CENWS-ODS-ND

MEMORANDUM FOR RECORD April 5, 2018

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF DREDGED MATERIAL FROM THE QUILLAYUTE FEDERAL NAVIGATION CHANNEL AND BOAT BASIN, EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR BEACH NOURISHMENT AT DESIGNATED BENEFICIAL USE SITES.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers [USACE], Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the suitability of 56,805 cubic yards (CY) of dredged material from the Quillayute River federal navigation channel and boat basin for removal and subsequent placement at designated beneficial use sites.

2. Background. The Quillayute River federal navigation channel project ("project") consists of the navigation channel and small boat basin at La Push, Washington. The authorized design depth is -10 ft Mean Lower Low Water (MLLW) plus 2 feet of overdepth in the project area. The USACE Seattle District is responsible for dredging portions of the authorized project as needed to maintain navigation.

   Sedimentation in the Quillayute navigation channel and boat basin is influenced primarily by input from the Quillayute River. A bathymetric survey conducted in February 2017 indicated significant infill above the authorized depth in the upstream portion of the inner navigation channel; smaller amounts of accumulation towards the mouth of the navigation channel were also observed. A small amount of accumulation above the authorized depth was also noted in the boat basin. USACE contracted with Anamar and subcontractor EcoAnalysts to characterize the navigation channel and boat basin to the authorized depth plus two feet of overdepth for all infilled areas.

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

Table 1. Project Summary and Tracking Information

Project ranking	Low: Navigation channel and boat basin (non-slip area) Moderate: boat basin (slip area)
Characterized volume (CY)	56,805
Authorized depth (feet MLLW)	-10
Characterized depth (authorized depth plus 2 feet overdepth)	-12
Draft SAP received	August 28, 2017
DMMP comments provided on draft SAP	September 11, 2017

Final SAP received	September 23, 2017
Sampling dates	September 25, 2017
Draft sediment characterization report received	December 20, 2017
DMMP comments provided on draft report	January 10, 2018
Final data report received	February 14, 2018
DMMO tracking number	QUILL-1-A-F-384
EIM Study ID	QUILL18
Recency Determination (low rank = 7 years; moderate rank = 5 years)	September 2024 : Navigation channel and non-slip boat basin area; September 2022: Slip area of boat basin

4. Project Ranking and Sampling Requirements. With the exception of the slip area within the boat basin, sediments in the navigation channel and non-slip areas of the boat basin are ranked "low" by the DMMP agencies for concern for potential contamination. The area including and immediately adjacent to the small boat slips (hereafter referred to as the "boat basin slip area") is ranked moderate due to the known presence of sunken vessels.

   For a project with homogeneous sediment, the number of analyses and field samples are calculated using the following guidelines for low and moderate-ranked projects:

	Low	Moderate
Maximum volume of sediment represented by each field sample	8,000 CY	4,000 CY
Maximum volume of sediment represented by each analysis	60,000 CY	16,000 CY

   Given the expected homogeneous nature of the sediments in the navigation channel and the relatively minor accumulation within the boat basin, no distinction between surface and subsurface material was required, and grab samples were approved by the DMMP agencies as a representative sampling technique.

   In total, four (4) Dredged Material Management Units (DMMUS) were defined to characterize 56,805 CY of material. The moderate-ranked slip area within the boat basin was retained as a separate DMMU.

5. Sampling. Grab sampling using a pneumatic power grab occurred on September 25, 2017 at the locations listed in Table 2 and shown in Figures 2 and 3. A total of 13 grab samples were collected and composited to represent four (4) DMMUs (Tables 2 and 3). Compositing was conducted onboard the sampling vessel. All samples were then placed on ice and transported to EcoAnalysts' Port Gamble laboratory.

   A total of 4 DMMU composite samples were submitted to ALS Laboratories in Kelso, Washington for chemical analysis. Sample material for potential bioassay testing was retained at the EcoAnalysts laboratory in Port Gamble.

6. Chemical Analysis. The DMMU composites were analyzed for sediment conventionals and the standard DMMP chemicals of concern for marine projects. The conventional and chemical data results are summarized in Table 4.

   Grain Size and Sediment Conventionals. Grain size amongst the four DMMUs ranged from predominantly gravel (>70%) with lesser amounts of sand in the navigation channel (inner and outer channel DMMUs) to a mixture of sand and silt in the boat basin (slip- and non-slip areas).

   Standard DMMP Chemicals of Concern. No chemistry results (detects and non-detects) exceeded the DMMP Screening Levels (SL) for the chemicals of concern (COC). Pesticides and PCBs were non-detect in all DMMUs. For the remaining standard COCs (metals, semivolatile organic carbons [SVOCs], chlorinated hydrocarbons), concentrations were generally lowest in the navigation channel.

   TBT. Tributyltin (TBT) testing was not required for this project.

   Dioxins/furans. Dioxins/furans testing was not required for this project.

   PBDEs. In response to the Essential Fish Habitat conservation recommendations that accompanied the National Marine Fisheries Service's biological opinion on the effects of dredged material disposal on listed rockfish species (DMMO, 2016), USACE agreed to conduct limited analysis of polybrominated diphenyl ethers (PBDEs) for federal dredging projects in urban areas. As a non-urban area, no DMMUs from this project were analyzed for PBDEs.

   Data Validation. All chemistry data were validated to a minimum of EPA Stage 2b. Initial analysis of semivolatile organic compounds (SVOCs) did not include a certified reference material (CRM), so samples were re-extracted to be analyzed concurrent to the reference material. The re-extraction occurred at 29 days of holding time, beyond the prescribed 14 day holding time recommended for preservation by freezing. All results were consequently flagged as estimated by the validators. Comparison between the two datasets showed similar results with no consistent low or high bias. In summary, all data were considered usable by the data validator for the study purpose.

7. Biological Testing. Biological testing was not required; concentrations of all detected and non-detected chemicals of concern were below the DMMP screening level criteria.

8. Sediment Exposed by Dredging. Sediment exposed by dredging must meet either the State of Washington Sediment Quality Standards (SQS) (Ecology, 2013) or the State's anti-degradation standard. Concentrations of all DMMP chemicals of concern were below the DMMP SLs. Furthermore, since TOC concentrations were greater than 0.5% in all DMMUs, all DMMP COCs were compared to their applicable state marine benthic standards; conversion to organic carbon-normalization ("OC-normalized") was performed where relevant (Table 5). All concentrations were below the state benthic standards. In summary, this project is in compliance with the State of Washington anti-degradation standard.

