

December 2, 2010

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATION AND MAINTENANCE DREDGED MATERIAL FROM GRAYS HARBOR, WASHINGTON (*Public Notice CENWS OD-TS-NS-38*) 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, and is reevaluated every six years.

For this project an estimated 2.5 million cubic yards (cy) of maintenance material is proposed to be dredged annually from the federal navigation channel. This characterization event begins the third six-year round of testing. Due to lower dredge rates in the past few years, more material than usual remains in the channel: approximately 2,586,821 cy is represented in this characterization 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.

PSAP Addendum Received	July 30, 2010
PSAPA approved	Verbal approval: August 2, 2010 Written comments: August 12, 2010
Sampling dates	August 3 – 4, 2010
Final data report submitted	October 4, 2010
Recency Determination: Low Concern (6 years)	August 2016
DAIS reference number	GRAYS-1-B-F-297

Table 2. Project Synopsis.

Time of proposed dredging	Annually, 16 July through 14 Feb, 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

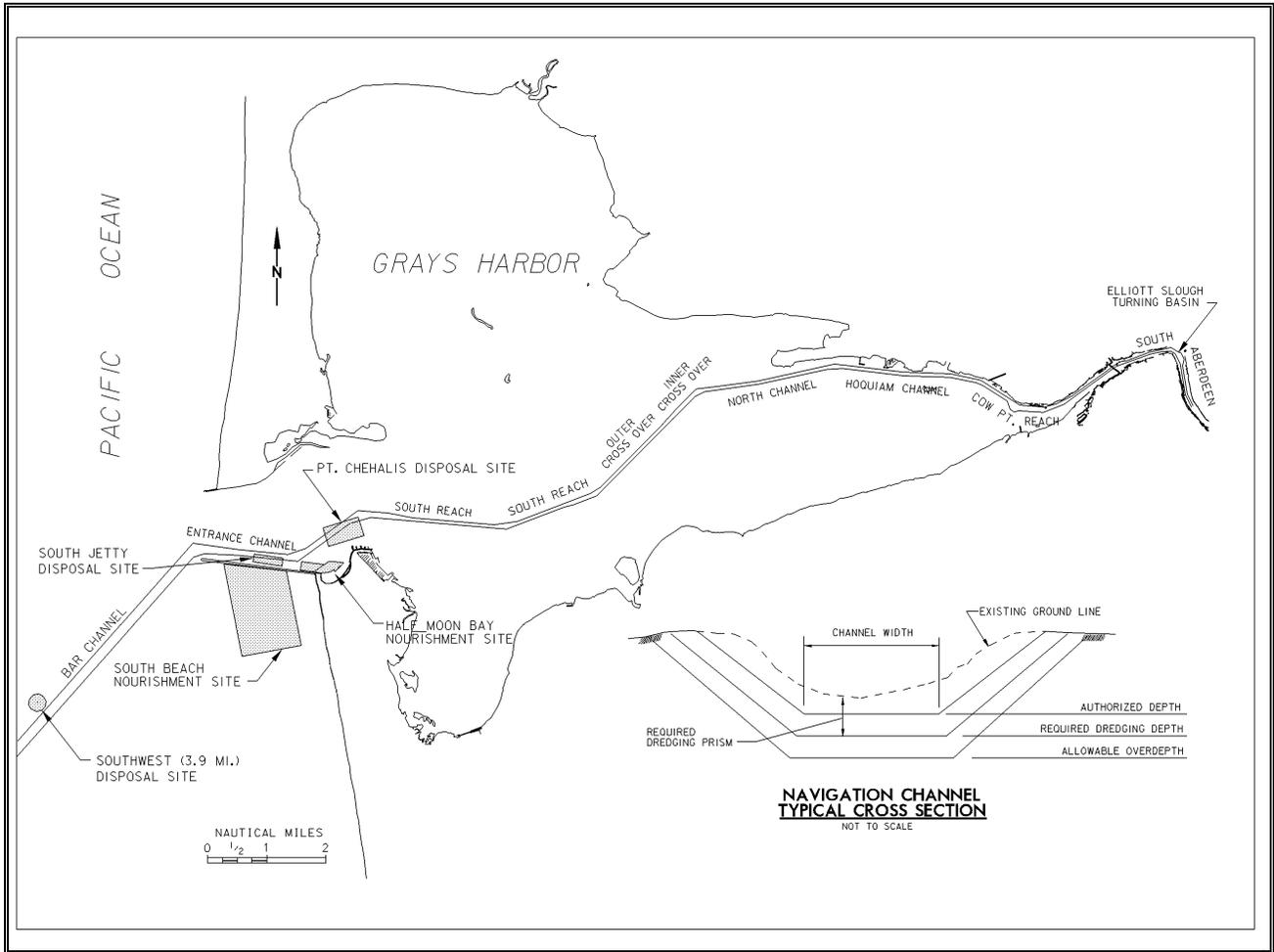


Figure 1. Grays Harbor navigation project. Samples taken for this characterization were from the Cow Point, Hoquiam, North Channel and Crossover reaches.

