Prepared by:
Dredged Material Management Office
Seattle District, US Army Corps of Engineers

Memorandum for Record May 26, 2026

Subject: Suitability Determination Memorandum for Boyer Towing Maintenance Dredging, Seattle, Washington (NWS-2023-554).

Introduction

This suitability determination memorandum (SDM) documents the consensus regarding the suitability of the proposed dredged material as determined by the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, and Washington Departments of Ecology and Natural Resources).

Project Description

Boyer Towing, Inc. (Boyer), is located along the Duwamish River in Seattle, Washington (Figure 1-1). The property is located within the Early Action Area 2 of the EPA designated Comprehensive Environmental Response, Compensation, and Liability Act Site (CERCLA; Superfund). The property is used for marine cargo and terminal services for ocean-rated tugboats and barges. Maintenance dredging last occurred in 2010 and previously in 2000. The proposed dredging in the barge terminal would target a depth of -10 feet (ft) mean low lower water (MLLW), with an additional 1-foot of overdredge (-11 ft MLLW). The sampling design also included a Z and Z2-sample to facilitate antidegradation evaluation that represented material from 11 to 14 ft MLLW).

Project Summary

Waterbody	Lower Duwamish Waterway
Water classification	Marine
Project rank	High
Total proposed dredging volume (cy)	3,500
Target proposed dredging depth	-10 ft MLLW
Max. proposed dredging depth (includes 1-ft overdepth allowance)	-11 ft MLLW
Proposed disposal location(s)	Elliott Bay
Dredged Material Management Units (DMMUs): No. of stations	2 DMMUs: 1 core per DMMU
EIM Study ID	LDWBT24
USACE Regulatory Number	NWS-2023-554
Sampling and Analysis Plan (SAP) Approval Date	October 15, 2024 (MFA, 2024)
SAP Addendum Approval Date	June 18, 2025 (MFA, 2025)
Sampling Dates	November 21, 2024; July 21, 2025
Testing Parameters	DMMP Marine COCs
Biological Testing	Bioaccumulation
Sediment Characterization Report Approval Date	May 26, 2026 (MFA, 2026)
Suitability Outcome	All material is suitable for unconfined aquatic placement
Recency Expiration Date (High = 3 years)	November 21, 2027
Antidegradation Assessment	In compliance

Sampling and Analysis Description

Sediment sampling for chemical analysis was conducted at Boyer Towing on November 21, 2024, via vibracores. Supplemental grab sampling for bioaccumulation testing was conducted on July 21, 2025. Both sampling efforts were aboard a research vessel operated by Research Support Services. Vertical positioning was measured via the nearest tidal gauge (NOAA Station #9447130; Seattle, Washington) and mudline elevation at each sampling location was measured using a lead line. Figure 2-1 shows the sediment sampling locations. Table 2-1 and 2-1 lists sample coordinates and core recoveries.

When possible, deviations from the approved Sampling and Analysis Plan (MFA, 2024; MFA, 2025) were coordinated with the DMMO. Deviations can be found in the Sediment Characterization Report (MFA, 2026). Multiple core attempts were taken for both DMMUs to meet the percent recovery criteria. Material representative of the dredge prism was obtained from two stations to form DMMU01 and DMMU02. In DMMU01, cores #3 and #4 were co-located to obtain enough material for an archive bioassay sample. In DMMU02, cores #2 and #4 were also co-located for a bioassay archive. With DMMO approval, the bioassay archives were not analyzed.

Samples were submitted to Apex Laboratories in Tigard, Oregon for chemical and physical analysis. Apex subcontracted AmTest Laboratories of Kirkland, Washington for sulfide analysis; Eurofins CalScience of Tustin, California for tributyltins; and Cape Fear Analytical of Wilmington, North Carolina for dioxin/furan congeners.

Bioaccumulation testing was conducted by EcoAnalysts of Port Gamble, Washington. Two grab samples, one from each DMMU, were composited to represent the entire dredge prism. Five replicates for each species (*Macoma nasuta* and *Alitta virens*) were conducted on the composite, reference sediment from FoxRef1, and three pre-test replicates for each species. The pretest and reference tissues were not submitted for chemical analysis under DMMP approval. All tissue replicates were analyzed for lipids and dioxin/furan congeners. Table 4-1 displays the test survival summary and Table 4-2 summarizes the tissue chemistry.

Data Validation

Maul Foster & Alongi, Inc. (MFA), conducted an EPA Stage 2B quality assurance/quality control validation of all sediment chemistry and tissue data. The validation processes resulted in some additional J qualified data (estimated values) and U qualified data (analytes associated with method blank detections) beyond those assigned by the lab, based on specified protocol or technical advisory. In sample DMMU02-SSED-0-2, benzoic acid was rejected in compliance with the National Functional Guidelines (EPA, 2020) due to the matrix spike being grossly outside of QA limits. Beyond the one rejected result, all remaining reported data are usable as qualified.

Analytical Testing Results

Table 3-1 summarizes the analytical results for the DMMU composite alongside the DMMP marine guidelines (DMMP, 2025). Due to the location of the site, the cores were also compared to the EPA Record of Decision (ROD) Remedial Action Levels (RALs) in Table 3-2. Grain size indicated the DMMUs were sandy silt in the upper two feet and transitioning to silty sand with depth (Table 3-1). The average Total Organic Carbon for DMMU01 was 2.1% and DMMU02 was 2.7%.

Exceedances of the DMMP screening level (SL) occurred for two analytes in the DMMUs, and for one analyte in comparison to the RAL. All exceedances are described below. No exceedances occurred in the Z-samples.

Metals. Zinc was above the SL in the subsurface (9.5 - 11.5 ft MLLW) of DMMU01. All other metals were below the SLs and RALs. With DMMP approval, the surface interval (SSED-0-2; 7.5-9.5 ft MLLW) and subsurface (SUBSED-2-4; 9.5 - 11.5 ft MLLW) were averaged, and the value was below the SL (see table below).

Analyte	DMMP SL	DMMU01	
		SSED-0-2	SUBSED-2-4
Zinc (mg/kg dw)	410	166	421
Average Zinc (mg/kg dw)	410	294	

Notes:
Above SL

SVOCs. Screening level and RAL exceedances of benzyl alcohol were detected in the surface interval of both DMMUs. All other analytes were below SLs and RALs.

Analyte	DMMP SL	EPA RAL	DMMU01		DMMU02	
			SSED-0-2	SUBSED-2-4	SSED-0-2	SUBSED-2-4
Benzyl Acid (µg/kg dw)	57	57	71.8	23.2 J	90.1	41.2 J
Average Benzyl Acid (µg/kg dw)	57	57	47.5		65.65	

Notes:
Above SL and RAL

Dioxins/furans. Dioxin/furan congeners were evaluated due to being a chemical of concern for the project area. Dioxin data is conveyed as Toxicity Equivalence (TEQ) values which are calculated by multiplying the Toxicity Equivalency Factor (TEF) of each congener by the concentration of the congener and summing the results. When non-detected (ND) values are encountered, the TEQ is calculated by using either half of the congener detection limit (DL) (ND=1/2 DL) or zero (ND=0).

The dioxin TEQ (ND=1/2 DL) values for DMMU01 and 02 were 8.32 and 9.06 ng/kg, respectively. Both DMMUs exceeded the screening level of 4 ng/kg but were below the bioaccumulation trigger of 10 ng/kg TEQ, see Table 3-1. Volume-weighted averaging (VWA) for dioxins is allowed for DMMUs with dioxin concentrations between 4 and 10 ng/kg TEQ as long as the final VWA concentration meets the disposal site management objective of 4 ng/kg TEQ. The VWA of DMMU01 and 02 was 8.69 ng/kg TEQ (ND = 1/2 DL). Due to the VWA exceeding the criteria of 4 ng/kg TEQ, a VWA approach was not applicable and bioaccumulation was warranted.

Butyltins. Butyltins (mono, di, tri, and tetra-) analysis was required by the DMMP for this project. Both DMMUs were non-detect.

Biological Results

Sediments for bioassays were collected during the initial sampling effort and archived. MFA proposed the bioassays should not be triggered based on the zinc average for the DMMU being below the SL and referenced the DMMP revised evaluation guidance for agencies to use best professional judgement that benzyl alcohol is not a significant cause of concern (DMMP, 2016). With DMMP approval and EPA review due to the RAL exceedance, bioassays were not triggered. Due to dioxin/furans not meeting the disposal site management objective, a second sampling effort occurred in July 2025 to collect sediment for bioaccumulation.

Bioaccumulation Testing

MFA used a weight-of-evidence approach, outlined in the DMMP User Manual (DMMP, 2025) to evaluate the bioaccumulation study tissue data. The factors included:

- Evaluation of Boyer tissue concentrations relative to the Practical Quantitation Limits (PQLs).
- Evaluation of the impact of non-detects on Boyer tissue total TEQ values.
- Comparison of Boyer tissue total TEQ values to those of comparable species found in the vicinity of the Elliott Bay DMMP Disposal Site.

Evaluation of Tissue Concentrations Relative to PQLs

The practical quantitation limit (PQL) is the lowest concentration of an analyte that can be reliably measured within specified limits of precision and accuracy under routine laboratory operating conditions. Concentrations reported above the PQL can be considered with a high degree of confidence, while concentrations below the PQL are typically considered estimated values. Therefore, PQLs are an important consideration for evaluating data when concentrations are low.

The significance of laboratory-reported estimated dioxin/furan congener concentrations can be evaluated by comparing TEQs measured in tissues to the sum TEF-weighted PQLs. The tissue PQL for dioxin/furans as a sum of TEQ is defined by Ecology as 1 ng/kg ww TEQ (Ecology, 2021). For both *M. nasuta* and *A. virens*, the mean total TEQ as well as the total TEQs for the five replicates analyzed were less than the Ecology PQL (Table 4-2).

Influence of Non-Detects on the Total TEQ

The total TEQ in the tissues were dominated by the summation of non-detected dioxin/furan congeners. A few congeners were flagged as non-detect with an estimated detection limit (EDL), with the remainder of the congeners being non-detect for both *M. nasuta* and *A. virens.* For *M. nasuta* tissues, an average of 87% of the congeners were not detected in the composite DMMU samples, and an average of 95.3% of the congeners were not detected for *A. virens* tissues.

