Prepared by:
The Dredged Material Management Office
Seattle District, U.S. Army Corps of Engineers

MEMORANDUM FOR RECORD February 14, 2019

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM J.A. JACK & SONS (NWS-2018-1179), EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT, FOR UNCONFINED OPEN-WATER DISPOSAL AT THE ELLIOT BAY NONDISPERSIVE SITE AND COMPLIANCE WITH THE WASHINGTON STATE ANTIDEGRADATION STANDARD.

1. Introduction. This memorandum 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) regarding the suitability of 218 cubic yards (cy) of dredged material from the J.A. Jack & Sons facility in Seattle, Washington (Figure 1) for disposal at the Elliott Bay nondispersive disposal site and compliance of the sediment surface to be exposed by this dredging and by removal of an additional 382 cy of spilled limestone aggregate with the State of Washington's antidegradation standard.

2. Background. The J.A. Jack & Sons facility processes limestone from its quarry located in British Columbia, Canada into calcium carbonate products for industry and agriculture. Limestone is transported to the facility by barge and unloaded by conveyor. The calcium carbonate products are shipped from the facility by rail and truck. Periodic maintenance dredging is needed to remove shoaled sediment and limestone aggregate spilled from the conveyor to provide navigational depths for vessel ingress and egress.

   Sediment characterization was last conducted in 2011, when 1,000 cy of spilled limestone were removed from the berthing area (DMMP, 2011). The dredged area failed to meet the State of Washington's antidegradation standard. Therefore, following removal of the spilled limestone, an additional two feet of sediment were dredged and the area was covered with a foot of clean sand. The approximate elevation of the sand cover was -17 to -18 ft MLLW.

   In June 2018, Anchor QEA notified the DMMP agencies on behalf of J.A. Jack & Sons that maintenance dredging of two high spots in the berthing area was needed. One high spot was due to mounding of approximately 382 cy of spilled limestone in the same location dredged in 2011. The other was due to natural shoaling of approximately 218 cy of sediment. This memorandum documents the evaluation of the shoaled sediment for open-water disposal and evaluation of the entire project for compliance with the State of Washington's antidegradation standard. Also, because this project is located within the Lower Duwamish Waterway (LDW) Superfund site, sampling and testing requirements were coordinated with the EPA remedial project manager (RPM) to ensure the project meets applicable cleanup requirements.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	High
Proposed dredge volume	600 CY
Proposed dredge depth	DMMU-1: -16 ft MLLW (plus 2 feet of overdepth) DMMU-2: -16 ft MLLW (plus 1 foot of overdepth)
Draft SAP received	June 19, 2018
DMMP comments on draft SAP	June 27, 2018
Revised SAP received	July 17, 2018
DMMP comments on revised SAP	July 23, 2018
Final SAP received	July 24, 2018
Final SAP approved	July 25, 2018
Sampling date(s)	August 27, 2018
Draft Sediment Characterization Report (SCR) received	December 20, 2018
DMMP comments on draft SCR	December 31, 2018
Revised SCR received	February 6, 2019
DMMP comments on revised SCR	February 7, 2019
Final SCR received	February 13, 2019
DMMO tracking number	JAJAS-1-A-F-400
EIM study ID	JAJAS18
USACE Permit Application Number	NWS-2018-1179
Recency Expiration Date (high rank = 3 years)	August 2021

4. Project Ranking and Sampling Requirements. With the exception of a portion of the federal navigation channel and Delta Marine Industries, projects downstream of the turning basin on the Duwamish River are ranked "high" (DMMP, 2018). For a high-ranked project, one field sample and one dredged material management unit (DMMU) are required for every 4,000 cy of sediment.

   For this project, the high spots were evaluated separately as two DMMUs (Figure 2). DMMU-1 consisted of the 218 cy of shoaled sediment and was evaluated for open-water disposal and antidegradation. DMMU-2 consisted of the 382 cy of spilled limestone aggregate and was evaluated for antidegradation only.

   For DMMU-1 a single core sample was required of the dredged material. Previous testing had shown the likelihood that the sediment surface exposed by dredging would be contaminated, so concurrent chemical testing of the Z-sample from DMMU-1 was required. Per consultation with the RPM, the two-foot Z-sample collected for DMMP testing was also considered acceptable to fulfil the CERCLA requirement for characterization of the 0 to 60 centimeter leave surface.