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 15 years of characterization in the area, continue to support this approach.

This characterization was the third (last) in the third six-year rotation. 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 PSAP addendum is prepared each year to address sampling issues specific to the given sampling and testing event.

3. **Sampling.** Sediment sampling took place from August 3 – 4, 2010. Because the dredging year, as defined by the DMMP, begins on 16 June, this characterization is considered to be a DY 2011 project. As in the past the area was ranked “low,” and the material available for dredging was considered homogenous. The approved programmatic and 2010 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 grab samples in each of nine dredged material management units (DMMUs) for a total of 72 sediment 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 for confirmatory bioassays. Conventional parameters measured in these 9 DMMU composites and the reference sediment are depicted in **Table 3**.

Table 3. Sediment conventional results.

DMMU	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9	REF 06
# samples in composite	8	8	8	8	8	8	8	8	8	-
Volume	194,935	196,236	207,431	200,845	584,614	554,539	207,464	223,160	217,597	---
Ammonia (mg/kg)	25.2	19.9	26.1	28.5	21.6	35.4	67.0	42.2	22.5	18.5
Total Solids (%)	55.80	61.20	60.70	55.90	61.00	54.60	42.60	40.00	41.70	51.80
Total Organic Carbon (%)	1.35	1.3	1.37	1.57	1.51	1.27	1.85	1.8	1.8	1.39
Total Volatile Solids (%)	5.63	4.12	4.13	5.26	4.53	6.18	8.09	9.02	8.29	6.01
Total Sulfides (mg/kg)	4.29 J	12.5 J	4.91 J	3.96 J	1.69 UJ	1.81 UJ	4.59 J	37.8 J	311 J	1220 J
Grain Size	Gravel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1 U
	Sand	55.0	56.6	60.8	54.3	61.0	35.1	13.6	8.2	7.6
	Silt	28.4	20.9	18.5	22.0	19.4	41.2	57.8	58.1	62.1
	Clay	16.7	22.4	20.6	23.8	19.5	23.6	28.6	33.7	30.3
	Fines	45.1	43.3	39.1	45.8	38.9	64.8	86.4	91.8	92.4

- Shaded DMMUs were those used in confirmatory bioassays.
- DMMU Reaches: CX=Crossover; NC=North Channel; HO=Hoquiam; CP=Cow Point
- U = Analyte not detected above reported sample quantitation limit;
- J = Analyte positively identified; associated numerical value is approximate;
- UJ = Analyte not detected above reported sample quantitation limit, but reported quantitation limit is approximate

4. **Chemical Analysis QA/QC.** Analytical Resources, Inc of Tukwila, WA performed the analyses of all sediment conventionals and all chemicals other than dioxins/furans. AXYS Environmental Services conducted the analysis of dioxin/furan congeners. All laboratory data were validated by an independent firm (EcoChem). Per EcoChem, data reported were acceptable with the following exceptions:

a. **Volatile Organics:** One data point (1,2,4-Trichlorobenzene in NC5) was rejected based on MS/MSD recoveries that were less than 10%.

b. **Semi-Volatile Organics:** Benzyl alcohol was not recovered in the laboratory control sample. This analyte was also not detected in the associated samples; reporting limits were rejected in all samples.

c. **Dioxins/Furans:** The following analytes were qualified in one of more samples based on method blank contamination: 2,3,7,8 TCDF; 2,3,4,7,8-PeCDF; 1,2,3,4,7,8-HxCDF and 2,3,4,5,7,8-HxCDF. In order to assess the impact of blank contamination on the reported sample results, action levels at five times the blank concentrations are established. Results for these instances were qualified as not detected, as the concentrations in the associated files samples were less than the action levels.

The QA/QC problems encountered during chemical analysis, including the rejected data, were considered minor by the DMMP agencies and did not significantly impact the overall quality of the data or its use for decision-making.

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 4) 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. 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.

a. **Resin acids.** Guaiacols have never been detected in Grays Harbor sampling, so they were dropped during this round as a COC. However, the analytical process used for resin acids also reports guaiacols, so these are also reported. Pimaric acid was not detected in any sample; abietic acid and dehydroabietic acid were detected in some samples. It is important to note that the DMMP does not have interpretive criteria for resin acids. Results for these compounds were comparable to previous years' data, showing no important changes over time. Levels of detected resin acids were much lower than levels generally associated with environmental or human health effects (Word *et al* 1990).

b. **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 5) showed detected levels of PCDD/PCDF in all samples. Toxic Equivalency (with non-detects calculated as ½ reporting limit) ranged from 2.75 – 7.99 ng/kg dry wt. (pptr), all well below the 15 TEQ suitability level set for Grays Harbor.

