BergerABAM

FINAL REPORT

Mukilteo Multimodal Project
Dredged Material Characterization

Prepared for

Washington State Department of Transportation

Ferries Division

Seattle, Washington

A14.0024.01

17 April 2014

BergerABAM

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17 April 2014

Kelsey van der Elst
U.S. Army Corps of Engineers, Seattle District
Dredged Material Management Office
P.O. Box 3755
Seattle, WA 98124-3755

Subject: Revised Final Dredged Material Characterization Report
Mukilteo Multimodal Project
Mukilteo, Washington

Dear Reviewer(s):

On behalf of the Washington State Department of Transportation Ferries Division, BergerABAM is pleased to submit our revised final report "Dredged Material Characterization Report, Mukilteo Multimodal Project, Mukilteo, Washington" for your review.

Please contact us if you have questions regarding this report.

Sincerely,

Victoria R. England, LG
Senior Environmental Scientist

Sally L. Fisher
Senior Project Manager

VRE:SLF:keh
Attachments

Revised Final
Dredged Material Characterization Report
Mukilteo Multimodal Project

Prepared for

U.S. Army Corps of Engineers, Seattle District
Dredged Material Management Office
Seattle, Washington

Attention: Kelsey van der Elst

17 April 2014

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REVISED FINAL DREDGED MATERIAL CHARACTERIZATION REPORT
MUKILTEO MULTIMODAL PROJECT

U.S. Army Corps of Engineers, Seattle District
Dredged Material Management Office
Seattle, Washington

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
COCs	Chemicals of concern
cy	Cubic yard
DMMO	Dredged Material Management Office
DMMP	Dredged Material Management Program
DMMU	Dredged Material Management Unit
Ecology	Department of Ecology
EPA	Environmental Protection Agency
GPS	Global positioning system
MLLW	Mean lower low water
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
NSM	New surface material
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PSEP	Puget Sound Estuary Program
QA/QC	Quality assurance/quality control
SAP	Sampling and Analysis Plan
SMS	Sediment Management Standards
SEPA	State Environmental Policy Act
SL	screening level
SVOC	Semivolatile organic compounds
TBT	Tributyltin
TPH	Total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
WAC	Washington State Administrative Code
WSDOT	Washington State Department of Transportation
WSF	WSDOT Ferries Division
WQC	Water Quality Certification

REVISED FINAL
DREDGED MATERIAL CHARACTERIZATION REPORT
MUKILTEO MULTIMODAL PROJECT
MUKILTEO, WASHINGTON

1.0 INTRODUCTION

This report presents the results of sediment sampling activities for characterizing potential dredged material at the proposed Mukilteo Multimodal Project (project) located in Mukilteo, Washington (see Figure 1). The project is proposed by the Washington State Department of Transportation (WSDOT) Ferries Division (WSF). The project site is located at the former U.S. Air Force (USAF) fuel tank farm and pier (herein referred to as the "site").

The project includes removing the former tank farm pier (pier) and dredging through the sediment located beneath the pier to create a ferry berth at the new terminal. The existing conditions and the proposed ferry berth at the site are shown on Figure 2.

The purpose of this characterization is to evaluate sediment quality conditions within the proposed dredge prism relative to in-water disposal suitability criteria. The characterization activities were completed in accordance with the Dredged Material Management Program (DMMP) User's Manual dated 5 July 2013 and our Revised Sampling and Analysis Plan (SAP) (BergerABAM, 3 April 2013). The SAP was approved by the Dredged Material Management Office (DMMO) in an e-mail dated 5 April 2013. The SAP and the DMMO approval e-mail are included as Appendix A.

Sampling depth and recovery were complicated by surface and subsurface debris as discussed below. Additional sampling is needed to fully characterize the lower portion of the nearshore third of the dredge prism and the new surface material that will be exposed in that area after dredging. The additional sampling will be conducted after the pier is demolished (2014/15) and prior to dredging (2015).

A detailed description of the site, historical sampling data, and proposed project characterization activities are summarized in the SAP (included as Appendix A).

1.1 Dredging Program

WSDOT proposes to dredge the berth/channel through the existing sediment beneath the pier starting approximately 210 feet from the shoreline and extending to 760 feet from the shoreline along the axis of the pier. The pier extends northeast into Possession Sound from the shoreline between former Tanks 2 and 3, as shown on Figures 1 and 2.

The dredge prism is expected to be approximately 120 feet wide and will extend to -30 MLLW (including 2 feet of overdredge), as shown on Figure 3. Existing mudline depths in the area to be dredged currently range from approximately -11 to -17 mean lower low water (MLLW). The dredge prism is designed to include a 2-foot-thick layer of material (-30 to -32 feet MLLW) that could be removed and replaced with a cap in the

event that contaminated sediment is present at the design dredge depth (-28 + 2-foot overdredge allowance). The -30- to -32-foot MLLW layer represents the Z-layer post-dredge surface if a cap is not needed. The dredging volume will be approximately 21,000 cubic yards (cy).

This area was dredged to -40 feet MLLW in the early 1940s prior to the construction of the pier. The proposed dredge prism does not extend to this previously dredged depth.

2.0 SAMPLING AND ANALYSIS PROGRAM

The objective of this sediment characterization is to characterize potential dredged materials within the project area to evaluate the following.

- Suitability of the material for disposal at a DMMP unconfined open-water disposal site.
- Suitability for beneficial use as in-water or upland fills.
- Upland disposal options (if the dredged material is not suitable for DMMP disposal or beneficial use).
- Sediment quality of the post-dredge surface material.

2.1 Sampling Activities

Sampling of the proposed dredged material was completed on 6 and 8 November 2013. Sampling activities were conducted in accordance with the SAP with deviations as described in Section 2.2 of this report. Dredge volume, dredge prism configuration, and sampling frequency are based on typical cross sections and conditions within the proposed dredging area as described in the SAP except where noted in Section 2.2 of this report.

Sampling was accomplished with diver-operated vibracores using sampling equipment owned and operated by Gravity Environmental of Redmond, Washington. Positioning at each core location was performed using a global positioning system (GPS). Vibracore location coordinates are included in Table 1.

The diver reported visible concrete, steel, and timber debris on the surface near and around all of the sampling locations. The debris was observed to be more prevalent on the nearshore third of the dredge prism (around sampling location MMP-1) and decreased with distance from the shoreline. The debris apparently extends below the surface and complicated sampling activities and sample recovery.

Cores were attempted in ten locations (six near MMP-1, three near MMP-2, and one near MMP-3) in and around the sampling locations proposed in the SAP. Sediment characterization samples were successfully collected from four vibracores (MMP-1, MM-1B, MMP-2, and MMP-3) to depths ranging from approximately 7 feet to 10 feet

below mudline. The sampling locations are shown on Figure 3. Vibracore MMP-1B was attempted near MMP-1 and is shown co-located with MMP-1 on Figures 2 and 3.

Target sampling depths were based upon the 2013 bathymetric survey data. Target sample depths were reached at MMP-2 and MMP-3 based on that information. The full target sampling depth was not achieved at MMP-1 or MMP-1B due to core refusal likely resulting from subsurface debris similar to that observed on the surface. The mudline measurements collected at the time of sampling and the new bathymetric survey completed in January 2014 indicate that none of the cores reached the post-dredge surface material as shown on Figures 3 and 3a and discussed in Section 2.2.

Sampling activities were monitored by a BergerABAM representative. Sediment cores were processed at the laboratory, including identifying and describing subsurface materials encountered, performing field screening tests, preparing logs of the borings, and compositing sample material. The cores were composited for analysis based upon a moderate ranking for the surface unit (DMMU-1) and a high ranking for the subsurface units (DMMU-2 and DMMU-3). The core logs are presented in Appendix B.

A stainless steel trowel was used to remove sediment sample material from the cores. Samples were homogenized in a stainless steel bowl prior to placing into laboratory-supplied sample containers. Samples were placed into a cooler with ice and submitted under chain-of-custody procedures to Analytical Resources Inc. (Tukwila, Washington) for chemical analytical testing.

Sediment samples were collected and composited as shown in the table below.

Sample Collection and Compositing Summary

Core	Section	Target Sampling Elevation (feet MLLW)	Sample Depth below Mudline (feet)	Actual Sampling Elevation (feet MLLW)	Analytical Composite Sample
MMP-1B	A	-14 to -18	0-4	-14.8 to -18.8	DMMU-1
	B	-18 to -22	4-7	-18.8 to -21.5	DMMU-2
	C	-22 to -30	Not collected due to refusal		
	Z	-30 to -32			
MMP-2	A	-16 to -20	0-4	-16.4 to -20.4	DMMU-1
	B	-20 to -21	4-5	-20.4 to -21.4	DMMU-2
	C	-21 to -30	5-7	-21.4 to -23.4	DMMU-3
			7-10	-23.4 to -26.3	DMMU-3C
	Z	-30 to -32	NA	Did not achieve Z-layer depth	
MMP-3	A	-16 to -20	0-4	-15.9 to -19.9	DMMU-1
	B	-20 to -21	4-5	-19.9 to -20.9	DMMU-2
	C	-21 to -30	5-7	-20.9 to -22.9	DMMU-3
			7-8	-22.9 to -23.9	DMMU-3C
	Z	-30 to -32	NA	Did not achieve Z-layer depth	

NA = depth was not achieved during sampling
DMMU = Dredged Material Management Unit

- Subsamples MMP-1B-A, MMP-2A, and MMP-3A were composited representing the interval 0 to 4 feet below mudline (DMMU-1, surface material).

- Subsample MMP-1B-B at interval 4 to 7 feet below mudline and subsamples MMP-2B and MMP-3B at interval 4 to 5 feet below mudline were composited from subsurface material as DMMU-2.

- Subsamples MMP-2C and MMP-3C were composited from subsurface material as DMMU-3.

- Archived subsamples MMP-2C at interval 7 to 10 feet below mudline and subsample MMP-3C at 7 to 8 feet below mudline were composited from subsurface material as DMMU-3C and analyzed for a focused list of chemicals of concern to confirm the results from DMMU-3.

- The depth of the Z-layer (-30 to -32 feet MLLW) was not reached in any of the vibracores completed for this investigation.

Table 1 includes the sample coordinates and corresponding depths of each core sample location.

2.2 SAP Deviations

The sampling program was completed in general accordance with protocols outlined in the DMMP-approved SAP (3 April 2013, BergerABAM). Deviations from the SAP are summarized below.

- The site bathymetry was updated in 2013 after the SAP was completed. The change in bathymetry resulted in a reconfiguration of the DMMUs prior to sampling. The DMMU reconfiguration was approved by the DMMP in an email dated 30 October 2013 and was used for the November 2013 sampling event.

- Post-sampling review of the mudline measurements collected at the time of sampling showed that the measured elevations were inconsistent with information from the October bathymetric survey. The mudline measurements were then compared to an updated, more accurate bathymetric survey that was completed in January 2014 after sampling was completed. The sampling information and depths were then evaluated relative to the January 2014 bathymetry, and the DMMU configuration used for sampling was overlain onto a cross-section showing the updated bathymetric data (Figure 3). The up-to-date bathymetry and November 2013 sampling locations are shown on the Schematic DMMU Plans (Figures 3 and 3a). The updated bathymetry and DMMU analysis are explained in more detail in the "Mukilteo Multimodal Project Dredged Material Characterization: Revised Plan and Report Based on January 2014 Bathymetry" memorandum (ABAM, 19 March 2014) provided to the DMMP agencies by email on 20 March 2014.

- The planned sampling depth of 17 feet below mudline on the nearshore (southern) portion of the dredge prism, locations MMP-1 or MMP-6 (alternate location attempted with no recovery), was not achieved because of subsurface conditions resulting in sample refusal at approximately 7 feet below mudline and shallower in all six attempts, likely due to subsurface obstructions as previously discussed.

- Sampling to the full target depth was not achieved in any of the coring attempts for MMP-1 (or MMP-1B) as described above, material was not collected from depths representing the nearshore portion of DMMU-3[1], and none of the cores penetrated the full depth of DMMU-3, as shown on Figure 3.

- Z-layer depths were not reached in any of the vibracores completed for the project.

3.0 PHYSICAL AND CHEMICAL ANALYTICAL PROGRAM

Four composite samples (DMMU-1 through DMMU-3C) were submitted to Analytical Resources Inc. of Tukwila, Washington, for physical and chemical analyses.

The chemical analytical program consisted of the standard list of DMMP/Washington State Sediment Management Standards (SMS) contaminants of concerns (COCs) plus tributyltin (TBT) and dioxins/furans as shown in Table 2 and Table 3, respectively, for DMMU-1 through DMMU-3. DMMU-3C was submitted for a focused list of analytes based on the results from the analysis of material sampled from the upper portion of DMMU-3.

Analyses were performed in accordance with applicable Environmental Protection Agency (EPA) methodology and DMMP and Puget Sound Estuary Program (PSEP) protocols as appropriate, including

- Conventional analyses (total organic carbon, total solids, ammonia, total sulfides, and grain size) using appropriate EPA and PSEP methods.

- Total metals using EPA Method 200.8/6010B/7471A.

- Semivolatile organic compounds (SVOCs) using EPA Method 8270D.

- Pesticides and polychlorinated biphenyls (PCBs) using EPA Method 8081/8082.

- TBT using Krone, et al., 1989.

- Dioxins and Furans using EPA Method 1613B.

Focused follow-up analysis was completed on composite sample DMMU-3C from the bottom 3 feet of material from MMP-2 and one foot of material from MMP-3. The

[1] Resampling of the nearshore portion of DMMU-3 will be conducted following pier removal and prior to dredging.

analysis was limited to only those COCs that were detected in the previously analyzed sample DMMU-3 and included PAHs and metals. Dioxins/furans analysis was not completed on DMMU-3C because dioxins/furans were detected at low levels in DMMU-2 and DMMU-3 (1.63 and 1.65 TEQ, respectively) and there are no indications that dioxin/furans are a concern in the subsurface material in the dredge prism.

3.1 Quality Assurance and Quality Control

The laboratory report is attached as Appendix C. Review of the data quality of the chemical analytical results indicates that laboratory goals were achieved based on the results of quality assurance/quality control (QA/QC) parameters, including surrogates, spikes, replicates, and method blanks. EIM formatted data are included as attachments to this report.

4.0 ANALYTICAL RESULTS

4.1 Grain Size Characteristics

The grain size results from the sediment samples are presented in Table 4. The grain size results were as follows.

- DMMU-1 consisted of 16 percent gravel, 62 percent sand, 12 percent silt, and 10 percent clay.
- DMMU-2 consisted of 33 percent gravel, 58 percent sand, 5 percent silt, and 5 percent clay.
- DMMU-3 consisted of 43 percent gravel, 54 percent sand, and less than 3.2 percent of silt and clay.

Organic matter was not removed from the samples prior to grain size analysis. Shell fragments were present in all of the samples thus the laboratory reported these results as the "apparent" grain size distribution.

4.2 Chemical Data

The chemical analytical results are summarized in Table 2 relative to DMMP criteria and in Table 3 relative to SMS criteria.

COCs were not detected at concentrations exceeding DMMP screening levels (SLs) or SMS criteria in any of the samples collected from DMMU-1, DMMU-2, and DMMU-3 (including DMMU-3C).