   DMMU-2 did not require characterization, since the majority of the material to be dredged there consisted of limestone aggregate, which will either be reused at the J.A. Jack facility or disposed at an upland site. Any incidental sediment removed with the limestone will be disposed at an upland site. Also, as long as dredging is limited to -17 ft MLLW, the 1-foot sand cover placed in 2011 will remain intact. Therefore, characterization of the Z-layer was not needed. J.A. Jack & Sons has agreed to

replenish the sand cover to its pre-dredge elevation should dredging exceed -17 ft MLLW in DMMU-2.

5. Sampling. Vibracore sampling was conducted August 27, 2018 by Anchor QEA and Gravity Marine Services (Anchor, 2019). Two attempts were made to collect a core from station C-1 (Figure 2). The core collected during the first attempt met the acceptance criteria for penetration and recovery but penetrated a layer of coarse angular gravel and had cobble in the core nose upon retrieval. A second attempt was made in an effort to get below the layer of gravel. The core collected during the second attempt had both better penetration (to -22.2 feet MLLW) and recovery (91%) than the first attempt. This core was accepted for use and processed onboard the sampling vessel R/V Discovery. Sediment from mudline to -18 ft MLLW was collected to represent DMMU-1. Sediment from -18 to -20 ft MLLW was processed as the Z-sample. Penetration was such that recovery of a second, deeper Z-sample was possible. This sample, collected from -20 to -22 ft MLLW was archived but not analyzed. Core collection data and sampling intervals are provided in Tables 2 and 3 respectively.

6. Analytical Results. DMMU-1 (DU1-A-180827) and the Z-sample collected from -18 to -20 ft MLLW (DU1-Z-180827) were analyzed for the standard marine DMMP chemicals of concern (COCs), plus dioxins/furans and tributyltin. The analytical results are summarized in Table 4.

   The sediment in the homogenized dredged material sample (DMMU-1) was predominantly fine-grained (74% combined silt and clay); the coarse-grained fraction was primarily sand (23%) with a small amount of gravel (3%). The Z-simple had a similar fines content (72% combined silt and clay), with 17% sand and 11% gravel. The total organic carbon (TOC) content of DMMU-1 and the Z-sample was 1.9% and 1.5% respectively.

   Polychlorinated biphenyls (PCBs) exceeded the DMMP screening level (SL) in both DMMU-1 and the Z-sample. The PCB concentrations in DMMU-1 and the Z-sample were 221 ug/kg and 186 ug/kg respectively (SL = 130 ug/kg). DMMU-1 and the Z-sample also exceeded the bioaccumulation trigger (BT) for dioxins/furans, with concentrations of 14 ng/kg toxic equivalents (TEQ) and 16 ng/kg TEQ respectively (BT = 10 ng/kg TEQ). The dioxin/furan concentrations were flagged "J" as estimates. In addition, the concentration of butylbenzyl phthalate in DMMU-1 was 390 J ug/kg, which exceeded the SL of 63 ug/kg. There were no other exceedances of the DMMP guideline values.

   Data validation (EPA Stage 2b) was conducted by Laboratory Data Consultants. Only minor issues were documented and all data were considered usable, as qualified, by the data validator.

7. Biological Testing. Exceedance of the SLs for PCBs and butylbenzyl phthalate and the BT for dioxins/furans resulted in the need to conduct bioassays and bioaccumulation testing respectively for the dredged material to be considered further for open-water disposal. J.A. Jack & Sons elected not to do this testing and to dispose of the dredged material at an upland site instead.

8. Sediment Exposed by Dredging. With the exception of butylbenzyl phthalate, chemical concentrations in the Z-sample associated with DMMU-1 were similar to those in the overlying dredged material. The dry-weight concentration of PCBs was slightly higher in the dredged material than in the Z-sample, while the dioxin/furan concentration in the Z-sample was slightly higher than in the dredged material. On a carbon-normalized basis, the PCB concentration in the Z-sample was slightly higher than in the dredged material. Butylbenzyl phthalate in the dredged material exceeded both the dry-weight SL and the carbon-normalized sediment cleanup objective (SCO) under the State of

Washington's Sediment Management Standards (SMS), but neither the SL nor SCO were exceeded in the Z-sample. There were no exceedances of the SMS cleanup screening level in either sample. Nor were there any exceedances of the LDW Superfund remedial action levels for Recovery Category 2 areas.