Table 4. Results of chemical analysis compared with DMMP guidelines.

ANALYTE	DMMP GUIDELINES			DMMUS								
	SL	BT	ML	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9
Metals (mg/kg)												
Antimony	150	--	200	0.4 UJ	0.3 UJ	0.3 UJ	0.3 UJ	0.3 UJ	0.4 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Arsenic	57	507.1	700	7.3	6.0	6.2	6.8	6.4	6.6	7.3	7.7	7.2
Cadmium	5.1	11.3	14	0.4 U	0.3 U	0.3 U	0.3 U	0.3 U	0.4 U	0.5 U	0.5 U	0.5 U
Chromium	--	267	--	28.3	25.7	25.9	27.7	29.1	34.0	40	40	39
Copper	390	1027	1300	27.4	29.6	25.6	30.4	32.7	45.3	54.3	58.7	56.8
Lead	450	975	1200	6	5	5	6	5	7	8	9	9
Mercury	0.41	1.5	2.3	0.04	0.03 U	0.04 U	0.04	0.04 U	0.04	0.06	0.06	0.06
Nickel	140	370	370	21	20	20	20	22	26	29	29	27
Selenium	--	3	--	0.9 U	0.8 U	0.8 U	0.9 U	0.8 U	0.9 U	1 U	1 U	1 U
Silver	6.1	6.1	8.4	0.4 UJ	0.3 UJ	0.3 UJ	0.3 UJ	0.3 UJ	0.4 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Zinc	410	2783	3800	64	59	58	62	65	76	86	88	85
Low-Molecular PAHs (µg/kg)												
Naphthalene	2100	--	2400	20 U	20 U	19 U	20 U					
Acenaphthylene	560	--	1300	20 U	20 U	19 U	20 U					
Acenaphthene	500	--	2000	20 U	20 U	19 U	20 U					
Fluorene	540	--	3600	20 U	20 U	19 U	20 U					
Phenanthrene	1500	--	21000	20 U	20 U	19 U	10 J	20 U	20 U	16 J	23	17 J
Anthracene	960	--	13000	20 U	20 U	19 U	20 U					
2-Methylnaphthalene	670	--	1900	20 U	20 U	19 U	20 U					
Total LPAH ¹	5200	--	29000	20 U	20 U	19 U	10 J	20 U	20 U	16 J	23	17 J

ANALYTE	DMMP GUIDELINES			DMMUS								
	SL	BT	ML	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9
High-Molecular PAHs (µg/kg)												
Fluoranthene	1700	4600	30000	20 U	20 U	19 U	15 J	20 U	13 J	19 J	34	29
Pyrene	2600	11980	16000	20 U	20 U	19 U	14 J	20 U	12 J	16 J	25	23
Benzo(a)anthracene	1300	--	5100	20 U	20 U	19 U	20 U	20 U	20 U	20 U	12 J	16 J
Chrysene	1400	--	21000	20 U	20 U	19 U	20 U	20 U	20 U	11 J	15 J	19 J
Total benzofluoranthenes	3200	--	9900	20 U	20 U	19 U	19.8 J	20 U	20 U	20 U	36 J	36 J
Benzo(a)pyrene	1600	--	3600	20 U	20 U	19 U	20 U					
Indeno(1,2,3-cd) pyrene	600	--	4400	20 U	20 U	19 U	20 U					
Dibenz(a,h)anthracene	230	--	1900	20 U	20 U	19 U	20 U					
Benzo(g,h,i)perylene	670	--	3200	20 U	20 U	19 U	20 U					
Total HPAH ¹	12000	--	69000	20 U	20 U	19 U	48.8 J	20 U	25 J	46 J	122 J	123 J
Chlorinated Hydrocarbons (µg/kg)												
1,3-Dichlorobenzene	170	--	--	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
1,4-Dichlorobenzene	110	--	120	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
1,2-Dichlorobenzene	35	--	110	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
1,2,4-Trichlorobenzene	31	--	64	6.6 U	6.1 U	6.2 U	6.8 U	R	6.9 U	9.5 U	9.4 U	9.1 U
Hexachlorobenzene	22	168	230	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	0.98 U
Phthalates (µg/kg)												
Dimethylphthalate	71	--	1400	20 U	20 U	19 U	20 U					
Diethylphthalate	200	--	1200	20 U	20 U	19 U	20 U					
Di-n-Butylphthalate	1400	--	5100	20 U	20 U	19 U	20 U					
Butylbenzylphthalate	63	--	970	20 U	20 U	19 U	20 U					
bis(2-Ethylhexyl) phthalate	1300	--	8300	14 J	20 U	19 U	11 J	11 J	9.8 J	18 J	15 J	17 J