The influence of the non-detected dioxin congeners on TEQs was evaluated based on their toxic equivalency factor (TEF)-weighted concentrations. Non-detected congeners contributed 82.3% to 88.2% of the total TEQ for M. nasuta in DMMU C2 when ND=1/2*EDL, with an average contribution of 87%. The combined contribution of non-detected and estimated non-detect was 100% of the total TEQ for *M. nasuta* tissues when the estimated fraction of the Total TEQ was calculated using one-half the reported result.

For *A. virens*, non-detected congeners contributed approximately 94.1% to 100% of the total TEQ when ND=1/2*EDL and an average of 95.3%. The combined contribution of non-detected and estimated non-detect was 100%.

Tissue Concentrations of Comparable Species in Elliott Bay

Comparing Boyer tissue total TEQ values to those measured in comparable species at the Elliott Bay DMMP disposal site provides additional evidence to evaluate the potential for Boyer material to cause unacceptable adverse ecological impacts at the site. In 2007, the DMMP conducted a special D/F study at the unconfined open water dredged material disposal sites in Puget Sound (SAIC 2008). Organisms were collected in the vicinity of the DMMP sites and analyzed for dioxin congeners. At the Elliott Bay DMMP site, three genera of polychaetes (*Glyceridae*, *Maldanidae*, and *Travisia*) were collected from twelve offsite stations in the vicinity of the disposal site boundary (perimeter, transect, and benchmark stations).

The table below presents a comparison of the Boyer dioxin/furan tissue total TEQs (ND=1/2*EDL) to tissue total TEQs from species found in the vicinity of the Elliott Bay disposal site. Observed dioxin/furan TEQ values in Boyer test organisms are generally comparable to those observed in polychaete tissues collected from the vicinity of the Elliott Bay DMMP disposal site.

Organism Genus	Location	Dioxin/Furan TEQ Concentration (ng/kg ww)
Glyciderae	Elliott Bay DMMP Disposal Site [Vicinity]	0.307 to 2.51
Maldanidae		0.417 to 0.525
Travisia		0.662
Alitta virens	Boyer Towing, Inc.	0.36 U to 0.97 U (average 0.61 U)
Macoma nasuta		0.24 U to 0.49 U (average 0.41 U)

Notes:
U = Non-detect

DMMP Determinations

Suitability Determination

The bioaccumulation testing data can be summarized as follows. Dredged material samples from Boyer resulted in bioaccumulated concentrations being very low, with the calculated TEQs being completely dominated by non-detects and non-detect estimated detection levels. The total TEQs were also below the Ecology tissue PQL. Lastly, the test results were within the range of tissue concentrations found in the vicinity of the Elliott Bay disposal site (perimeter, transect, and benchmark stations) during the 2007 testing. The DMMP agencies have concluded that all 3,500 cubic yards proposed for dredging from Boyer Towing are suitable for open-water disposal at the Elliott Bay non-dispersive site.

Antidegradation Determination

The sediment to be exposed by dredging must meet the State's Antidegradation Standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008). The Z-layer samples resulted in an average dioxin/furan congener TEQ of 9.5 ng/kg. This is a similar concentration to the surface material. The average of the leave surface and area weighted average is below a TEQ of 10 ng/kg. This project

complies with the State of Washington Antidegradation Standard, and it is believed the new exposed surface would not be contaminated relative to the overlying materials.

Suitability for Beneficial Use

The DMMP agencies do not determine the suitability of material for beneficial use projects. It is up to the project proponents, the site receiving the material, and other interested stakeholders including applicable resource agencies and Tribes to determine the physical and chemical suitability of dredged materials for a beneficial use site.

Aquatic Invasive Species (AIS)

Per RCW 77.135.020, the Washington Department of Fish and Wildlife (WDFW) is the lead agency for managing invasive species statewide. The DMMP defers to WDFW's expertise for decisions regarding AIS management and transport.

Debris Management

The DMMP agencies implemented a debris management requirement following the 2015 SMARM to prevent the disposal of debris (natural or anthropogenic) greater than 12 inches in any dimension at open-water disposal sites in Puget Sound (DMMP, 2015). Debris screens shall be used for this project unless it can be demonstrated that debris is unlikely to be present or that the debris is large woody debris that can be easily observed and removed by other means during dredging. Debris screen usage, or an alternative debris management plan, must be included in the dredging quality assurance plan.

Notes and Clarifications

The decisions documented in this memorandum do **not** constitute final agency approval of the project. During the public comment period that follows a public notice, 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. EPA CERCLA remedial project managers participate in a CERCLA coordination review process that is distinct from the DMMP's determination of open-water disposal suitability. Through this process, EPA may request special permit conditions.

A pre-dredge meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to dredging. A dredging quality control plan must be developed and submitted to the USACE Seattle District's Regulatory Branch and Ecology. Refer to the USACE permit and Ecology 401 certification for project-specific submittal requirements and timelines.

Hydraulically-dredged material may not be placed at non-dispersive sites.

Projects proposing to use one of the DMMP open-water disposal sites must submit their application for a Site Use Authorization (SUA) to the Washington State Department of Natural Resources (DNR) at least 4 weeks prior to dredging. Applications submitted less than 4 weeks prior to dredging may be subject to delays.

References

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

Dredged Material Management Program, 2015. *Debris Screening Requirements for Dredged Material Disposed at Open-Water Sites*. A clarification paper prepared by Erika Hoffman (EPA), Celia Barton (Washington State DNR), and David Fox (USACE) for the DMMP agencies, October 2015.

Dredged Material Management Program, 2016. *Revised Evaluation Guidelines for Benzyl Alcohol in Marine Sediments*. A clarification paper prepared by Heather Whitney Fourie (USACE) and David Fox (USACE) for the DMMP agencies. June 2016.

Dredged Material Management Program, 2025. *Dredged Material Evaluation and Disposal Procedures User Manual*. Dredged Material Management Office, U.S. Army Corps of Engineers, Seattle District.

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

EPA, 2020. National Functional Guidelines for Organic Superfund Methods Data Review.

Maul Foster & Alongi, Inc., 2024. *Sediment Sampling and Analysis Plan, Boyer Towing Maintenance Dredging, Seattle, Washington.* Prepared for 48 North Solutions, Inc., October 2024.

Maul Foster & Alongi, Inc., 2025. *Addendum to Sediment Sampling and Analysis Plan, Boyer Towing Maintenance Dredging, Seattle, Washington.* Prepared for Environmental Science Associates, June 2025.

Maul Foster & Alongi, Inc., 2026. *Sediment Characterization Report, Boyer Towing Maintenance Dredging, Seattle, Washington*. Prepared for Environmental Science Associates, January 2026. Revised April 2026.

Agency Signatures

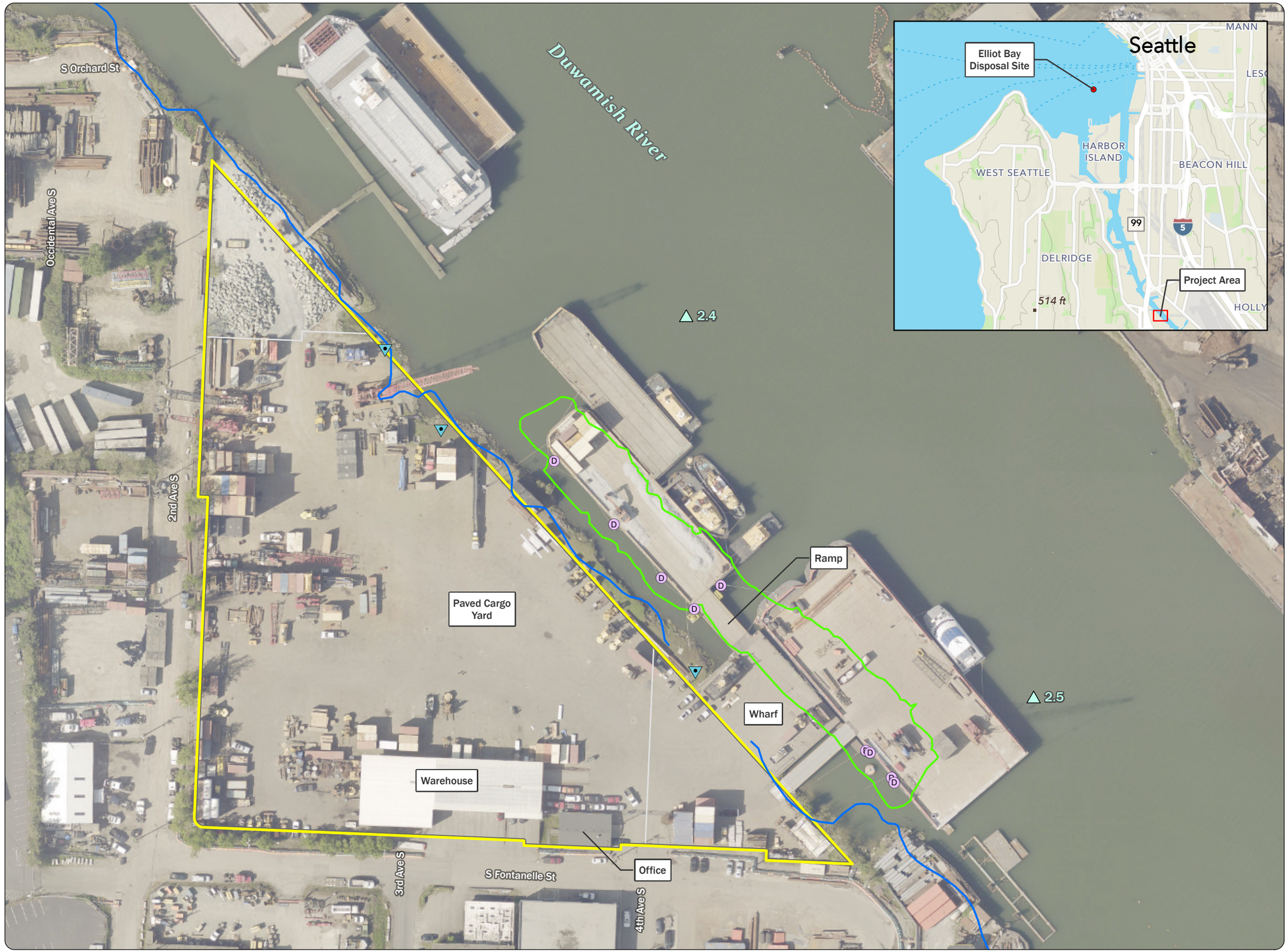
The signed copy is on file in the Dredged Material Management Office, Seattle District U.S. Army Corps of Engineers

_____	_____
Date	Sarah Benson – U.S. Army Corps of Engineers, Seattle District
_____	_____
Date	Whitney Conard, PhD. – U.S. Environmental Protection Agency, Region 10
_____	_____
Date	Laura Inouye, PhD. – Washington State Department of Ecology
_____	_____
Date	Shannon Soto – Washington State Department of Natural Resources

Copies Furnished:
DMMP agencies
Alex Sutton, USACE Regulatory
Celeste Barnes-Crouse, Environmental Science Associates
Phil Wiescher, Maul Foster & Alongi
DMMO File

Figure 1-1
Property Location and Features

Boyer Towing Maintenance Dredging
Seattle, Washington



Legend

- Outfall
- Dolphin Piling
- River Mile
- Approximate Dredging Area
- Mean High Water Line
- Property Boundary
- Tax Lot

0 100
Feet

Data Sources
Aerial photograph and tax lot data obtained from King County.

