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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

Reply To
Attn Of: ECO-083

MEMORANDUM

SUBJECT: Pacific Sound Resource: Determination of the Suitability of Dredged Material from Federal Operations and Maintenance activities at the Lower Snohomish River Settling Basin and adjacent Navigation Channel for Capping Material

FROM: John Malek, Team Leader
Sediment Management Program
Aquatic Resources Unit

TO: Sally Thomas, Remedial Project Manager

1. The Corps of Engineers intends to maintenance dredge up to 272,000 cubic yards of sediment from the lower Snohomish settling basin and the adjacent navigation channel (between 304+00 and 375+00), an authorized federal project, at Everett, Washington. As part of the Corps' approval process, the material was characterized pursuant to the guidance and requirements of the Dredged Material Management Program (DMMP), of which EPA is a member agency. The DMMP agencies completed and signed a Determination of Suitability, dated January 28, 2004, for the project (attached). The DMMP determination was for proposed disposal at the DMMP open water site in Port Gardner and/or for beneficial use. The primary record supporting the Determination of Suitability is located at the Seattle District office; however, copies of primary documents (e.g., Sampling and Analysis Plan and Data Report) are also filed in the Aquatic Resources Unit at the Region.

2. The remedy for the Pacific Sound Resources Superfund project includes construction of a sediment cap. The remedy anticipated that dredged material(s) determined to be suitable for construction of the cap remedy could become available during construction (either from Corps dredging projects or private projects permitted by the Corps) and should be able to be accepted and used by EPA for the selected remedy. (Appendix F of the *Final Design Submittal , Pacific Sound Resources Superfund Site, Marine Sediment Unit, Seattle Washington*, dated February 3, 2002 presents design drawing and example specifications to be used in construction of the sediment cap; material specification for Dredged Cap Material are provided in attachment F-1.) The characterization protocols used by the DMMP agencies to determine suitability for permit actions are appropriate for characterizations under Superfund, in this instance as capping material at the Pacific Sound Resources site. As appropriate permits/permissions must be secured to

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dredge any sediments, EPA decided that the most efficient protocol would be to review such projects after such approvals are completed for suitability of the material for use with the Pacific Sound Resources remedy. No permit is needed for discharge at the Superfund site if the material is accepted by EPA. Clean dredged material (that meets the specifications for capping) would be placed as cap material, in accordance with the design plans under Corps oversight. Because barge loads of dredged material are not identical, the Corps may exclude or reject individual dredged material management units or barge loads.

3. EPA (Justine Barton) reviewed the characterization performed for the DMMP agencies leading to the DMMP Suitability of Determination. I have reviewed the DMMP determination and primary documents with regards to the type of material needed by EPA for use as cap material. Particular attention was paid to the grain size composition of the dredged material in addition to the chemical nature of the material. Based on this evaluation, I conclude that the dredged material from the Corps maintenance dredging project are suitable for use as cap material at the Pacific Sound Resources site and can be accepted for that purpose. It is noted that the dredged material management unit characterized by sample SNO-09 contains relatively more silt than the other units and may require special attention during placement.

Effective: April 27, 2004

Attachment

cc: Justine Barton, EPA
Corps DMMO(Lauren Cole-Warner)
Corps HTRW (Miriam Gilmer)
Corps Operations (Patty Miller)

CENWS-OD-TS-DM

MEMORANDUM FOR: RECORD January 28, 2004

SUBJECT: DETERMINATION ON THE SUITABILITY OF PROPOSED FEDERAL OPERATIONS AND MAINTENANCE DREDGED MATERIAL FROM THE **LOWER SNOHOMISH RIVER SETTLING BASIN AND ADJACENT NAVIGATION CHANNELS** EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT (CWA) FOR OPEN-WATER DISPOSAL AT THE PORT GARDNER NONDISPERSIVE DISPOSAL SITE AND/OR FOR BENEFICIAL USE.

1. Introduction. The following summary reflects the consensus determination of the Dredged Material Management Program (DMMP) Agencies' (U.S. Army Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency) with jurisdiction on dredging and disposal on the suitability of up to 272,000 cy of sediment from the lower settling basin and adjacent navigational channel between Stations 304+00 and 375+00. This federal maintenance material from the Lower Snohomish Navigation Channel in Everett, Washington is proposed to be disposed at the Port Gardner DMMP unconfined open-water disposal site or at an approved beneficial use site.