ANALYTE	DMMP GUIDELINES			DMMUS								
	SL	BT	ML	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9
Di-n-Octyl phthalate	6200	--	6200	20 U	20 U	19 U	20 U					
Phenols (µg/kg)												
Phenol	420	--	1200	20 U	20 U	19 U	20 U					
2-Methylphenol	63	--	77	20 U	20 U	19 U	20 U					
4-Methylphenol	670	--	3600	20 U	20 U	19 U	14 J	20 U	20 U	13 J	16 J	11 J
2,4-Dimethylphenol	29	--	210	20 U	20 U	19 U	20 U					
Pentachlorophenol	400	504	690	99 U	99 U	96 U	98 U	98 U	98 U	99 U	98 U	98 U
Miscellaneous Extractables (µg/kg)												
Benzyl Alcohol	57	--	870	R	R	R	R	R	R	R	R	R
Benzoic Acid	650	--	760	200 U	200 U	190 U	200 U	43 J	200 U	43 J	200 U	200 U
Dibenzofuran	540	--	1700	20 U	20 U	19 U	20 U					
Hexachloroethane	1400	--	14000	20 U	20 U	19 U	20 U					
Hexachlorobutadiene	29	--	270	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	0.98 U
N-Nitrosodiphenylamine	28	--	130	20 U	20 U	19 U	20 U					
1-Methylnaphthalene	--	--	--	20 U	20 U	19 U	20 U					
Volatile Organics (µg/kg)												
Trichloroethene	160	--	1600	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
Tetrachloroethene	57	--	210	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
Ethylbenzene	10	--	50	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
Total Xylene (sum of o-, m-, p-) ¹	40	--	160	1.3 U	1.2 U	1.2 U	1.4 U	1.2 UJ	1.4 U	1.9 U	1.9 U	1.8 U
Pesticides & PCBs (µg/kg)												
Total DDT ¹	6.9	50	69	2.0 U	1.9 U	1.9 U	2.0 U	1.9 U	1.9 U	2.0 U	2.0 U	2.0 U
Aldrin	10	--	--	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	0.98 U

ANALYTE	DMMP GUIDELINES			DMMUS								
	SL	BT	ML	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9
cis-Chlordane	--	--	--	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	0.98 U
cis-Nonachlor	--	--	--	2.0 U	1.9 U	1.9 U	2.0 U	1.9 U	1.9 U	2.0 U	2.0 U	2.0 U
Dieldrin	10	--	--	2.0 U	1.9 U	1.9 U	2.0 U	1.9 U	1.9 U	2.0 U	2.0 U	2.0 U
gamma-BHC (Lindane)	10	--	--	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	0.98 U
Heptachlor	10	--	--	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	3.8
oxy Chlordane	--	--	--	2.0 U	1.9 U	1.9 U	2.0 U	1.9 U	1.9 U	2.0 U	2.0 U	2.0 U
Total Chlordane ¹	10	37	--	2.0 U	1.9 U	1.9 U	2.0 U	1.9 U	1.9 U	2.0 U	2.0 U	2.0 U
trans-Chlordane	--	--	--	0.99 U	0.97 U	0.97 U	0.98 U	0.96 U	0.97 U	0.98 U	0.98 U	0.98 U
trans-Nonachlor	--	--	--	2.0 U	1.9 U	1.9 U	2.0 U	1.9 U	1.9 U	2.0 U	2.0 U	2.0 U
Total PCB Aroclors	130	38(mg/kg OC)	3100	20 U	20 U	19 U	20 U	20 U	19 U	20 U	20 U	20 U
Guaiacols and Resin Acids (µg/kg)												
3,4,5-Trichloroguaiacol	--	--	--	20 U	20 U	19 U	20 U					
Tetrachloroguaiacol	--	--	--	20 U	20 U	19 U	20 U					
Abietic Acid	--	--	--	98 U	98 U	97 U	470 J	96 U	180 J	370 J	240 J	230 J
Dehydroabietic Acid	--	--	--	130	120	97 U	270	96 U	190	330	210	240
Pimaric Acid	--	--	--	98 U	98 U	97 U	99 U	96 U	97 U	98 U	97 U	98 U

- Data were qualified by both the analytical laboratory and the validating firm.
- J = Estimated value; concentration is less than method reporting limit but greater than or equal to method detection limit as reported by the analytical laboratory
- U = Not detected at or above the method detection limit as reported by the analytical laboratory
- R = Rejected
- For chemical groups with all parameters undetected, totals are reported as the highest detection limit. For chemical groups with some detected parameters, totals are reported as the sum of only the detected values with qualifiers.
- **Shaded DMMU** (HO6 and CP8) were used for confirmatory bioassays.

Table 5. Summary of PCDD/PCDF data, reported in parts per trillion (ng/kg dry wt).