4.3 Related Chemical Analytical Data

A detailed discussion of previous sampling is provided in the project SAP (Appendix A). Samples collected during the 2012 preliminary sediment sampling event (Parametrix 2012) completed in association with project permit documents were collected within the dredge prism, at the perimeter of the dredge prism, and seaward of the dredge prism

along the tank farm pier as shown on Figure 4. The only samples collected within or near the project dredge prism were collected in the vicinity of MMP-2. The analytical results showed that the samples collected near MMP-2 (V1 [-30.1 to -41.3] and V6 [-26.4 to -35.4) met DMMP and SMS screening criteria for all chemicals of concern except chlordanes. Chlordanes were detected in the composite of samples V1 and V6 at –26.4 to -34.1 feet MLLW. The elevations represented by the V1/V6 composite roughly correlate with the Z-layer of the proposed dredge prism and the lower portion of DMMU-2 in that location.

Sediment data from other previous studies in the project area but outside of the proposed dredge prism either did not include chlordanes or was inconclusive with respect to the presence of chlordanes because of elevated detection limits. Chlordanes were not detected in any of the samples analyzed for this dredged material characterization.

Exceedances of PAHs and dioxins/furans were encountered in samples collected from locations outside of the proposed dredge prism boundary during the 2012 preliminary sampling event (Parametrix 2012). Exceedances of PAHs were detected in one discrete sample collected from 8 to 12 feet below mudline at a location approximately 450 feet to the north northeast of the northeast boundary of the dredge prism. A dioxins/furans exceedance was encountered in one composite sample collected from 0 to 4 feet below mudline at a location approximately 75 feet to the northeast of the northeast boundary of the dredge prism. PAHs and dioxins/furans were detected at concentrations less than their respective DMMP/SMS criteria in all of the samples (DMMU-1, DMMU-2, and DMMU-3) analyzed for this dredged material characterization (ABAM, 2013).

5.0 SUMMARY

The sediment characterization was completed to support the Mukilteo Multimodal Project. WSF proposes to dredge a channel through the sediment located beneath the pier (after pier demolition) to accommodate the ferry berth at the new ferry terminal. The purpose of this characterization is to evaluate the suitability of the proposed dredged material for open-water disposal and beneficial use.

Three sediment cores were completed within the dredge prism: MMP-1B, MMP-2, and MMP-3. Sediment from the cores was sampled and analyzed in general accordance with the DMMP/SMS and the project SAP. Contaminants of concern either were not detected or were detected at concentrations less than the DMMP and SMS criteria in all of the samples analyzed for this characterization. The data indicate that approximately 18,200 cy of the approximately 21,000 cy in the dredge prism are suitable for in-water placement, upland placement, and/or beneficial use. Additional sampling and analysis will be performed as discussed to complete characterization of the material in the nearshore portion of DMMU-3 that was not characterized due to site conditions. A summary of the results of this sediment investigation are described below.

- The dredged material from DMMU-1 and DMMU-2 (11,800 cy) meets applicable criteria and is suitable for in-water placement, upland placement, and/or beneficial use based on the chemical analytical results from this sediment investigation.

- The dredged material in the north 2/3 of DMMU-3 (6,400 cy), represented by samples DMMU-3 and DMMU-3C, also meets applicable criteria and is suitable for in-water placement, upland placement, and/or beneficial use based upon the chemical analytic results from this sediment investigation.

- The data results indicate that there is no need to collect post-dredge surface samples from the north 2/3 of the dredge prism. The results from DMMU-1, DMMU-2 and the north 2/3 of DMMU-3 show that the dredge material from those units meets DMMP/SMS criteria and indicate that there is reason to believe that the post-dredge surface material on the north 2/3 of the dredge prism will also meet SMS criteria.

- The condition of the dredged material in DMMU-3 in the nearshore 1/3 of the dredge prism cannot be assessed because samples representing that portion of DMMU-3 were not collected due to refusal as previously discussed. This material will be characterized during a future sampling event that will be completed after the pier has been removed and prior to dredging. Material from the post-dredge surface in this nearshore area will be collected and archived pending the results from the overlying material. A SAP addendum describing the proposed sampling will be submitted to the DMMP for review and approval prior to sample collection.

6.0 LIMITATIONS

This report has been prepared for WSDOT/WSF, for their use in evaluating and documenting the suitability of proposed dredged material for in-water and upland placement. This study is based on sampling and analyses conducted in accordance with the guidelines of the DMMP and a project-specific SAP. It is possible that sediment quality may vary over time and/or at locations that were not sampled.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted environmental science practices for dredged material characterization in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

7.0 BIBLIOGRAPHY

Dredged Material Management Program, 2013. "Dredged Material Evaluation and Disposal Procedures (User's Manual)." November 2009, Revised July 2013.

Parametrix, 2012. "Mukilteo Multimodal Project Y-10936 TAA, Sediment Sampling Data Report." November 2012.

PSEP. 1997c. Recommended guidelines for sampling marine sediment, water column, and tissue in Puget Sound. Final Report. Prepared for U.S. Environmental Protection Agency, Seattle, WA.

Figures

NOTES:

1. THE LOCATIONS OF FEATURES SHOWN ARE APPROXIMATE
2. THIS FIGURE IS FOR INFORMATION PURPOSES AND IS INTENDED TO ASSIST IN SHOWING FEATURES DISCUSSED IN THE ATTACHED DOCUMENT.

250 0 250 500
scale feet

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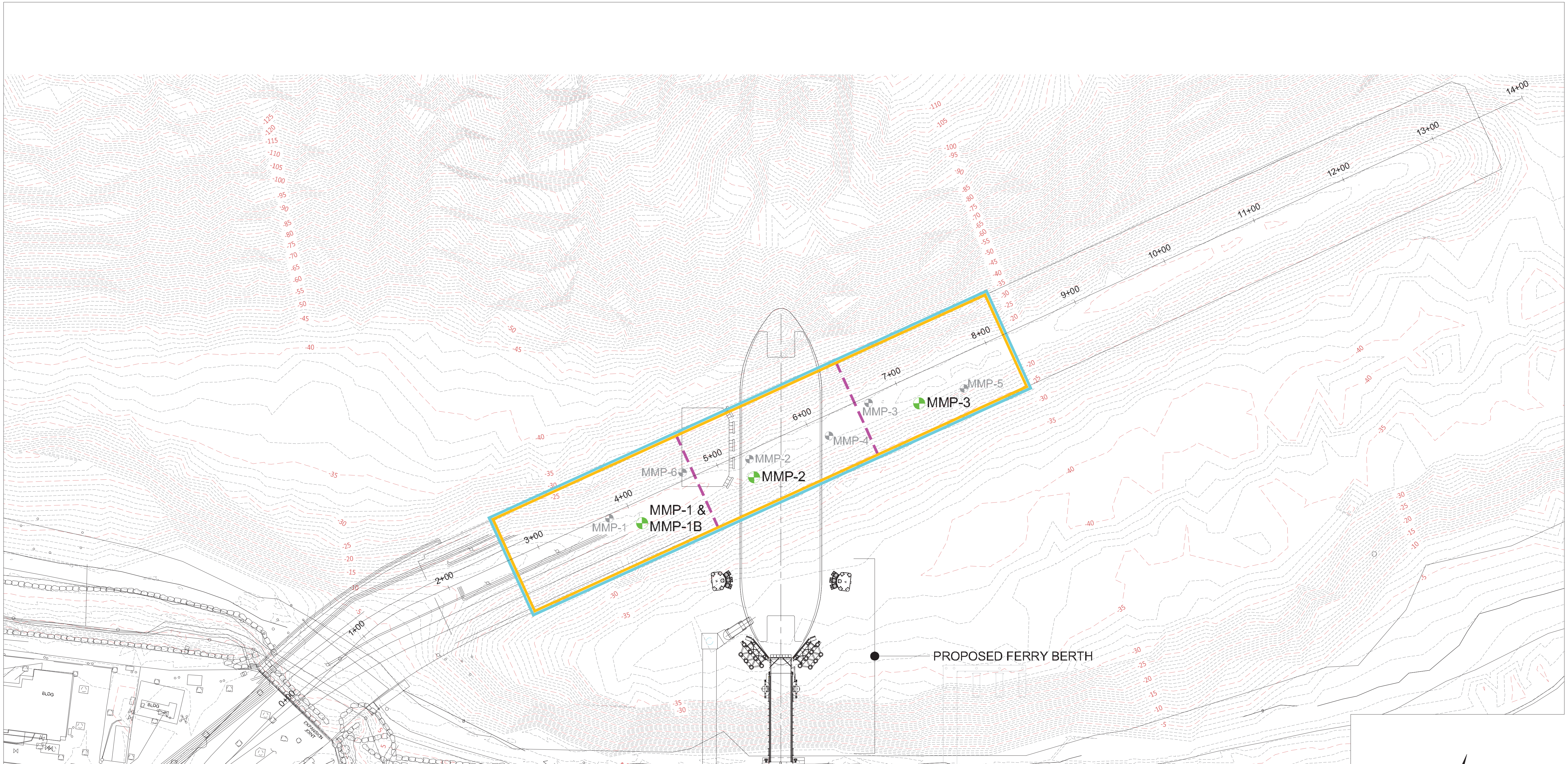
MUKILTEO MULTIMODAL PROJECT: DREDGED MATERIAL CHARACTERIZATION

FIGURE 1: VICINITY MAP

Last Saved by: Cesar.delrosario on: Jan 9, 2014 9:54 AM File: Q:\Federal Way\2007\FAWAT437-868\Proj\Mgt\HazWin\Sediment\SAP\Figures\DMC_Fig1_VICINITY.dwg



NOTES:
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SURFACE DMMU BOUNDARY
DMMU SUBUNIT BOUNDARY
BOUNDARY OF DREDGE PRISM

MMP-1 LOCATION OF NOVEMBER 2013 VIBRACORE
MMP-1 PROPOSED VIBRACORE LOCATIONS FROM APPROVED DMMP SAP (2013)

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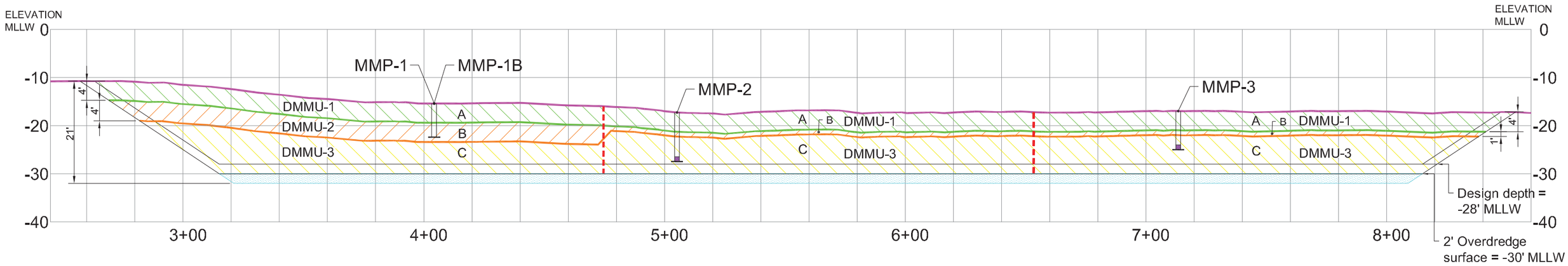
MUKILTEO MULTIMODAL PROJECT: DREDGED MATERIAL CHARACTERIZATION

FIGURE 2: SITE PLAN - DREDGE PRISM AND VIBRACORE LOCATIONS



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VERTICAL: 1"=20'

20 0 20 40
scale feet

NOTES:

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3. THE DREDGE PRISM IS ~550 FEET LONG BY ~120 FEET WIDE WITH A DESIGN DEPTH OF -30 FEET MLLW, INCLUDING 2 FEET OF OVERDREDGE.

LEGEND

- MUDLINE
- DMMU-1 (MODERATE RANKING SURFACE MATERIAL)
- DMMU-2 (HIGH RANKING SUBSURFACE MATERIAL)
- DMMU-3 (HIGH RANKING SUBSURFACE MATERIAL)
- POST-DREDGED SURFACE MATERIAL
- DMMU-3C
- DMMU SUBUNIT BOUNDARY

MLLW	MEAN LOWER LOW WATER
DMMU-1	DREDGED MATERIAL MANAGEMENT UNIT
MMP-1	APPROXIMATE VIBRACORE LOCATION
A	SUBUNIT IDENTIFICATION

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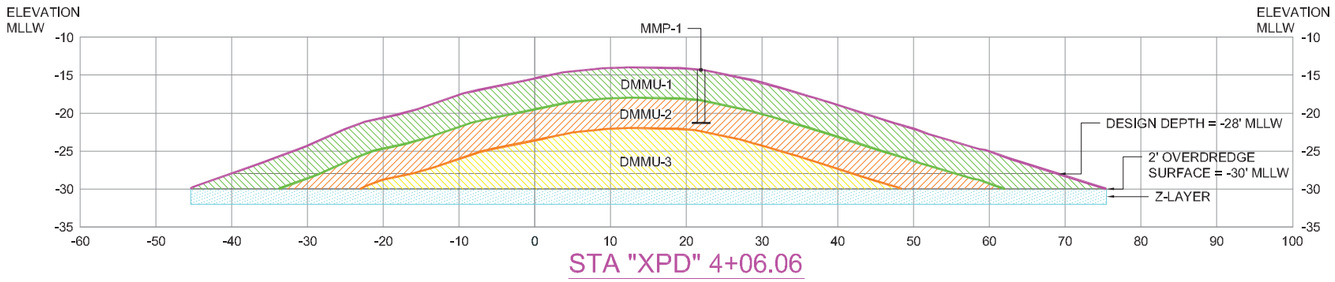
MUKILTEO MULTIMODAL PROJECT: DREDGED MATERIAL CHARACTERIZATION

FIGURE 3: SCHEMATIC DMMU PLAN



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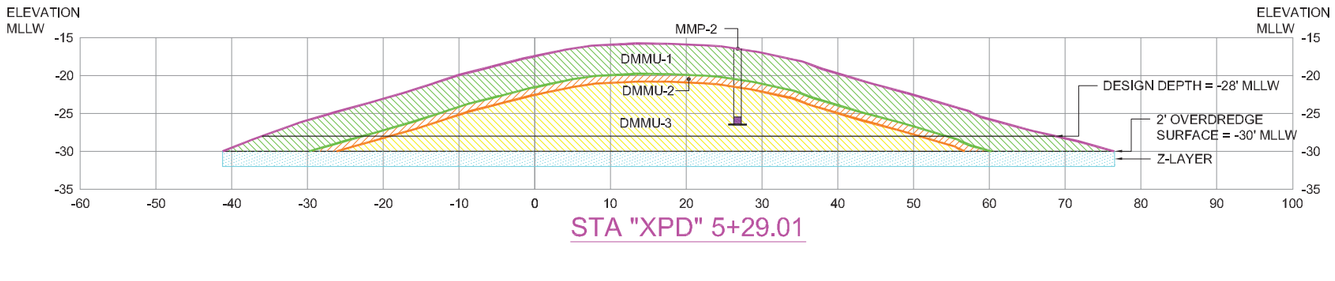