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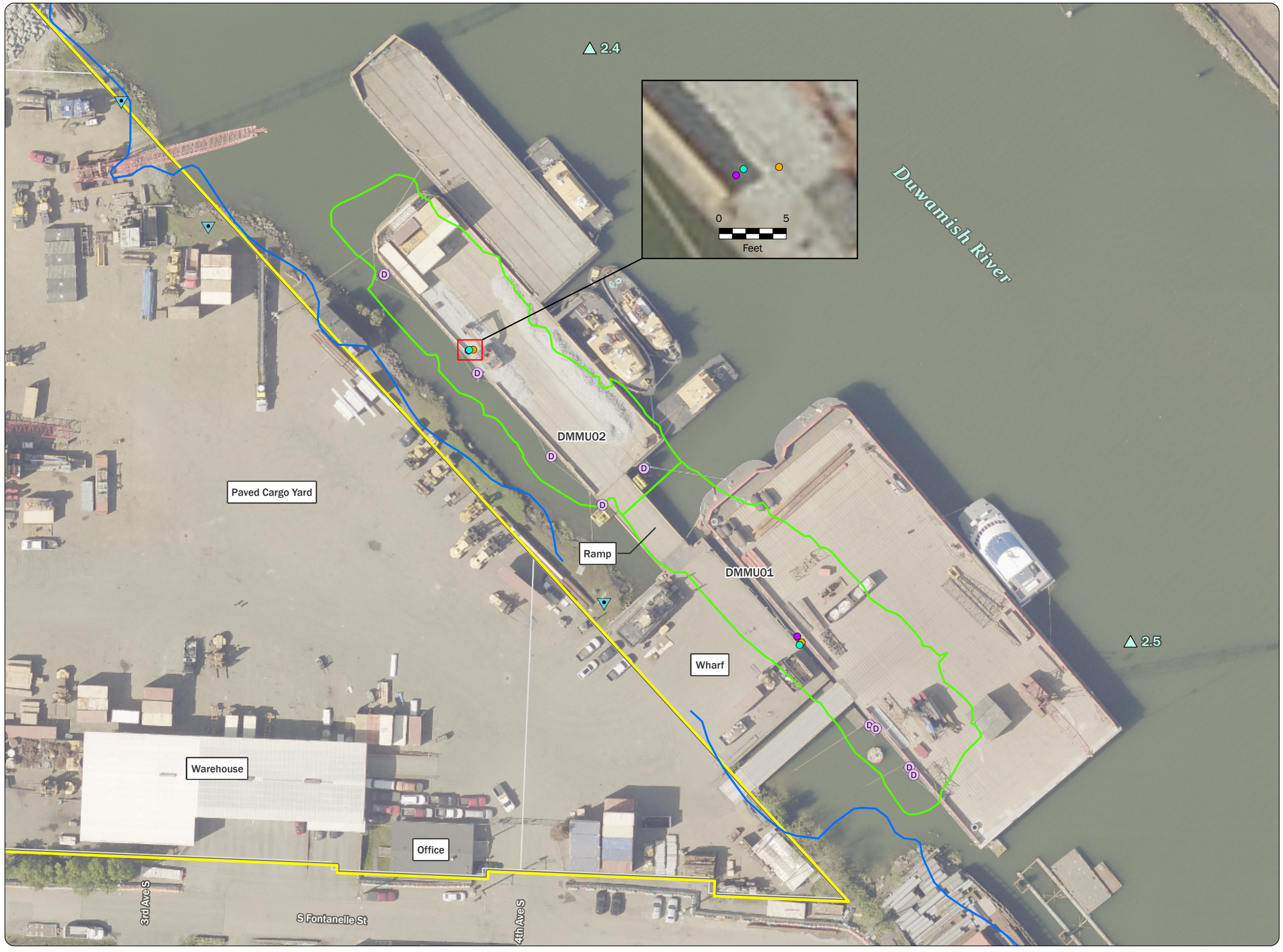
Path: X:\0_MFA_Projects\M2765\01\002\Pro\M2765_01_002_001_annx\Fig 1-1 Property Location and Features
Print Date: 8/14/2024
Reviewed By: tbellows
Produced By: sturner
Project: M2765.01.002

Figure 2-1
[Final] DMMUs and Sample Locations

Boyer Towing Maintenance Dredging
Seattle, Washington



Legend

- Bioaccumulation Grab (July 2025)
- Actual Boring (November 2024)
- Proposed Boring
- Outfall
- Dophin Piling
- River Mile
- DMMU
- Mean High Water Line
- Property Boundary
- Tax Lot

Note
DMMU = dredged material management unit.

0 50
Feet

Data Sources
Aerial photograph and tax lot data obtained from King County.

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Print Date: 4/28/2026
Reviewed By: tbellows
Produced By: sturner
Project: M2765.01.002

Table 2-1

DMMU01 Sediment Core Field Sheet
Boyer Towing Maintenance Dredging
Seattle, Washington

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Project/Location Information			
Vessel Name	Carolyn Dow	Location ID	DMMU01
Weather Conditions	Raining, 45 °F	Sampling Date	11/21/2024
Depth Sounding Method	Lead line	MFA Personnel	F. Bellows, C. Wise
River/Tide Gage Source	NOAA 9447130	**Subcontractor Personnel**	
Gage Height (ft)	10.6	Captain	Eric Parker
Gage Time	13:03	Deckhand	River, Julian
Sampling Equipment	Vibracore	**Proposed Coordinates (WGS84)**	
Core Tube Length	10 ft	Latitude	47.537233
Target Drive Depth	-14 MLLW	Longitude	-122.32838

Attempt Summary

Attempt #	Time	Gage Height (ft)	Radius from Target (ft)	Actual Coordinates (WGS84)		Measurements (to nearest 0.1 ft):				Avg. % Recovery (=length/ total)	Bottom Conditions	Core Accepted (Y/N)
				Latitude	Longitude	Depth of Water (ft)	Mudline Elevation (ft MLLW)	Recovery Length (ft)	Total Drive Length (ft)			
1	13:03	10.31	5.90	47.537223306	-122.328360722	18.1	-7.79	5.25	8.0	65.6	Coarse	N
2	13:32	10.04	5.90	47.537238719	-122.328357768	17.5	-7.46	NA	0.6	NA	NA	N
3	13:56	9.36	6.60	47.537248370	-122.328365892	16.9	-7.54	4.71	7.0	67.3	Woody	Y
4	14:26	8.75	1.90	47.537237993	-122.328377661	16.4	-7.65	5.83	7.0	83.3	Sandy	Y
5	15:01	8.15	7.20	47.537232520	-122.328350809	15.8	-7.65	NA	7.1	NA	NA	N

Sample Information

Sample ID	Sample Time	Sample Layer/Type	No. of Containers
DMMU01-SSED-0-2	16:30	Surface	6
DMMU01-SUBSED-2-4	16:45	Subsurface	6
DMMU01-Z1-4-5	17:00	Upper leave layer	6
DMMU01-Z2-5-5.8	17:05	Lower leave layer	6
DMMU01-BIO	17:15	Bioassay	1

Additional Comments

Core attempt #2 hit obstruction around 1.5 ft below mudline, did not complete attempt and discarded.
Core attempt #3 hit wood waste around 7.0 ft below mudline. Completed attempt to 7.0 ft.
Core attempt #5 had poor recovery (estimated <50%), discarded.
Core processing and sampling completed on shore by C. Wise.
With USACE approval, core attempt #4 used for analytical fractions; core attempt #3 used to supplement bioassay fraction.

Table 2-2

DMMU02 Sediment Core Field Sheet
Boyer Towing Maintenance Dredging
Seattle, Washington

MAUL FOSTER ALONGI

Project/Location Information			
Vessel Name	Carolyn Dow	Location ID	DMMU02
Weather Conditions	Partly cloudy, 43 °F	Sampling Date	11/21/2024
Depth Sounding Method	Lead line	MFA Personnel	F. Bellows, C. Wise
River/Tide Gage Source	NOAA 9447130	**Subcontractor Personnel**	
Gage Height (ft)	12.79	Captain	Eric Parker
Gage Time	9:35	Deckhand	River, Julian
Sampling Equipment	Vibracore	**Proposed Coordinates (WGS84)**	
Core Tube Length	10 ft	Latitude	47.537752
Target Drive Depth	-14 MLLW	Longitude	-122.329275

Attempt Summary

Attempt #	Time	Gage Height (ft)	Radius from Target (ft)	Actual Coordinates (WGS84)		Measurements (to nearest 0.1 ft):				Avg. % Recovery (=length/ total)	Bottom Conditions	Core Accepted (Y/N)
				Latitude	Longitude	Depth of Water (ft)	Mudline Elevation (ft MLLW)	Recovery Length (ft)	Total Drive Length (ft)			
1	9:37	12.79	4.10	47.537758986	-122.329262051	19.8	-7.01	4.83	8.1	59.6	Sandy	N
2	10:17	12.87	1.90	47.537748176	-122.329280434	19.8	-6.93	5.08	7.1	71.5	Sandy	Y
3	10:49	12.70	5.60	47.537740542	-122.329289986	19.3	-6.60	NA	7.0	NA	Sandy	N
4	11:10	12.48	2.60	47.537744959	-122.329273191	19.2	-6.72	5.50	7.0	78.6	Sandy	Y

Sample Information

Sample ID	Sample Time	Sample Layer/Type	No. of Containers
DMMU02-SSED-0-2	13:40	Surface	6
DMMU02-SUBSED-2-4	14:15	Subsurface	6
DMMU02-Z1-4-5	15:00	Upper leave layer	6
DMMU02-Z2-5-5.5	15:15	Lower leave layer	6
DMMU02-BIO	14:40	Bioassay	1

Additional Comments

Core attempt #3 had poor recovery (estimated <50%), discarded.
Core processing and sampling completed on shore by C. Wise.
With USACE approval, core attempt #4 used for analytical fractions; core attempt #2 used to supplement bioassay fraction.