This determination of suitability for open-water disposal is based on the acceptability of the sampling conducted by Seattle District, Corps of Engineers contractors and subcontractors in September 2003 (Table 1). All relevant test data from this sampling event is contained in a report submitted by Anchor Environmental dated December 2003. These data were considered sufficient and acceptable for decision-making by the Agencies.

Table 1. Project Summary.

Time of proposed dredging	Fall – Winter 2004/2005
Proposed disposal sites	Port Gardner non-dispersive disposal site, or beneficial use
Sediment ranking	Low moderate, homogenous
Project last dredged	Stations 333+50 to 345+50: 15 Jan - 8 Feb 2001 Stations 304+00 to 324+00: Jan 2002

Table 2. Regulatory Tracking Table.

SAP received	September 2, 2003
SAP Approval date	September 22, 2003
Sampling date(s):	Sept. 23 - 25, 2003
Data report submittal date:	December 2003
DAIS Tracking #	EVEDS-1-A-F-190
Recency Determination Date: LM Concern (5-7 years)	Sept. 2008 – 2010

2. Background. The area proposed for maintenance dredging was last characterized in 1996 and dredged in 2002 (Table 1). Material from this portion of the Snohomish River navigation channel has been used previously for beneficial uses, including capping and for the Jetty Island habitat restoration project.

3. Sampling. The area proposed for dredging is ranked "low-moderate" by the DMMP agencies, based on previous test data. For low-moderate homogenous material, the DMMP requires a minimum of one field sample for each 8,000 cy and one laboratory analysis for each 40,000 cy. For the current characterization, 36 separate core samples were combined into 9 composites for analysis. Each analysis represented one DMMU of between 11,000 and 37,000 cy of material (see Table 3). Each DMMU met the requirement of dredging independence, such that the area represented by each sample could be dredged independently from surrounding DMMUs should they have different suitabilities for open water disposal or beneficial use.

Sampling took place on September 23-25, 2003 aboard the Corps vessel Puget. The approved SAP was followed. Thirty-six core samples were taken with a Vibracore sampler and processed on board the vessel. Material from each core was taken to the depth of the dredge prism and composited with other cores from a given DMMU. Material from the one-foot layer directly below the dredge prism was taken as a Z-sample for most cores and archived. No Z-samples were collected from 7 out of 36 samples due to core refusal short of the target sampling depth.

4. Conventional and Chemical Analysis. The Agencies' approved sampling and analysis plan was followed, and quality assurance/quality control guidelines specified by PSEP and the DMMP program were generally complied with. Conventional (Table 3) and chemical analyses (Appendix A) were performed by Columbia Analytical Services (CAS) of Kelso, Washington. Chemical analysis results demonstrated that there were no detected or non-detected SL exceedances of any DMMP chemical of concern in any sample. Also, because this material has been proposed for use as capping material, it was tested for Atterberg limits--a test used to estimate strength and settling characteristics. All material tested was found to be "non-plastic" by the Atterberg limit testing.

All data complied with general QA/QC requirements of the DMMP (Table 4) and were acceptable as qualified by the laboratory.

Table 3. Conventional Results, Lower Snohomish Settling Basin, DY 2004.

Parameter		S1	S2	S3	S4	S5	S6	S7	S8	S9
Depth Interval		0-4.7 ft	0-8.4 ft	0-11.9 ft	0-10.1 ft	0-7.8 ft	0-6.4 ft	0-4.2 ft	0-5.3 ft	0-5 ft
Volume, cubic yards		11,360	36,550	35,430	36,990	32,620	23,910	24,740	35,800	33,810
Grain Size (%)	Gravel	0.6	0.9	0.5	0.4	0.2	0.3	0.1	0.1	1.1
	Total Sand	76.4	71.5	81.3	67.6	60.0	64.4	58.4	53.9	48.3
	Silt	15.8	21.2	12.7	23.1	31.5	26.2	33.8	36.2	41.8
	Clay	5.0	7.0	5.2	7.9	8.0	8.1	7.1	9.0	8.7
	Fines (silt + clay)	20.8	28.2	17.9	31.0	39.5	34.3	40.9	45.2	50.5
Total Organic Carbon (%)		0.6 J	1.4 J	2.48	1.19	1.94	1.42	1.44	4.55	2.71
Total solids (%)		75.7	65.2	66.5	63	59.3	66.3	62.2	61.4	58.1
Total volatile solids (%)		2.34	6.19	4.6	5.36	6.15	4.4	5.31	5.47	6.2
N-Ammonia (mg/kg)		26	48	41	57	52	52	48	49	42
Sulfide (mg/kg)		0.9	173	43 J	158 J	480	118	190	127	0.9 U