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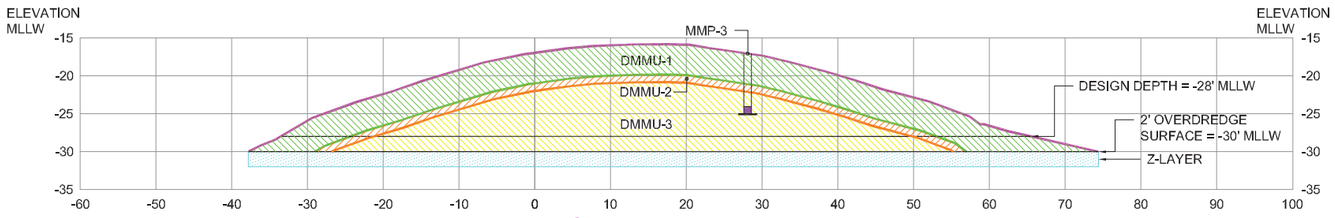

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SCALE: HORIZONTAL: 1"=20'
VERTICAL: 1"=20'

20 0 10 20
scale feet

LEGEND

- MUDLINE
- DMMU-1 (MODERATE RANKING SURFACE MATERIAL)
- DMMU-2 (HIGH RANKING SUBSURFACE MATERIAL)
- DMMU-3 (HIGH RANKING SUBSURFACE MATERIAL)
- POST-DREDGED SURFACE MATERIAL
- DMMU-3C
- DMMU SUBUNIT BOUNDARY

MLLW	MEAN LOWER LOW WATER
DMMU-1	DREDGED MATERIAL MANAGEMENT UNIT
MMP-1	APPROXIMATE VIBRACORE LOCATION
A	SUBUNIT IDENTIFICATION

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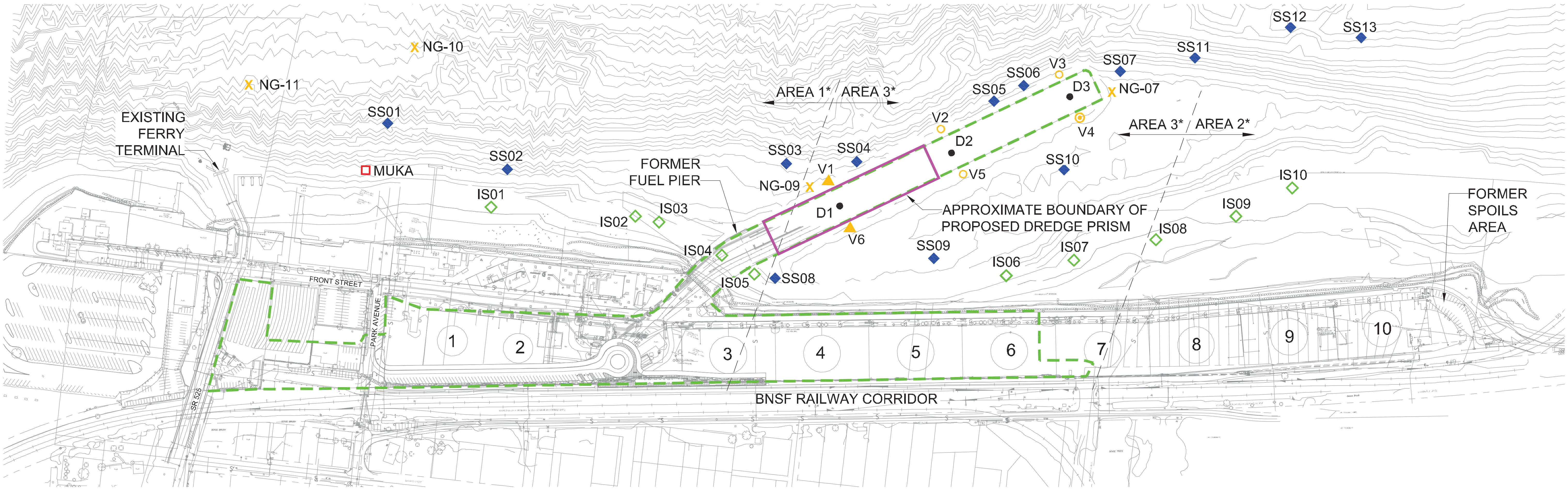
MUKILTEO MULTIMODAL PROJECT: DREDGED MATERIAL CHARACTERIZATION

FIGURE 3A: SCHEMATIC DMMU PLAN: LATERAL CROSS-SECTIONS



Perimeter Sediment Samples

YEAR	SAMPLE ID	DEPTH	COCs[1]
1983	MUKA	SURFACE	fluoranthene
1986	NG-07	SURFACE	acenaphthene
	NG-09		benzoic acid
	NG-10		phenol
	NG-11		acenaphthene, phenol, fluorene
2003	SS01 - SS13	SURFACE	No Exceedences
	IS01 - IS10		
2012[4]	V1/V6	0-4' (composite)	chlordanes
	V2/V5		chlordanes, dioxins/furans
	V3/V4		chlordanes
	V1/V6	4-8' (composite)	No Exceedances
	V3/V4		chlordanes
	V4	8-12' (discrete)	++

++PAHs (indeno(1,2,3-c,d)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene), pyrene, total HPAHs

Under Pier Sediment Samples

YEAR	SAMPLE ID	DEPTH	COCs[1]
2012[4]	D1	0-4' (discrete)	No Exceedences
	D2		
	D3		
	D2	4-8' (discrete)	Archived; not analyzed
	D3		

LEGEND

MUKILTEO MULTIMODAL PROJECT BOUNDARY

APPROXIMATE BOUNDARY OF DREDGE PRISM

COCS = CONTAMINANTS OF CONCERN
PAHS = POLYCYCLIC AROMATIC HYDROCARBONS
NFA = NO FURTHER ACTION
SMS = SEDIMENT MANAGEMENT STANDARDS
SQS = SEDIMENT QUALITY STANDARDS
DMMP = DREDGED MATERIAL MANAGEMENT PROGRAM
SL/ML = SCREENING LEVEL/MAXIMUM LEVEL

*AREAS AS IDENTIFIED IN THE "MUKILTEO MULTIMODAL PROJECT DRAFT ENVIRONMENTAL IMPACT STATEMENT HAZARDOUS MATERIALS DISCIPLINE REPORT" JANUARY 2012

NOTES:

1. SEDIMENT COCS ENCOUNTERED AT CONCENTRATIONS GREATER THAN DMMP SL/ML AND/OR SMS SQS.
2. ECOLOGY GRANTED THE SITE AN NFA IN 2006. UNDER THE AGREED ORDER NO CLEANUP LEVELS WERE PROMULGATED FOR PETROLEUM HYDROCARBONS. THERE IS THE POTENTIAL THAT SHALLOW SOIL (0-8' BGS) AND GROUNDWATER IN THE UPLAND PORTION OF THE SITE ARE IMPACTED BY PETROLEUM HYDROCARBONS, PAHS AND BTEX BASED ON THE HISTORICAL SITE USE.
3. THE SEDIMENT SAMPLE LOCATIONS SHOWN ARE APPROXIMATE.
4. SEDIMENT SAMPLES COLLECTED 2012 (PARAMETRIX).

150 0 150 300
scale feet

BergerABAM

MUKILTEO MULTIMODAL PROJECT: DREDGED MATERIAL CHARACTERIZATION

FIGURE 4: HISTORICAL SEDIMENT INVESTIGATION - CONTAMINANTS OF CONCERN: IN-WATER SEDIMENT

Tables

TABLE 1

SUMMARY OF SAMPLE COORDINATES, CORE RECOVERY AND DEPTH INTERVALS

MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION

MUKILTEO, WASHINGTON

Sample ID	Sample Coordinates		Mudline (Feet CRD)	Penetration (feet)	Core Recovered (feet)	Percent Recovery	Interval (CRD)
	Latitude	Longitude					
MMP-1B	47.9508552°	-122.2977464°	-14.8	7 to refusal	6.7	96	-14.8 to -21.5
MMP-2	47.9510902°	-122.2973857°	-16.35	10 to refusal	9.9	99	-16.35 to -26.25
MMP-3	47.9514533°	-122.2968654°	-15.86	10 to refusal	8	80	-15.86 to-23.86

Datum: MLLW = 0.0 (Everett, 1983 to 2001 Epoch)

NAD 83

TABLE 2

SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO DMMP CRITERIA[2]

MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION

MUKILTEO, WASHINGTON

	DMMU ID				PSR	DMMP Criteria		
Chemical	DMMU 1	DMMU 2	DMMU 3	DMMU-3C	SRM***	SL	BT	ML
Conventionals								
Total Solids (%)	64.93	77.94	85.92	--	--	--	--	--
Total Volatile Solids (%)	3.04	1.77	1.21	--	--	--	--	--
Total Organic Carbon (%)	3.81	2.86	2.05	0.824	--	--	--	--
Ammonia (mg/kg)	6.88	7.21	7.27	--	--	--	--	--
Total Sulfides (mg/kg)	362	8.64	336	--	--	--	--	--
Metals (mg/kg dry weight)								
Antimony	20 U	6 U	6 U	6 U	--	150	--	200
Arsenic	20 U	6 U	6 U	6 U	--	57	507.1	700
Cadmium	0.7 U	0.3 U	0.2 U	**0.2**	--	5.1	11.3	14
Chromium	**26**	**87.3**	**21**	**25.3**	--	260	260	--
Copper	**28.4**	**22.1**	**11.1**	**11.3**	--	390	1,027	1,300
Lead	**8**	**3**	**4**	**4**	--	450	975	1,200
Mercury	**0.05**	**0.04**	**0.04**	0.03 U	--	0.41	1.5	2.3
Nickel	**30**	**59**	**26**	**30**	--	--	--	--
Selenium	0.8 U	0.7 U	0.6 U	0.6 U	--	--	3	--
Silver	1 U	0.4 U	0.3 U	0.3 U	--	6.1	6.1	8.4
Zinc	**38**	**34**	**31**	**26**	--	410	2,783	3,800
LPAHs (µg/kg dry weight)								
Acenaphthylene	**54**	**24**	19 U	**5.3**	--	560	--	1,300
Acenaphthene	**29**	**34**	**16 J**	**7.6**	--	500	--	2,000
Anthracene	**90**	**66**	**20**	**16**	--	960	--	13,000
Fluorene	**42**	**32**	**18 J**	**9.1**	--	540	--	3,600
Naphthalene	**93**	**88**	**40**	**20**	--	2,100	--	2,400
Phenanthrene	**230**	**120**	**50**	**30**	--	1,500	--	21,000
2-Methylnaphthalene	**26**	**19**	19 U	**4.8**	--	670	--	1,900
Total LPAH[3]	**538**	**364**	**154**	**88**	--	5,200	--	29,000
HPAHs (µg/kg dry weight)								
Benzo(a)anthracene	**190**	**160**	**32**	**28**	--	1,300	--	5,100
Benzo(a)pyrene	**360**	**280**	**71**	**71**	--	1,600	--	3,600
Total Benzofluoranthenes[4]	**980**	**740**	**170**	**160**	--	3,200	--	9,900
Benzo(g,h,i)perylene	**200**	**140**	**27**	**30**	--	670	--	3,200
Chrysene	**450**	**320**	**48**	**43**	--	1,400	--	21,000
Dibenzo(a,h)anthracene	**62**	**44**	**8.8**	**7.9**	--	230	--	1,900
Fluoranthene	**380**	**230**	**55**	**54**	--	1,700	4,600	30,000
Indeno(1,2,3-c,d)pyrene	**180**	**130**	**26**	**24**	--	600	--	4,400
Pyrene	**1,300**	**920**	**250**	**240**	--	2,600	11,980	16,000
Total HPAHs[5]	**4,102**	**2,964**	**688**	**658**	--	12,000	--	69,000

TABLE 2

SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO DMMP CRITERIA[2]

MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION

MUKILTEO, WASHINGTON

	DMMU ID				PSR	DMMP Criteria		
Chemical	**DMMU 1**	**DMMU 2**	**DMMU 3**	**DMMU-3C**	**SRM*** **	SL	BT	ML
Chlorinated Hydrocarbons (µg/kg dry weight)								
Hexachlorobenzene	4.8U	4.8U	4.9 U	--	--	22	168	230
Hexachlorobutadiene	4.8U	4.8U	4.9 U	--	--	11	--	270
1,2-Dichlorobenzene	4.8U	4.8U	4.9 U	--	--	35	--	110
1,3-Dichlorobenzene	4.8U	4.8U	4.9 U	--	--	--	--	--
1,4-Dichlorobenzene	4.8U	4.8U	4.9 U	--	--	110	--	120
1,2,4-Trichlorobenzene	4.8U	4.8U	4.9 U	--	--	31	--	64
Phthalates (µg/kg dry weight)								
Diethyl phthalate	**100 B**	**24 B**	**53 B**	--	--	200	--	1,200
Dimethyl phthalate	19 U	19 U	19 U	--	--	71	--	1,400
Di-n-butyl phthalate	19 U	19 U	19 U	--	--	1,400	--	5,100
Di-n-octyl phthalate	19 U	19 U	19 U	--	--	6,200	--	6,200
Bis(2-ethylhexyl)phthalate	48 U	48 U	49 U	--	--	1,300	--	8,300
Butyl benzyl phthalate	19 U	19 U	19 U	--	--	63	--	970
Phenols & Misc. (µg/kg dry weight)								
Pentachlorophenol	96 U	97 U	97 U	--	--	400	504	690
Phenol	**65**	**23**	19 U	--	--	420	--	1,200
2 Methylphenol	**6.0**	**4.1 J**	19 U	--	--	63	--	77
4 Methylphenol	19 U	19 U	19 U	--	--	670	--	3,600
2,4-Dimethylphenol	24 U	24 U	24 U	--	--	29	--	210
Miscellaneous Compounds (µg/kg dry weight)								
Benzoic acid	**98 J**	190 U	190 U	--	--	650	--	760
Benzyl alcohol	19 U	19 U	19 U	--	--	57	--	870
Dibenzofuran	**40**	**31**	**16 J**	**8.8**	--	540	--	1,700
Hexachloroethane	19 U	19 U	19 U	--	--	--	--	--
N-Nitrosodiphenylamine	4.8 U	4.8 U	19 U	--	--	28	--	130
Volatile Organics (µg/kg dry weight)								
Ethylbenzene	1.1 U	1.1 U	0.9 U	--	--	--	--	--
Xylene(s) (sum of o, m, p)	1.1 U	1.1 U	0.9 U	--	--	--	--	--
Pesticides (µg/kg dry weight)								
DDD	0.96 U	**1.2**	0.97 U	--	--	16	--	--
DDE	0.96 U	0.94 U	0.97 U	--	--	9	--	--
DDT	0.96 U	0.94 U	0.97 U	--	--	12	--	--
Total DDD, DDE and DDT	0.96 U	**1.2**	0.97 U	--	--	--	50	69
Aldrin	0.48 U	0.47 U	0.53 Y	--	--	9.5	--	--
Total Chlordane	0.48 U	0.47 U	0.49 U	--	--	2.8	37	--
Dieldrin	0.96 U	0.94 U	0.97 U	--	--	1.9	--	1700
Heptachlor	0.48 U	0.47 U	0.49 U	--	--	1.5	--	270
Lindane	0.48 U	0.47 U	0.49 U	--	--	--	--	--

TABLE 2

SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO DMMP CRITERIA[2]

MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION

MUKILTEO, WASHINGTON

	DMMU ID				PSR	DMMP Criteria		
Chemical	**DMMU 1**	**DMMU 2**	**DMMU 3**	**DMMU-3C**	**SRM*** **	SL	BT	ML
PCBs (µg/kg dry weight)								
Arochlor 1016	9.1 U	9.1 U	<9.7	--	10 U	--	--	--
Arochlor 1221	9.1 U	9.1 U	<9.7	--	10 U	--	--	--
Arochlor 1232	14 Y	18 Y	<9.7	--	10 U	--	--	--
Arochlor 1242	9.1 U	9.1 U	<9.7	--	10 U	--	--	--
Arochlor 1248	9.1 U	9.1 U	<9.7	--	30 UY	--	--	--
Arochlor 1254	**17 P**	9.1 U	**11**	**--**	**96 P**	--	--	--
Arochlor 1260	9.1 U	9.1 U	<9.7	--	**100**	--	--	--
Total PCBs (ug/kg dry weight)	**54**	**45**	**40**	**--**	**231**	130	38[6]	3,100
Tributyltin (µg/kg dry weight)	3.5 U	3.5 U	3.7 U	--	--	--	73	--
Dioxins and Furans (pptr dry weight)								
2,3,7,8-TCDD (TEF = 1.0)	**0.365 BJEMPC**	**0.245 BJEMPC**	**0.172 BJEMPC**	**--**	**0.987 BJ**	DMMP screening level for the sum of all dioxins/furans		
1,2,3,7,8-PeCDD (TEF = 1.0)	**0.968 J**	**0.475 BJEMPC**	**0.315 BJEMPC**	**--**	**1.266**			
1,2,3,4,7,8-HxCDD (TEF = 0.1)	**0.956 BJ**	**0.366 BJ**	**0.196 BJ**	**--**	**1.73**			
1,2,3,6,7,8-HxCCD (TEF = 0.1)	**3.59**	**1.36 B**	**0.655 BJ**	**--**	**4.22**			
1,2,3,7,8,9-HxCDD (TEF = 0.1)	**2.17**	**0.898 BJ**	**0.475 BJ**	**--**	**3.26**			
1,2,3,4,6,7,8-HpCDD (TEF = 0.01)	**83.2**	**24.0 B**	**9.34 B**	**--**	**104**			
OCDD (TEF = 0.0003)	**652**	**169 B**	**59 B**	**--**	**921**			
2,3,7,8-TCDF (TEF = 0.1)	**2.48**	**0.679 J**	**0.283 JEMPC**	**--**	**0.923 JEMPC**			
1,2,3,7,8-PeCDF (TEF = 0.03)	**0.418 J**	**0.214 BJ**	**0.180 BJEMPC**	**--**	**1.2**			
2,3,4,7,8-PeCDF (TEF = 0.3)	**0.566 J**	**0.309 J**	**0.208 J**	**--**	**0.867 JEMPC**			
1,2,3,4,7,8-HxCDF (TEF = 0.1)	**0.727 J**	**0.447 J**	**0.228 JEMPC**	**--**	**3.11**			
1,2,3,6,7,8-HxCDF (TEF = 0.1)	**0.546 JEMPC**	**0.313 J**	**0.194 J**	**--**	**1.24**			
2,3,4,6,7,8-HxCDF (TEF = 0.1)	**0.821 J**	**0.269 JEMPC**	**0.214 J**	**--**	**2.21**			
1,2,3,7,8,9-HxCDF (TEF = 0.1)	**0.249 J**	**0.109 J**	**0.0699 J**	**--**	**0.795 J**			
1,2,3,4,6,7,8-HpCDF (TEF = 0.01)	**12.9**	**7.23**	**4.12**	**--**	**20.4**			
1,2,3,4,7,8,9-HpCDF (TEF = 0.01)	**0.687 J**	**0.396 J**	**0.178 JEMPC**	**--**	**1.96**			
OCDF (TEF = 0.0003)	**38.9**	**16.0**	**8.33**	**--**	**70.9**			
Total TEQ of dioxins/furans	**3.63**	**1.26**	**0.68**	**--**	**5.68**	4	10	--

TABLE 2
SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO DMMP CRITERIA[2]
MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION
MUKILTEO, WASHINGTON

Notes:

[1] Chemical analysis performed by Analytical Resources, Inc., Tukwila, Washington. The laboratory reports are presented in Appendix C.

[2] Dredged Material Management Program (DMMP) Criteria Guideline Chemistry Values updated July 2013; Screening Level (SL), Bioaccumulation Trigger (BT), and Maximum Level (ML).

[3] Total LPAHs = The sum of acenaphthylene, acenaphthene, anthracene, fluorene, napthalene and phenanthrene.

[4] Total benzofluoranthenes = The sum of the "b", "j" and "k" isomers.

[5] Total HPAHs = The sum of benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, Indeno(1,2,3-c,d)pyrene and pyrene.

[6] Result is normalized relative to total organic carbon content.

DMMU = Dredged Material Management Unit

***Puget Sound Reference Material sample SRM-111813

PRM = Puget Sound Reference Material

LPAH = low molecular weight polycyclic aromatic hydrocarbon compounds

HPAH = high molecular weight polycyclic aromatic hydrocarbon compounds

TEF = toxicity equivalency factor

TEQ = toxicity equivalency quotient

BOLD = analyte detected in sample at listed concentration.

U = Laboratory data qualifier indicating analyte undetected at given reporting limit

B = Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's reporting limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J = Estimated concentration when the value is less than ARI's established reporting limits.

EMPC = Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and/or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria".

Y = The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

P = The analyte was detected on both chromatographic columns but the quantified values differ by $\geq$ RPD with no obvious chromotographic interference.

pptr = parts per trillion or picograms per gram

-- = Not available or not applicable

TABLE 3

SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO SMS CRITERIA[2]

MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION

MUKILTEO, WASHINGTON

Chemical	DMMU ID				SMS Criteria	
	DMMU 1	DMMU 2	DMMU 3	DMMU-3C	SQS[3]	MC[4]
Conventionals						
Total Solids (%)	64.93	77.94	85.92	--	--	--
Total Volatile Solids (%)	3.04	1.77	1.21	--	--	--
Total Organic Carbon (%)	3.81	2.86	2.05	0.824	--	--
Ammonia (mg/kg)	6.88	7.21	7.27	--	--	--
Total Sulfides (mg/kg)	362	8.64	336	--	--	--
Metals (mg/kg dry weight)						
Antimony	20 U	6 U	6 U	6 U	--	--
Arsenic	20 U	6 U	6 U	6 U	57	93
Cadmium	0.7 U	0.3 U	0.2 U	**0.2**	5.1	6.7
Chromium	**26**	**87.3**	**21**	**25.3**	260	270
Copper	**28.4**	**22.1**	**11.1**	**11.3**	390	390
Lead	**8**	**3**	**4**	**4**	450	530
Mercury	**0.05**	**0.04**	**0.04**	0.03 U	0.41	0.59
Nickel	**30**	**59**	**26**	**30**	--	--
Selenium	0.8 U	0.7 U	0.6 U	0.6 U	--	--
Silver	1 U	0.4 U	0.3 U	0.3 U	6.1	6.1
Zinc	**38**	**34**	**31**	**26**	410	960
LPAHs (mg/kg OC)						
Acenaphthylene	**1.4**	**0.84**	0.46 U	**0.64**	66	66
Acenaphthene	**0.76**	**1.19**	**0.78**	**0.92**	16	57
Anthracene	**2.4**	**2.31**	**0.98**	**1.94**	220	1,200
Fluorene	**1.1**	**1.12**	**0.89**	**1.10**	23	79
Naphthalene	**2.4**	**3.08**	**2.0**	**2.43**	99	170
Phenanthrene	**6.04**	**4.20**	**2.4**	**3.64**	100	480
2-Methylnaphthalene	**0.68**	**0.66**	0.46 U	**0.58**	38	64
Total LPAH[5]	**14.8**	**13.39**	**7.26**	**10.68**	370	780
HPAHs (mg/kg OC)						
Benzo(a)anthracene	**0.5**	**5.59**	**1.56**	**3.40**	110	270
Benzo(a)pyrene	**9.4**	**9.79**	**3.46**	**8.62**	99	210
Total Benzofluoranthenes[6]	**26**	**25.87**	**8.29**	**19.42**	230	450
Benzo(g,h,i)perylene	**5.0**	**4.90**	**1.32**	**3.64**	31	78
Chrysene	**11.8**	**11.19**	**2.34**	**5.22**	110	460
Dibenzo(a,h)anthracene	**1.6**	**1.54**	**0.43**	**0.96**	12	33
Fluoranthene	**9.9**	**8.04**	**2.68**	**6.55**	160	1,200
Indeno(1,2,3-c,d)pyrene	**4.7**	**4.55**	**1.27**	**2.91**	34	88
Pyrene	**34**	**32.17**	**12.20**	**29.13**	1,000	1,400
Total HPAHs[7]	**108**	**104**	**34**	**80**	960	5,300

TABLE 3

SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO SMS CRITERIA[2]

MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION

MUKILTEO, WASHINGTON

Chemical	DMMU ID				SMS Criteria	
	DMMU 1	DMMU 2	DMMU 3	DMMU-3C	SQS[3]	MC[4]
Miscellaneous Compounds (mg/kg OC)						
Benzoic acid (mg/kg dry weight)	**98 J**	190 U	190 U	--	650	650
Benzyl alcohol (mg/kg dry weight)	19 U	19 U	19 U	--	57	73
Dibenzofuran	**1.0**	**1.1 B**	**0.78 J**	**1.07**	15	58
Hexachloroethane	0.25 U	0.33 U	0.93 U	--	--	--
N-Nitrosodiphenylamine	0.25 U	0.33 U	0.93 U	--	11	11
Hexachlorobutadiene (mg/kg dry weight)	0.063 U	0.084 U	0.46 U	--	3.9	6.2
Chlorinated Hydrocarbons (mg/kg OC)						
1,2-Dichlorobenzene	0.063 U	0.084 U	0.12 U	--	2.3	2.3
1,3-Dichlorobenzene	0.063 U	0.084 U	0.12 U	--	--	--
1,4-Dichlorobenzene	0.063 U	0.084 U	0.12 U	--	3.1	9
1,2,4-Trichlorobenzene	0.063 U	0.084 U	0.12 U	--	0.81	1.8
Phthalates (mg/kg OC)						
Diethyl phthalate	**2.6 B**	**0.84 B**	**2.6 B**	--	61	110
Dimethyl phthalate	0.25 U	0.33 U	0.46 U	--	53	53
Di-n-butyl phthalate	0.25 U	0.33 U	0.46 U	--	220	1700
Di-n-octyl phthalate	0.25 U	0.33 U	0.46 U	--	58	4500
Bis (2-ethylhexyl) phthalate	0.63 U	0.84 U	1.2 U	--	47	78
Butyl benzyl phthalate	0.25 U	0.33 U	0.46 U	--	4.9	64
Phenols & Misc. (ug/kg dry weight)						
Pentachlorophenol	96 U	97 U	97 U	--	360	690
Phenol	**65**	**23**	19 U	--	420	1200
2 Methylphenol	**6.0**	**4.1 J**	19 U	--	63	63
4 Methylphenol	19 U	19 U	19 U	--	670	670
2,4-Dimethylphenol	24 U	24 U	24 U	--	29	29
Pesticides (mg/kg OC)						
DDD	0.013 U	**0.042**	0.02 U	--	--	--
DDE	0.013 U	0.016 U	0.02 U	--	--	--
DDT	0.013 U	0.016 U	0.02 U	--	--	--
Total DDD, DDE and DDT	0.013 U	**0.042**	0.02 U	--	--	--
Aldrin	0.0063 U	0.0082 U	0.02 U	--	--	--
Chlordane	0.0063 U	0.0082 U	0.0024 U	--	--	--
Dieldrin	0.013 U	0.01 U	0.02 U	--	--	--
Heptachlor	0.0063 U	0.0082 U	0.0024 U	--	--	--
Lindane	0.0063 U	0.0082 U	0.0024 U	--	--	--

TABLE 3
SUMMARY OF CHEMICAL ANALYTICAL RESULTS[1] RELATIVE TO SMS CRITERIA[2]
MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION
MUKILTEO, WASHINGTON

Chemical	DMMU ID				SMS Criteria	
	DMMU 1	DMMU 2	DMMU 3	DMMU-3C	SQS[3]	MC[4]
PCBs (mg/kg OC)						
Arochlor 1016	0.48 U	0.64 U	0.95 U	--	--	--
Arochlor 1221	0.48 U	0.64 U	0.95 U	--	--	--
Arochlor 1232	0.73 Y	1.3 Y	0.95 U	--	--	--
Arochlor 1242	0.48 U	0.64 U	0.95 U	--	--	--
Arochlor 1248	0.48 U	0.64 U	0.95 U	--	--	--
Arochlor 1254	**0.45 P**	**0.59**	**0.049**	--	--	--
Arochlor 1260	0.48 U	0.64 U	0.05 U	--	--	--
Total PCBs (mg/kg OC)	**0.45 P**	**0.59**	**0.049**	**--**	12	65

Notes:

[1] Chemical analysis performed by Analytical Resources, Inc., Tukwila, Washington. The laboratory reports are presented in Appendix C.

[2] SMS = Sediment Management Standards

[3] SQS = Sediment Quality Standards

[4] MC = Maximum Criteria

[5] Total LPAHs = The sum of acenaphthylene, acenaphthene, anthracene, fluorene, napthalene and phenanthrene.

[6] Total benzofluoranthenes = The sum of the "b", "j" and "k" isomers.

[7] Total HPAHs = The sum of benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, Indeno(1,2,3-c,d)pyrene and pyrene.

DMMU = Dredged Material Management Unit

LPAH = low molecular weight polynuclear aromatic hydrocarbon compounds

HPAH = high molecular weight polynuclear aromatic hydrocarbon compounds

BOLD = analyte detected in sample at listed concentration.

U = Laboratory data qualifier indicating analyte undetected at given reporting limit

B = Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's reporting limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J = Estimated concentration when the value is less than ARI's established reporting limits.

EMPC = Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and/or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria".

Y = The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

P = The analyte was detected on both chromatographic columns but the quantified values differ by $\geq$ RPD with no obvious chromotographic interference.

ND = not detected

-- = Not available or not applicable

TOC = Total organic carbon

mg/kg OC = milligrams per kilogram organic carbon normalized

Shading indicates that the criteria and results are TOC normalized. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

TABLE 4
GRAIN SIZE DATA
MUKILTEO MULTIMODAL PROJECT DREDGED MATERIAL CHARACTERIZATION
MUKILTEO, WASHINGTON

	Sample ID		
Grain Size in %	**DMMU-1**	**DMMU-2**	**DMMU-3**
Gravel	16	33	43
Sand	62	57.6	54
Silt	11.7	4.5	<3.2
Clay	10.4	4.7	<3.2

Notes:

1. Organic matter (including shell fragments) was not removed prior to testing. The laboratory report identifies these values as the "apparent" grain size distribution.

Appendix A
SAP and DMMO Approval E-Mail

From: Vanderelst, Kelsey NWS <Kelsey.Vanderelst@usace.army.mil>
Sent: Friday, April 05, 2013 8:14 AM
To: England, Victoria; BARTON, CELIA (DNR); Barton.Justine@epamail.epa.gov; Inouye, Laura (ECY)
Cc: Fisher, Sally; Paul Krueger (paul.krueger@wsdot.wa.gov); Sasha Visconty (sasha@axisenviro.com); Glover, Sandy
Subject: RE: Revised Final DMMP SAP: Mukilteo Multimodal Project (UNCLASSIFIED)

Follow Up Flag: Follow up
Flag Status: Completed

Classification: UNCLASSIFIED
Caveats: NONE

Hi Victoria,

The DMMP agencies hereby approve the Mukilteo Multimodal Project SAP. We understand there is some concern over the recency of the high ranked subsurface DMMUs and we will do our best to work with you on that in the event a recency extension is needed.