Table 3-1
Sediment Analytical Results Compared to DMMP Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	DMMP Marine Guidelines[1]			DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:				DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:				11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	07/21/2025
Collection Depth (feet bml):	SL	BT	ML	0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):				-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
Conventional Parameters										
Ammonia (as nitrogen) (mg/kg)	NV	NV	NV	56.3	58.3	40.0	28.9 J	45.1	21.7	--
Sulfide (mg/kg)	NV	NV	NV	717	932	474	718	576	307	--
Total organic carbon (%)	NV	NV	NV	2.4	1.8	1.4	2.9	2.5	1.1	2.9
Total solids (%)	NV	NV	NV	60.5	68.5	72.6	53.8	62.2	66.6	48.9
Total volatile solids (%)	NV	NV	NV	6.29	4.60	3.09	7.19	5.32	4.25	--
Grain Size (%)										
Percent retained 4,750-micron sieve (#4)	NV	NV	NV	3.02	0.91	2.26	0.71	0.33	0.73	0.51
Percent retained 2,000-micron sieve (#10)	NV	NV	NV	1.26	1.07	1.17	0.23	0.23	0.36	0.93
Percent retained 850-micron sieve (#20)	NV	NV	NV	1.93	1.42	3.55	0.46	0.69	1.41	1.59
Percent retained 425-micron sieve (#40)	NV	NV	NV	5.64	6.12	18.7	2.77	6.48	13.2	2.80
Percent retained 250-micron sieve (#60)	NV	NV	NV	7.73	11.6	22.1	4.41	9.82	19.8	4.54
Percent retained 150-micron sieve (#100)	NV	NV	NV	6.05	10.4	11.9	3.68	5.97	9.11	4.61
Percent retained 106-micron sieve (#140)	NV	NV	NV	4.98	6.69	4.74	4.91	4.64	5.40	5.43
Percent retained 63-micron sieve (#230)	NV	NV	NV	3.56	3.44	2.01	4.12	3.79	3.37	4.80
Percent retained 75-micron sieve (#200)	NV	NV	NV	5.83	6.32	3.80	6.78	5.43	5.88	7.09
Gravel	NV	NV	NV	4.29	1.98	3.43	0.94	0.56	1.09	1.45
Sand	NV	NV	NV	35.7	46.0	66.8	27.1	36.8	58.2	30.9
Silt	NV	NV	NV	48.1	43.8	24.6	60.2	51.7	33.7	58.3
Clay	NV	NV	NV	11.9	8.20	5.20	11.7	10.9	7.10	9.34
Total Metals (mg/kg)										
Antimony	150	NV	200	0.441 J	0.420 J	0.394 J	0.456 U	0.534 J	0.599 J	--
Arsenic	57	507.1	700	11.0	9.59	6.99	12.2	10.1	8.83	--
Cadmium	5.1	NV	14	0.277	0.231	0.149	0.333	0.293	0.244	--
Chromium	260	NV	NV	23.4	26.6	14.6	26.1	22.9	19.5	--
Copper	390	NV	1,300	53.5	45.9	29.9	60.7	50.2	45.9	--
Lead	450	975	1,200	22.1	19.9	19.4	25.1	23.4	25.8	--
Mercury	0.41	1.5	2.3	0.115	0.0710	0.0642	0.382 J	0.116	0.0748	--
Selenium	NV	3	NV	0.420 U	0.387 U	0.361 U	0.456 U	0.400 U	0.374 U	--
Silver	6.1	NV	8.4	0.166 J	0.0994 J	0.0891 J	0.196	0.167	0.158	--
Zinc	410	NV	3,800	166	421	71.9	125	106	94.8	--
Organotins (ug/kg)										
Tributyltin	NV	73	NV	2.3 U	1.9 U	1.9 U	2.8 U	2.2 U	2.1 U	--
PAHs (ug/kg)										
2-Methylnaphthalene	670	NV	1,900	8.76 U	30.7	15.3	9.92 U	8.34 UJ	12.0 J	--
Acenaphthene	500	NV	2,000	5.78 J	37.0	29.1	4.94 U	10.8 J	71.2	--
Acenaphthylene	560	NV	1,300	4.36 U	9.83	14.2	4.94 U	4.15 UJ	4.10 J	--
Anthracene	960	NV	13,000	14.6	62.9	50.0	10.0	43.7 J	130	--
Benzo(a)anthracene	1,300	NV	5,100	39.8	151	175	41.7	116 J	320	--
Benzo(a)pyrene	1,600	NV	3,600	51.8	168	176	49.8	137 J	400	--
Benzo(b,j)fluoranthene	NV	NV	NV	78.0	310	320	74.9	178 J	483	--
Benzo(ghi)perylene	670	NV	3,200	26.9	79.8	62.7	26.1	67.4 J	210	--
Benzo(k)fluoranthene	NV	NV	NV	28.8 J	94.8 J	97.3 J	29.4 J	61.8 J	165 J	--
Chrysene	1,400	NV	21,000	53.4	244	255	59.4	132 J	387	--
Dibenzo(a,h)anthracene	230	NV	1,900	6.37 J	21.6	21.3	6.02 J	17.8 J	53.8	--
Fluoranthene	1,700	4,600	30,000	94.9	373	475	59.3	284 J	931	--

Table 3-1
Sediment Analytical Results Compared to DMMP Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	DMMP Marine Guidelines[1]			DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:				DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:				11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	07/21/2025
Collection Depth (feet bml):	SL	BT	ML	0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):				-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
PAHs cont. (ug/kg)										
Fluorene	540	NV	3,600	7.42 J	36.1	28.3	4.94 U	16.1 J	80.1	--
Indeno(1,2,3-cd)pyrene	600	NV	4,400	24.3	81.2	72.1	24.6	68.7 J	206	--
Naphthalene	2,100	NV	2,400	10.4 J	114	31.0	9.92 U	8.34 UJ	30.6	--
Phenanthrene	1,500	NV	21,000	37.1	185	105	28.6	160 J	712	--
Pyrene	2,600	11,980	16,000	118	432	671	67.3	244 J	789	--
Total benzo(b,j,k)fluoranthenes[a]	3,200	NV	9,900	107 JT	405 JT	417 JT	104 JT	240 JT	648 JT	--
Total LPAH[b]	NV	5,200	NV	75.3 JT	445 T	258 T	38.6 T	231 JT	1,030 JT	--
Total HPAH[c]	12,000	NV	69,000	522 JT	1,960 JT	2,330 JT	439 JT	1,310 JT	3,940 JT	--
Chlorinated Hydrocarbons (ug/kg)										
1,2,4-Trichlorobenzene	31	NV	64	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
1,2-Dichlorobenzene	35	NV	110	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
1,4-Dichlorobenzene	110	NV	120	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
Hexachlorobenzene	22	168	230	4.36 U	3.67 U	3.49 U	4.94 U	4.15 UJ	3.89 U	--
Phthalates (ug/kg)										
Bis(2-ethylhexyl) phthalate	1,300	NV	8,300	65.6 U	55.1 U	52.4 U	74.3 U	62.4 UJ	58.5 U	--
Butylbenzyl phthalate	63	NV	970	21.9 U	18.4 U	17.9 J	24.8 U	20.8 UJ	24.2 J	--
Diethyl phthalate	200	NV	1,200	21.9 U	18.4 U	17.5 U	24.8 U	20.8 UJ	19.5 U	--
Dimethyl phthalate	71	NV	1,400	21.9 U	18.4 U	17.5 U	24.8 U	20.8 UJ	19.5 U	--
Di-n-butyl phthalate	1,400	NV	5,100	21.9 U	18.4 U	17.5 U	24.8 U	20.8 UJ	19.5 U	--
Di-n-octyl phthalate	6,200	NV	6,200	36.4 U	29.5 U	34.9 U	39.7 U	33.4 UJ	31.3 U	--
Phenols (ug/kg)										
2,4-Dimethylphenol	29	NV	210	21.9 U	18.4 U	17.5 U	24.8 U	20.8 U	19.5 U	--
2-Methylphenol	63	NV	77	10.9 U	9.18 U	8.73 U	12.4 U	10.4 U	9.74 U	--
3- & 4-Methylphenol (m,p-Cresol)[d]	670	NV	3,600	10.9 U	9.18 U	8.73 U	12.4 U	10.4 U	9.74 U	--
Pentachlorophenol	400	504	690	43.6 U	36.7 U	34.9 U	49.4 U	41.5 U	38.9 U	--
Phenol	420	NV	1,200	55.7 J	44.7 J	53.3 J	17.0 J	44.5 J	34.0 J	--
Miscellaneous Extractables (ug/kg)										
Benzoic acid	650	NV	760	548 U	460 U	438 U	620 R	521 U	489 U	--
Benzyl alcohol	57	NV	870	71.8	23.2 J	41.4	90.1	41.2 J	19.5 U	--
Dibenzofuran	540	NV	1,700	5.75 J	19.9	19.9	4.94 U	5.86 J	43.8	--
Hexachlorobutadiene	11	NV	270	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
N-Nitrosodiphenylamine	28	NV	130	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
Organochlorine Pesticides (ug/kg)										
4,4'-DDD	16	NV	NV	3.51 U	1.28 U	2.46 U	1.59 U	1.40 U	1.26 U	--
4,4'-DDE	9	NV	NV	2.92 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
4,4'-DDT	12	NV	NV	2.92 U	2.56 U	2.46 U	3.18 U	2.81 U	3.01 U	--
Aldrin	9.5	NV	NV	2.92 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
alpha-Chlordane	NV	NV	NV	1.46 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
beta-Chlordane	NV	NV	NV	1.46 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
cis-Nonachlor	NV	NV	NV	1.41 U	1.27 U	2.34 U	1.63 U	2.82 U	1.32 U	--
Dieldrin	1.9	NV	1,700	2.92 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
Heptachlor	1.5	NV	270	3.51 U	1.28 U	1.23 U	3.18 U	1.40 U	1.26 U	--
Oxychlordane	NV	NV	NV	1.41 U	1.27 U	1.17 U	1.63 U	1.41 U	1.32 U	--
trans-Nonachlor	NV	NV	NV	1.41 U	1.27 U	1.17 U	1.63 U	2.82 U	1.32 U	--