9. Debris Management. The DMMP agencies implemented a debris management requirement following the 2015 SMARM in order to prevent the disposal of debris (wood or otherwise) greater than 12 inches in any dimension at open-water disposal sites in Puget Sound. While debris management is a concern at this project, particularly in the boat basin slip areas, a debris screen is not required for this project because this project is hydraulically dredged, and the upland and beach placement locations are monitored for debris of any size per conditions of the project water quality certification and required BMPs.

10. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment from the federal navigation project and berthing areas in the Quillayute River federal navigation channel and small boat basin for unconfined open-water disposal. The data gathered were determined to be sufficient and acceptable for regulatory decision-making under the DMMP program.

    In summary, based on the results of the testing, the DMMP agencies have concluded that all 56,805 CY of dredged material are suitable for unconfined open-water disposal. However, due to the lack of a local open-water disposal site; this option is unlikely to be exercised.

    In lieu of open-water disposal, the USACE Navigation dredging program uses the dredged material determined suitable for open-water disposal for beach nourishment or places the material at a nearby upland beneficial use site. USACE Navigation maintains the appropriate environmental documentation to cover this activity.

11. References.

Anamar and EcoAnalysts, 2017. Quillayute River Navigation Channel and Boat Basin Dredged Material Characterization Sampling and Analysis Plan. September 2017.

Anamar and EcoAnalysts, 2018. Quillayute River Navigation Channel and Boat Basin Dredged Material Characterization Report. February 2018.

DMMO, 2016. *Statutory Response to EFH Conservation Recommendations for the Continued Use of Multi-User Dredged Material Disposal Sites in Puget Sound and Grays Harbor (Fourth Field HUCs 17110020 Dungeness-Elwha, 17110002 Strait of Georgia, 1711019 Puget Sound, and 17100105 Grays Harbor) Washington. NMFS Consultation Number: WCR-2015-2975.* Prepared by the Seattle District Dredged Material Management Office, January 2016.

DMMP, 2016. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, August 2016.

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

10. Agency Signatures.

signed copy on file in DMMO - Seattle District office

Concur:

_____	_____
Date	Heather Whitney Fourie - Seattle District Corps of Engineers
_____	_____
Date	Justine Barton - Environmental Protection Agency
_____	_____
Date	Laura Inouye, Ph.D. - Washington Department of Ecology
_____	_____
Date	Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
John Hicks, CENWS-ODS-NS
Elizabeth Chien, CENWS-ODS-NS
John Pell, CENWS-ODS-NS

Table 2. Sample Station Summary

DMMU	Volume of Accreted Material (cy)	Sample Station	SAP Target Locations			Actual Sample Locations				
			Latitude	Longitude	Elevation (ft MLLW)	Latitude	Longitude	Water Depth	Tide Height (ft)	Elevation (tide – water depth = elev. Ft MLLW)
Outer Channel (QUIL17-OC)	1408	01	47.906127	-124.644082	-9.6	47.906203	-124.644109	12.6	2.69	-9.9
		02	47.906572	124.643616	-9.9	47.906598	-124.643740	12.8	2.6	-10.2
Inner Channel (QUIL17-IC)	50,798	01	47.909770	-124.639842	-9.7	47.909765	-124.639850	10.2	2.55	-7.7
		02	47.910481	-124.638886	-8.3	47.910489	-124.638898	9.9	2.59	-7.3
		03	47.910756	-124.639159	-4.9	47.910748	-124.639163	9.0	2.59	-6.4
		04	47.911096	-124.638478	-7.3	47.911106	-124.638479	9.3	2.78	-6.5
		05	47.911701	-124.638604	-5.1	47.911711	-124.638606	7.0	2.94	-4.1
		06	47.911972	-124.637914	-5.9	47.911969	-124.637924	9.2	2.94	-6.3
		07	47.912531	-124.638313	-4.0	47.912510	-124.638303	8.0	3.12	-4.9
Boat Basin – Non-slip Area (QUIL17-NSA)	3329	01	47.910329	-124.637504	-9.4	47.910326	-124.637506	12.5	3.35	-9.2
		02	47.912708	-124.636821	-9.8	47.912711	-124.636822	13.5	3.35	-10.2
Boat Basin – Slip Area (QUIL17-SA)	1270	01	47.910491	-124.637206	-9.7	47.910493	-124.637218	13.5	3.87	-9.6
		02	47.911256	-124.636318	-5.5	47.911256	-124.636311	8.6	4.17	-4.4
Total Volume Characterized	56,805									

Table 3. DMMU sample summary

DMMU Composite	Number of Stations	Number of Grab Samples	Volume per Grab (L)	Total Volume Collected (L)
Outer Channel	2	4	2	8
Inner Channel	7	7	1.25	8.75
Boat Basin Non-slip Area	2	2	4	8
Boat Basin Slip Area	2	2	4	8