Please let me know once your sampling dates have been set.

Thanks,

Kelsey van der Elst
Dredged Materials Management Office
Seattle District - U.S. Army Corps of Engineers kelsey.vanderelst@usace.army.mil
phone: 206-764-6945

-----Original Message-----
From: England, Victoria [mailto:Victoria.England@abam.com]
Sent: Wednesday, April 03, 2013 2:31 PM
To: Vanderelst, Kelsey NWS; BARTON, CELIA (DNR); Barton.Justine@epamail.epa.gov; Inouye, Laura (ECY)
Cc: Fisher, Sally; Paul Krueger (paul.krueger@wsdot.wa.gov); Sasha Visconty (sasha@axisenviro.com); Glover, Sandy
Subject: Revised Final DMMP SAP: Mukilteo Multimodal Project

Good Afternoon,

The DMMP SAP for the Mukilteo Multimodal Project Dredge Material Characterization is provided on behalf of the Washington State Department of Transportation Ferries Division. The SAP has been revised in response to additional edits and comments that we received from you. We have included a pdf of the full revised report, a pdf of the body of the report with the revisions in "track changes," and a comment/response form including your most recent comments.

Please contact me with any questions or comments.

Upon your approval, this document will serve as the final SAP for the dredge material characterization associated with the project.

_____

Victoria England, LG

Senior Environmental Scientist

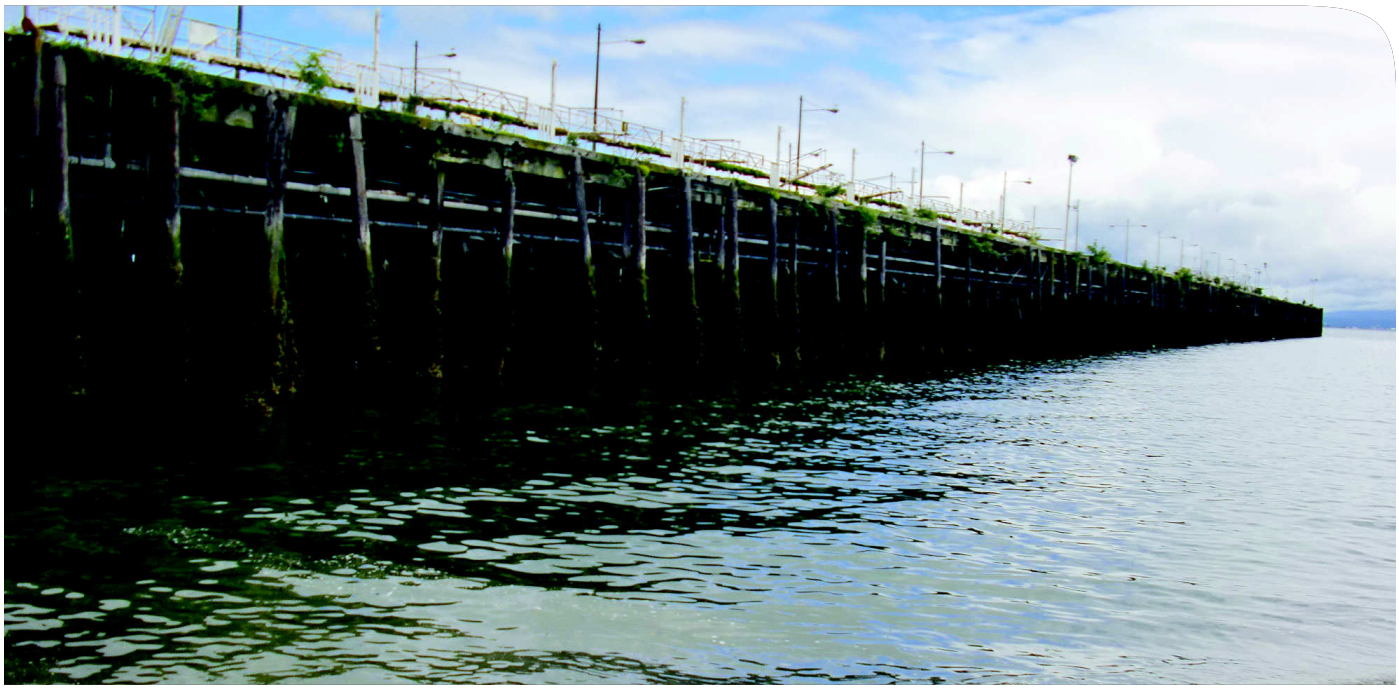
Voice 206-357-5621
Email Victoria.england@abam.com

BergerABAM
1301 Fifth Avenue, Suite 1200
Seattle, Washington 98101-2677
http://www.abam.com

Classification: UNCLASSIFIED
Caveats: NONE

BergerABAM

REVISED Final Sampling and Analysis Plan



Mukilteo Multimodal Project
Dredge Material Characterization

Prepared for
Washington State Department of Transportation
Ferries Division
Seattle, Washington

A07.0859.00

3 April 2013

Revised Sampling and Analysis Plan (SAP)

Mukilteo Multimodal Project
Dredged Material Characterization

Prepared for

Washington State Department of Transportation
Ferries Division
Seattle, Washington

Attention: Dredged Material Management Office (DMMO)

3 April 2013

Prepared by

BergerABAM
1111 Main Street, Suite 300
Vancouver, Washington 98660

Job No. A07.0859.00

Sally L. Fisher
Senior Project Manager

Victoria R. England, LG
Environmental Scientist

REVISED SAMPLING AND ANALYSIS PLAN

Washington State Department of Transportation Ferries Division
Mukilteo Multimodal Project
Dredged Material Characterization

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Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act/Superfund
COCs	contaminants of concern
CFR	Code of Federal Regulations
CSL	cleanup screening level
CUL	cleanup level
CSCSL	Confirmed or Suspected Contaminated Sites List
DMMO	Dredge Material Management Office
DMMP	Dredge Material Management Program
DMMU	Dredge Material Management Unit
DNR	Department of Natural Resources
Ecology	Department of Ecology
EDR	Environmental Data Resources, Inc.
EIM	Environmental Information Management
EPA	Environmental Protection Agency
EPTA	Evaluation Procedures Technical Appendix
G	grams
GPS	Global Positioning System
xxH:xxV	Horizontal to Vertical
KG	kilograms
LUST	leaking underground storage tank
MG	milligrams
ML	maximum level
MLLW	mean lower low water
mls	milliliters
NAD	North American Datum
NPL	National Priorities List
PCS	petroleum contaminated soil

PSDDA	Puget Sound Dredged Disposal Analysis program
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RHA	River and Harbors Act
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SD	Suitability Determination
SL	screening level
SMS	Sediment Management Standards
SQS	Sediment Quality Standards
SVOCs	semi-volatile organic compounds
UST	underground storage tank
VOCs	volatile organic compounds
WAC	Washington State Administrative Code
µg	micrograms

1.0 INTRODUCTION

The Washington State Department of Transportation (WSDOT) Ferries Division proposes the Mukilteo Multimodal Project (project) to improve the operations and facilities serving the mainland terminus of the Mukilteo-Clinton ferry route in Washington State. The project will include a new ferry berth, loading area, waiting area, and associated infrastructure to be located approximately 1,800 feet to the northeast of the existing Mukilteo ferry terminal. The project location is shown on the Vicinity Map and Site Plan (Figures 1 and 2).

The project is located at the site of the Mukilteo Tank Farm (tank farm) and associated Tank Farm Pier (pier). The project includes removing the pier and dredging through a sediment mound located beneath the pier to create a channel to accommodate the passage of ferry boats to and from the new terminal.

The tank farm, currently owned by the United States Air Force (USAF), is in the process of being transferred to the Port of Everett in accordance with congressional action. WSDOT will acquire a portion of the property from the Port of Everett for the project. The existing conditions within the project area are shown on Figure 2.

This draft Sampling and Analysis Plan (SAP) describes the site history, potential sources of contaminants, existing data, the proposed project, and associated sampling and analysis of the proposed dredge material. The analytical results will be used to characterize the sediment to evaluate the potential suitability of dredge material for open-water disposal in accordance with Dredged Material Management Program (DMMP) protocols. This draft SAP is provided to the Dredge Material Management Office (DMMO) for the DMMP's approval of the sampling program and procedures prior to completing sediment sampling.

2.0 PROPOSED PROJECT

2.1 Potential Dredging Configuration

WSDOT proposes to dredge the berth/channel through the existing sediment beneath the pier starting approximately 210 feet from the shoreline and extending to 690 feet from the shoreline along the axis of the pier. The pier extends northeast into Possession Sound from the shoreline between former Tanks 2 and 3, as shown on Figure 2 and Figure 3. The pier is 1,360 feet long by 102 feet wide and is supported by approximately 3,900 pressure-treated creosote piles. The pier decking and piles will be removed prior to dredging. The decking will be recycled if possible, and the piles will be transported off site for disposal at an appropriate upland site in accordance with applicable regulations. Complete pile removal will be attempted

and best management practices will be in place during pier and pile removal activities to prevent debris from being left in the sediment.

Sediment has mounded beneath the pier to elevations ranging from -14 feet mean lower low water (MLLW) to approximately -25 feet MLLW. Existing depths in the area to be dredged currently range from approximately -14 to -25 MLLW. The dredge prism is expected to be approximately 120 feet wide and will extend to -30 MLLW (including 2 feet of overdredge), as shown on Figures 4 and 5. The dredging volume will be approximately 23,500 cubic yards (see Table 1).

2.2 Project Area Dredging History

The area on the east side of the pier appears to have been dredged when the pier was constructed in 1941, based on the bathymetry shown on historic construction drawings. Dredging beneath the pier footprint has likely not occurred since the pier's construction. The mound beneath the pier consists of sediment that was trapped by the pier piles and accumulated over time on top of native material. The depth to native material cannot be determined based upon recent sampling events.

3.0 EXISTING SITE CONDITIONS

3.1 General

The upland portion of the project site occupies parcels of property currently owned by the USAF (former tank farm and pier, Parcel 13), WSDOT (existing ferry holding area, Parcel 5), A&J Enterprises (ferry holding lanes leased to WSDOT, Parcel 6), and James Mongrain (pressed or blown glass and glassware, Parcel 8). Approximately 80 percent of the tank farm property is paved with asphalt or concrete, as shown on Figure 2.

Stormwater on the tank farm was historically collected in oil/water separators and discharged from three outfalls within the Mukilteo Multimodal Project footprint. Currently, stormwater on the west portion of the site is collected in catch basins and routed through oil/water separators (one associated with the historical tank farm and one with the existing National Oceanographic and Atmospheric Administration facility) and discharged into Possession Sound. Figure 2 shows existing outfall and oil/water separator locations.

Proposed Dredge Area

A portion of the pier occupies the proposed dredge prism. Tank farm infrastructure still exists on the pier, including fuel piping from historic fueling operations and railroad spurs. The railroad spurs extend approximately 400 feet onto the pier from the shoreline. The pier is in disrepair and currently cannot be accessed.

4.0 SITE HISTORY

The history of the project area, as described below, was compiled from various sources provided by WSDOT, including USAF reports, site investigation reports,

and regulatory agency files. The following information relates only to the historical use of the tank farm pier and activities along the waterfront (tank farm) in the proposed ferry berth area.

4.1 Upland

The tank farm property was occupied by a lumber and shingle mill from approximately 1909 through 1930. The mill buildings were destroyed in a fire in 1938.

The tank farm property was acquired by the U.S. Army during World War II and the site was used for loading ammunition on to ships bound for the Pacific theater during the war. The property facilities included administration buildings, maintenance buildings, an ammunition repair shop, railroad spurs, coal-fired equipment, and a pile retaining wall.

The tank farm property was transferred to the USAF in 1951. The property operated as a fuel storage and transfer facility under the USAF and, later, the Defense Logistics Agency (DLA). Fuel storage and transfer operations ceased at the property in 1989.

Environmental site investigations and remediation were conducted at the site after the operations shut down. A remedial treatment system was operated on a portion of the site from 1997 through 2002. Subsequent compliance monitoring led to the Washington State Department of Ecology (Ecology) issuing a Satisfaction of Enforcement Order No. DE 93TC-N268 for the project site in 2006 and the removal of the site from Ecology's Hazardous Sites List in 2008. No further monitoring was required at the site by Ecology after 2006. The site investigations and remediation are described in Section 5.2.

4.2 Tank Farm Pier

The tank farm pier was built in 1941 and was used to load ammunition onto ships during World War II. Munitions were reportedly lost over the side of the pier during this time.

The tank farm pier deck was reinforced with concrete to allow four railroad spurs to be constructed on the pier in 1951. One of the spurs was later removed to accommodate fuel pipelines that extend the entire length of the pier. Approximately 520 of the original tank farm pier piles were removed and replaced in 1959. The remaining 3,380 (approximate) appear to be the original piles placed at the time of pier construction.

The pier was used to receive deliveries of jet fuel (JP-4) and aviation gasoline from 1953 through at least 1973 and possibly until 1989 when fuel storage and transfer operations ceased on the tank farm. The tank farm pier had fallen into disrepair and was no longer used for loading fuel onto railcar tankers by the late 1970s. The fuels

delivered to the pier were distributed by a network of pipes and associated equipment, including the 10 tank farm tanks, to barges, railcars, and tanker trucks. The pier's fuel pipelines remain on the pier and were reportedly flushed after 1989.

5.0 POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination were identified based on a comprehensive review of various available sources, including databases, reports, investigations, and data provided by WSDOT and information from Ecology's Environmental Information Management (EIM) database.

5.1 Database Review

5.1.1 Regulatory Database Search

We reviewed a regulatory database search completed by Environmental Data Resources Inc. (EDR) to identify potential sites of concern within and adjacent to the dredge area. The EDR report was obtained by WSDOT in March 2011 for the draft Hazardous Material Discipline Report associated with the project. The results of the review are summarized in the following sections.

5.1.1.1 Project Area. The former tank farm (listed as the fuel laboratory and U.S. Defense Fuel Support Point) is listed as a conditionally exempt small-quantity generator (CE-SQG), leaking underground storage tank (LUST)/underground storage tank (UST) site and on the Confirmed or Suspected Contaminated Sites List (CSCSL), with a No Further Action (NFA) determination dated 2006. Six USTs are listed as either removed or closed in place and 10 USTs are listed as exempt. The contents of the USTs are not listed in the EDR report.

5.1.1.2 Adjacent to Project Area. Other properties in the vicinity of the dredge area listed in the EDR report are either cross-gradient or too far from the study area to be considered potential sources of concern.

5.1.2 Available Site Data Review

We reviewed reports and documents for the project area provided by WSDOT in August and September of 2012 to identify potential sources of contamination that may have impacted sediment quality within the proposed dredge prism. The following sections discuss the findings of that review.