SAMPLE ID	CX1			CX2			CX3			CX4			NC5			HO6			CP7			CP8			CP9		
		L Q	V Q		L Q	V Q		L Q	V Q		L Q	V Q		L Q	V Q		L Q	V Q		L Q	V Q		L Q	V Q		L Q	V Q
2,3,7,8-TCDD	0.842	B J		1.13	B		0.932	B J		0.927	B J		1.07	B		1.90	B		1.86	B		2.28	B		2.43	B	
1,2,3,7,8-PECDD	1.04	B J		1.26	B J		1.12	B J		1.30	B J		1.32	B J		2.08	B J		2.15	B J		2.89	B J		3.16	B J	
1,2,3,4,7,8-HXCDD	0.345	K J	U	0.399	K J	U	0.396	J		0.511	J		0.470	K J	U	0.713	K J	U	0.892	J		0.959	J		1.08	K J	U
1,2,3,6,7,8-HXCDD	1.32	B J		1.28	B J		1.30	B J		1.45	B J		1.41	B J		2.32	B J		2.81	B J		3.48	B J		3.56	B J	
1,2,3,7,8,9-HXCDD	3.19	B J		3.90	B J		3.35	B J		3.90	B J		3.94	B J		6.43	B		7.28	B		8.74	B		9.87	B	
1,2,3,4,6,7,8-HPCDD	13.7	B		13.3	B		13.4	B		16.0	B		16.3	B		31.6	B		34.1	B		40.5	B		41.7	B	
OCDD	83.1	B		76.8	B		78.6	B		104	B		98.0	B		212	B		231	B		270	B		280	B	
2,3,7,8-TCDF	0.859	B J	U	0.637	B J	U	0.606	B J	U	0.762	B J	U	0.559	B J	U	0.824	B J	U	1.08	B	U	1.16	B	U	1.34	B	U
1,2,3,7,8-PECDF	0.199	K B J	U	0.167	B J		0.166	B J		0.169	K B J	U	0.168	K B J	U	0.214	K B J	U	0.256	K B J	U	0.303	B J		0.289	B J	
2,3,4,7,8-PECDF	0.536	B J	U	0.403	K B J	U	0.361	B J	U	0.433	K B J	U	0.402	B J	U	0.429	B J	U	0.618	K B J	U	0.632	B J	U	0.669	B J	U
1,2,3,4,7,8-HXCDF	0.340	B J	U	0.279	K B J	U	0.295	B J	U	0.345	B J	U	0.293	B J	U	0.459	B J		0.681	B		0.772	K B J	U	0.764	B J	
1,2,3,6,7,8-HXCDF	0.251	K J	U	0.189	J		0.214	K J	U	0.262	J		0.217	K J	U	0.303	J		0.428	J		0.564	J		0.567	J	

SAMPLE ID	CX1			CX2			CX3			CX4			NC5			HO6			CP7			CP8			CP9		
1,2,3,7,8,9-HXCDF	0.0570	K J U		0.0492	U		0.0488	U		0.0567	U		0.0490	U		0.0501	U		0.0520	U		0.0487	U		0.0540	U	
2,3,4,6,7,8-HXCDF	0.285	B J U		0.191	B J U		0.199	B J U		0.247	B J U		0.252	B J U		0.282	B J U		0.404	K B J U		0.455	B J U		0.476	K B J U	
1,2,3,4,6,7,8-HPCDF	6.41			4.51	J		5.37			6.35			5.58			8.84			15.8			15.9			15.3		
1,2,3,4,7,8,9-HPCDF	0.24	K J U		0.177	J		0.206	K J U		0.181	J		0.206	J		0.316	K J U		0.567	J		0.702	J		0.631	J	
OCDF	7.79	B J		6.64	B J		6.37	B J		8.33	B J		8.50	B J		16.8	B		24.3	B		26.6	B		25.0	B	
TEQ full DL ¹	2.94			3.41			3.02			3.37			3.49			5.73			6.15			7.65			8.24		
TEQ 1/2 DL ²	2.75			3.28			2.90			3.24			3.33			5.57			5.97			7.45			7.99		
TEQ 0 DL ³	2.56			3.14			2.77			3.10			3.18			5.40			5.80			7.26			7.74		

- LQ = Lab Qualifier (ARI)
- VQ = Validation Qualifier (EcoChem)
- U = not detected;
- K = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration;
- B = analyte found in sample and the associated blank;
- DMMU Reaches: CX=Crossover; NC=North Channel; HO=Hoquiam; CP=Cow Point
- J = Analyte positively identified; associated numerical value is approximate;
- **Shaded DMMUs** were those subjected to bioassays.

- 1 Toxic equivalent quotient (TEQ) calculated using the full value of the detection limit for undetected congener concentrations and mammalian toxic equivalency factor (TEF) values from Van den Berg et al., 2006.
- 2 Toxic equivalent quotient (TEQ) calculated using one-half the detection limit for undetected congener concentrations and mammalian TEF values.
- 3 TEQ calculated using mammalian TEF values and excluding undetected congeners.