Table 4. QA/QC Warning and Action Limits (DMMP Program).

	QA Element	Warning Limits	Action Limits
Precision	Metals	None	20% RPD or COV
	Organics	35% RPD or COV	50% COV or a factor of 2 for duplicates
Matrix Spikes	Metals	None	75-125% recovery
	Organics: Volatiles Semivolatiles and Pesticides	70-150% 50-150%	None (however, zero percent recovery may be cause for data rejection)
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	Volatiles	85% minimum recovery	EPA CLP chemical-specific recovery limits
	Pesticides	60% minimum recovery	
	Semi-volatiles	50% minimum recovery	

5. Comparison to SMS Guidelines. All results of the chemical analyses were organic carbon normalized, if necessary, and compared to Washington State Sediment Management Standards (Appendix B). This analysis showed that levels of all detected and most undetected contaminants were below the Sediment Quality Standards (SQS) set by Washington State. One chemical (hexachlorobenzene) was not detected, but the organic carbon normalized detection limit in one sample (0.47 mg/kg OC) was slightly above the SQS guidelines (0.38 mg/kg OC). This occurred in SNO-1, with the lowest total organic carbon concentration (0.6%) of all project samples. This apparent exceedance was likely caused by the low organic carbon concentration as well as a general difficulty for achieving low detection limits for HCB. The DMMP agencies agreed that there is no reason to believe that this non-detected chemical is present at any level of concern. Thus, this analysis indicates that all sediments tested are suitable for beneficial uses under Washington State Sediment Management Standards, including use as cap material.

6. Suitability. This memorandum documents the suitability of proposed dredged sediments from the lower Snohomish settling basin and adjacent navigation channel for disposal at a DMMP open-water disposal site, or at an approved beneficial use site. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the previously described testing, the DMMP agencies concluded that all **271,210 cy are suitable** for open water disposal. This determination of suitability does not preclude the consideration of this material for an appropriate beneficial use. It does not constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

7. References.

Anchor Environmental 2003. Data Report: Sediment characterization results for the Lower Snohomish River settling basin and adjacent navigation channels. Prepared for the Seattle District, US Army Corps of Engineers, December 2003.

Concur:

1/28/04
Date

Lauran Cole Warner, Seattle District Corps of Engineers

2/5/04
Date

Justine Barton, Environmental Protection Agency

2/5/04
Date

Tom Gries, Washington Department of Ecology

2/5/2004
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APPENDIX A

Lower Snohomish chemical results compared to DMMP guidelines

	SL	BT	ML	SNO-1	SNO-2	SNO-3	SNO-4	SNO-5	SNO-6	SNO-7	SNO-8	SNO-9
Metals (mg/kg)												
Antimony	150	–	200	0.09 N	0.11 N	0.13 N	0.13 N	0.14 N	0.13 N	0.16 N	0.15 N	0.17 N
Arsenic	57	507.1	700	6.4	6.9	6.6	7.4	11.1	7.9	10	11	10.7
Cadmium	5.1	11.3	14	0.19	0.18	0.15	0.18	0.23	0.18	0.19	0.2	0.24
Chromium	–	267	–	25.8 N	28.7 N	30.5 N	32.5 N	32.8 N	35.6 N	34.1 N	36.7 N	35.3 N
Copper	390	1027	1300	20.3	22.5	24.9	28.3	30.8	28.7	33.6	35	36
Lead	450	975	1200	4.69	6.5	6.39	7.05	8.95	7	9.42	9.52	9.59
Mercury	0.41	1.5	2.3	0.03	0.05	0.05	0.06	0.05	0.04	0.08	0.08	0.06
Nickel	140	370	370	24.7	27.5	28.4	30.9	30.8	32.1	32.5	33.7	34.6
Selenium	–	3	–	0.5 B	0.6 B	0.4 B	0.3 B	0.4 B	0.4 B	0.6 B	0.8	1.1
Silver	6.1	6.1	8.4	0.05	0.07	0.06	0.08	0.1	0.08	0.1	0.11	0.11
Zinc	410	2783	3800	35 N	38.4 N	42.7 N	45.1 N	51.9 N	46.3 N	50.2 N	49.5 N	51.2 N
Tributyltin (µg/l porewater)	0.15	0.15	–	0.046 U	0.024 U	0.045 U	0.025 U	0.02 U	0.023 U	0.02 U	0.02 U	0.02 U
LPAHs (µg/kg-DW)												
Total LPAH	5200	–	29000	4 2	37	45.8	39.2	33.7	49.6	56.4	47.1	60.4
Naphthalene	2100	–	2400	10 U	10	9.2 J	4.9 J	4.2 J	8.8 J	8 J	7 J	9.1 J
Acenaphthylene	560	–	1300	10 U	2.7 J	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Acenaphthene	500	–	2000	10 U	3.7 J	6 J	4.6 J	4.3 J	6.3 J	8.8 J	5 J	8.9 J
Fluorene	540	–	3600	10 U	3.4 J	5.2 J	5 J	4.4 J	5.8 J	6.6 J	5.1 J	7.1 J
Phenanthrene	1500	–	21000	2 J	13	19	19	16	23	22	15	26
Anthracene	960	–	13000	2.2 J	4.2 J	6.4 J	5.7 J	4.8 J	5.7 J	11	15	9.3 J
2-Methylnaphthalene	670	–	1900	10 U	2.5 J	3.6 J	10 U	10 U	4.3 J	3.4 J	2.5 J	3.7 J
HPAHs (µg/kg-DW)												
Total HPAH	12000	–	69000	19.5	100.9	119.3	100.6	121.4	137.9	138.5	102.9	236.1
Fluoranthene	1700	4600	30000	7.6 J	25	35	23	25	42	33	25	60
Pyrene	2600	11980	16000	6.9 J	23	31	20	27	38	28	22	53
Benzo(a)anthracene	1300	–	5100	2.6 J	9.1 J	8.8 J	8.8 J	11	8.2 J	12	11 J	29
Chrysene	1400	–	21000	2.4 J	12	11	13	16	30	22	12	29
Total benzofluoranthenes	3200	–	9900	10 U	14.6	17.4	18.8	22	13.5	22	16.7	35
Benzo(a)pyrene	1600	–	3600	10 U	7.4 J	7.5 J	7.8 J	9.4 J	6.2 J	10	7.9 J	16
Indeno(1,2,3-cd)pyrene	600	–	4400	10 U	4.5 J	4.4 J	4.4 J	5.4 J	9.8 U	6.3 J	4.2 J	7.6 J
Dibenzo(a,h)anthracene	230	–	1900	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Benzo(g,h,i)perylene	670	–	3200	10 U	5.3 J	4.2 J	4.8 J	5.6 J	9.8 U	5.2 J	4.1 J	6.5 J
Chlorinated Hydrocarbons (µg/kg-DW)												
1,3-Dichlorobenzene	170	–	–	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
1,4-Dichlorobenzene	110	–	120	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
1,2-Dichlorobenzene	35	–	110	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
1,2,4-Trichlorobenzene	31	–	64	2 U	2.4 U	2.3 U	2.4 U	2.6 U	2.3 U	2.6 U	2.5 U	2.6 U
Hexachlorobenzene	22	168	230	2.8 U	3.3 U	3.2 U	3.4 U	3.6 U	3.2 U	3.4 U	3.5 U	3.7 U
Phthalates (µg/kg-DW)												
Dimethylphthalate	1400	–	–	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Diethylphthalate	1200	–	–	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Di-n-butylphthalate	5100	–	–	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Butylbenzylphthalate	970	–	–	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	3.1 J
bis(2-Ethylhexyl)phthalate	8300	–	–	7.3 J	15 J	17 J	11 J	18 J	14 J	7.3 J	18 J	14 J
Di-n-octylphthalate	6200	–	–	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U