Table 3-1
Sediment Analytical Results Compared to DMMP Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	DMMP Marine Guidelines[1]			DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:				DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:				11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	07/21/2025
Collection Depth (feet bml):	SL	BT	ML	0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):				-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
Organochlorine Pesticides cont. (ug/kg)										
Total DDT[e]	NV	50	69	3.51 UT	2.56 UT	2.46 UT	3.18 UT	2.81 UT	3.01 UT	--
Total chlordane[f]	2.8	37	NV	1.46 UT	1.28 UT	2.34 UT	1.63 UT	2.82 UT	1.32 UT	--
PCB Aroclors (ug/kg)										
Aroclor 1016	NV	NV	NV	7.19 U	6.24 U	5.99 U	8.27 U	7.21 U	6.40 U	--
Aroclor 1221	NV	NV	NV	7.19 U	6.24 U	5.99 U	8.27 U	7.21 U	6.40 U	--
Aroclor 1232	NV	NV	NV	7.19 U	6.24 U	5.99 U	8.27 U	7.21 U	6.40 U	--
Aroclor 1242	NV	NV	NV	10.1 J	10.4 J	17.6 J	13.0 J	14.2 J	16.9 J	--
Aroclor 1248	NV	NV	NV	7.19 U	6.24 U	5.99 U	8.27 U	7.21 U	6.40 U	--
Aroclor 1254	NV	NV	NV	26.6 J	23.4 J	49.3 J	34.3 J	38.3 J	42.4 J	--
Aroclor 1260	NV	NV	NV	14.8 J	13.2 J	51.7 J	19.7 J	28.9 J	23.8 J	--
Total PCBs[g]	130	NV	3,100	51.5 JT	47.0 JT	119 JT	67.0 JT	81.4 JT	83.1 JT	--
Total PCBs (mg/kg-OC)[g]	NA	38	NA	2.15 JT	2.61 JT	8.47 JT	2.31 JT	3.26 JT	7.55 JT	--
Dioxins/Furans (pg/g)										
1,2,3,4,6,7,8-HpCDD	NV	NV	NV	320	216	252	193	357	323	108
1,2,3,4,6,7,8-HpCDF	NV	NV	NV	71.4 J	37.0 J	27.3 J	42.4 J	58.4 J	40.2 J	18.7
1,2,3,4,7,8,9-HpCDF	NV	NV	NV	5.46	2.12 J	1.88 J	3.24 J	4.46 J	3.27 J	1.67 J
1,2,3,4,7,8-HxCDD	NV	NV	NV	2.07 J	1.99 J	2.26 J	1.72 J	3.21 J	2.93 J	1.10 J
1,2,3,4,7,8-HxCDF	NV	NV	NV	6.87	2.85 J	2.63 J	5.21	6.33	4.44 J	2.41 J
1,2,3,6,7,8-HxCDD	NV	NV	NV	7.44	6.33	7.94	5.76	10.0	9.60	3.61 J
1,2,3,6,7,8-HxCDF	NV	NV	NV	1.93 J	1.53 J	1.42 J	1.85 J	2.55 J	2.41 UJK	0.727 J
1,2,3,7,8,9-HxCDD	NV	NV	NV	4.93 J	5.04	5.37	3.72 J	6.41	7.23	2.09 J
1,2,3,7,8,9-HxCDF	NV	NV	NV	1.44 UJK	0.743 J	0.819 J	1.20 J	1.43 UJK	1.36 UJK	0.723 J
1,2,3,7,8-PeCDD	NV	NV	NV	1.53 UJK	1.31 J	1.39 J	1.27 UJK	2.36 UJK	2.53 J	0.683 J
1,2,3,7,8-PeCDF	NV	NV	NV	0.964 J	0.651 J	0.771 J	0.775 J	1.01 J	1.09 J	0.629 UJ
2,3,4,6,7,8-HxCDF	NV	NV	NV	2.88 J	1.88 J	1.79 J	2.19 J	3.49 J	2.67 J	1.29 J
2,3,4,7,8-PeCDF	NV	NV	NV	2.46 J	1.92 UJK	1.85 J	2.47 J	3.13 J	2.39 J	1.10 J
2,3,7,8-TCDD	NV	NV	NV	0.323 J	0.216 U	0.265 UJK	0.278 J	0.415 J	0.414 U	0.250 J
2,3,7,8-TCDF	NV	NV	NV	1.48	1.10	1.29	1.13	1.85	1.60	0.747 J
OCDD	NV	NV	NV	3,050	1,810	2,250	1,810	3,140	2,710	909
OCDF	NV	NV	NV	244	79.0	68.2	131	196	125	59.9
Total HpCDDs	NV	NV	NV	821	680	891	519	848	832	313
Total HpCDFs	NV	NV	NV	313 JK	110	93.3	159	225	159	68.1 JK
Total HxCDDs	NV	NV	NV	72.6	71.8	87.8	59.2	92.9	90.8	33.7 JK
Total HxCDFs	NV	NV	NV	81.3 JK	45.4	42.0 JK	60.2 JK	84.7 JK	61.6 JK	27.5 JK
Total PeCDDs	NV	NV	NV	12.6 UJK	11.0 JK	11.9 JK	11.2 UJK	17.7 UJK	18.1 JK	4.45 JK
Total PeCDFs	NV	NV	NV	29.2 JK	20.7 JK	20.1	23.4 JK	31.2 JK	31.7 JK	12.2 JK
Total TCDDs	NV	NV	NV	3.75 JK	2.62 JK	4.87 UJK	3.35 JK	6.24 JK	3.34 UJK	1.46 JK
Total TCDF	NV	NV	NV	25.3 JK	13.8 JK	29.1 JK	24.3 JK	32.8 JK	29.9 JK	8.77 JK
Dioxin/Furan TEQ (ND=0.5)[h][1]	NA	NA	NA	9.64 JT	6.99 JT	7.96 JT	6.92 JT	11.2 JT	11.0 JT	4.12 J
Dioxin/Furan TEQ (ND=0)[i][1]	NA	NA	NA	8.81 JT	6.59 JT	7.83 JT	6.29 JT	9.97 JT	10.6 JT	4.11 J
DMMU Average TEQ (ND=0.5)[j][1]	10 (DMMU)[k][1]			8.32		NA	9.06		NA	NA
DMMU Average TEQ (ND=0)[j][1]	10 (DMMU)[k][1]			7.70		NA	8.13		NA	NA
Project VWA (ND=0.5)[l][1]	4 (VWA)[k][1]			8.69						4.12 J
Project VWA (ND=0)[l][1]	4 (VWA)[k][1]			7.92						4.11 J

Table 3-1
Sediment Analytical Results Compared to DMMP Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Notes

Data summation rules are as follows (except dioxin/furan TEQ): non-detect results are multiplied by zero when used for sums. When all results are non-detect, the highest detection limit is provided as the sum.

Shading indicates exceedances of DMMP marine guidelines. Non-detect results (U and UJ) and rejected results (R) were not compared with screening criteria.

-- = not analyzed.

bml = below mudline.

BT = bioaccumulation trigger value.

DMMP = Dredged Material Management Program.

DMMU = dredged material management unit.

HPAH = high-molecular-weight polycyclic aromatic hydrocarbon.

J = result is estimated.

JK = result is estimated and an estimated maximum potential concentration.

LPAH = low-molecular-weight polycyclic aromatic hydrocarbon.

mg/kg = milligrams per kilogram.

mg/kg-OC = milligrams per kilogram, organic carbon normalized.

ML = maximum level.

MLLW = mean low lower water,

NA = not applicable.

ND = non-detect.

NV = no value.

PAH = polycyclic aromatic hydrocarbon.

PCB = polychlorinated biphenyl.

pg/g = picograms per gram.

R = result is rejected. The analyte may or may not be present in the sample. Rejected results shown at the detection limit.

SL = screening level.

T = result is calculated.

TEQ = toxicity equivalent.

U = result is non-detect at the method detection limit or sample-specific estimated detection limit.

ug/kg = micrograms per kilogram.

UJ = result is non-detect with an estimated method detection limit.

UJK = result is non-detect, an estimated value, and an estimated maximum potential concentration.

VWA = volume-weighted average.

[a]Total benzofluoranthenes is the sum of b, j, and k benzofluoranthene isomers.

[b]Total LPAH is the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene.

[c]Total HPAH is the sum of total benzofluoranthenes, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene and benzo(g,h,i)perylene.

[d]3- and 4-methylphenol coelude. Screening levels for 4-methylphenol are applied to the coelution.

[e]Total DDT is the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

[f]Total chlordane is the sum of cis-chlordane, cis-nonachlor, oxychlordane, trans-chlordane, and trans-nonachlor.

[g]Total PCBs is the sum of Aroclor 1016, 1221, 1232, 1242, 1248, 1254, and 1260. Results presented in ug/kg-dry weight and mg/kg-OC to compare to bioaccumulation trigger value.

[h]Dioxin/furan TEQ calculated as the sum of each congener concentration multiplied by the corresponding mammalian toxicity equivalency factor. ND values are multiplied by one-half.

[i]Dioxin/furan TEQ calculated as the sum of each congener concentration multiplied by the corresponding mammalian toxicity equivalency factor. ND values are multiplied by zero.

[j]DMMU average calculated as the average of the dioxin/furan TEQ results for dredge and over-dredge layers for each DMMU. Z-layer (leave layer) results are not included.

[k]Puget Sound non-dispersive site guidelines. DMMUs with concentrations below 10 ng/kg TEQ will be allowed for disposal as long as the VWA concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 ng/kg TEQ.

[l]Project VWA calculated as the average of the dioxin/furan TEQ results for dredge and over-dredge layers from all DMMUs. Z-layer (leave layer) results are not included.

Reference

[1]U.S. Army Corps of Engineers. 2021. *Dredged Material Evaluation and Disposal Procedures User Manual* . U.S. Army Corps of Engineers, Dredged Material Management Office, Seattle District. July.