Table 4. Chemical Analytical Results

Analyte	DMMP Guidelines			Maximum Detected Value		Outer Channel					Inner Channel					Boat Basin – Non-slip Area					Boat Basin – Slip Area				
	SL	BT	ML	Result	Qualifier	Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier	
									Lab	Inter.				Lab	Inter.				Lab	Inter.				Lab	Inter.
Grain Size / Conventionals																									
Gravel (%)						79.42			NA	NA	73.34			NA	NA	0.17			NA	NA	0.00			NA	NA
Sand (%)						22.88			NA	NA	12.88			NA	NA	69.36			NA	NA	36.83			NA	NA
Silt (%)						1.79			NA	NA	6.10			NA	NA	23.78			NA	NA	55.50			NA	NA
Clay (%)						0.54			NA	NA	2.26			NA	NA	5.74			NA	NA	7.64			NA	NA
Fines (% Silt & Clay)						2.33			NA	NA	8.36			NA	NA	29.52			NA	NA	63.14			NA	NA
Ammonia as N (mg/kg)						16.5	0.57	0.05	NA	NA	30.2	0.67	0.06	NA	NA	17.1	0.8	0.07	NA	NA	12.6	0.84	0.07	NA	NA
Sulfide (mg/kg)						43	29	9	NA	NA	330	220	70	NA	NA	210	140	50	NA	NA	260	150	50	NA	NA
TOC (%)						0.93	0.05	0.02	NA	NA	0.776	0.05	0.02	NA	NA	1.23	0.05	0.02	NA	NA	1.28	0.05	0.02	NA	NA
Total Solids (%)						85.0	NA	NA	NA	NA	72.9	NA	NA	NA	NA	61.4	NA	NA	NA	NA	58.5	NA	NA	NA	NA
Total Volatile Solids (%)						3.3	0.1	NA	NA	NA	3.3	0.1	NA	NA	NA	5.0	0.1	NA	NA	NA	5.3	0.1	NA	NA	NA
Metals																									
Antimony (mg/kg dw)	150	---	200	0.06	NA	0.025	0.042	0.008	J	J	0.053	0.059	0.012	J	J	0.06	0.054	0.011	NA	J	0.04	0.068	0.014	J	J
Arsenic (mg/kg dw)	57	507.1	700	7.36	NA	2.96	0.42	0.03	NA	J	3.46	0.59	0.05	NA	J	7.07	0.54	0.04	NA	J	7.36	0.68	0.05	NA	J
Cadmium (mg/kg dw)	5.1	---	14	0.143	NA	0.062	0.017	0.006	NA	J	0.143	0.024	0.008	NA	J	0.129	0.022	0.008	NA	J	0.133	0.027	0.01	NA	J
Chromium (mg/kg dw)	260	---	---	30.8	NA	13.5	0.17	0.05	NA	J	17.2	0.24	0.07	NA	J	30.8	0.22	0.07	NA	J	30.6	0.27	0.08	NA	J
Copper (mg/kg dw)	390	---	1300	26.9	NA	15.7	0.084	0.033	NA	J	17.5	0.12	0.05	NA	J	26.7	0.11	0.04	NA	J	26.9	0.14	0.05	NA	J
Lead (mg/kg dw)	450	975	1200	7.79	NA	2.65	0.042	0.017	NA	J	3.53	0.059	0.024	NA	J	7.05	0.054	0.022	NA	J	7.79	0.068	0.027	NA	J
Mercury (mg/kg dw)	0.41	1.5	2.3	0.049	NA	0.017	0.019	0.002	J	J	0.022	0.022	0.002	NA	NA	0.039	0.021	0.002	NA	NA	0.049	0.03	0.003	NA	NA
Selenium (mg/kg dw)	---	3	---	0.4	J	0.1	0.84	0.06	J	J	0.2	1.2	0.08	J	J	0.3	1.1	0.08	J	J	0.4	1.4	0.1	J	J
Silver (mg/kg dw)	6.1	---	8.4	0.079	NA	0.014	0.017	0.003	J	J	0.032	0.024	0.005	NA	NA	0.064	0.022	0.004	NA	NA	0.079	0.027	0.005	NA	NA
Zinc (mg/kg dw)	410	---	3800	76.4	NA	32.1	0.42	0.17	NA	J	38.8	0.59	0.24	NA	J	71.2	0.54	0.22	NA	J	76.4	0.68	0.27	NA	J
Pesticides																									
Heptachlor (µg/kg)	1.5	---	270	0.66	U	0.42	1.1	0.42	U	U	0.52	1.4	0.52	U	U	0.57	1.5	0.57	U	U	0.66	1.7	0.66	U	U
Aldrin (µg/kg)	9.5	---	---	6.1	Ui	0.63	1.1	0.63	U	U	6.1	6.1	6.1	Ui	U	0.86	1.5	0.86	U	U	1.0	1.7	1.0	U	U
Dieldrin (µg/kg)	1.9	---	1700	0.38	U	0.24	1.1	0.24	U	U	0.29	1.4	0.29	U	U	0.32	1.5	0.32	U	U	0.38	1.7	0.38	U	U
4,4'-DDE (µg/kg)	9	---	---	0.68	U	0.43	1.1	0.43	U	U	0.53	1.4	0.53	U	U	0.58	1.5	0.58	U	U	0.68	1.7	0.68	U	U
4,4'-DDD (µg/kg)	16	---	---	1.1	U	0.64	1.1	0.64	U	U	0.79	1.4	0.79	U	U	0.87	1.5	0.87	U	U	1.1	1.7	1.1	U	U
4,4'-DDT (µg/kg)	12	---	---	1.1	U	0.65	1.1	0.65	U	U	0.8	1.4	0.8	U	U	0.89	1.5	0.89	U	U	1.1	1.7	1.1	U	U
Total 4,4' DDx [1]	---	50	69	1.7	U	1.1			U	U	1.4			U	U	1.5			U	U	1.7			U	U
Oxychlordane (µg/kg)	---	---	---	0.43	U	0.27	1.1	0.27	U	U	0.33	1.4	0.33	U	U	0.37	1.5	0.37	U	U	0.43	1.7	0.43	U	U
gamma-Chlordane (µg/kg)	---	---	---	0.65	U	0.41	1.1	0.41	U	U	0.5	1.4	0.5	U	U	0.56	1.5	0.56	U	U	0.65	1.7	0.65	U	U
cis-Chlordane (µg/kg)	---	---	---	0.7	U	0.44	1.1	0.44	U	U	0.54	1.4	0.54	U	U	0.6	1.5	0.6	U	U	0.7	1.7	0.7	U	U
cis-Nonachlor (µg/kg)	---	---	---	0.49	U	0.31	1.1	0.31	U	U	0.38	1.4	0.38	U	U	0.42	1.5	0.42	U	U	0.49	1.7	0.49	U	U
trans-Nonachlor (µg/kg)	---	---	---	1.2	U	0.75	1.1	0.75	U	U	0.94	1.4	0.94	U	U	1.1	1.5	1.1	U	U	1.2	1.7	1.2	U	U
Total Chlordane (µg/kg)[1]	2.8	37	---	1.2	U	0.75			U	U	0.94			U		1.1			U	U	1.2			U	U
PCBs																									
Aroclor 1016 (µg/kg)	---	---	---	4.9	U	3.1	11	3.1	U	U	3.8	14	3.8	U	U	4.2	15	4.2	U	U	4.9	17	4.9	U	U
Aroclor 1221 (µg/kg)	---	---	---	4.9	U	3.1	22	3.1	U	U	3.8	27	3.8	U	U	4.2	29	4.2	U	U	4.9	34	4.9	U	U
Aroclor 1232 (µg/kg)	---	---	---	4.9	U	3.1	11	3.1	U	U	3.8	14	3.8	U	U	4.2	15	4.2	U	U	4.9	17	4.9	U	U