5.1.2.1 Project Area.

Former Tank Farm Pier

Sediment has built up under the pier around the pier piles, with the top of the sediment mound being as much as 25 feet higher than the surrounding sediment. The presence of treated piles within the dredge area is a potential environmental concern during pile pulling and dredging activities. The impact may be limited

because of the age of the pilings and based on the findings of a limited pile study conducted in 1982.[1]

A 1982 physical and core-sample investigation by the USAF of the pier's piles indicates that the piles may not have been fully treated prior to pier construction, and there is little creosote remaining in the exposed portion of the piles. However, only 10 percent of the piles were examined for the study, and the results did not address the condition of the portion of the pile below the mudline. Previous studies of creosote impacts from treated piles/poles indicate that the area of impact around the treated piles will likely be limited to a 1-foot halo around each of the treated piles (Environmental Literacy Council, 2002 and North American Wood Pole Coalition, undated report).

Crates of ammunition were reportedly lost over the side of the pier during ship-loading operations in World War II. U.S. Navy divers recovered several World War II vintage ammunition shells from beneath the pier in 1986 and 1987.

An underwater marine sediment ordnance survey was conducted in 1993. The survey was completed to a depth of 12 inches from 20 feet under the pier to 50 feet away from the pier to locate potentially buried ordnance remaining from World War II ammunition loading operations. No ordnance was found.[2] It is unlikely, though possible, that ammunition exists in the sediment mound beneath the pier or in the vicinity of the pier in sediment deeper than 12 inches below the mudline.

Some of the JP-4 and aviation gasoline fuels delivered to the pier may have spilled into Possession Sound due to equipment and pipe leaks, malfunctions, and failures, though it is not noted in any of the documentation reviewed for this report. If spills did occur, the fuel may have contaminated sediments that make up the sediment mound.

Light standards, an elevated walkway, pier operations building/guard shack, smaller sheds, and piping are located on the pier. The walkway and piping could be coated with paint containing lead and possibly other heavy metals such as chromium. Light fixture ballasts and other oil-filled electrical equipment in the building and sheds and on the pier could contain PCBs. Mercury switches, such as thermostats, as well as asbestos-containing material (ACM), could exist in any structures on the pier.

[1] "Structural Survey Mukilteo Fuel Pier," by KPFF Consulting Engineers for the Defense Logistics Agency, dated 28 October 1982.

[2] "After Action Report on DFSP Pier Mukilteo, WA 6-10" by U.S. Department of the Navy, dated 22 July 1993.

5.1.2.2 Upland Project Area.

Former Tank Farm – Upland Area

The tank farm was operated by the USAF and DLA from 1951 until 1989. Each bulk fuel tank was cleaned every two to five years, and the tank sludge was disposed of in the truck turnaround area east of Tank 10 prior to 1965.

Several spills and releases of petroleum hydrocarbons (including gasoline-, diesel-, lube oil-, and jet fuel-range) were reported at the tank farm between 1979 and 1987, including a release of approximately 6,700 gallons of JP-4 to the ground from a section of damaged underground pipeline in 1986. Petroleum hydrocarbons were observed in beach seeps and a sheen was observed on Possession Sound that resulted from the 1986 release.

Five of the bulk storage tanks (Tanks 1 through 3, 7, and 8) were sandblasted and repainted in 1986. Approximately 30 cubic yards of spent sandblasting grit from this operation was transported off site. Site files do not indicate whether or not the soils around these tanks were assessed for the presence of residual sandblast grit or associated contaminants of concern (chromium and lead) that were identified in the sandblast grit transported off of the property. Water samples were collected by Ecology from stormwater around Tanks 3, 7, and 8 and tested for metals in 1996. The water from Tanks 7 and 8 was found to be clean enough to discharge to sanitary sewers. Water samples collected around Tank 3 were found to be contaminated with metals at concentrations greater than state surface water cleanup standards.

Nineteen tanks were removed from the site on or after 1991. Four aboveground storage tanks (ASTs) for diesel, FS11, and non-potable water still remain on the upland portion of the property. Three of these ASTs are empty and inactive and the non-potable water AST is still active. (U. S. Air Mobility Command, August 2012)

Contaminants of concern (COCs) were encountered at concentrations greater than site-specific cleanup levels (CULs) and/or Washington State Model Toxics Control Act (MTCA) Method A CULs for unrestricted land use (where site-specific cleanup levels were not promulgated for a particular contaminant) in upland site soil during 2006/2007 archaeological and geotechnical investigations completed in Area 1 and the west side of Area 3. The exceedances were encountered at depths that roughly correlate with the groundwater smear zone, between 8 feet and 12 feet below ground surface (bgs), where tidal influence causes the groundwater level to fluctuate. The condition of groundwater at these locations is not known. The following COCs were encountered at concentrations greater than site-specific cleanup levels for soil.

- Benzene
- Benzo(a)anthracene
- Chrysene
- Benzo(b) and (k) anthracenes
- Lead

- Silver

Diesel-, lube oil-, and gasoline-range petroleum hydrocarbons were also encountered at concentrations greater than the MTCA Method A CULs for those analytes. The sampling locations and areas where COCs exceedances were encountered are shown on Figure 3.

COCs at concentrations greater than site-specific cleanup levels and/or MTCA Method A CULs were also encountered in the surface granular asphalt bedding material beneath the bottom pad of Tank 3. It is possible that this contamination exists in bedding material beneath all large AST pads.

Remaining tank farm features that may represent COC sources include the welded steel bottoms of the 10 bulk fuel storage tanks; the concrete containment walls and their access stairways; the reinforced concrete floors; the network of underground piping, valves, fuel filters, and pumping systems; the oil/water separators and their associated drain lines; and underground piping and structures, as well as monitoring, extraction, and air sparging wells that may still remain on site from remediation activities. Residual petroleum may be encountered during decommissioning of underground pipelines and structures.

5.2 Previous Investigations

5.2.1 Upland Investigations and Site Remediation

Various site investigations and remedial actions have been completed on the tank farm portion of the site. Hazardous materials were encountered in the tank farm soil, groundwater, surface water, and sediment in the late 1970s through 1980s. COCs detected in soil and groundwater at the site during investigations conducted between the late 1970s and 1980s include total petroleum hydrocarbons, volatile organic compounds (VOCs) [3], and lead. Floating product was observed on groundwater on the west and east portions of the site throughout the 1980s. COCs detected in soil and/or groundwater at the site between the 1980s and 2007 include jet fuel, other petroleum hydrocarbons (including liquid and dissolved phase petroleum hydrocarbons), polychlorinated biphenyls (PCBs), VOCs, metals, polycyclic aromatic hydrocarbons (PAHs), and semi-volatile organic compounds (SVOCs).

Environmental impacts at the site are generally related to the petroleum transfer and storage operations, including a spill of 6,700 gallons of jet fuel (JP-4) after a distribution pipe was damaged in 1986/1987. The spill led to petroleum hydrocarbons discharging in seeps on the beach and a sheen on Possession Sound. The spill was the result of a damaged section of underground distribution pipeline

[3] VOCs detected at the site in the 1970s and 1980s include benzene, ethylbenzene, toluene, chloroform, methylene chloride, and tetrahydrofuran.

located north of Tank 9. The conditions at the site and the 1986/1987 spill prompted the Washington State Office of the Attorney General to issue Remedial Action Order DE90-N209 requiring DLA to complete a remedial investigation and feasibility study (RI/FS) for cleanup of the Mukilteo Tank Farm pursuant to MTCA and its associated cleanup regulations (1990 Remedial Action Order).

Completed cleanup actions generally consisted of tank removals and groundwater cleanup. A fuel recovery well was installed between the fuels laboratory and an oil-water separator in 1982. The DLA completed an RI/FS for the tank farm (including in-water areas) in 1996 that established site-specific soil and groundwater cleanup levels for certain VOCs, SVOCs/PAHs, and metals.[4] No site-specific soil or groundwater standards were developed for petroleum hydrocarbons.

The Mukilteo Tank Farm was divided into three operable units or areas (Area 1, Area 2, and Area 3, as shown on Figure 2) for corrective action purposes after investigative work was performed in the early 1990s. Area 1 focused mainly on contamination in the vicinity of the USAF Fuels Laboratory. Area 2 was found to have soil and groundwater contamination, with a dissolved groundwater contaminant plume centered between Tanks 9 and 10, extending parallel to the shoreline from the west end of the Tank 9 containment to the east end of the Tank 10 containment. Corrective action was not required in Area 3 because significant contaminant levels were not identified in that area.

Soil vapor extraction and air sparge remediation systems were installed in Area 1 and Area 2. The remedial systems were operational from May 1997 to November 2000. Approximately 338,000 pounds of hydrocarbons (or approximately 49,400-56,100 gallons of hydrocarbons, using conversion factors of 6.02 pounds per gallon for aviation gasoline fuels and 6.84 pounds per gallon for JP-4) was removed from the site during remediation system operation.

Ecology issued a Partial Satisfaction of Enforcement Order No. DE 93TC-N268 indicating that no further monitoring was required for most of the site on April 21, 2005. Soil, groundwater, surface water and marine sediment compliance monitoring was conducted following the shutdown of the remediation system (through 2006) when Ecology determined that the Enforcement Order had been satisfied and no further monitoring was required.

[4] Site specific CULs were promulgated for VOCs- acetone (soil only), benzene, toluene, ethylbenzene, and xylenes (BTEX; soil and groundwater); SVOCs - anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, di-n-butylphthalate, fluoranthene, fluorene, and pyrene (soil only) and 2-methylnapthalene and naphthalene (soil and groundwater); and metals - arsenic (As), chromium (Cr)-VI, copper (Cu), lead (Pb), mercury (Hg), silver (Ag), zinc (Zn) –(soil and groundwater), and Cr-III (groundwater only)

Contaminants of concern (including petroleum hydrocarbons, metals, VOCs, and PAHs)[5] were encountered in site soil at concentrations greater than site-specific CULs and/or MTCA Method A CULs for unrestricted land use during geotechnical and archaeological investigations completed in 2006 and 2007 for WSDOT. The impacted soil was encountered at depths that roughly correlate with the groundwater smear zone (8-12 feet bgs) where tidal fluctuations influence groundwater level fluctuations at the site. The extent of impacted soil on this portion of the project area is not known. Figure 3 shows areas of concern identified during the 2006/2007 investigation and suspected areas of concern based on the 2006/2007 investigation findings and site use history. The soil conditions on the upland portion of the site have not been evaluated since 2007 and the groundwater conditions have not been evaluated since compliance monitoring ended at the site in 2006.

The upland environmental conditions are discussed in detail in the project Draft Hazardous Materials Discipline Report (WSDOT 2012) and other documents.

5.2.2 Sediment Investigations

Various investigations of surface sediment quality conditions were conducted by the USAF and U.S. Environmental Protection Agency (EPA) offshore of the tank farm property between 1983 and 2003 and by WSDOT in 2012 as described below. The sediment sampling locations are shown on Figure 3. Investigation results are summarized below.

- The USAF subcontracted a survey of pollutant levels in clams, beach sediments, and seawater in an area located to the east of the dredge prism and project area in 1983 and found no evidence of hydrocarbon contamination in the marine environment. Fluoranthene was detected at a concentration greater than the DMMP Maximum Level (ML) for that analyte in one sediment sample (MUKA) located offshore of the west end of the Tank Farm.

- COCs were encountered at concentrations greater than the associated DMMP Screening Levels (SL) and ML in four surface sediment samples collected during a 1986 investigation conducted by the EPA. The COC exceedances include acenaphthene, benzoic acid, phenol, and fluorene.[6]

- A 1994 sediment investigation was completed by GSI on behalf of the USAF as part of ongoing RI/FS activities. There were no exceedances of SMS SQS encountered in any of the sediment samples analyzed for the 1994 sediment investigation. However, some biological tests of those samples failed. Continued sediment monitoring was included in the Compliance Monitoring Plan (CMP,

[5] See "Mukilteo Multimodal Project Draft l Environmental Impact Statement: Hazardous Materials Discipline Report," prepared for the U.S. Department of Transportation Federal Transit Administration and WSDOT, January 2012.

[6] This data was reviewed in Ecology's EIM database https://fortress.wa.gov/ecy/eimreporting/

1998) associated with RI/FS activities for the site. The CMP identified area-specific monitoring requirements for site sediments associated with the site upland remedial actions.

- Marine sediment samples collected for the USAF RI/FS in 2003 from the top 10 cm (4 inches) at 10 intertidal and 13 subtidal locations were found to comply with regulatory cleanup criteria for all organic and inorganic COCs. The samples had been analyzed for VOCs and SVOCs, pesticides, PCBs, metals, and nitroaromatic compounds (for the presence of ammunition constituents). No further assessment or remedial cleanup action for marine sediment along the shoreline at the Mukilteo Tank Farm was required by Ecology based on these results. Ecology issued a "No Further Action" determination for the Mukilteo Tank Farm in 2006 and project site was given a site cleanup status of "Removal from Hazardous Sites List Completed" in Ecology's 2008 Sediment Cleanup Site Status Report. (Shaw Environmental, Inc., 2004)

- WSDOT conducted preliminary sediment sampling in 2012 (Parametrix) to support the NEPA/SEPA process for the Mukilteo Multimodal Project. The sampling was conducted based upon February 2012 Sediment Sampling and Analysis Plan (Parametrix/Leon Environmental 2012 for WSDOT). Sediment samples were collected from locations around the perimeter of the pier and beneath the pier, as shown on Figure 3.

  The sediment observed in the cores collected in 2012 consists primarily of loosely consolidated shell hash, silty fines, medium to coarse sand or clay, and some cobbles and pebbles. Masses of woody debris, shells, and other debris were observed at all sampling locations though there were no clear layers observed from location to location. Small pockets of black material resembling asphalt were observed around a rock or cobble in all depth intervals in the samples collected from three of the perimeter cores (V4 through V6). Leon Environmental attributed this black material to debris originating from the aging paved pier deck surface.

  Composited samples from the upper interval (surface to 4 feet) at three perimeter locations, one on each side of the pier along three transects, were analyzed for standard list of DMMP/SMS COCs plus dioxins/furans (analyzed only in the surface composite samples), tributyltin and petroleum hydrocarbons (diesel-, gasoline-, and motor oil-range). Two composite samples and one discrete sample were analyzed from the 4- to 8-foot interval and three discrete samples were analyzed from the 8- to 12-foot interval from sample locations around the pier. One or more COCs were encountered at concentrations greater than DMMP Screening Levels SLs and/or SMS SQS in sediment samples collected from six locations around the perimeter of the former fuel pier. The COCs encountered at

concentrations greater than DMMP SL and/or SMS SQS in the pier perimeter samples include:

- Chlordane (surface to 4-foot interval – V1/V6, V2/V5, V3/V4 composite samples).
- Chlordane (4- to 8-foot interval - V3/V4 composite sample).
- PAHs (8- to 12-foot interval - V4 discrete sample).
- Dioxins/Furans (0- to 4-foot interval – V2/V5 composite sample).

The sediment samples were analyzed for petroleum hydrocarbons due to the historical use of the pier as a former fueling and loading pier. The petroleum hydrocarbon results are presented in the 2012 Parametrix report for informational purposes and were not compared to any screening levels as there are no DMMP or SMS SLs for petroleum hydrocarbons. The petroleum hydrocarbon results indicated:

- Gasoline-range hydrocarbons were not detected in any of the sediment samples analyzed.
- Diesel-range petroleum hydrocarbons were either not detected or were detected at concentrations ranging from 17 to 120 mg/kg (discrete sample V4 collected from the 8 to 12 feet interval).
- Motor oil-range petroleum hydrocarbons were either not detected or were detected at concentrations ranging from 28 to 200 mg/kg (discrete sample V4 collected from the 8 to 12 feet interval).