For DMMU-2, it is anticipated that removal of the limestone aggregate will expose the clean sand cover placed in 2011.

9. Suitability and Antidegradation Determination. Based on the results of the previously described testing, and in the absence of bioassay and bioaccumulation testing, the DMMP agencies have concluded that the dredged material in DMMU-1 is unsuitable for open-water disposal. With regard to antidegradation, the DMMP agencies have determined that the sediment to be exposed by dredging will be similar to, or of better quality than, the overlying material if certain conditions are met, as described in the next paragraph.

   For DMMU-1, the antidegradation standard will be met if the post-dredge survey shows that no material has been removed deeper than -19 ft MLLW (this dredge depth would leave at least one foot of the tested Z-layer in place). For DMMU-2, the antidegradation standard will be met if the post-dredge survey shows that no material has been removed deeper than -17 ft MLLW (this dredged depth will leave the 2011 sand layer in place).

   If the post-dredge survey indicates that dredging deeper than -19 ft MLLW has occurred in the footprint of DMMU-1, a one-foot sand cover will need to be placed over the entire footprint. Likewise, if dredging of DMMU-2 extends deeper than -17 ft MLLW, the sand cover placed in 2011 will need to be restored to its predredge condition.

   This determination 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.

10. References.

Anchor, 2018. Sampling and Analysis Plan – J.A. Jack & Sons, Inc. – Duwamish River Facility, Berth Maintenance Dredging Sediment Characterization. Prepared for J.A. Jack & Sons, Inc. by Anchor QEA, LLC, July 2018.

Anchor, 2019. Sediment Characterization Data Report – J.A. Jack & Sons, Inc. – Duwamish River Facility, Berth Maintenance Dredging Sediment Characterization. Prepared for J.A. Jack & Sons, Inc. by Anchor QEA, LLC, February 2019.

DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated)*. A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

DMMP, 2011. Determination on the Suitability of Exposed Sediment Surface Relative to Washington State Antidegradation Compliance after Proposed Maintenance Removal of Limestone Spill Aggregate from J.A. Jack and Sons Off-Loading Berth Area, Duwamish Waterway (NWS-2011-570) Evaluated under Section 404 of the Clean Water Act for Upland Beneficial Reuse Disposal. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, October 6, 2011.

DMMP, 2018. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, December 2018.

Ecology, 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, Revised February 2013.

11. Agency Signatures.

Concur:

signed copy on file in DMMO, Seattle District Army Corps of Engineers

_____	_____
Date	David Fox – U.S. Army Corps of Engineers, Seattle District
_____	_____
Date	Erika Hoffman - Environmental Protection Agency
_____	_____
Date	Laura Inouye, Ph.D. - Washington Department of Ecology
_____	_____
Date	Celia Barton - Washington Department of Natural Resources

Copies furnished:
DMMP signatories
Rory Lee – Seattle District Regulatory
Joy Dunay – Anchor QEA
Brody Oakley – J.A. Jack & Sons
Dana Henry – ACG Materials

SOURCE: Drawing prepared from DeLorme Topo USA®.

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ANCHOR QEA

Figure 1
Vicinity Map

Sediment Characterization Data Report
J.A. Jack & Sons, Inc - Duwamish River Facility Berth Maintenance Dredging Sediment Characterization

LEGEND:

- Existing Bathymetric Contours (1-ft and 5-ft Intervals)
- Proposed Dredge Prism (Proposed Dredge Elevation of -16 ft MLLW and Payable Allowance to -18 ft MLLW)
- Navigation Channel
- Proposed Sediment Core Location
- Actual Sediment Core Location

Difference in Elevation Between Existing and Design Surface		
DMMU Number	Dredge Thickness in Feet	Volume in Cubic Yards
DMMU-1	0.0 to -3.64	218
DMMU-2	Limestone Removal	382

SOURCE: Existing bathymetry prepared from a survey provided by eTrac, Inc., dated 5/18/18. Aerial photograph from Google Earth Pro (May 2017).
HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