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

CHEMICAL	SQS	CSL	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9									
TOC (decimal)			0.0135	0.0130	0.0137	0.0157	0.0151	0.0127	0.0185	0.0180	0.0180									
METALS (mg/kg dry)																				
Arsenic	57	93	7.3	6	6.2	6.8	6.4	6.6	7.3	7.7	7.2									
Cadmium	5.1	6.7	0.4	U	0.3	U	0.3	U	0.3	U	0.5	U	0.5	U	0.5	U				
Chromium	260	270	28.3		25.7		25.9		27.7		29.1		34		40		40		39	
Copper	390	390	27.4		29.6		25.6		30.4		32.7		45.3		54.3		58.7		56.8	
Lead	450	530	6		5		5		6		5		7		8		9		9	
Mercury	0.41	0.59	0.04		0.03	U	0.04	U	0.04		0.04	U	0.04		0.06		0.06		0.06	
Silver	6.1	6.1	0.4	U	0.3	U	0.3	U	0.3	U	0.3	U	0.4	U	0.5	U	0.5	U	0.5	U
Zinc	410	960	64	J	59	J	58	J	62	J	65	J	76	J	86	J	88	J	85	J
LPAH (mg/kg OC)																				
2-Methylnaphthalene	38	64	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Acenaphthene	16	57	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Acenaphthylene	66	66	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Anthracene	220	1200	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Fluorene	23	79	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Naphthalene	99	170	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Phenanthrene	100	480	1.5	U	1.5	U	1.4	U	1.3	J	1.3	U	1.6	U	0.6	J	0.8		1.1	J
Total LPAH	370	780	1.5	U	1.5	U	1.4	U	1.3	J	1.3	U	1.1	U	0.6	J	0.8		1.1	J
HPAH (mg/kg OC)																				
Benzo(a)anthracene	110	270	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	J	1.1	J
Benzo(a)pyrene	99	210	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Benzo(g,h,i)perylene	34	88	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Benzofluoranthenes	230	450	1.5	U	1.5	U	1.4	U	1.3	J	1.3	U	1.6	U	1.1	U	2.0	J	2.0	J
Chrysene	110	460	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	0.6	J	0.8	J	1.1	J
Dibenzo(a,h)anthracene	12	33	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Fluoranthene	160	1200	1.5	U	1.5	U	1.4	U	1.0	J	1.3	U	1.0	J	1.0	J	1.9		1.6	
Indeno(1,2,3-c,d)pyrene	34	88	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U
Pyrene	1000	1400	1.5	U	1.5	U	1.4	U	0.9	J	1.3	U	0.9	J	0.9	J	1.4		1.3	
Total HPAH	960	5300	1.5	U	1.5	U	1.4	U	3.1	J	1.3	U	2.0	J	2.5	J	6.8		6.8	

CHEMICAL	SQS	CSL	CX1	CX2	CX3	CX4	NC5	HO6	CP7	CP8	CP9										
CHLORINATED HYDROCARBONS (mg/kg OC)																					
1,2,4-Trichlorobenzene	0.81	1.8	0.5	U	0.5	U	0.5	U	0.4	U	R		0.5	U	0.5	U	0.5	U	0.5	U	
1,2-Dichlorobenzene	2.3	2.3	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	
1,4-Dichlorobenzene	3.1	9	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	
Hexachlorobenzene	0.38	2.3	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	
PHTHALATES (mg/kg OC)																					
Bis(2-ethylhexyl)phthalate	47	78	1.0	J	1.5	U	1.4	U	0.7	J	0.7	J	0.8	J	1.0	J	0.8	J	0.9	J	
Butyl benzyl phthalate	4.9	64	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
Di-n-butyl phthalate	220	1700	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
Di-n-octyl phthalate	58	4500	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
Diethyl phthalate	61	110	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
Dimethyl phthalate	53	53	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
PHENOLS (ug/kg dry)																					
2 Methylphenol	63	63	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
2,4-Dimethylphenol	29	29	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
4 Methylphenol	670	670	1.5	U	1.5	U	1.4	U	0.9	J	1.3	U	1.6	U	0.7	J	0.9	J	0.6	J	
Pentachlorophenol	360	690	7.3	U	7.6	U	7.0	U	6.2	U	6.5	U	7.7	U	5.4	U	5.4	U	5.4	U	
Phenol	420	1200	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
MISCELLANEOUS EXTRACTABLES																					
Benzoic acid (ug/kg dry)	650	650	200	U	200	U	190	U	200	U	43	J	200	U	43	J	200	U	200	U	
Benzyl alcohol (ug/kg dry)	57	73	R		R		R		R		R		R		R		R		R		
Dibenzofuran (mg/kg OC)	15	58	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
Hexachlorobutadiene (mg/kg OC)	3.9	6.2	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	
N-Nitrosodiphenylamine (mg/kg OC)	11	11	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.6	U	1.1	U	1.1	U	1.1	U	
PCBs (mg/kg OC)	12	65	1.5	U	1.5	U	1.4	U	1.3	U	1.3	U	1.5	U	1.1	U	1.1	U	1.1	U	