Exceedances were not detected in the samples that were collected from the surface interval (surface to 4 feet) beneath the pier. Deeper sediment samples (from the 4- to 8-foot interval) collected from two of the three sample locations beneath the pier were not analyzed.

Composited samples from the full sample length (0 to 12 feet interval) at each pier perimeter location (V1/V6, V2/V5 and V3/V4) and from the full sample length (0 to 4 feet interval) at each under pier location (D1 through D3) were submitted to a specialized laboratory (Engineering/Remediation Resource Group, Inc.) for an independent technical evaluation of likely munitions and explosives contamination of concern based on analysis of nitroaromatics and nitramines concentrations. Munitions-related analytes were not detected in any of the samples analyzed for those constituents.

The results of the study are summarized below and in Appendix A.

5.2.3 Polychlorinated Dibenzo-p-dioxins and Furans (PCDD/F)

Data regarding the potential presence of polychlorinated dibenzo-p-dioxins and furans (PCDD/F) in the vicinity of the project area were not found during our review of available documents and the Ecology EIM database. Historical activities in and around the project area and existing site use do not appear to be potential sources of PCDD/F in the proposed dredge prism.

The DMMP SL for dioxins/furans was exceeded in one surface composite (V2/V5) collected from the pier perimeter during the 2012 sampling event. Exceedances were not encountered in any of the other samples analyzed for those constituents during the 2012 sampling event.

6.0 PROGRAM OBJECTIVES AND APPROACH

6.1 Objectives

The objective of this SAP is to characterize potential dredge materials within the project area to evaluate the following:

- Suitability of the material for disposal at a DMMP unconfined open-water disposal site.
- Suitability for beneficial use as in-water or upland fills.
- Upland disposal options (if the dredged material is not suitable for DMMP disposal or beneficial use).

6.2 Approach Considerations

6.2.1 General Assumptions

The approach is based on the following:

- This draft SAP is based on the assumption that the Dredge Material Management Office (DMMO) will determine that the surface dredge material (upper 4-feet interval) is moderate ranked and the subsurface dredge material (below 4 feet below the mudline) is high ranked with the associated sampling frequency and recency guidelines based on existing site conditions and historical site use.[7]
- Samples for DMMP characterization will be collected from a vessel outfitted for sediment sampling and sample collection will be attempted both from perimeter and under pier sample vibracore locations.
- Z-sample collection will be attempted, but it may not be possible to collect a sample from the depth representing the newly exposed dredge surface prior to dredging due to sediment conditions or access to the under-pier sample

[7] Recency guidelines allow characterization data to be valid for low-moderate to moderate ranked sites for 5 to 7 years and for high ranked sites for 2 years .

locations. If a pre-dredging sample is not collected, the newly exposed surface will be sampled after dredging to characterize that material.

6.2.2 Eligibility for Potential Open-Water Disposal

It is assumed for the purposes of this SAP that the material within the project area will be defined as "dredged material" and may be considered potentially eligible for unconfined open-water disposal at the Port Gardner DMMP disposal site and/or beneficial use.

6.2.3 Site Ranking

The DMMP (DMMO, 2009, revised 2013) defines site ranking as follows:

- "Low" ranking where there are "Few or no sources of chemicals of concern. Data are available to verify low chemical concentrations (below DMMP screening levels) and no significant response in biological tests."
- "Low-moderate" ranking is used where "Available data indicate a low rank may be warranted, but there are insufficient data to confirm the ranking."
- "Moderate" ranking is used at those sites where "Sources exist in the vicinity of the project, or there are present or historical uses of the project site, with the potential for producing chemical concentrations within a range associated historically with some potential for causing adverse biological impacts."
- "High" ranking is used at those sites where "Many known chemical sources, high concentrations of chemicals of concern, and/or biological testing failures in one or both of the two most recent cycles of testing."

6.2.3.1 Surface Sediment

The portion of Possession Sound around the city of Mukilteo generally has a high ranking with respect to chemicals of concern based on the historical and existing use of upland facilities in the area according to the DMMP User's Manual, "Current general and project-specific rankings for Puget Sound."[8] However, research of historic and existing activities in the vicinity of the dredge area, historic sediment sampling results and the results of the 2012 sediment sampling indicate a moderate ranking for the surface (upper 4 feet), which is supported by the following:

- Potential sources of contamination at the site include the presence of creosote-treated piles within the dredge prism, the historical storage and transfer of petroleum products on the pier and adjacent upland and stormwater outfalls in the site area.

[8] "Dredged Material Evaluation and Disposal Procedures (Users' Manual), Table 4-2" by DMMO, US Army Corps of Engineers Seattle District, dated July 2008 (revised November 2009).

- Existing data indicate that COCs were detected in a limited number of sediment samples at concentrations greater than SMS/DMMP screening level criteria:

  - SMS/DMMP exceedances were not detected in the surface samples collected around the project site in 2003 (Shaw Environmental) or the samples collected in 2012 from the upper 4 feet of material under the pier (Parametrix/Leon Environmental). The sample locations are shown on Figure 4.

  - Exceedances of chlordanes were detected in the samples collected from the upper 4 feet of material around the perimeter of the pier during the 2012 sampling event. Exceedance of dioxins/furans was detected in one of the pier perimeter composite samples (V2/V5) collected from the surface 0- to 4- foot interval during the 2012 sampling event.

- The site was removed from Ecology's Hazardous Sites list in the 2008 Sediment Cleanup Status Report.

6.2.3.2 Subsurface Sediment

Research of historic and existing activities in the vicinity of the dredge area, historic sediment sampling results and the results of the 2012 sediment sampling indicate a high rank for subsurface material (greater than 4 feet below the mudline), which is supported by the following:

- Potential sources of contamination at the site include the presence of creosote-treated piles within the dredge prism, the historical storage and transfer of petroleum products on the pier and adjacent upland and stormwater outfalls in the site area.

- Historical bioassays conducted during the 1994 sampling event (USAF) indicated toxicity in some sediment samples collected in the area.

- Existing data indicate exceedances in samples collected from greater than 4 feet below the mudline including

  - DMMP SL Exceedances of chlordanes detected in the samples collected from one composite sample collected from the 4- to 8-foot interval around the north end of the pier.

  - DMMP SL and SMS SQS exceedances of PAHs in a discrete sample collected from the 8- to 12-foot interval near the northeast corner of the pier.

7.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

7.1 General

Dredge volume, dredge prism configuration and sampling frequency are based on typical cross sections and conditions within the project area. The dredge prism for the option considered for this SAP is based on the following assumptions:

- The existing top of slope ranges from approximately elevation -14 to -25 feet MLLW.
- The design dredging depth will be elevation –30 feet MLLW, including 2 feet of allowable overdredge depth.
- The new slope face will have a 2H:1V slope from the top of bank to -30 feet MLLW.
- The surface material (mudline to 4 feet interval) in the dredge prism will be ranked moderate.
- The subsurface material (below 4 feet) in the dredge prism will be ranked high.

7.2 General Sampling Scheme

The sampling and analyses frequency for DMMP characterization for this project has been determined in accordance with the proposed site rankings as discussed above. We expect that this frequency will also be sufficient for evaluating suitability for beneficial use, compliance with the Sediment Management Standards (SMS, WAC 173-204) and/or other disposal options. It is recognized that material considered for upland beneficial use or disposal may require additional testing appropriate to the proposed scenario based on other regulatory programs and/or requirements that are outside the scope of the DMMP review and approval authority.

We have assumed for planning purposes that the dredge prism consists entirely of material that was deposited beneath the tank farm pier via longshore drift. The material characteristics will be documented in the boring logs. The dredge depths range from approximately 13 feet at the northeast end of the prism to approximately 20 feet at the southwest end of the prism. Sample collection will be attempted at least 2 foot deeper than the proposed dredge depth (including 2 feet of overdredge) at each boring location in order to collect Z-samples representing the newly exposed, post-dredge surface conditions.

Post-dredge surface samples will be collected where pre-dredge Z-samples cannot be achieved during the dredge material characterization sampling. The post dredge samples will be collected from the newly exposed dredge surface in the approximate locations of the boring locations identified for the sampling event described in this

SAP. The three proposed vibracore borings and three alternate locations will be located approximately as shown on Figures 4 and 5.

Sampling and analysis for this project will be performed in accordance with DMMP/Puget Sound Estuary Program (PSEP) protocols. Samples will be collected using a diver guided winch mounted vibracore sampler similar to what was used during the 2012 sampling event. Cores will be processed and samples collected either as soon as the core is extruded on the boat or onshore at the end of each sampling day. Material will be continually sampled from the surface to a depth of approximately 13 feet (along the majority of the prism) and, if possible, to a depth of approximately 20 feet at the southwest end of the prism.

The project area has been delineated into dredge material management units (DMMUs) as follows.

- The potential dredge area has been delineated into three DMMUs ranging from approximately 3 to 12 feet thick, as shown on Figure 5.
- Each DMMU will be further divided into 3- to 12-foot-thick subunits that will be composited for analysis in accordance with the compositing scheme shown in Figure 5. Nine samples will be collected and composited for analysis of the three DMMUs as shown in Table 1.

One additional sample will be collected and archived from each vibracore location as Z-samples (up to three discrete samples archived for potential Z-layer analysis) representative of the post-dredge surface conditions. These samples will be collected from material at depths greater than the bottom of the dredge prism (-30 to -32 feet MLLW), as shown on Figure 5. Up to three additional cores (MMP-4 through MMP-6 on Figure 5) will be completed to collect Z-samples if the proposed vibracores (MMP-1 through MMP-3) cannot reach the post-dredge surface elevation because of sediment conditions or access challenges.

Surface samples from the newly exposed post-dredge surface will be collected after dredging is completed from locations coinciding with vibracores MMP-1 through MMP-3 if pre-dredging Z-sample collection is unsuccessful. The post-dredge surface samples will be collected from the upper two feet of the sediment surface using vibracore sampling equipment operated from a vessel outfitted for that purpose.

Post-dredge surface samples are typically collected from the top 10 cm of the newly exposed dredge surface. However, the post-dredge surface at the project site will be subject to some prop wash scour when the new ferry terminal is operational. The "Mukilteo Hydrodynamics & Sediment Transport Technical Memorandum " (Coast and Harbor, 2013) indicates limited scour (up to 1.4 feet deep) may be caused by prop wash at elevations of approximately -20 to -25 feet MLLW. The scour may impact a portion of the newly dredged surface in the proposed dredge prism, which

is why we propose to collect Z-samples from the upper two feet of the post-dredge surface after dredging is completed if none of the pre-dredge Z-samples can be collected.

Each DMMU sample will be analyzed for DMMP/SMS conventional parameters, the full suite of DMMP/SMS COCs, non-chlorinated volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) PCBs, PCDD/F, pesticides, and tributyltin (TBT) as shown on Table 2. Sediment reference material will also be submitted for analysis of PCBs and PCDD/F in accordance with DMMP guidance.

7.3 Compositing Scheme

7.3.1 General

Samples will be collected from the subunits in each boring and composited to represent DMMUs as described above. Details of the compositing scheme, including depth, subunits and DMMU volumes are shown on Table 1. The anticipated compositing schemes are shown schematically on Figure 5. DMMU samples will be collected and archived for bioassays. Subunit samples will be collected and archived for potential future chemical analysis, if needed.

7.3.2 Surface Unit

DMMP requirements for sampling and analysis of surface sediment for a moderate-ranked site consist of one sample per 4,000 cubic yards and one analysis per 16,000 cubic yards.

The volume of the surface unit (DMMU 1) is estimated to be approximately 8,300 cubic yards. Subunit samples representing approximately 2,700 to 2,800 cubic yards (see Table 1) of material each will be collected. Three subunit samples will be composited to represent DMMU 1, as shown on Figure 5.

7.3.3 Subsurface Units

DMMP requirements for sampling and analysis of subsurface sediment for a high-ranked site consist of one sample per 4,000 cubic yards and one analysis per 12,000 cubic yards.

DMMU 2 and DMMU 3 represents the subsurface units of the dredge prism, as shown on Figure 5. The volume of DMMU 2 is estimated to be approximately 6,100 cubic yards and the volume of DMMU 3 is estimated to be approximately 9,100 cubic yards. Subunit samples representing approximately 1,600 to 4,200 cubic yards (see Table 1) of material will be collected and composited for chemical analysis of DMMU 2 and DMMU 3 as shown on Table 1. Subunit samples will also be archived for potential future analysis.

7.3.4 Post-dredge Surface Z-Samples

Three discrete samples representing the post-dredge sediment surface will be collected from each of the three vibracore locations, if possible. The post-dredge

surface is considered to be at -30 feet MLLW for the purposes of this project. The Z-layer samples will be archived pending results from the overlying DMMU sample. The Z-samples collected will be submitted for analysis if the analytical results from DMMU-3 show concentrations of COCs exceeding the associated DMMP SLs and/or SMS SQS.

Up to three additional vibracores (MMP-4 through MMP-6 on Figures 4 and 5) will be attempted if it is not possible to reach the Z-sample elevation in any of the planned vibracore locations (MMP-1 through MMP-3). Up to three samples will be collected from the newly exposed sediment surface after dredging is completed if Z-samples cannot be collected in the locations shown on Figure 5.

The Z-samples and post-dredge samples, if necessary, will be submitted for analysis of conventionals and the COCs (if any) detected at concentrations exceeding SMS SQS or DMMP SLs in the overlying DMMU 3. Portions of these samples will be archived and frozen pending the need for additional analyses.

7.4 Sample Collection and Handling Procedures

DMMP-approved sample requirements, analytical methods and QA/QC criteria are included in Appendix B. Sample volumes, holding times, containers, preservatives, and chemical analytical methods are summarized in Table B-1 in Appendix B. QA/QC criteria are summarized in Table B-2 and B-3 .

7.4.1 Sample Collection

7.4.1.1 Pre-Dredge Characterization

Samples will be collected using a diver-directed vibracore operated from a vessel outfitted for that purpose. Floats will be secured to the coring assembly and a diver will tow the vibracore to a viable sampling location under the pier. The diver will attach the vibracore assembly to an overhead or side-positioned line and pulley and remove the floats when a viable sampling location has been identified. The assembly will be lowered to the mudline and the vibracore will be triggered and vibrated into the sediment until the sample depth is reached or it hits refusal. The diver will guide the assembly back to the boat once the core has been extracted and the floats are attached.

Depth of core penetration into the subsurface will be compared to the length of the core recovered during sampling. The amount of recovery will be recorded and the cores will be capped with aluminum foil and core barrel caps on each end of the core pending sample extrusion.

The vibratory action during sampling tends to consolidate the sample material, so the core length frequently does not match the penetration depth. The sample recovery will be evaluated against the acceptable threshold of 80 percent recovery as recommended by the DMMP. Resampling and/or moving the sampling location, as

appropriate, will be conducted if the initial core recovery is less than 80 percent. The sampling team will make at least 3 sampling attempts in the target area before moving the sampling station to another location within the DMMU. The sampling team will contact the DMMO representative, Kelsey Vanderelst, to discuss options if 80 percent recovery cannot be obtained within three attempts.

The proposed method is based upon primarily successful methodology that Parametrix and Leon Environmental used for the 2012 sediment sampling (Parametrix 2012). BergerABAM (on behalf of WSDOT) will consult with Parametrix regarding these procedures prior to sampling.