Analyte	DMMP Guidelines			Maximum Detected Value		Outer Channel					Inner Channel					Boat Basin – Non-slip Area					Boat Basin – Slip Area				
	SL	BT	ML	Result	Qualifier	Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier	
									Lab	Inter.				Lab	Inter.				Lab	Inter.				Lab	Inter.
Aroclor 1242 (µg/kg)	---	---	---	4.9	U	3.1	11	3.1	U	U	3.8	14	3.8	U	U	4.2	15	4.2	U	U	4.9	17	4.9	U	U
Aroclor 1248 (µg/kg)	---	---	---	4.9	U	3.1	11	3.1	U	U	3.8	14	3.8	U	U	4.2	15	4.2	U	U	4.9	17	4.9	U	U
Aroclor 1254 (µg/kg)	---	---	---	4.9	U	3.1	11	3.1	U	U	3.8	14	3.8	U	U	4.2	15	4.2	U	U	4.9	17	4.9	U	U
Aroclor 1260 (µg/kg)	---	---	---	4.9	U	3.1	11	3.1	U	U	3.8	14	3.8	U	U	4.2	15	4.2	U	U	4.9	17	4.9	U	U
Total PCBs (µg/kg) [1]	130	38	3100	4.9	U	3.1			U	U	3.8			U	U	4.2			U	U	4.9			U	U
LMW PAH																									
2-Methylnaphthalene (µg/kg)	670	---	1900	210	NA	67	6	2.8	NA	J	36	6.9	2.8	NA	J	210	8.2	2.8	NA	J	170	8.6	2.8	NA	J
Acenaphthene (µg/kg)	500	---	2000	21	NA	3.2	6	3.2	U	UJ	3.2	6.9	3.2	U	UJ	21	8.2	3.2	NA	J	9.3	8.6	3.2	NA	J
Acenaphthylene (µg/kg)	560	---	1300	4.6	Ui	2.6	6	2.6	U	UJ	2.6	6.9	2.6	U	UJ	4.2	8.2	2.6	Ui	UJ	4.6	8.6	2.6	Ui	UJ
Anthracene (µg/kg)	960	---	13000	7.2	J	3.2	6	3.2	U	UJ	3.2	6.9	3.2	U	UJ	7.2	8.2	3.2	J	J	5.4	8.6	3.2	J	J
Fluorene (µg/kg)	540	---	3600	45	NA	9.6	6	3.3	NA	J	6.5	6.9	3.3	J	J	45	8.2	3.3	NA	J	35	8.6	3.3	NA	J
Naphthalene (µg/kg)	2100	---	2400	100	NA	32	6	2.9	NA	J	18	6.9	2.9	NA	J	100	8.2	2.9	NA	J	78	8.6	2.9	NA	J
Phenanthrene (µg/kg)	1500	---	21000	160	NA	48	6	3.6	NA	J	28	6.9	3.6	NA	J	160	8.2	3.6	NA	J	160	8.6	3.6	NA	J
Total LMW PAHs(µg/kg)[1,2]	5200	---	29,000	333.2	J	89.6			NA	J	52.5			NA	NA	333.2			NA	NA	287.7			NA	NA
HMW PAH																									
Benz(a)anthracene (µg/kg)	1300	---	5100	17	NA	3.6	6	3.6	U	UJ	3.6	6.9	3.6	U	UJ	17	8.2	3.6	NA	J	11	8.6	3.6	NA	J
Benzo(a)pyrene (µg/kg)	1600	---	3600	6.8	J	3.6	6	3.6	U	UJ	3.6	6.9	3.6	U	UJ	6.8	8.2	3.6	J	J	6.7	8.6	3.6	J	J
Benzo(b)fluoranthene (µg/kg)	3200	---	9900	22	NA	3.4	6	3.4	U	UJ	3.4	6.9	3.4	U	UJ	15	8.2	3.4	NA	J	22	8.6	3.4	NA	J
Benzo(g,h,i)perylene (µg/kg)	670	---	3200	4.3	J	3.7	6	3.7	U	UJ	3.7	6.9	3.7	U	UJ	3.7	8.2	3.7	U	UJ	4.3	8.6	3.7	J	J
Benzo(k)fluoranthene (µg/kg)	3200	---	9900	6.2	J	4	6	4	U	UJ	4	6.9	4	U	UJ	4.2	8.2	4	J	J	6.2	8.6	4	J	J
Chrysene (µg/kg)	1400	---	21,000	35	NA	4.7	6	4.1	J	J	4.1	6.9	4.1	U	UJ	27	8.2	4.1	NA	J	35	8.6	4.1	NA	J
Dibenz(a,h)anthracene (µg/kg)	230	---	1900	3	U	3	6	3	U	UJ	3	6.9	3	U	UJ	3	8.2	3	U	UJ	3	8.6	3	U	UJ
Fluoranthene (µg/kg)	1700	4600	30,000	85	NA	3.7	6	3.7	U	UJ	3.7	6.9	3.7	U	UJ	51	8.2	3.7	NA	J	85	8.6	3.7	NA	J
Indeno(1,2,3-cd)pyrene (µg/kg)	600	---	4400	4.3	J	3.2	6	3.2	U	UJ	3.2	6.9	3.2	U	UJ	3.2	8.2	3.2	U	UJ	4.3	8.6	3.2	J	J
Pyrene (µg/kg)	2600	11,980	16,000	58	NA	3.8	6	3.7	J	J	3.7	6.9	3.7	U	UJ	36	8.2	3.7	NA	J	58	8.6	3.7	NA	J
Total HMW PAHs (µg/kg) [1]	12,000	---	69,000	232.5	J	8.5			J	J	4.1			U	UJ	157			J	J	232.5			J	J
Chlorinated Hydrocarbons																									
1,4-Dichlorobenzene (µg/kg)	110	---	120	2.5	U	2.5	6	2.5	U	UJ	2.5	6.9	2.5	U	UJ	2.5	8.2	2.5	U	UJ	2.5	8.6	2.5	U	UJ
1,2-Dichlorobenzene (µg/kg)	35	---	110	2.4	U	2.4	6	2.4	U	UJ	2.4	6.9	2.4	U	UJ	2.4	8.2	2.4	U	UJ	2.4	8.6	2.4	U	UJ
1,2,4-Trichlorobenzene (µg/kg)	31	---	64	2.6	U	2.6	6	2.6	U	UJ	2.6	6.9	2.6	U	UJ	2.6	8.2	2.6	U	UJ	2.6	8.6	2.6	U	UJ
Hexachlorobenzene (µg/kg)	22	168	230	3.3	U	3.3	6	3.3	U	UJ	3.3	6.9	3.3	U	UJ	3.3	8.2	3.3	U	UJ	3.3	8.6	3.3	U	UJ
Phthalates																									
Dimethyl Phthalate (µg/kg)	71	---	1400	4	U	4	6	4	U	UJ	4	6.9	4	U	UJ	4	8.2	4	U	UJ	4	8.6	4	U	UJ
Diethyl Phthalate (µg/kg)	200	---	1200	3.7	U	3.7	6	3.7	U	UJ	3.7	6.9	3.7	U	UJ	3.7	8.2	3.7	U	UJ	3.7	8.6	3.7	U	UJ
Di-n-butyl Phthalate (µg/kg)	1400	---	5100	4.8	U	4.8	12	4.8	U	UJ	4.8	14	4.8	U	UJ	4.8	17	4.8	U	UJ	4.8	18	4.8	U	UJ
Butyl Benzyl Phthalate (µg/kg)	63	---	970	4.2	J	3.7	6	3.7	U	UJ	3.7	6.9	3.7	U	UJ	4.2	8.2	3.7	J	J	4	8.6	3.7	J	J
Bis(2-ethylhexyl) Phthalate (µg/kg)	1300	---	8300	13	J	8.9	59	8.9	U	UJ	8.9	69	8.9	U	UJ	9.8	82	8.9	J	J	13	86	8.9	J	J
Di-n-octyl Phthalate (µg/kg)	6200	---	6200	10	U	5.6	6	3.2	J	J	7.3	6.9	3.2	NA	J	7.3	8.2	3.2	J	J	10	8.6	3.2	U	UJ
Phenols																									
Phenol (µg/kg)	420	---	1200	17	J	7.4	18	3.1	J	J	5.9	21	3.1	J	J	7.8	25	3.1	J	J	17	26	3.1	J	J
2-Methylphenol (µg/kg)	63	---	77	4.1	U	4.1	6	4.1	U	UJ	4.1	6.9	4.1	U	UJ	4.1	8.2	4.1	U	UJ	4.1	8.6	4.1	U	UJ
4-Methylphenol (µg/kg)	670	---	3600	40	NA	4.5	6	4.5	U	UJ	40	6.9	4.5	NA	J	8.1	8.2	4.5	J	J	8.5	8.6	4.5	J	J