- Data were qualified by both the analytical laboratory and the validating firm.
- J = Estimated value; concentration is less than method reporting limit but greater than or equal to method detection limit as reported by the analytical laboratory
- U = Not detected at or above the method detection limit as reported by the analytical laboratory
- R = Rejected

6. **Comparison with SMS Guidelines.** Chemical results were carbon normalized if necessary, and compared with Washington State Sediment Management Standards to determine if the sediments were suitable for beneficial uses under both DMMP and state guidelines (**Table 6**). Levels of all detected and undetected compounds were below SMS guidelines. 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.

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. All biological testing was performed by NewFields Northwest in compliance with standard bioassay protocols (PSEP 1995). Biological testing was done concurrently with chemical analysis, so DMMUs for biological testing were chosen prior to sampling. The DMMP chose to test fine sediments from DMMUs closest to potential sources, including the industrial areas of Aberdeen and Hoquiam (HO6 and CP8). Reference sediment was collected from Reference site 6 in the North Bay of Grays Harbor. Results from wet sieving of the test sediments in the field were used to find reference sediments of similar grain size to the test sediments.

Grays Harbor disposal sites are dispersive sites, which under DMMP guidelines require more conservative bioassay data interpretation than with non-dispersive sites due to the inability to monitor disposed material over time.

a. **Protocol Adjustments:** The Corps chose to evaluate protocol adjustments to the sediment larval bioassay and the *Neanthes* growth bioassay by running side-by-side tests with project sediments. The DMMP recommended this step to evaluate methods to reduce false positive responses. Protocol adjustments (SMARM 2010) were:

Larval Development test: The sediment larval bioassay was terminated by two different methods, with data from both methods being reported. The first method was the usual PSEP termination procedure of decanting and subsampling the overlying test water with no agitation. The second termination procedure ("resuspension") was agitation of overlying water and subsequent settlement for approximately 24 hours prior to decantation and subsampling.

Neanthes Growth test: The *Neanthes* growth bioassay breakdown procedure was modified as follows: after recording dry weight of worms at the end of the test period, the dried material was subjected to oxidation in a muffle oven to determine the ash-free dry weight. Both dry weight and AFDW were reported in the final report.

b. **Test Performance:** Negative control and reference sediments met DMMP performance criteria for both the larval and amphipod tests (**Table 7**). For the *Neanthes* growth test, the mortality performance standard was met for both the control and reference sediments, as was the mean individual growth (MIG) rate performance standard for the negative control. The MIG performance standard was not met for the reference sediment.

Ammonia and sulfide reference toxicant tests were performed on animals for all bioassays. NOEC levels were all well above the levels seen in test containers.

Table 7. Bioassay Performance Summary.

BIOASSAY		NEGATIVE CONTROL PERFORMANCE	REFERENCE SEDIMENT PERFORMANCE
Amphipod (<i>E. estuarius</i>) Mortality	Standard	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$
	Actual	$M_C = 3\%$	$M_R - M_C = 9\%$
Larval (<i>M. galloprovincialis</i>) Development	Standard	$M_R - M_C \geq 0.70$	$N_R/N_C \geq 0.65$
	Actual	$M_R - M_C = 0.944$	$N_R/N_C = 0.924$
Juvenile Polychaete (<i>N. arenaceodentata</i>) growth	Standard	$M_C \leq 10\%$ and $MIG_C \geq 0.38$	$M_R \leq 20\%$ and $MIG_R/MIG_C \geq 0.80$
	Actual	$M_C = 0\%$ and $MIG_C = 0.60$	$M_R = 8.0\%$ and $MIG_R/MIG_C = 0.46$ (AFDW = 0.56)

M = mortality, N = normal larvae, MIG = mean individual growth rate mg/individual/day
Subscripts: R = reference sediment, C = negative control

c. **Results:** The amphipod (Table 8) and larval (Table 9) bioassays both passed dispersive guidelines with no hits. The resuspension protocol for the larval test did not appreciably alter the results. The *Neanthes* results are displayed in Table 10. DMMP guidance allows comparison of test sediment to control rather than reference in situations where the control sediments are similar in grain size and TOC to the test sediments. In this case, with 0% fines in the control sediment and 64-91% fines in the test sediments, the DMMP did not believe that this was an appropriate comparison. In such a case the data has to be considered uninterpretable. A retest was not performed, as there was no indication that there were flaws in the test procedure, or test animals, that would warrant a retest. For these reasons, the DMMP set aside the results for the Juvenile polychaete growth test for the purposes of this suitability determination.