Lower Snohomish chemical results compared to DMMP guidelines												
	SL	BT	ML	SNO-1	SNO-2	SNO-3	SNO-4	SNO-5	SNO-6	SNO-7	SNO-8	SNO-9
Phenols (µg/kg-DW)												
Phenol	420	–	1200	15 J	70	38	23 J	29 J	28 J	47	19 J	35
2-Methylphenol	63	–	77	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
4-Methylphenol	670	–	3600	10 U	27	42	23	51	46	30	13	13
2,4-Dimethylphenol	29	–	210	7.3 U	8.5 U	8.3 U	8.8 U	9.3 U	8.3 U	8.9 U	9 U	9.5 U
Pentachlorophenol	400	504	690	50 U	50 U	50 U	50 U	50 U	49 U	50 U	51 U	35 J
Miscellaneous (µg/kg-DW)												
Benzyl alcohol	57	–	870	10 U	9.9 U	12	8.4 J	13	9.8 U	9.9 U	6.9 J	14
Benzoic acid	650	–	760	200 U	200 U	200 U	200 U	200 U	200 U	200 U	210 U	200 U
Dibenzofuran	540	–	1700	10 U	2.6 J	3.1 J	2.9 J	2.9 J	3.8 J	4.3 J	3.2 J	4.3 J
Hexachloroethane	1400	–	14000	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Hexachlorobutadiene	29	–	270	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
n-Nitrosodiphenylamine	28	–	130	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
Volatiles (µg/kg-DW)												
Ethylbenzene	10	–	50	6.5 U	7.6 U	7.5 U	7.9 U	8.4 U	7.5 U	8.1 U	8 U	8.7 U
Tetrachloroethene	57	–	210	6.5 U	7.6 U	0.92 J	1.1 J	8.4 U	7.5 U	0.82 J	8 U	8.7 U
Trichloroethene	160	–	1600	6.5 U	7.6 U	7.5 U	7.9 U	8.4 U	7.5 U	8.1 U	8 U	8.7 U
Xylene (total)	40	–	160	6.5 U	7.6 U	7.5 U	7.9 U	8.4 U	7.5 U	8.1 U	8 U	8.7 U
Pesticides (µg/kg-DW)												
DDT (total)	6.9	50	69	0.86 U	0.97 U	0.91 U	1 U	2.7	2.13	0.96 U	2.2	1.2
4,4'-DDD	–	–	–	0.86 U	0.97 U	0.91 U	1 U	1.1 U	0.23 J	0.96 U	0.98 U	1.2
4,4'-DDE	–	–	–	0.86 U	0.97 U	0.91 U	1 U	1.1 U	0.91 U	0.96 U	0.98 U	1.1 U
4,4'-DDT	–	–	–	0.86 U	0.97 U	0.91 U	1 U	2.7	1.9 P	0.96 U	2.2 P	1.1 U
Aldrin	10	–	–	0.86 U	0.97 U	0.91 U	1 U	1.1 U	0.91 U	0.96 U	0.98 U	1.1 U
Dieldrin	10	–	–	0.86 U	0.97 U	0.91 U	1 U	1.1 U	0.91 U	0.96 U	0.98 U	1.1 U
gamma-BHC (Lindane)	10	–	–	0.86 U	0.97 U	0.91 U	1 U	0.31 JP	0.91 U	0.96 U	0.98 U	1.1 U
Total chlordane (DMMP)	10	37	–	0.86 U	1.2 U	0.91 U	0.13	1.78	0.91 U	0.32	0.19	0.23
Heptachlor	10	–	–	0.86 U	1.2 U	0.91 U	1 U	1.1 U	0.91 U	0.96 U	0.98 U	1.1 U
PCBs (µg/kg-DW)												
Aroclor 1016	–	–	–	8.6 U	9.7 U	9.1 U	10 U	11 U	9.1 U	9.6 U	9.8 U	11 U
Aroclor 1221	–	–	–	18 U	20 U	19 U	20 U	21 U	19 U	20 U	20 U	21 U
Aroclor 1232	–	–	–	8.6 U	9.7 U	9.1 U	10 U	11 U	9.1 U	9.6 U	9.8 U	11 U
Aroclor 1242	–	–	–	8.6 U	9.7 U	9.1 U	10 U	11 U	9.1 U	9.6 U	9.8 U	11 U
Aroclor 1248	–	–	–	8.6 U	9.7 U	9.1 U	10 U	11 U	9.1 U	9.6 U	9.8 U	11 U
Aroclor 1254	–	–	–	8.6 U	9.7 U	9.1 U	10 U	11 U	9.1 U	9.6 U	9.8 U	11 U
Aroclor 1260	–	–	–	8.6 U	9.7 U	9.1 U	10 U	11 U	9.1 U	9.6 U	9.8 U	11 U
Total PCBs	–	–	–	18 U	20 U	19 U	20 U	21 U	19 U	20 U	20 U	21 U
PCBs/Pesticides (mg/kg-OC)												
alpha-BHC	–	10	–	0.14 U	0.07 U	0.04 U	0.08 U	0.06 U	0.06 U	0.07 U	0.02 U	0.04 U
Total PCBs	–	38	–	3 U	1.43 U	0.77 U	1.68 U	1.08 U	1.34 U	1.39 U	0.44 U	0.77 U