Analyte	DMMP Guidelines			Maximum Detected Value		Outer Channel					Inner Channel					Boat Basin – Non-slip Area					Boat Basin – Slip Area				
	SL	BT	ML	Result	Qualifier	Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier	
									Lab	Inter.				Lab	Inter.				Lab	Inter.				Lab	Inter.
2,4-Dimethylphenol (µg/kg)	29	---	210	6.3	U	6.3	30	6.3	U	UJ	6.3	35	6.3	U	UJ	6.3	41	6.3	U	UJ	6.3	43	6.3	U	UJ
Pentachlorophenol (µg/kg)	400	540	690	5.3	U	5.3	59	5.3	U	UJ	5.3	69	5.3	U	UJ	5.3	82	5.3	U	UJ	5.3	86	5.3	U	UJ
Miscellaneous Extractables																									
Benzyl Alcohol (µg/kg)	57	---	870	8.5	J	4.9	12	4.9	U	UJ	8.5	14	4.9	J	J	5.3	17	4.9	JX	J	4.9	18	4.9	U	UJ
Benzoic Acid (µg/kg)	650	---	760	96	U	96	240	96	U	UJ	96	280	96	U	UJ	96	330	96	U	UJ	96	350	96	U	UJ
Dibenzofuran (µg/kg)	540	---	1700	11	U	11	6	3.4	U	UJ	6.1	6.9	3.4	U	UJ	3	8.2	3.4	U	UJ	3	8.6	3.4	U	UJ
Hexachlorobutadiene (µg/kg)	11	---	270	3	---	3	6	3	NA	J	3	6.9	3	J	J	3	8.2	3	NA	J	3	8.6	3	NA	J
N-Nitrosodiphenylamine (µg/kg)	28	---	130	8.5	U	3.2	6	3.2	U	UJ	8.5	6.9	3.2	U	UJ	3.2	8.2	3.2	U	UJ	3.2	8.6	3.2	U	UJ

Notes: Gray shaded cells and NA indicate not applicable, dashed lines indicate there are currently no DMMP guidelines for an analyte.
[1] Summed values calculated according to DMMP clarification (van der Elst, 2015)
[2] Total LMW PAH value does not include 2-methylnaphthalene

Table 5. Comparison of Chemical Analytical Results to Marine Sediment Management Standards