The *Neanthes* growth bioassay has shown incongruous results in Grays Harbor many times over the years; the performance issues with this test were one reason the DMMP chose to do side-by-side tests of the protocol adjustment with standard procedures. A similar performance issue (reference sediment not meeting MIG performance standards) was seen in the DY09 results. The AFDW protocol somewhat reduced the difference in growth between the control sediment and the field sediments (both reference and test) but did not help the performance failure. The AFDW protocol removes any weight differences between worms that may be due to ingestion of sediment particles. In this case the AFDW results imply that the dry weight of worms in the control sediments had a slightly higher contribution of inorganic sediments in the guts, a result consistent with worms in sediment with larger grain sizes. Further inquiry into factors affecting this bioassay may be necessary in future biological testing in Grays Harbor.

Table 8. Results of 10-Day Amphipod Bioassay.

STATION	% Fines	% Clay	Amphipod (<i>E. estuarius</i>) Mortality (%)		DMMP Pass/Fail (dispersive guidelines)
			mean	sd	
Control	0	0	3	4.5	n/a
Reference - GH6	77.8	33.7	9	7.4	n/a
HO6	64.8	23.6	2	2.7	Pass
CP8	91.8	33.7	7	4.3	Pass

- Reference toxicant: Cadmium chloride, 96 hr LC₅₀: 10.99 mg Cd/L
- Lab Control limits: 4.22 - 12.03 mg Cd/L

Table 9. Results of Larval Development Bioassay.

STATION	% Fines	% Clay	Sediment Larval (<i>M. galloprovincialis</i>) NCMA (%)		Re-suspension Sediment Larval (<i>M. galloprovincialis</i>) NCMA (%)		DMMP Pass/Fail (dispersive guidelines)
			mean	sd	mean	sd	
Control	0	0	94.4	4.3	99.7	0.6	n/a
Reference - GH6	77.8	33.7	92.4	6.4	87.0	5.2	n/a
HO6	64.8	23.6	94.0	7.7	91.1	5.7	Pass
CP8	91.8	33.7	94.4	5.2	83.7	6.4	Pass

- Reference toxicant: Copper sulfate, normality: 6.18 µg/L Cu
- Lab Control limits: 3.66 - 15.6 µg/L Cu

Table 10. Results of Juvenile Polychaete Growth Bioassay.

STATION	% Fines	% Clay	Mortality (%)	Conventional Protocol (Dry Weight)				Test Protocol (Ash-Free Dry Wt.)				DMMP Pass/Fail (dispersive guidelines)
				MIG (mg/ind/day)		MIG % of cont.	MIG % of ref.	MIG (mg/ind/day)		MIG % of cont.	MIG % of ref.	
				mean	sd			mean	sd			
Control	0	0	0	0.597	0.072	--	--	0.415	0.073	--	--	n/a
Reference GH6	77.8	33.7	8	0.273	0.052	46	--	0.233	0.045	56	--	n/a
HO6	64.8	23.6	0	0.287	0.133	48	105	0.250	0.111	60	107	Not useable
CP8	91.8	33.7	0	0.352	0.035	59	129	0.300	0.033	72	129	Not useable

- Reference toxicant: Cadmium chloride, 96 hr EC₅₀: 10.6 mg/L Cd
- Lab Control limits: 4.26 - 13.1 mg/L Cd
- Results not useable due to failure of reference to control performance guidelines.

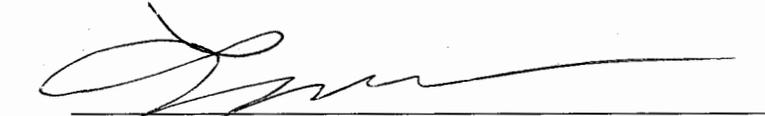
8. **Suitability.** This memo documents the suitability of all proposed dredged sediments in the Grays Harbor navigation channel for open-water disposal. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the chemical 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 sites. 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 approved beneficial use (nearshore or onshore) sites. Material from Inner Reaches may be used for beneficial use only after appropriate comparison of dioxin concentrations in the source and receiving areas. This suitability determination does not constitute final agency approval of the project.

9. References.

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Concur:

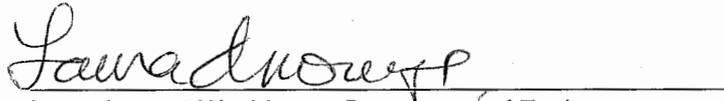
12/3/10
Date


Lauran Warner, Seattle District Corps of Engineers

12/2/10
Date


Justine Barton, Environmental Protection Agency

12/02/2010
Date


Laura Inouye, Washington Department of Ecology

12/2/2010
Date


David Vagt, Washington Department of Natural Resources

Copied furnished:

- DMMP signatories
- Hiram Arden, Corps Navigation
- Joe Schumacker, Quinault Tribe
- Mike Johnson, Port of Grays Harbor
- Steve Martin, Corps ERB
- DMMO file