0 50
Feet

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ANCHOR QEA

Figure 2
Proposed and Actual Sampling Locations

Sediment Characterization Data Report
J.A. Jack & Sons, Inc - Duwamish River Facility Berth Maintenance Dredging Sediment Characterization

Table 2
Core Collection Data

DMMU	Station	Date	Location[1]		Measured Water Depth (feet)	Water Level (feet MLLW)[2]	Mudline Elevation (feet MLLW)	Drive Penetration (feet)	Recovery Measurement (feet)	Recovery (%)
			X Coordinate	Y Coordinate						
DMMU-1	C-1	8/27/2018	1268159	205614	15.7	0.5	-15.2	7.0	6.4	91

Notes:
1. Coordinates are in North American Datum of 1983 Washington State Plane North, US feet.
2. Preliminary observed water level for Seattle, WA (NOAA station 9447130)

DMMU: Dredge Material Management Unit
MLLW: mean lower low water

Source: Table 1 from Sediment Characterization Data Report (Anchor, 2019)

Table 3
Core Sampling Intervals and Analysis

DMMU	Station	Design Elevation (feet MLLW)	Dredged Material Surface Sample (A) Elevation Interval (feet MLLW)[1]	Z-Layer Sample Elevation Interval (feet MLLW)[1]	Samples and Analyses
DMMU-1	C-1	-18	-15.2 to -18.0	-18.0 to -20.0	DU1-A-180827: Marine DMMP[2], D/F, TBT-Bulk DU1-Z-180827: Marine DMMP[2], D/F, TBT-Bulk DU1-Z-2-180827[3]: Archive

Notes:
1. Sample intervals were corrected for length based on core recovery. Cores are assumed to have uniform compaction through the core.
2. Marine DMMP testing parameters include semivolatile organic compounds, polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyls, metals, sulfide, ammonia, total organic carbon, grain size, total volatile solids, and total solids.
3. An extra 'Z2' sample was collected for potential analysis.
D/F: dioxins furan
DMMP: Dredged Material Management Program
DMMU: Dredged Material Management Unit
MLLW: mean lower low water

Source: Table 2 from Sediment Characterization Data Report (Anchor, 2019)

Table 4
Sample Results Summary

							Sample ID Sample Date	DU1-A-180827 8/27/2018	DU1-Z-180827 8/27/2018
		DMMP SL	DMMP BT	DMMP ML	SMS Marine SCO	SMS Marine CSL	LDW Superfund RALs Category 2 Areas		
Conventional Parameters (mg/kg)									