Analyte	DMMP Guidelines		Maximum Detected Value		Outer Channel			Inner Channel			Boat Basin – Non-slip Area			Boat Basin – Slip Area		
	SQS (SCO)	CSL	Result	Qualifier	Result	Qualifier		Result	Qualifier		Result	Qualifier		Result	Qualifier	
						Lab	Inter.		Lab	Inter.		Lab	Inter.		Lab	Inter.
TOC (%)					0.93	NA	NA	0.776	NA	NA	1.23	NA	NA	1.28	NA	NA
Metals																
Arsenic (mg/kg dw)	57	93	7.36	J	2.96	NA	J	3.46	NA	J	7.07	NA	J	7.36	NA	J
Cadmium (mg/kg dw)	5.1	6.7	0.143	J	0.062	NA	J	0.143	NA	J	0.129	NA	J	0.133	NA	J
Chromium (mg/kg dw)	260	270	30.8	J	13.5	NA	J	17.2	NA	J	30.8	NA	J	30.6	NA	J
Copper (mg/kg dw)	390	390	26.9	J	15.7	NA	J	17.5	NA	J	26.7	NA	J	26.9	NA	J
Lead (mg/kg dw)	450	530	7.79	J	2.65	NA	J	3.53	NA	J	7.05	NA	J	7.79	NA	J
Mercury (mg/kg dw)	0.41	0.59	0.049	NA	0.017	J	J	0.022	NA	NA	0.039	NA	NA	0.049	NA	NA
Silver (mg/kg dw)	6.1	6.1	0.079	NA	0.014	J	J	0.032	NA	NA	0.064	NA	NA	0.079	NA	NA
Zinc (mg/kg dw)	410	960	76.4	J	32.1	NA	J	38.8	NA	J	71.2	NA	J	76.4	NA	J
PCBs																
Total PCBs (mg/kg OC)[1]	12	65	0.490	U	0.333	U	U	0.490	U	U	0.341	U	U	0.383	U	U
LMW PAH																
2-Methylnaphthalene (mg/kg OC) [2]	38	64	17.1	J	7.20	NA	J	4.64	NA	J	17.1	NA	J	13.3	NA	J
Acenaphthene (mg/kg OC)	16	57	1.71	J	0.344	U	UJ	0.412	U	UJ	1.71	NA	J	0.727	NA	J
Acenaphthylene (mg/kg OC)	66	66	0.359	UJ	0.280	U	UJ	0.335	U	UJ	0.341	Ui	UJ	0.359	Ui	UJ
Anthracene (mg/kg OC)	220	1200	0.585	J	0.344	U	UJ	0.412	U	UJ	0.585	J	J	0.422	J	J
Fluorene (mg/kg OC)	23	79	3.66	J	1.03	NA	J	0.838	J	J	3.66	NA	J	2.73	NA	J
Naphthalene (mg/kg OC)	99	170	8.13	J	3.44	NA	J	2.32	NA	J	8.13	NA	J	6.09	NA	J
Phenanthrene (mg/kg OC)	100	480	13.0	J	5.16	NA	J	3.61	NA	J	13.0	NA	J	12.5	NA	J
Total LMW PAHs (mg/kg OC) [1]	370	780	27.1	NA	9.63	NA	NA	6.77	NA	NA	27.1	NA	NA	22.5	NA	NA
HMW PAH																
Benzo(a)anthracene (mg/kg OC)	110	270	1.38	J	0.387	U	UJ	0.464	U	UJ	1.38	NA	J	0.859	NA	J
Benzo(a)pyrene (mg/kg OC)	99	210	0.553	J	0.387	U	UJ	0.464	U	UJ	0.553	J	J	0.523	J	J
Total benzofluoranthenes (mg/kg OC) [3]	230	450	2.20	J	0.430	U	UJ	0.515	U	UJ	1.56	NA	J	2.20	NA	J
Benzo(g,h,i)perylene (mg/kg OC)	31	78	0.477	UJ	0.398	U	UJ	0.477	U	UJ	0.301	U	UJ	0.336	J	J
Chrysene (mg/kg OC)	110	460	2.73	J	0.505	J	J	0.528	U	UJ	2.20	NA	J	2.73	NA	J
Dibenz(a,h)anthracene (mg/kg OC)	12	33	0.387	UJ	0.323	U	UJ	0.387	U	UJ	0.244	U	UJ	0.234	U	UJ
Fluoranthene (mg/kg OC)	160	1200	6.64	J	0.398	U	UJ	0.477	U	UJ	4.15	NA	J	6.64	NA	J
Indeno(1,2,3-cd)pyrene (mg/kg OC)	34	88	0.412	UJ	0.344	U	UJ	0.412	U	UJ	0.260	U	UJ	0.336	J	J
Pyrene (mg/kg OC)	1000	1,400	4.53	J	0.409	J	J	0.477	U	UJ	2.93	NA	J	4.53	NA	J
Total HMW PAHs (mg/kg OC) [1]	960	5300	18.2	J	0.914	J	J	0.528	U	UJ	12.8	J	J	18.2	J	J
Chlorinated Hydrocarbons																
1,4-Dichlorobenzene (µg/kg)	3.1	9	0.322	UJ	0.269	U	UJ	0.322	U	UJ	0.203	U	UJ	0.195	U	UJ

Analyte	DMMP Guidelines		Maximum Detected Value		Outer Channel			Inner Channel			Boat Basin – Non-slip Area			Boat Basin – Slip Area		
	SQS (SCO)	CSL	Result	Qualifier	Result	Qualifier		Result	Qualifier		Result	Qualifier		Result	Qualifier	
						Lab	Inter.		Lab	Inter.		Lab	Inter.		Lab	Inter.
1,2-Dichlorobenzene (µg/kg)	2.3	2.3	0.309	UJ	0.258	U	UJ	0.309	U	UJ	0.195	U	UJ	0.188	U	UJ
1,2,4-Trichlorobenzene (µg/kg)	0.81	1.8	0.335	UJ	0.280	U	UJ	0.335	U	UJ	0.211	U	UJ	0.203	U	UJ
Hexachlorobenzene (µg/kg)	0.38	2.3	0.425	UJ	0.355	U	UJ	0.425	U	UJ	0.268	U	UJ	0.258	U	UJ
Phthalates																
Dimethyl Phthalate (µg/kg)	53	53	0.515	UJ	0.430	U	UJ	0.515	U	UJ	0.325	U	UJ	0.313	U	UJ
Diethyl Phthalate (µg/kg)	61	110	0.477	UJ	0.398	U	UJ	0.477	U	UJ	0.301	U	UJ	0.289	U	UJ
Di-n-butyl Phthalate (µg/kg)	220	1700	0.619	UJ	0.516	U	UJ	0.619	U	UJ	0.390	U	UJ	0.375	U	UJ
Butyl Benzyl Phthalate (µg/kg)	4.9	64	0.477	UJ	0.398	U	UJ	0.477	U	UJ	0.341	J	J	0.313	J	J
Bis(2-ethylhexyl) Phthalate (µg/kg)	47	78	1.15	UJ	0.957	U	UJ	1.15	U	UJ	0.797	J	J	1.02	J	J
Di-n-octyl Phthalate (µg/kg)	58	4500	0.941	J	0.602	J	J	0.941	NA	J	0.593	J	J	0.781	U	UJ
Phenols																
Phenol (µg/kg)	420	1200	17	J	7.40	J	J	5.90	J	J	7.80	J	J	17.0	J	J
2-Methylphenol (µg/kg)	63	63	4.10	UJ	4.10	U	UJ	4.10	U	UJ	4.10	U	UJ	4.10	U	UJ
4-Methylphenol (µg/kg)	670	670	40	J	4.50	U	UJ	40.0	NA	J	8.10	J	J	8.50	J	J
2,4-Dimethylphenol (µg/kg)	29	29	6.30	UJ	6.30	U	UJ	6.30	U	UJ	6.30	U	UJ	6.30	U	UJ
Pentachlorophenol (µg/kg)	360	690	0.683	UJ	0.57	U	UJ	0.683	U	UJ	0.431	U	UJ	0.414	U	UJ
Miscellaneous Extractables																
Benzyl Alcohol (µg/kg)	57	73	8.50	J	4.90	U	UJ	8.50	J	J	5.3	JX	J	4.90	U	UJ
Benzoic Acid (µg/kg)	650	650	96.0	UJ	96.0	U	UJ	96.0	U	UJ	96.0	U	UJ	96.0	U	UJ
Dibenzofuran (µg/kg)	15	58	1.18	UJ	1.18	U	UJ	0.786	U	UJ	0.244	U	UJ	0.234	U	UJ
Hexachlorobutadiene (µg/kg)	3.9	6.2	0.387	J	0.32	NA	J	0.387	J	J	0.244	NA	J	0.234	NA	J
N-Nitrosodiphenylamine (µg/kg)	11	11	1.10	UJ	0.34	U	UJ	1.10	U	UJ	0.260	U	UJ	0.250	U	UJ

[1] Summed values calculated according to DMMP clarification (van der Elst, 2015)
[2] Total LMW PAH value does not include 2-methylnaphthalene
[3] Total Benzofluoranthenes are based on the sum of Benzo(b)fluoranthene and Benzo(k)fluoranthene.