Notes:

- U: The compound was analyzed for, but not detected ("Non-detect") at or above the method detection limit (MDL).
- J: The result is an estimated concentration based on either a laboratory quality control sample exceedence, or the reported concentration is less than the method reporting limit (MRL) but greater than the MDL.
- DW: Dry weight
- OC: Organic carbon
- 2-Methylnaphthalene is not added to other LPAHs as part of the total LPAH levels.

APPENDIX B

Lower Snohomish chemical results compared to SMS guidelines	SQS	CSL	SNO-1	SNO-2	SNO-3	SNO-4	SNO-5	SNO-6	SNO-7	SNO-8	SNO-9
Metals (mg/kg)											
Arsenic	57	93	6.4	6.9	6.6	7.4	11.1	7.9	10	11	10.7
Cadmium	5.1	6.7	0.19	0.18	0.15	0.18	0.23	0.18	0.19	0.2	0.24
Chromium	260	270	25.8 N	28.7 N	30.5 N	32.5 N	32.8 N	35.6 N	34.1 N	36.7 N	35.3 N
Copper	390	390	20.3	22.5	24.9	28.3	30.8	28.7	33.6	35	36
Lead	450	530	4.69	6.5	6.39	7.05	8.95	7	9.42	9.52	9.59
Mercury	0.41	0.59	0.03	0.05	0.05	0.06	0.05	0.04	0.08	0.06	0.06
Silver	6.1	6.1	0.05	0.07	0.06	0.08	0.1	0.08	0.1	0.11	0.11
Zinc	410	960	35 N	38.4 N	42.7 N	45.1 N	51.9 N	46.3 N	50.2 N	49.5 N	51.2 N
Phenols (µg/kg)											
Phenol	420	1200	15 J	70	38	23 J	29 J	28 J	47	19 J	35
2-Methylphenol	63	63	10 U	9.9 U	10 U	10 U	10 U	9.8 U	9.9 U	11 U	10 U
4-Methylphenol	670	670	10 U	27	42	23	51	48	30	13	13
2,4-Dimethylphenol	29	29	7.3 U	8.5 U	8.3 U	8.8 U	9.3 U	8.3 U	8.9 U	9 U	9.5 U
Pentachlorophenol	360	690	50 U	50 U	50 U	50 U	50 U	49 U	50 U	51 U	35 J
Miscellaneous (µg/kg)											
Benzyl alcohol	57	73	10 U	9.9 U	12	8.4 J	13	9.8 U	9.9 U	6.9 J	14
Benzoic acid	650	650	200 U	200 U	200 U	200 U	200 U	200 U	200 U	210 U	200 U
Organic Carbon Normalized											
LPAHs (mg/kg-OC)											
Total LPAH	370	780	0.7	2.64	1.85	3.29	1.74	3.49	3.92	1.04	2.23
Naphthalene	99	170	1.67 U	0.71	0.37 J	0.41 J	0.22 J	0.62 J	0.56 J	0.15 J	0.34 J
Acenaphthylene	66	66	1.67 U	0.19 J	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
Acenaphthene	16	57	1.67 U	0.26 J	0.24 J	0.39 J	0.22 J	0.44 J	0.61 J	0.11 J	0.33 J
Fluorene	23	79	1.67 U	0.24 J	0.21 J	0.42 J	0.23 J	0.41 J	0.46 J	0.11 J	0.26 J
Phenanthrene	100	480	0.33 J	0.93	0.77	1.6	0.82	1.62	1.53	0.33	0.96
Anthracene	220	1200	0.37 J	0.3 J	0.26 J	0.48 J	0.25 J	0.4 J	0.76	0.33	0.34 J
2-Methylnaphthalene	38	64	1.67 U	0.18 J	0.15 J	0.84 U	0.52 U	0.3 J	0.24 J	0.05 J	0.14 J
HPAHs (mg/kg-OC)											
Total HPAH	960	5300	3.25	7.21	4.81	8.45	6.26	9.71	9.62	2.26	8.71
Fluoranthene	160	1200	1.27 J	1.79	1.41	1.93	1.29	2.96	2.29	0.65	2.21
Pyrene	1000	1400	1.15 J	1.64	1.25	1.68	1.39	2.68	1.94	0.48	1.96
Benzo(a)anthracene	110	270	0.43 J	0.65 J	0.35 J	0.74 J	0.57	0.58 J	0.83	0.24 J	1.07
Chrysene	110	460	0.4 J	0.86	0.41	1.09	0.82	2.11	1.53	0.26	1.07
Benzo(a)pyrene	99	210	1.67 U	0.53 J	0.3 J	0.66 J	0.48 J	0.44 J	0.69	0.17 J	0.59
Indeno(1,2,3-cd)pyrene	34	88	1.67 U	0.32 J	0.18 J	0.37 J	0.28 J	0.69 U	0.44 J	0.09 J	0.28 J
Dibenzo(a,h)anthracene	12	33	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
Benzo(g,h,i)perylene	31	78	1.67 U	0.38 J	0.17 J	0.4 J	0.29 J	0.69 U	0.36 J	0.09 J	0.24 J
Total benzofluoranthenes	230	450	1.67 U	1.04	0.7	1.58	1.13	0.95	1.53	0.37	1.29
Chlorinated Hydrocarbons (mg/kg-OC)											
1,4-Dichlorobenzene	3.1	9	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
1,2-Dichlorobenzene	2.3	2.3	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
1,2,4-Trichlorobenzene	0.81	1.8	0.33 U	0.17 U	0.09 U	0.2 U	0.13 U	0.16 U	0.17 U	0.05 U	0.1 U
Hexachlorobenzene	0.38	2.3	0.47 U	0.24 U	0.13 U	0.29 U	0.19 U	0.23 U	0.24 U	0.08 U	0.14 U