Ammonia as nitrogen	SM4500NH3H	--	--	--	--	--	--	**36.4**	**53.6**
Sulfide	SM4500S2D	--	--	--	--	--	--	**2830**	**8480**
Conventional Parameters (pct)									
Total organic carbon	Plumb 1981	--	--	--	--	--	--	**1.9 J**	**1.53 J**
Total Solids	SM2540G	--	--	--	--	--	--	**55.55**	**55.52**
Total volatile solids	PSEP	--	--	--	--	--	--	**7.21**	**6.76**
Grain Size (pct)									
Gravel	PSEP	--	--	--	--	--	--	**3**	**11.1**
Sand, very coarse	PSEP	--	--	--	--	--	--	**2.1**	**3.4**
Sand, coarse	PSEP	--	--	--	--	--	--	**2.7**	**3.4**
Sand, medium	PSEP	--	--	--	--	--	--	**5.9**	**3.2**
Sand, fine	PSEP	--	--	--	--	--	--	**5.5**	**2.8**
Sand, very fine	PSEP	--	--	--	--	--	--	**6.5**	**3.8**
Total sands	PSEP	--	--	--	--	--	--	**25.7**	**27.7**
Silt, coarse	PSEP	--	--	--	--	--	--	**9.4**	**6.9**
Silt, medium	PSEP	--	--	--	--	--	--	**26.1**	**17.7**
Silt, fine	PSEP	--	--	--	--	--	--	**20.6**	**25.6**
Silt, very fine	PSEP	--	--	--	--	--	--	**5.2**	**7.1**
Clay, coarse	PSEP	--	--	--	--	--	--	**3.3**	**4.1**
Clay, medium	PSEP	--	--	--	--	--	--	**2.7**	**3.5**
Clay, fine	PSEP	--	--	--	--	--	--	**7.2**	**7.3**
Total fines (silts and clays)	PSEP	--	--	--	--	--	--	**74.5**	**72.2**
Metals (mg/kg)									
Antimony	SW6020A	150	--	200	--	--	--	0.34 UJ	0.35 UJ
Arsenic	SW6020A	57	507.1	700	57	93	57	**11.1**	**12.7**
Cadmium	SW6020A	5.1	11.3	14	5.1	6.7	10.2	**0.42**	**0.54**
Chromium	SW6020A	260	260		260	270	520	**28.1**	**27.6**
Copper	SW6020A	390	1027	1300	390	390	780	**70.2**	**70.8**
Lead	SW6020A	450	975	1200	450	530	900	**42.5**	**52.8**
Mercury	SW7471B	0.41	1.5	2.3	0.41	0.59	0.82	**0.34 J**	**0.21 J**
Selenium	SW6020A	--	3	--	--	--	--	**2.12**	**1.92**
Silver	SW6020A	6.1	6.1	8.4	6.1	6.1	12.2	**0.4 J**	**0.54 J**
Zinc	SW6020A	410	2783	3800	410	960	820	**129**	**132**
Organometallic Compounds (µg/kg)									
Tributyltin (ion)	SW8270DMSIM	--	73	--	--	--	--	**41.7 J**	**50.6**
Semivolatile Organics (µg/kg)									
1,2,4-Trichlorobenzene	SW8270DSIM	31	--	64	--	--	--	5 U	5 U
1,2-Dichlorobenzene	SW8270DSIM	35	--	110	--	--	--	5 U	5 U
1,4-Dichlorobenzene	SW8270DSIM	110	--	120	--	--	--	5 UJ	**4.3 J**
2,4-Dimethylphenol	SW8270DSIM	29	--	210	29	29	58	24.8 UJ	**9.6 J**

