU	Predicted Volume to be Dredged Cubic Feet	Cubic Yards
DMMU 6	1,566,571	58,021

This analysis based on 2005 bathymetric data. Dredge prism is based on 38' required dredge depth, plus 2' allowable overdepth. A 1V:3H slope is included in analysis and volume calculations.

Figure 3-3. DMMUs, Estimated Dredge Volumes, and Actual Sampling Locations in Hoquiam Reach, Based on Real-time Bathymetry



DMMU	Predicted Volume to be Dredged Cubic Feet	Cubic Yards
DMMU 7	1,568,624	58,097
DMMU 8	1,574,357	58,310
DMMU 9	1,536,887	56,922

This analysis based on 2005 bathymetric data. Dredge prism is based on 38' required dredge depth, plus 2' allowable overdepth. A 1V:3H slope (& 1:1.5 slope South Side) is included in analysis

Figure 3-4. DMMUs, Estimated Dredge Volumes, and Actual Sampling Locations in Cow Point, Based on Real-time Bathymetry