Lower Snohomish chemical results compared to SMS guidelines	SQS	CSL	SNO-1	SNO-2	SNO-3	SNO-4	SNO-5	SNO-6	SNO-7	SNO-8	SNO-9
Phthalates (mg/kg-OC)											
Dimethylphthalate	53	53	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
Diethylphthalate	61	110	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
Di-n-butylphthalate	220	1700	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
Butylbenzylphthalate	4.9	64	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.11 J
bis(2-Ethylhexyl)phthalate	47	78	1.22 J	1.07 J	0.69 J	0.92 J	0.93 J	0.99 J	0.51 J	0.4 J	0.52 J
Di-n-octylphthalate	58	4500	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
Miscellaneous (mg/kg-OC)											
Dibenzofuran	15	58	1.67 U	0.19 J	0.12 J	0.24 J	0.15 J	0.27 J	0.3 J	0.07 J	0.16 J
Hexachlorobutadiene	3.9	6.2	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
n-Nitrosodiphenylamine	11	11	1.67 U	0.71 U	0.4 U	0.84 U	0.52 U	0.69 U	0.69 U	0.24 U	0.37 U
PCBs (mg/kg-OC)											
Total PCBs	12	65	3 U	1.43 U	0.77 U	1.68 U	1.08 U	1.34 U	1.39 U	0.44 U	0.77 U

Notes:

- N: for metals: the matrix spike sample recovery is not within control limits.
- U: The compound was analyzed for, but not detected ("Non-detect") at or above the method detection limit (MDL).
- DW: Dry weight
- OC: Organic carbon
- Shaded hexachlorobenzene value exceeds SMS criteria; see text for details