Source: Table 3 from Sediment Characterization Data Report (Anchor, 2019)

Table 4
Sample Results Summary

							Sample ID Sample Date	DU1-A-180827 8/27/2018	DU1-Z-180827 8/27/2018
		DMMP SL	DMMP BT	DMMP ML	SMS Marine SCO	SMS Marine CSL	LDW Superfund RALs Category 2 Areas		
2-Methylphenol (o-Cresol)	SW8270DSIM	63	--	77	63	63	--	5 U	**5.9**
4-Methylphenol (p-Cresol)	SW8270DSIM	670	--	3600	670	670	1340	**11**	**17**
Benzoic acid	SW8270DSIM	650	--	760	650	650	1300	**261 J**	**188 J**
Benzyl alcohol	SW8270DSIM	57	--	870	57	73	114	**18.2 J**	**16.7 J**
bis(2-Ethylhexyl)phthalate	SW8270D	1300	--	8300	--	--	--	**364**	**432**
Butylbenzyl phthalate	SW8270D	63	--	970	--	--	--	**390 J**	**33.7**
Diethyl phthalate	SW8270DSIM	200	--	1200	--	--	--	19.9 U	24 U
Dimethyl phthalate	SW8270DSIM	71	--	1400	--	--	--	**8.8**	**8.9**
Di-n-butyl phthalate	SW8270D	1400	--	5100	--	--	--	**13.8 J**	**10.6 J**
Di-n-octyl phthalate	SW8270D	6200	--	6200	--	--	--	19.9 U	19.9 U
Hexachlorobenzene	SW8270DSIM	22	168	230	--	--	--	5 U	5 U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	SW8270DSIM	11	--	270	--	--	--	5 U	5 U
n-Nitrosodiphenylamine	SW8270DSIM	28	--	130	--	--	--	**3.8 J**	**6.1**
Pentachlorophenol	SW8270DSIM	400	504	690	360	690	720	**8.9 J**	**8.8 J**
Phenol	SW8270DSIM	420	--	1200	420	1200	840	28.2 UJ	**79.6 J**
Semivolatile Organics (mg/kg-OC)									
1,2,4-Trichlorobenzene	SW8270DSIM	--	--	--	0.81	1.8	1.62	0.3 U	0.3 U
1,2-Dichlorobenzene	SW8270DSIM	--	--	--	2.3	2.3	4.6	0.3 U	0.3 U
1,4-Dichlorobenzene	SW8270DSIM	--	--	--	3.1	9	6.2	0.3 UJ	**0.3 J**
bis(2-Ethylhexyl)phthalate	SW8270D	--	--	--	47	78	94	**19.2**	**28.2**
Butylbenzyl phthalate	SW8270D	--	--	--	4.9	64	9.8	**20.5 J**	**2.2**
Diethyl phthalate	SW8270DSIM	--	--	--	61	110	--	1.0 U	1.6 U
Dimethyl phthalate	SW8270DSIM	--	--	--	53	53	106	**0.5**	**0.6**
Di-n-butyl phthalate	SW8270D	--	--	--	220	1700	--	**0.7 J**	**0.7 J**
Di-n-octyl phthalate	SW8270D	--	--	--	58	4500	--	1.0 U	1.3 U
Hexachlorobenzene	SW8270DSIM	--	--	--	0.38	2.3	0.76	0.3 U	0.3 U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	SW8270DSIM	--	--	--	3.9	6.2	--	0.3 U	0.3 U
n-Nitrosodiphenylamine	SW8270DSIM	--	--	--	11	11	22	**0.2 J**	**0.4**
Polycyclic Aromatic Hydrocarbons (µg/kg)									
2-Methylnaphthalene	SW8270D	670	--	1900	--	--	--	**16 J**	**29**
Acenaphthene	SW8270D	500	--	2000	--	--	--	**16 J**	**17 J**
Acenaphthylene	SW8270D	560	--	1300	--	--	--	19.9 U	**30.5**
Anthracene	SW8270D	960	--	13000	--	--	--	**84 J**	**86 J**
Benzo(a)anthracene	SW8270D	1300	--	5100	--	--	--	**157**	**164**
Benzo(a)pyrene	SW8270D	1600	--	3600	--	--	--	**270**	**305**
Benzo(b,j,k)fluoranthenes	SW8270D	3200	--	9900	--	--	--	**707**	**754**
Benzo(g,h,i)perylene	SW8270D	670	--	3200	--	--	--	**188**	**194**
Chrysene	SW8270D	1400	--	21000	--	--	--	**397 J**	**327**
Dibenzo(a,h)anthracene	SW8270DSIM	230	--	1900	--	--	--	**71**	**65**
Dibenzofuran	SW8270D	540	--	1700	--	--	--	**21**	**26**
Fluoranthene	SW8270D	1700	4600	30000	--	--	--	**325 J**	**262**

Source: Table 3 from Sediment Characterization Data Report (Anchor, 2019)