Figure 1. Project Overview Map

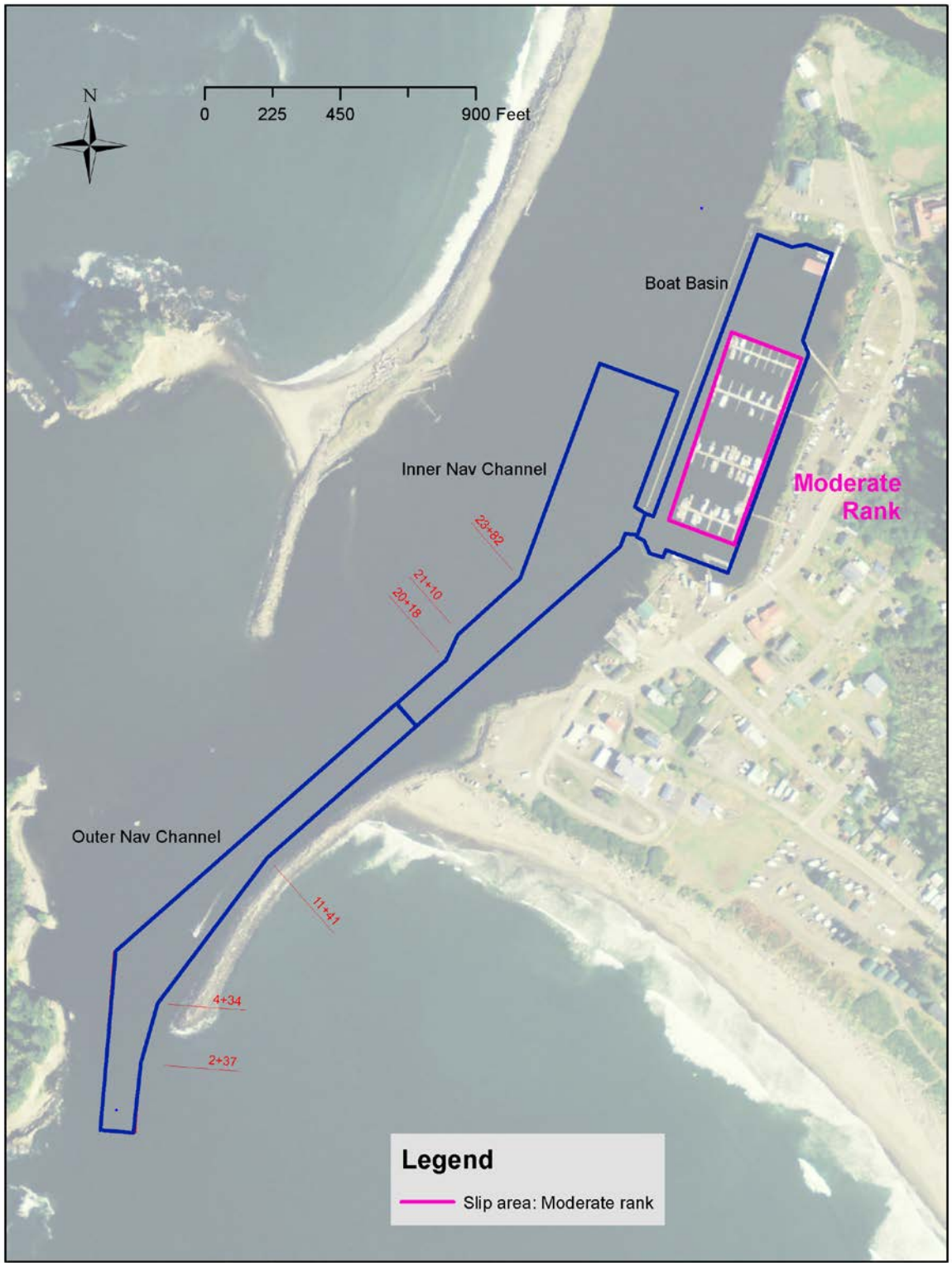
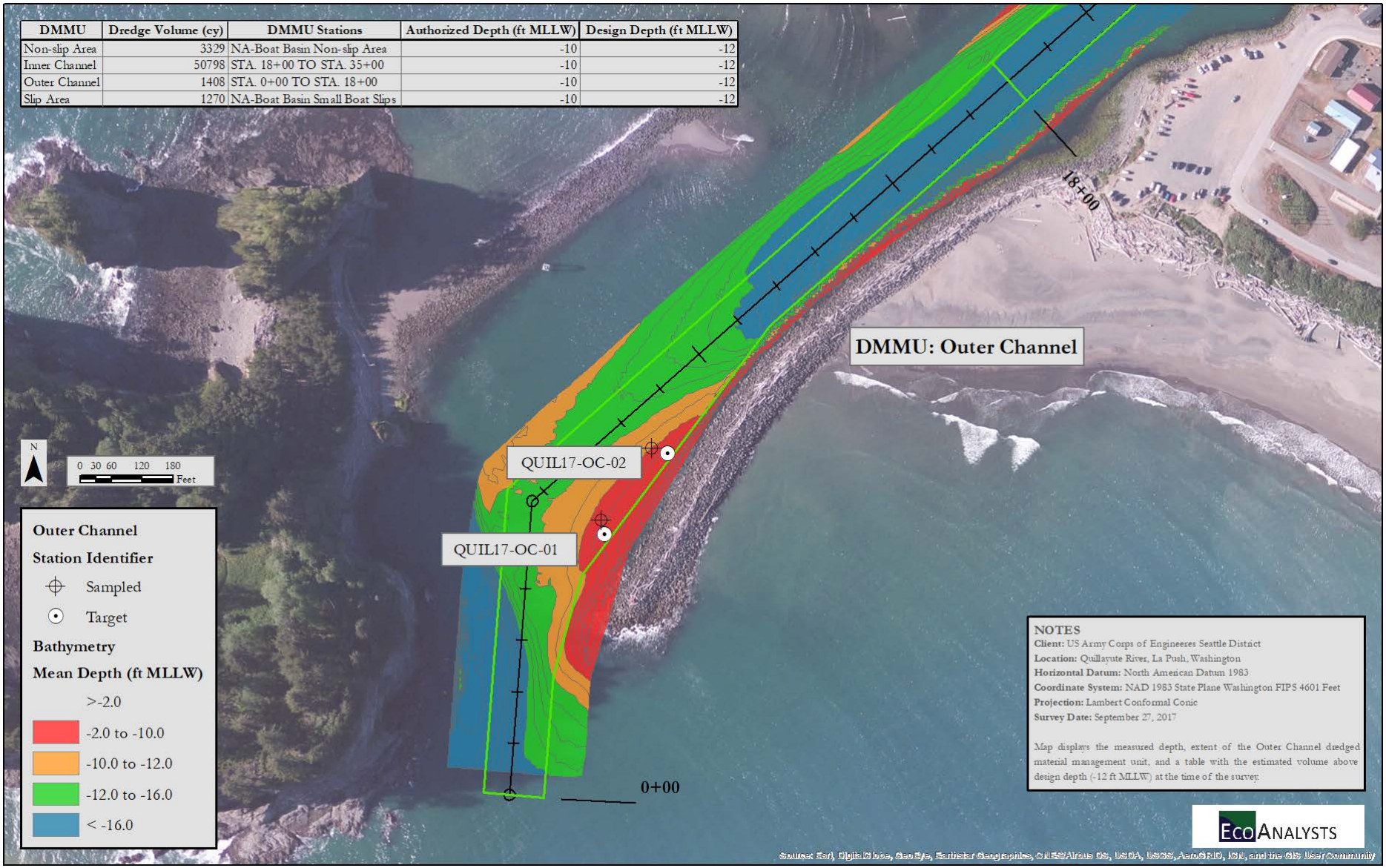
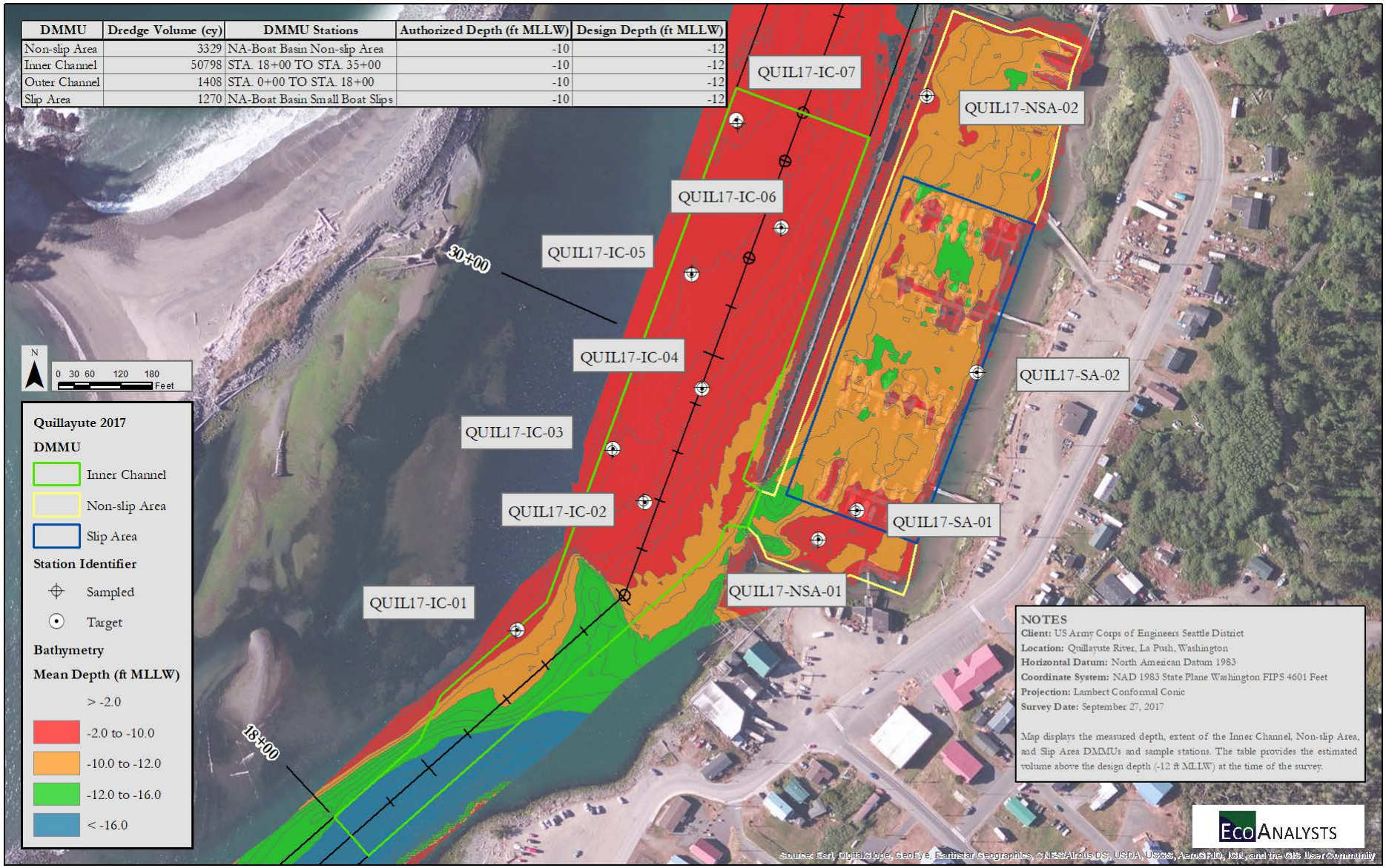


Figure 2. Target and actual sampling locations for the Outer Channel DMMU.



DMMU	Dredge Volume (cy)	DMMU Stations	Authorized Depth (ft MLLW)	Design Depth (ft MLLW)
Non-slip Area	3329	NA-Boat Basin Non-slip Area	-10	-12
Inner Channel	50798	STA. 18+00 TO STA. 35+00	-10	-12
Outer Channel	1408	STA. 0+00 TO STA. 18+00	-10	-12
Slip Area	1270	NA-Boat Basin Small Boat Slips	-10	-12

Figure 3. Target and actual sampling location for the Inner Channel, Non-slip Area, and Slip Area DMMUs.



DMMU	Dredge Volume (cy)	DMMU Stations	Authorized Depth (ft MLLW)	Design Depth (ft MLLW)
Non-slip Area	3329	NA-Boat Basin Non-slip Area	-10	-12
Inner Channel	50798	STA. 18+00 TO STA. 35+00	-10	-12
Outer Channel	1408	STA. 0+00 TO STA. 18+00	-10	-12
Slip Area	1270	NA-Boat Basin Small Boat Slips	-10	-12