Table 3-2
Sediment Analytical Results Compared to ROD Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	ROD RALs, Subtidal Sediments, Recovery Category 1[1]		DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:			DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:	Human Health (top 60 cm)[a]	Benthic Protection (top 60 cm)[a]	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	7/21/2025
Collection Depth (feet bml):			0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):			-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
Conventional Parameters									
Ammonia (as nitrogen) (mg/kg)	NV	NV	56.3	58.3	40.0	28.9 J	45.1	21.7	--
Total organic carbon (%)	NV	NV	2.4	1.8	1.4	2.9	2.5	1.1	2.9
Total solids (%)	NV	NV	60.5	68.5	72.6	53.8	62.2	66.6	48.9
Sulfide (mg/kg)	NV	NV	717	932	474	718	576	307	--
Total volatile solids (%)	NV	NV	6.29	4.60	3.09	7.19	5.32	4.25	--
Grain Size (%)									
Percent retained 4,750-micron sieve (#4)	NV	NV	3.02	0.91	2.26	0.71	0.33	0.73	0.51
Percent retained 2,000-micron sieve (#10)	NV	NV	1.26	1.07	1.17	0.23	0.23	0.36	0.93
Percent retained 850-micron sieve (#20)	NV	NV	1.93	1.42	3.55	0.46	0.69	1.41	1.59
Percent retained 425-micron sieve (#40)	NV	NV	5.64	6.12	18.7	2.77	6.48	13.2	2.80
Percent retained 250-micron sieve (#60)	NV	NV	7.73	11.6	22.1	4.41	9.82	19.8	4.54
Percent retained 150-micron sieve (#100)	NV	NV	6.05	10.4	11.9	3.68	5.97	9.11	4.61
Percent retained 106-micron sieve (#140)	NV	NV	4.98	6.69	4.74	4.91	4.64	5.40	5.43
Percent retained 63-micron sieve (#230)	NV	NV	3.56	3.44	2.01	4.12	3.79	3.37	4.80
Percent retained 75-micron sieve (#200)	NV	NV	5.83	6.32	3.80	6.78	5.43	5.88	7.09
Gravel	NV	NV	4.29	1.98	3.43	0.94	0.56	1.09	1.45
Sand	NV	NV	35.7	46.0	66.8	27.1	36.8	58.2	30.9
Silt	NV	NV	48.1	43.8	24.6	60.2	51.7	33.7	58.3
Clay	NV	NV	11.9	8.20	5.20	11.7	10.9	7.10	9.34
Total Metals (mg/kg)									
Antimony	NV	NV	0.441 J	0.420 J	0.394 J	0.456 U	0.534 J	0.599 J	--
Arsenic	57	57	11.0	9.59	6.99	12.2	10.1	8.83	--
Cadmium	NV	5.1	0.277	0.231	0.149	0.333	0.293	0.244	--
Chromium	NV	260	23.4	26.6	14.6	26.1	22.9	19.5	--
Copper	NV	390	53.5	45.9	29.9	60.7	50.2	45.9	--
Lead	NV	450	22.1	19.9	19.4	25.1	23.4	25.8	--
Mercury	NV	0.41	0.115	0.0710	0.0642	0.382 J	0.116	0.0748	--
Selenium	NV	NV	0.420 U	0.387 U	0.361 U	0.456 U	0.400 U	0.374 U	--
Silver	NV	6.1	0.166 J	0.0994 J	0.0891 J	0.196	0.167	0.158	--
Zinc	NV	410	166	421	71.9	125	106	94.8	--
Organotins (ug/kg)									
Tributyltin	NV	NV	2.30 U	1.90 U	1.90 U	2.80 U	2.20 U	2.10 U	--
PAHs (ug/kg)									
2-Methylnaphthalene	NV	NV	8.76 U	30.7	15.3	9.92 U	8.34 UJ	12.0 J	--
Acenaphthene	NV	NV	5.78 J	37.0	29.1	4.94 U	10.8 J	71.2	--
Acenaphthylene	NV	NV	4.36 U	9.83	14.2	4.94 U	4.15 UJ	4.10 J	--
Anthracene	NV	NV	14.6	62.9	50.0	10.0	43.7 J	130	--
Benzo(a)anthracene	NV	NV	39.8	151	175	41.7	116 J	320	--
Benzo(a)pyrene	NV	NV	51.8	168	176	49.8	137 J	400	--
Benzo(b,j)fluoranthene	NV	NV	78.0	310	320	74.9	178 J	483	--
Benzo(ghi)perylene	NV	NV	26.9	79.8	62.7	26.1	67.4 J	210	--
Benzo(k)fluoranthene	NV	NV	28.8 J	94.8 J	97.3 J	29.4 J	61.8 J	165 J	--
Chrysene	NV	NV	53.4	244	255	59.4	132 J	387	--
Dibenzo(a,h)anthracene	NV	NV	6.37 J	21.6	21.3	6.02 J	17.8 J	53.8	--
Fluoranthene	NV	NV	94.9	373	475	59.3	284 J	931	--

Table 3-2
Sediment Analytical Results Compared to ROD Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	ROD RALs, Subtidal Sediments, Recovery Category 1[1]		DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:			DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:	Human Health (top 60 cm)[a]	Benthic Protection (top 60 cm)[a]	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	7/21/2025
Collection Depth (feet bml):			0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):			-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
PAHs cont. (ug/kg)									
Fluorene	NV	NV	7.42 J	36.1	28.3	4.94 U	16.1 J	80.1	--
Indeno(1,2,3-cd)pyrene	NV	NV	24.3	81.2	72.1	24.6	68.7 J	206	--
Naphthalene	NV	NV	10.4 J	114	31.0	9.92 U	8.34 UJ	30.6	--
Phenanthrene	NV	NV	37.1	185	105	28.6	160 J	712	--
Pyrene	NV	NV	118	432	671	67.3	244 J	789	--
Total benzo(b,j,k)fluoranthenes[b]	NV	NV	107 J	405 J	417 J	104 J	240 J	648 J	--
Total LPAH[c]	NV	NV	75.3 JT	445 T	258 T	38.6 T	231 JT	1,030 JT	--
Total HPAH[d]	NV	NV	522 JT	1,960 JT	2,330 JT	439 JT	1,310 JT	3,940 JT	--
cPAH TEQ[e][2] ND=0.5	1,000	NV	70.1 JT	236 JT	247 JT	68.1 JT	183 JT	527 JT	--
cPAH TEQ[e][2] ND=0	1,000	NV	70.1 JT	236 JT	247 JT	68.1 JT	183 JT	527 JT	--
PAHs (mg/kg-OC)									
2-Methylnaphthalene	NV	38	0.365 U	1.71	1.09	0.342 U	0.334 UJ	1.09 J	--
Acenaphthene	NV	16	0.241 J	2.06	2.08	0.170 U	0.432 J	6.47	--
Acenaphthylene	NV	NV	0.182 U	0.546	1.01	0.170 U	0.166 UJ	0.373 J	--
Anthracene	NV	220	0.608	3.49	3.57	0.345	1.75 J	11.8	--
Benzo(a)anthracene	NV	110	1.66	8.39	12.5	1.44	4.64 J	29.1	--
Benzo(a)pyrene	NV	99	2.16	9.33	12.6	1.72	5.48 J	36.4	--
Benzo(b,j)fluoranthene	NV	NV	3.25	17.2	22.9	2.58	7.12 J	43.9	--
Benzo(ghi)perylene	NV	31	1.12	4.43	4.48	0.900	2.70 J	19.1	--
Benzo(k)fluoranthene	NV	NV	1.20 J	5.27 J	6.95 J	1.01 J	2.47 J	15.0 J	--
Chrysene	NV	110	2.23	13.6	18.2	2.05	5.28 J	35.2	--
Dibenzo(a,h)anthracene	NV	12	0.265 J	1.20	1.52	0.208 J	0.712 J	4.89	--
Fluoranthene	NV	160	3.95	20.7	33.9	2.04	11.4 J	84.6	--
Fluorene	NV	23	0.309 J	2.01	2.02	0.170 U	0.644 J	7.28	--
Indeno(1,2,3-cd)pyrene	NV	34	1.01	4.51	5.15	0.848	2.75 J	18.7	--
Naphthalene	NV	99	0.433 J	6.33	2.21	0.342 U	0.334 UJ	2.78	--
Phenanthrene	NV	100	1.55	10.3	7.50	0.986	6.40 J	64.7	--
Pyrene	NV	1,000	4.92	24.0	47.9	2.32	9.76 J	71.7	--
Total benzo(b,j,k)fluoranthenes[b]	NV	230	4.45 JT	22.5 JT	29.9 JT	3.59 JT	9.59 JT	58.9 JT	--
Total LPAH[c]	NV	370	3.14 JT	24.7 T	18.4 T	1.33 T	9.23 JT	93.4 JT	--
Total HPAH[d]	NV	960	21.8 JT	109 JT	166 JT	15.1 JT	52.3 JT	359 JT	--
Chlorinated Hydrocarbons (mg/kg-OC)									
1,2,4-Trichlorobenzene	NV	0.81	0.454 U	0.510 U	0.624 U	0.428 U	0.416 UJ	0.885 U	--
1,2-Dichlorobenzene	NV	2.3	0.454 U	0.510 U	0.624 U	0.428 U	0.416 UJ	0.885 U	--
1,4-Dichlorobenzene	NV	3.1	0.454 U	0.510 U	0.624 U	0.428 U	0.416 UJ	0.885 U	--
Hexachlorobenzene	NV	0.38	0.182 U	0.204 U	0.249 U	0.170 U	0.166 UJ	0.354 U	--
Phthalates (mg/kg-OC)									
Bis(2-ethylhexyl)phthalate	NV	47	2.73 U	3.06 U	3.74 U	2.56 U	2.50 UJ	5.32 U	--
Butylbenzylphthalate	NV	4.9	0.913 U	1.02 U	1.28 J	0.855 U	0.832 UJ	2.20 J	--
Diethyl phthalate	NV	NV	0.913 U	1.02 U	1.25 U	0.855 U	0.832 UJ	1.77 U	--
Dimethyl phthalate	NV	53	0.913 U	1.02 U	1.25 U	0.855 U	0.832 UJ	1.77 U	--
Di-n-butyl phthalate	NV	NV	0.913 U	1.02 U	1.25 U	0.855 U	0.832 UJ	1.77 U	--
Di-n-octyl phthalate	NV	NV	1.52 U	1.64 U	2.49 U	1.37 U	1.34 UJ	2.85 U	--