Table 4
Sample Results Summary

							Sample ID Sample Date	DU1-A-180827 8/27/2018	DU1-Z-180827 8/27/2018
		DMMP SL	DMMP BT	DMMP ML	SMS Marine SCO	SMS Marine CSL	LDW Superfund RALs Category 2 Areas		
Fluorene	SW8270D	540	--	3600	--	--	--	**25**	**25**
Indeno(1,2,3-c,d)pyrene	SW8270D	600	--	4400	--	--	--	**172**	**181**
Naphthalene	SW8270D	2100	--	2400	--	--	--	**30 J**	**39 J**
Phenanthrene	SW8270D	1500	--	21000	--	--	--	**194**	**126**
Pyrene	SW8270D	2600	11980	16000	--	--	--	**755**	**987**
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 0)	Calculated	--	--	--	--	--	1000 µg TEQ/kg dry weight	**385 J**	**425**
Total HPAH (DMMP) (U = 0)	Calculated	12000	--	69000	--	--	--	**3042 J**	**3239**
Total LPAH (DMMP) (U = 0)	Calculated	5200	--	29000	--	--	--	**349 J**	**323 J**
Polycyclic Aromatic Hydrocarbons (mg/kg-OC)									
2-Methylnaphthalene	SW8270D	--	--	--	38	64	76	**0.9 J**	**1.9**
Acenaphthene	SW8270D	--	--	--	16	57	32	**0.8 J**	**1.1 J**
Acenaphthylene	SW8270D	--	--	--	66	66	---	1.0 U	**2**
Anthracene	SW8270D	--	--	--	220	1200	440	**4.4 J**	**5.6 J**
Benzo(a)anthracene	SW8270D	--	--	--	110	270	220	**8.3**	**11**
Benzo(a)pyrene	SW8270D	--	--	--	99	210	198	**14**	**20**
Benzo(g,h,i)perylene	SW8270D	--	--	--	31	78	62	**9.9**	**13**
Chrysene	SW8270D	--	--	--	110	460	220	**21 J**	**21**
Dibenzo(a,h)anthracene	SW8270DSIM	--	--	--	12	33	24	**3.7**	**4.2**
Dibenzofuran	SW8270D	--	--	--	15	58	30	**1.1**	**1.7**
Fluoranthene	SW8270D	--	--	--	160	1200	320	**17.1 J**	**17.1**
Fluorene	SW8270D	--	--	--	23	79	46	**1.3**	**1.7**
Indeno(1,2,3-c,d)pyrene	SW8270D	--	--	--	34	88	68	**9.1**	**11.8**
Naphthalene	SW8270D	--	--	--	99	170	198	**1.6 J**	**2.5 J**
Phenanthrene	SW8270D	--	--	--	100	480	200	**10.2**	**8.2**
Pyrene	SW8270D	--	--	--	1000	1400	2000	**40**	**65**
Total Benzofluoranthenes (b,j,k) (U = 0)	SW8270D	--	--	--	230	450	4650	**37**	**49**
Total HPAH (SMS) (U = 0)	Calculated	--	--	--	960	5300	1920	**160 J**	**212**
Total LPAH (SMS) (U = 0)	Calculated	--	--	--	370	780	740	**18 J**	**21 J**
Pesticides (µg/kg)									
4,4'-DDD (p,p'-DDD)	SW8081B	16	--	--	--	--	--	1.0 UJ	1.0 UJ
4,4'-DDE (p,p'-DDE)	SW8081B	9	--	--	--	--	--	1.0 UJ	1.0 UJ
4,4'-DDT (p,p'-DDT)	SW8081B	12	--	--	--	--	--	8.9 UJ	6.9 UJ
Aldrin	SW8081B	9.5	--	--	--	--	--	0.5 UJ	0.5 UJ
Chlordane, alpha- (Chlordane, cis-)	SW8081B	--	--	--	--	--	--	0.5 U	0.5 U
Chlordane, beta- (Chlordane, trans-)	SW8081B	--	--	--	--	--	--	3.0 UJ	2.5 UJ
Dieldrin	SW8081B	1.9	--	1700	--	--	--	2.5 UJ	2.5 UJ
Heptachlor	SW8081B	1.5	--	270	--	--	--	0.5 U	0.5 U
Nonachlor, cis-	SW8081B	--	--	--	--	--	--	5.9 UJ	6.4 UJ
Nonachlor, trans-	SW8081B	--	--	--	--	--	--	4.9 UJ	1.0 U
Oxychlordane	SW8081B	--	--	--	--	--	--	1.0 U	1.0 U

Source: Table 3 from Sediment Characterization Data Report (Anchor, 2019)