Table 3-2
Sediment Analytical Results Compared to ROD Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	ROD RALs, Subtidal Sediments, Recovery Category 1[1]		DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:			DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:	Human Health (top 60 cm)[a]	Benthic Protection (top 60 cm)[a]	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	7/21/2025
Collection Depth (feet bml):			0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):			-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
Phenols (ug/kg)									
2,4-Dimethylphenol	NV	29	21.9 U	18.4 U	17.5 U	24.8 U	20.8 U	19.5 U	--
2-Methylphenol	NV	NV	10.9 U	9.18 U	8.73 U	12.4 U	10.4 U	9.74 U	--
3- & 4-Methylphenol (m,p-Cresol)[f]	NV	670	10.9 U	9.18 U	8.73 U	12.4 U	10.4 U	9.74 U	--
Pentachlorophenol	NV	360	43.6 U	36.7 U	34.9 U	49.4 U	41.5 U	38.9 U	--
Phenol	NV	420	55.7 J	44.7 J	53.3 J	17.0 J	44.5 J	34.0 J	--
Miscellaneous Extractables (ug/kg)									
Benzoic acid	NV	650	548 U	460 U	438 U	620 R	521 U	489 U	--
Benzyl alcohol	NV	57	71.8	23.2 J	41.4	90.1	41.2 J	19.5 U	--
Dibenzofuran	NV	NV	5.75 J	19.9	19.9	4.94 U	5.86 J	43.8	--
Hexachlorobutadiene	NV	NV	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
N-Nitrosodiphenylamine	NV	NV	10.9 U	9.18 U	8.73 U	12.4 U	10.4 UJ	9.74 U	--
Miscellaneous Extractables (mg/kg-OC)									
Benzoic acid	NV	NV	22.8 U	25.6 U	31.3 U	-- R	20.8 U	44.5 U	--
Benzyl alcohol	NV	NV	2.99	1.29 J	2.96	3.11	1.65 J	1.77 U	--
Dibenzofuran	NV	15	0.240 J	1.11	1.42	0.170 U	0.234 J	3.98	--
Hexachlorobutadiene	NV	NV	0.454 U	0.510 U	0.624 U	0.428 U	0.416 UJ	0.885 U	--
N-Nitrosodiphenylamine	NV	11	0.454 U	0.510 U	0.624 U	0.428 U	0.416 UJ	0.885 U	--
Organochlorine Pesticides (ug/kg)									
4,4'-DDD	NV	NV	3.51 U	1.28 U	2.46 U	1.59 U	1.40 U	1.26 U	--
4,4'-DDE	NV	NV	2.92 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
4,4'-DDT	NV	NV	2.92 U	2.56 U	2.46 U	3.18 U	2.81 U	3.01 U	--
Aldrin	NV	NV	2.92 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
alpha-Chlordane	NV	NV	1.46 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
beta-Chlordane	NV	NV	1.46 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
cis-Nonachlor	NV	NV	1.41 U	1.27 U	2.34 U	1.63 U	2.82 U	1.32 U	--
Dieldrin	NV	NV	2.92 U	1.28 U	1.23 U	1.59 U	1.40 U	1.26 U	--
Heptachlor	NV	NV	3.51 U	1.28 U	1.23 U	3.18 U	1.40 U	1.26 U	--
Oxychlordane	NV	NV	1.41 U	1.27 U	1.17 U	1.63 U	1.41 U	1.32 U	--
trans-Nonachlor	NV	NV	1.41 U	1.27 U	1.17 U	1.63 U	2.82 U	1.32 U	--
Total DDx[g]	NV	NV	3.51 UT	2.56 UT	2.46 UT	3.18 UT	2.81 UT	3.01 UT	--
Total chlordane[h]	NV	NV	1.46 UT	1.28 UT	2.34 UT	1.63 UT	2.82 UT	1.32 UT	--
PCB Aroclors (mg/kg-OC)									
Aroclor 1016	NV	NV	0.300 U	0.347 U	0.428 U	0.285 U	0.288 U	0.582 U	--
Aroclor 1221	NV	NV	0.300 U	0.347 U	0.428 U	0.285 U	0.288 U	0.582 U	--
Aroclor 1232	NV	NV	0.300 U	0.347 U	0.428 U	0.285 U	0.288 U	0.582 U	--
Aroclor 1242	NV	NV	0.421 J	0.578 J	1.26 J	0.448 J	0.568 J	1.54 J	--
Aroclor 1248	NV	NV	0.300 U	0.347 U	0.428 U	0.285 U	0.288 U	0.582 U	--
Aroclor 1254	NV	NV	1.11 J	1.30 J	3.52 J	1.18 J	1.53 J	3.85 J	--
Aroclor 1260	NV	NV	0.617 J	0.733 J	3.69 J	0.679 J	1.16 J	2.16 J	--
Total PCBs[i]	12	12	2.15 JT	2.61 JT	8.47 JT	2.31 JT	3.26 JT	7.55 JT	--

Table 3-2
Sediment Analytical Results Compared to ROD Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Location:	ROD RALs, Subtidal Sediments, Recovery Category 1[1]		DMMU01			DMMU02			DMMU01/DMMU02
Sample Name:			DMMU01-SSED-0-2	DMMU01-SUBSED-2-4	DMMU01-Z1-4-5	DMMU02-SSED-0-2	DMMU02-SUBSED-2-4	DMMU02-Z1-4-5	BOYER-COMP
Collection Date:	Human Health (top 60 cm)[a]	Benthic Protection (top 60 cm)[a]	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	11/21/2024	7/21/2025
Collection Depth (feet bml):			0 to 2	2 to 4	4 to 5	0 to 2	2 to 4	4 to 5	0 to 1
Collection Depth (feet MLLW):			-7.65 to -9.65	-9.65 to -11.65	-11.65 to -12.65	-6.72 to -8.72	-8.72 to -10.72	-10.72 to -11.72	NA (composite)
Dioxins/Furans (pg/g)									
1,2,3,4,6,7,8-HpCDD	NV	NV	320	216	252	193	357	323	108
1,2,3,4,6,7,8-HpCDF	NV	NV	71.4 J	37.0 J	27.3 J	42.4 J	58.4 J	40.2 J	18.7
1,2,3,4,7,8,9-HpCDF	NV	NV	5.46	2.12 J	1.88 J	3.24 J	4.46 J	3.27 J	1.67 J
1,2,3,4,7,8-HxCDD	NV	NV	2.07 J	1.99 J	2.26 J	1.72 J	3.21 J	2.93 J	1.10 J
1,2,3,4,7,8-HxCDF	NV	NV	6.87	2.85 J	2.63 J	5.21	6.33	4.44 J	2.41 J
1,2,3,6,7,8-HxCDD	NV	NV	7.44	6.33	7.94	5.76	10.0	9.60	3.61 J
1,2,3,6,7,8-HxCDF	NV	NV	1.93 J	1.53 J	1.42 J	1.85 J	2.55 J	2.41 UJK	0.727 J
1,2,3,7,8,9-HxCDD	NV	NV	4.93 J	5.04	5.37	3.72 J	6.41	7.23	2.09 J
1,2,3,7,8,9-HxCDF	NV	NV	1.44 UJK	0.743 J	0.819 J	1.20 J	1.43 UJK	1.36 UJK	0.723 J
1,2,3,7,8-PeCDD	NV	NV	1.53 UJK	1.31 J	1.39 J	1.27 UJK	2.36 UJK	2.53 J	0.683 J
1,2,3,7,8-PeCDF	NV	NV	0.964 J	0.651 J	0.771 J	0.775 J	1.01 J	1.09 J	0.629 UJ
2,3,4,6,7,8-HxCDF	NV	NV	2.88 J	1.88 J	1.79 J	2.19 J	3.49 J	2.67 J	1.29 J
2,3,4,7,8-PeCDF	NV	NV	2.46 J	1.92 UJK	1.85 J	2.47 J	3.13 J	2.39 J	1.10 J
2,3,7,8-TCDD	NV	NV	0.323 J	0.216 U	0.265 UJK	0.278 J	0.415 J	0.414 U	0.25 J
2,3,7,8-TCDF	NV	NV	1.48	1.10	1.29	1.13	1.85	1.60	0.747 J
OCDD	NV	NV	3,050	1,810	2,250	1,810	3,140	2,710	909
OCDF	NV	NV	244	79.0	68.2	131	196	125	59.9
Total HpCDDs	NV	NV	821	680	891	519	848	832	313
Total HpCDFs	NV	NV	313 JK	110	93.3	159	225	159	68.1 JK
Total HxCDDs	NV	NV	72.6	71.8	87.8	59.2	92.9	90.8	33.7 JK
Total HxCDFs	NV	NV	81.3 JK	45.4	42.0 JK	60.2 JK	84.7 JK	61.6 JK	27.5 JK
Total PeCDDs	NV	NV	12.6 UJK	11.0 JK	11.9 JK	11.2 UJK	17.7 UJK	18.1 JK	4.45 JK
Total PeCDFs	NV	NV	29.2 JK	20.7 JK	20.1	23.4 JK	31.2 JK	31.7 JK	12.2 JK
Total TCDDs	NV	NV	3.75 JK	2.62 JK	4.87 UJK	3.35 JK	6.24 JK	3.34 UJK	1.46 JK
Total TCDF	NV	NV	25.3 JK	13.8 JK	29.1 JK	24.3 JK	32.8 JK	29.9 JK	8.77 JK
Dioxin/Furan TEQ (ND=0.5)[j][1]	25	NV	9.64 JT	6.99 JT	7.96 JT	6.92 JT	11.2 JT	11.0 JT	4.12 J
Dioxin/Furan TEQ (ND=0)[k][1]	25	NV	8.81 JT	6.59 JT	7.83 JT	6.29 JT	9.97 JT	10.6 JT	4.11 J

Table 3-2
Sediment Analytical Results Compared to ROD Criteria
Boyer Towing Maintenance Dredging, Seattle, Washington

Notes

Shading indicates exceedances of ROD benthic protection RALs.

-- = not analyzed.

bml = below mudline.

cm = centimeters.

cPAH = carcinogenic polycyclic aromatic hydrocarbon.

Ecology = Washington State Department of Ecology.

EPA = U.S. Environmental Protection Agency.

J = result is estimated.

JK = result is estimated and an estimated maximum potential concentration.

mg/kg = milligrams per kilogram.

mg/kg-OC = milligrams per kilogram, organic carbon normalized.

MLLW = mean low lower water,

NA = not applicable.

ND = non-detect.

PAH = polycyclic aromatic hydrocarbon.

NV = no value.

PCB = polychlorinated biphenyl.

pg/g = picograms per gram.

R = result is rejected. The analyte may or may not be present in the sample. Rejected results shown at the detection limit.

RAL = remedial action level.

ROD = Record of Decision.

T = result is calculated.

TEQ = toxicity equivalent.

U = result is non-detect at the sample-specific estimated detection limit.

ug/kg = micrograms per kilogram.