Table 4
Sample Results Summary

							Sample ID Sample Date	DU1-A-180827 8/27/2018	DU1-Z-180827 8/27/2018
		DMMP SL	DMMP BT	DMMP ML	SMS Marine SCO	SMS Marine CSL	LDW Superfund RALs Category 2 Areas		
Sum 4,4 DDT, DDE, DDD (U = 0)	Calculated	--	50	69	--	--	--	8.9 UJ	6.9 UJ
Total DMMP Chlordane (U = 0)	Calculated	2.8	37	--	--	--	--	5.9 UJ	6.4 UJ
Dioxin Furans (ng/kg)									
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	--	--	--	--	--	--	**0.6 J**	**0.6 J**
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	--	--	--	--	--	--	**2.2**	**2.4**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	--	--	--	--	--	--	**2.9**	**3.4**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	--	--	--	--	--	--	**12.9**	**14.5**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	--	--	--	--	--	--	**6.9**	**7.3**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	--	--	--	--	--	--	**448**	**553**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613B	--	--	--	--	--	--	**4230 J**	**5250 J**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	--	--	--	--	--	--	**9.0 J**	**10**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	--	--	--	--	--	--	**13**	**15**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	--	--	--	--	--	--	**126**	**153**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	--	--	--	--	--	--	**1190**	**1520**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613B	--	--	--	--	--	--	**1.4**	**1.6**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	--	--	--	--	--	--	**1.2**	**1.3**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	--	--	--	--	--	--	**2.4**	**2.4**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	--	--	--	--	--	--	**8.9**	**8.7**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	--	--	--	--	--	--	**2.9**	**2.9**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613B	--	--	--	--	--	--	**1.6**	**1.5**
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	--	--	--	--	--	--	**1.8 J**	**2**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613B	--	--	--	--	--	--	**77**	**77**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613B	--	--	--	--	--	--	**5.8**	**6.0**
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613B	--	--	--	--	--	--	**285 J**	**297 J**
Total Tetrachlorodibenzofuran (TCDF)	E1613B	--	--	--	--	--	--	**31**	**32**
Total Pentachlorodibenzofuran (PeCDF)	E1613B	--	--	--	--	--	--	**40**	**48**
Total Hexachlorodibenzofuran (HxCDF)	E1613B	--	--	--	--	--	--	**136**	**150**
Total Heptachlorodibenzofuran (HpCDF)	E1613B	--	--	--	--	--	--	**299**	**288**
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)	Calculated	4	10	--	--	--	25	**14 J**	**16 J**
PCB Aroclors (µg/kg)									
Aroclor 1016	SW8082A	--	--	--	--	--	---	3.9 U	3.9 U
Aroclor 1221	SW8082A	--	--	--	--	--	---	3.9 U	3.9 U
Aroclor 1232	SW8082A	--	--	--	--	--	---	3.9 U	3.9 U
Aroclor 1242	SW8082A	--	--	--	--	--	---	3.9 U	3.9 U
Aroclor 1248	SW8082A	--	--	--	--	--	---	**62**	**52**
Aroclor 1254	SW8082A	--	--	--	--	--	---	**95**	**78**
Aroclor 1260	SW8082A	--	--	--	--	--	---	**64**	**55**
Aroclor 1262	SW8082A	--	--	--	--	--	---	3.9 U	3.9 U
Aroclor 1268	SW8082A	--	--	--	--	--	---	3.9 U	3.9 U
Total DMMP PCB Aroclors (U = 0)	Calculated	130	--	3100	--	--	---	**221**	**186**

Source: Table 3 from Sediment Characterization Data Report (Anchor, 2019)

Table 4
Sample Results Summary

							Sample ID	DU1-A-180827	DU1-Z-180827
							Sample Date	8/27/2018	8/27/2018
		DMMP SL	DMMP BT	DMMP ML	SMS Marine SCO	SMS Marine CSL	LDW Superfund RALs Category 2 Areas		
PCB Aroclors (mg/kg-OC)									
Total PCB Aroclors (U = 0)	Calculated	--	38	--	12	65	195	**11.6**	**12.1**

Italicized = Non-detected concentration is above one or more identified screening levels
Bold = Detected result
Detected concentration exceeds one or more screening levels
Detected concentration exceeds LDW Category 2 RAL (and DMMP criteria, if applicable)
Totals are calculated as the sum of all detected results (U=0). If all results are not detected, the highest reporting limit value is reported as the sum.
Total LPAH consists of the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene
Total HPAH consists of the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b,j,k)fluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
Total cPAH TEQ (7 minimum CAEPA 2005) calculation includes benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene and indeno(1,2,3-c,d)pyrene.
Total DDT consists of the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.
Total Chlordane includes cis-chlordane, trans-chlordane, cis-nonaclor, trans-nonaclor, and oxychlordane.
Total PCB does not include Aroclor 1262 and 1268.
µg/kg: microgram per kilogram
BT: bioaccumulation trigger
CSL: Cleanup Screening Level
DMMP: Dredged Material Management Program
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
J: Estimated value
LDW Superfund RALs: Lower Duwamish Waterway Human Health Remedial Action Levels
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
mg/kg-OC: milligram per kilogram total organic carbon normalized
ML: maximum level
PCB: polychlorinated biphenyl
pct: percent
SCO: Sediment Cleanup Objective
SL: screening level
SMS: Sediment Management Standards
TEQ: Toxic Equivalency Quotient
U: compound analyzed, but not detected above detection limit
UJ: compound analyzed, but not detected above estimated detection limit

Source: Table 3 from Sediment Characterization Data Report (Anchor, 2019)