UJ = result is non-detect with an estimated method detection limit.

UJK = result is non-detect, an estimated value, and an estimated maximum potential concentration.

[a]ROD Subtidal Sediments Recovery Category 1 RALs are only applicable to sediments within the top 60 cm below mudline. Subsurface sediments below 2 feet below mudline are not screened to RALs.

[b]Total benzofluoranthenes is the sum of b, j, and k benzofluoranthene isomers.

[c]Total LPAH is the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene.

[d]Total HPAH is the sum of total benzofluoranthenes, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene and benzo(g,h,i)perylene.

[e]cPAH TEQ is calculated as the sum of each constituent concentration multiplied by the corresponding toxicity equivalency factor value.

[f]3- and 4-methylphenol coelude. Screening levels for 4-methylphenol are applied to the coelution.

[g]Total DDx is the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

[h]Total chlordane is the sum of cis-chlordane, cis-nonachlor, oxychlordane, trans-chlordane, and trans-nonachlor.

[i]Total PCBs is the sum of Aroclor 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

[j]Dioxin/furan TEQ calculated as the sum of each congener concentration multiplied by the corresponding mammalian toxicity equivalency factor. ND values are multiplied by one-half.

[k]Dioxin/furan TEQ calculated as the sum of each congener concentration multiplied by the corresponding mammalian toxicity equivalency factor. ND values are multiplied by zero.

References

[1]EPA. 2014. *Record of Decision, Lower Duwamish Waterway Superfund Site* . U.S. Environmental Protection Agency Region 10: Seattle, WA. November.

[2]Ecology. 2021. *Sediment Cleanup User's Manual (SCUM)* . Publication No. 12-09-057. Washington State Department of Ecology. December.

Table 4-1
Bioaccumulation Test Survival Summary
Boyer Towing Maintenance Dredging, Seattle, Washington

Test Species	Sample	Replicate	Survival (%)	Mean Survival (%)	Standard Deviation	Total Wet Tissue Weight (grams)	Mean Wet Tissue Weight (grams)
Alitta virens	Pre-Test	1	NA			42.6	46.1
		2				48.6	
		3				47.0	
	Control	1	100	82.5	32.6	43.0	34.0
		2	100			37.5	
		3	87.5			36.9	
		4	100			43.7	
		5	25.0			8.80	
	FOXREF1	1	100	97.5	5.60	43.7	42.1
		2	100			39.9	
		3	100			36.9	
		4	100			50.5	
		5	87.5			39.3	
	BOYER-COMP	1	100	100	0.0	46.4	44.3
		2	100			41.3	
		3	100			42.2	
		4	100			47.2	
		5	100			44.2	
Macoma nasuta	Pre-Test	1	NA			42.8	40.6
		2				38.1	
		3				41.0	
	Control	1	83.3	83.3	11.8	27.8	30.5
		2	83.3			34.6	
		3	100			34.6	
		4	83.3			30.6	
		5	66.7			25.0	
	FOXREF1	1	66.7	83.3	10.2	23.4	29.8
		2	91.7			29.9	
		3	91.7			34.3	
		4	83.3			33.7	
		5	83.3			27.8	
	BOYER-COMP	1	91.7	86.7	9.50	37.7	32.6
		2	83.3			29.3	
		3	75.0			25.5	
		4	100			37.2	
		5	83.3			33.1	

Table 4-2
Bioaccumulation Tissue Analytical Results
Boyer Towing Maintenance Dredging, Seattle, Washington

Organism:	*Alitta virens*					*Macoma nasuta*				
Sample Name:	BOYER-COMP ALITTA REP 1	BOYER-COMP ALITTA REP 2	BOYER-COMP ALITTA REP 3	BOYER-COMP ALITTA REP 4	BOYER-COMP ALITTA REP 5	BOYER-COMP MACOMA REP 1	BOYER-COMP MACOMA REP 2	BOYER-COMP MACOMA REP 3	BOYER-COMP MACOMA REP 4	BOYER-COMP MACOMA REP 5
Collection Date:	09/16/2025	09/16/2025	09/16/2025	09/16/2025	09/16/2025	09/16/2025	09/16/2025	09/16/2025	09/16/2025	09/16/2025
Lipids (%-wet)										
Lipids	2.3	1.8	1.9	1.8	2.6	1.0	1.3	1.2	1.3	1.2
Dioxins/Furans (pg/g-wet)										
1,2,3,4,6,7,8-HpCDD	0.45 U	0.74 U	0.56 U	0.72 U	0.72 U	5.6 UJ	9.5 UJ	5.3 UJ	5.1 UJ	7.4 UJ
1,2,3,4,6,7,8-HpCDF	0.26 U	0.37 U	0.31 U	0.35 U	0.30 U	0.18 U	0.21 U	0.20 U	0.13 U	0.17 U
1,2,3,4,7,8,9-HpCDF	0.32 U	0.43 U	0.37 U	0.43 U	0.37 U	0.21 U	0.28 U	0.24 U	0.15 U	0.22 U
1,2,3,4,7,8-HxCDD	0.18 U	0.35 U	0.39 U	0.38 U	0.33 U	0.34 U	0.29 U	0.34 U	0.24 U	0.23 U
1,2,3,4,7,8-HxCDF	1.4 U	2.0 U	1.6 U	1.4 U	1.7 U	0.88 U	0.92 U	0.71 U	0.71 U	0.67 U
1,2,3,6,7,8-HxCDD	0.20 U	0.35 U	0.38 U	0.37 U	0.33 U	0.33 U	0.31 U	0.33 U	0.24 U	0.25 U
1,2,3,6,7,8-HxCDF	1.2 U	1.9 U	1.5 U	1.4 U	1.7 U	0.81 U	0.85 U	0.68 U	0.67 U	0.68 U
1,2,3,7,8,9-HxCDD	0.18 U	0.34 U	0.37 U	0.37 U	0.32 U	0.33 U	0.29 U	0.32 U	0.23 U	0.23 U
1,2,3,7,8,9-HxCDF	1.2 U	1.8 U	1.4 U	1.3 U	1.5 U	0.74 U	0.79 U	0.60 U	0.60 U	0.60 U
1,2,3,7,8-PeCDD	0.72 U	1.3 U	0.89 U	0.89 U	1.2 U	0.91 U	0.97 U	0.87 U	0.48 U	0.79 U
1,2,3,7,8-PeCDF	0.57 U	0.95 U	0.76 U	0.59 U	0.90 U	0.43 U	0.48 U	0.40 U	0.30 U	0.32 U
2,3,4,6,7,8-HxCDF	1.2 U	1.8 U	1.4 U	1.3 U	1.5 U	0.76 U	0.81 U	0.62 U	0.62 U	0.59 U
2,3,4,7,8-PeCDF	0.47 U	0.77 U	0.64 U	0.49 U	0.76 U	0.36 U	0.39 U	0.35 U	0.25 U	0.28 U
2,3,7,8-TCDD	0.077 U	0.083 U	0.064 U	0.086 U	0.11 U	0.072 U	0.091 U	0.068 U	0.097 U	0.070 U
2,3,7,8-TCDF	0.27 U	0.47 U	0.40 U	0.34 U	0.47 U	0.34 U	0.43 U	0.33 U	0.29 U	0.27 U
OCDD	57 U	44 UJ	63 U	39 UJ	62 U	56 U	91 U	46 UJ	37 UJ	80 U
OCDF	1.3 UJ	0.35 U	1.4 UJ	0.40 U	0.24 U	2.6 UJ	9.7 UJ	0.25 U	1.5 UJ	3.0 UJ
Total HpCDDs	26 U	20 UJ	43	17 UJ	19 UJ	14 UJ	23 UJ	12 UJ	15 UJ	20 UJ
Total HpCDFs	3.3 UJ	4.8 UJ	4.7 UJ	0.43 U	4.4 UJ	0.21 U	6.1 UJ	3.5 UJ	2.8 UJ	4.4 UJ
Total HxCDDs	0.20 U	0.35 U	5.5 J	0.38 U	0.33 U	0.34 U	0.31 U	0.34 U	0.24 U	0.25 U
Total HxCDFs	26	24	26	21 J	12 J	8.3 J	7.1 U	4.3 U	4.0 U	0.68 U
Total PeCDDs	0.72 U	1.3 U	0.89 U	0.89 U	1.2 U	0.91 U	0.97 U	0.87 U	0.48 U	0.79 U
Total PeCDFs	17 U	9.9 U	9.3 U	15 U	9.1 J	14 U	14 U	0.40 U	3.2 J	3.7 J
Total TCDDs	0.077 U	0.083 U	0.064 U	0.086 U	0.11 U	0.072 U	0.091 U	0.068 U	0.097 U	0.070 U
Total TCDF	5.7 U	7.1 U	1.6 U	1.3 U	0.47 U	4.3 U	8.7 U	0.59 U	3.2 U	7.7 U
Dioxin/Furan TEQ (ND=0.5)[(a)(1)]	0.36 UT	0.65 UT	0.97 UT	0.45 UT	0.60 UT	0.46 UT	0.49 UT	0.44 UT	0.24 UT	0.40 UT
Dioxin/Furan TEQ (ND=0)[(b)(1)]	0 UT	0 UT	0 UT	0 UT	0 UT	0 UT	0 UT	0 UT	0 UT	0 UT
Organism Average TEQ (ND=0.5)[(a)(1)]	0.61 UT					0.41 UT				
Organism Average TEQ (ND=0)[(b)(1)]	0 UT					0 UT				

Notes

J = result is estimated.

ND = non-detect.

pg/g = picograms per gram.

T = result is calculated.

TEQ = toxicity equivalent.

U = result is non-detect at the sample-specific estimated detection limit.

UJ = result is non-detect with an estimated detection limit.

[(a)]Dioxin/furan TEQ calculated as the sum of each congener concentration multiplied by the corresponding mammalian toxicity equivalency factor. Non-detect values are multiplied by one-half. When all dioxin/furan congeners are non-detect, the highest product resulting from multiplying each congener detection limit by the corresponding TEF is provided as the TEQ.

[(b)]Dioxin/furan TEQ calculated as the sum of each congener concentration multiplied by the corresponding mammalian toxicity equivalency factor. Non-detect values are multiplied by zero. When all dioxin/furan results are non-detect, the TEQ is presented as zero.

Reference

[(1)]U.S. Army Corps of Engineers. 2021. *Dredged Material Evaluation and Disposal Procedures User Manual* . U.S. Army Corps of Engineers, Dredged Material Management Office, Seattle District. July.