7.4.1.2 Post-Dredge Characterization

Up to three post-dredge surface sediment samples will be collected from the newly exposed sediment surface from any of the three areas (delineated by red-dashed lines on Figure 5) where pre-dredge Z-sample collection could not be achieved. The post-dredge surface samples will be collected from the upper 2 feet of the sediment surface using vibracore sampling equipment operated from a vessel outfitted for that purpose.

7.4.2 Sampling Equipment Decontamination

Samples will be collected using a vibracore sampler operated from a vessel outfitted for that purpose. All samplers and miscellaneous sampling tools will be thoroughly cleaned prior to use according to the following procedure:

- Hot water rinse
- Wash with brush and Alconox soap
- Triple rinse with distilled water

All sampling equipment not used immediately after cleaning will be wrapped in aluminum foil and/or stored in plastic bags. The rule of "potential for contaminants" will be used such that any sampling equipment suspected of contamination will be rejected and decontaminated prior to use.

7.4.3 Sample Handling and Compositing

Material at each boring location will be continuously sampled from the existing surface to the dredge design depth for the pre-dredge characterization sampling. Post-dredge surface samples collected after the dredging is completed, if needed, will be collected from borings continuously sampled from the newly exposed dredge surface to 2 feet below the mudline (-30 to -32 MLLW).

Samples from each boring will be separated into 3.0-foot to 12.0-foot fractions representing the subunits as shown on Figure 5, (identified as subunit layers A through C), and Table 1. The fractions will be stored separately for compositing with subunits collected from the other borings, as appropriate. An equal and

representative portion of material will be taken from each core sample to be composited for each sample that will be submitted for analysis.

Logs and field notes of all samples will be maintained during sampling activities. At a minimum, the following will be included in the log:

- Elevation of each station sampled as measured from MLLW
- Station location determined in latitude and longitude using GPS
- Date and time of collection of each sample
- Names of field person(s) collecting and logging in the sample
- Sample characteristics, including grain size, density, and moisture
- Weather conditions
- Tidal conditions and tidal stage
- The sample station number as derived from this sampling plan
- Length and depth intervals of each sample and percent recovery for each sample
- Apparent resistance of the material to sampling based on the depth of penetration of the sampler
- Percent of apparent compression of core samples (significant compaction is not anticipated based on the sandy composition of recently collected samples)
- Picture of each core
- Any deviation from the approved sampling plan

The sample material will be composited and thoroughly mixed in stainless steel bowls. One to 2 liters of homogenized sample will be jarred to provide adequate volume for physical and chemical analyses. Approximately 4 liters of the homogenized sample will be jarred (with zero headspace) to provide adequate volume for bioassay testing. The composited samples will be stored in iced coolers for transport to the laboratory.

All handwork (extruding, mixing, and compositing) will be performed using stainless steel spoons. All sampling, mixing, and compositing equipment will be decontaminated prior to collection at each sampling station. Disposable latex/nitrile gloves will be used and will be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between composites to prevent cross contamination.

7.4.4 Volatiles and Sulfides Subsampling

Volatile (ethylbenzene and total xylenes) and sulfides subsamples will be collected immediately upon sample extrusion and prior to compositing (volatiles and sulfides could be lost while compositing) from one randomly chosen sample representing each DMMU. Subsamples will be collected along the entire length of the representative sample section, from material that has not had contact with the sampler.

Two separate 4-ounce containers will be completely filled with sample sediment for volatiles. No headspace will be allowed to remain in either container. Two samples will be collected to ensure that an acceptable sample is submitted to the laboratory for analysis.

Sulfides samples will be preserved using 5 milliliters (mls) of 2 Normal zinc acetate per 30-g of sediment (DMMP, updated November 2009). The acetate will be placed in a 4-ounce sampling jar and the sample material will be placed in the jar, covered, and shaken vigorously to completely expose the material to the zinc acetate.

7.5 Sample Archiving

A portion of the material collected from each subunit at each DMMU will be archived for potential future individual analysis and/or bioassay analysis.

7.6 Field Sampling Schedule

The sampling will be performed using vibracore equipment owned and operated by a subcontractor licensed to work in the state of Washington. Sampling is expected in mid-2013, but is not scheduled.

7.7 Positioning

Station positions will be determined in latitude and longitude using a hand-held GPS unit (North American Datum [NAD] 83/07) to the nearest 0.1 second. The accuracy of measured and recorded horizontal coordinates will be within 3 meters.

Vertical elevations within each boring location will be measured directly based on depth sampled compared to mudline. Depths below mudline can typically be determined within approximately 0.1 foot. Vertical elevations will be referenced to MLLW based tidal stage and mudline elevations at the time of sampling.

7.8 Sample Transport and Chain-of-Custody Procedures

The samples will be transported to an accredited chemical analytical laboratory when the sampling and compositing is completed. Chain-of-custody procedures will be used to track sample handling from field collection through delivery of the samples to the laboratory. Specific procedures will be as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations, as specified in 49 CFR 173.6 and 49 CFR 173.24.

- The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler, and BergerABAM's office name and address) to enable positive identification.

- A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.

- Signed and dated chain-of-custody seals will be placed on all coolers prior to shipping.

- Sample coolers will be transported by vehicle to an accredited chemical analytical laboratory.

The chain-of-custody form will be signed by the persons transferring custody of the coolers upon transfer of sample possession to the laboratory. The shipping container seal will be broken and the condition of the samples will be recorded by the receiver upon receipt of samples at the laboratory.

8.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

8.1 Analysis Program

The analysis program for this project has been developed primarily to evaluate suitability for open-water disposal in accordance with DMMP. Chemical analysis of the composite samples will consist of sediment conventionals, tributyltin, dioxins/furans, non-chlorinated VOCs (ethylbenzene and total xylenes) and DMMP and SMS COCs, as shown in Table 2. Analysis for TCLP will be performed if needed for upland disposal evaluation.

DMMP screening levels and SMS sediment quality standards (SQS) are shown in Table 2. Chemical analysis of material archived from the individual sampling stations may be performed if DMMP screening levels are exceeded. The decision to test individual subunits will be made in conjunction with the WSDOT and the Dredged Material Management Office (DMMO).

The Puget Sound Sediment Reference Material (SRM) will be requested from the DMMO and will be submitted for PCB and dioxins/furans analysis for data evaluation and validation purposes. Certified reference material, as identified in documentation provided by Analytical Resources, Inc. and included as Appendix C, will be used for data evaluation and validation purposes for the metals, SVOCs and pesticides analyses. The material will be handled and analyzed in accordance with DMMP guidance (DMMP, 2009 and 2012).

The chemical analytical data generated from the chemical analysis will also be used to evaluate general sediment quality in accordance with the SMS (also shown in Table 2). Information regarding the chemical characteristics of sediments that will be

potentially suspended and/or dispersed during construction may be required for obtaining Ecology's Short-term Water Quality Modification and Water Quality Certification permits for the project. Suitability for various beneficial uses may also be indicated using the SMS evaluation.

The SMS evaluation will be used by WSDOT as appropriate in making project decisions regarding beneficial uses under consideration, but the results of the SMS evaluation will not affect DMMP suitability for open water disposal. Results of the SMS evaluation will be used to determine the antidegradation status of the surface material exposed by dredging and to evaluate potential water quality effects during in-water activities such as pile removal. Additional testing for dredge material characterizationwill not be triggered based on the results of the SMS evaluation.

The need to submit samples for bioassay testing will be evaluated after the dredge material characterization data results are reviewed. Bioassay testing will be triggered by the exceedance of one or more screening levels for DMMP COCs in the DMMU samples. Samples selected for bioassay testing will be submitted for both acute and chronic tests to characterize toxicity. Bioassay testing will include the following tests.

- 10-day amphipod (Eohaustorieus estuaries) mortality testing (acute toxicity)
- 20-day juvenile infaunal (Neanthes arenaceodentata) growth test (chronic toxicity)
- Sediment larval (Mytilus galloprovincialis or Dendraster exentricus) test (acute toxicity).

8.2 Laboratory Analyses Protocols

Analytic protocols, including sample holding times and method detection limits, will be in accordance with EPA and Puget Sound Estuary Program (PSEP) protocols and requirements. Laboratory testing procedures will be conducted in accordance with the Puget Sound Dredged Disposal Analysis (PSDDA) Evaluation Procedures Technical Appendix (EPTA), June 1988; the PSDDA Phase II Management Plan Report, September 1989; and with the PSEP Recommended Protocols. Several details of these procedures are discussed below.

8.3 Chain-of-Custody

A chain-of-custody record for the samples will be maintained throughout all sampling activities and will accompany samples during shipment to the laboratory, as previously described. Information tracked by the chain-of-custody records in the laboratory include sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

8.4 Limits of Detection

The samples will be analyzed for all the parameters listed in Table 2. Detection limits of all chemicals of concern must be below DMMP screening levels (SLs). Failure to achieve this may result in a requirement to reanalyze or to conduct bioassays. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-detection below DMMP SLs.

All conventional parameters, including grain size, total organic carbon, total solids, total volatile solids, ammonia, and sulfides, will be analyzed. Particle grain-size distribution for each composite sample will be determined in accordance with American Society for Testing and Materials (ASTM) D 422 (modified). Wet sieve analysis will be used for the sieve sizes U.S. No. 4, 10, 20, 40, 60, 140, 200 and 230. Hydrogen peroxide will not be used in preparations for grain-size analysis. Hydrometer analysis will be used for particle sizes finer than the 230 sieve. Water content will be determined using ASTM D 2216. Sediment classification designation will be made in accordance with U.S. Soil Classification System, ASTM D 2487.

8.5 Quality Assurance/Quality Control

The chemistry QA/QC procedures will follow PSEP and the QA/QC criteria established for the PSDDA/DMMP programs. The bioassay procedures will follow PSEP protocols and Puget Sound Water Quality Authority "Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments" and the QA/QC criteria established for the SMS/DMMP programs. Bioassay performance standards and evaluation guidelines are included in Appendix B (Table B-3).

8.6 Laboratory Written Report

A written report will be prepared by the analytical laboratory documenting all the activities associated with sample analyses. At a minimum, the following will be included in the report:

- Results of the laboratory analyses and QA/QC results, including case narrative
- All protocols used during analyses
- Chain-of-custody procedures, including explanation of any deviation from those identified herein
- Any protocol deviations from the approved sampling plan
- Location and availability of data
- QA2 data required by Ecology for the EDD in EIM format

As appropriate, this sampling plan may be referenced in describing protocols.

9.0 REPORTING

9.1 QA Report

The project quality assurance representative will prepare a quality assurance report based upon activities involved with the field sampling and review of the laboratory analytical data. The laboratory QA/QC reports will be incorporated by reference. This report will identify any field and laboratory activities that deviated from the approved sampling plan and the referenced protocols and will make a statement regarding the overall validity of the data collected. The QA/QC report will be incorporated into the Final Report.

9.2 Final Report

A written report shall be prepared by BergerABAM documenting all activities associated with collection, compositing, transportation of samples and chemical analysis. The chemical analytical report will be included as an appendix. The following will be included in the Dredge Material Characterization Report:

- Type of sampling equipment used.
- Protocols used during sampling and testing and an explanation of any deviations from the sampling plan protocols.
- Logs of the borings showing descriptions of each sample and indicating the native horizon.
- Methods used to locate the sampling positions within an accuracy of 3 meters.
- Locations of the borings where the samples were collected. Locations will be reported in latitude and longitude to the nearest tenth of a second.
- A plan view of the project showing the actual sampling locations and DMMU boundaries.
- Chain-of-custody procedures used and explanation of any deviations from the sampling plan procedures.
- Description of sampling and compositing procedures.
- Final QA report and validation report.
- Data results relative to DMMP and SMS criteria in a table.
- Percent recovery for each core.
- Measured water depth and tide info for each core.

- A table with compositing scheme and length of each core in feet and relative to MLLW.
- Bioassay results, including bioassay laboratory report, if applicable.
- Sampling field logs, as appendix.
- Data in EIM format submitted to DMMO.
- QA2 data required by Ecology for data validation prior to entering data in their Sediment Quality database. In addition, all field and laboratory analyses results and associated QA data will be submitted to the Corps of Engineers in electronic format.
- Project cost data will be forwarded to the DMMO separately.

10.0 STUDY TEAM AND RESPONSIBILITIES

10.1 General

The SAP includes: (1) project planning and coordination; (2) field sample collection; (3) laboratory preparation and analyses; (4) QA/QC management; and (5) final data report. The program will use the following team members and responsibilities.

10.1.1 Project Planning and Coordination

Ms. Sally Fisher of BergerABAM is the primary contact for characterization activities and project permitting coordination. Ms. Victoria England of BergerABAM is the primary technical representative for characterization activities.

10.1.2 Field Sample Collection

Ms. England will provide overall direction to the field and laboratory programs and will coordinate field activities. She will be responsible for assuring that all the required logistics elements and protocols are followed, including accurate sample positioning, sample handling and field decontamination procedures, physical evaluation and logging of samples, and chain of custody of the samples until delivered to the analytical laboratory. Samples will be collected using equipment owned and operated by a subcontractor licensed to work in the State of Washington. The driller will be provided with this SAP and will be required to follow the procedures described herein. The driller will record any deviations from the SAP in their daily logs.

10.1.3 Laboratory Analysis

Analytical Resources, Inc. (ARI) will perform chemical analysis for this project. ARI will be provided with this SAP and will be required to follow the procedures described herein. The laboratory staff will record any deviations from the SAP in their analytical data package for the project. Quality Assurance/Quality Control Management

Ms. Fisher will provide QA/QC oversight and senior review for the field-sampling and laboratory programs. Ms. Amber Roesler, BergerABAM, will review laboratory QA/QC data to assure validity of data and conformance to QA/QC requirements, and will provide a written QA/QC report.

10.1.4 Final Data Report

Ms. England will be responsible for preparation of the final sampling data report identifying sample locations, field and laboratory methods, QA/QC, lessons learned, and data results.

11.0 REFERENCES

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Table 1 - Compositing Scheme and DMMU Volumes

DMMU/ Sample	Total DMMU Volume (cy)	Vibracore	Depth (feet below mudline)	Sample	Sample Volume	Material[1]
DMMU-1	8,300	MMP-1	0-4	MMP-1A	2,800	Surface
DMMU-2	6,100		4-8	MMP-1B	2,000	Subsurface
DMMU-3	9,100		8-19	MMP-1C	4,200	Subsurface
Z	-NA-		19-21	Z1	-NA-	Post-dredge surface[2]
DMMU -1	8,300	MMP-2	0-4	MMP-2A	2,800	Surface
DMMU-2	6,100		4-8	MMP-2B	2,000	Subsurface
DMMU-3	9,100		8-13	MMP-2C	3,300	Subsurface
Z	-NA-		13-15	Z2	-NA-	Post-dredge surface[2]
DMMU -1	8,300	MMP-3	0-4	MMP-3A	2,700	Surface
DMMU-2	6,100		4-8	MMP-3B	2,100	Subsurface
DMMU-3	9,100		8-12	MMP-3C	1,600	Subsurface
Z	-NA-		12-14	Z3	-NA-	Post-dredge Surface[2]
P1	-NA-	MMP-4	12-14	P1[3]	-NA-	Post-dredge Surface
P2	-NA-	MMP-5	12-14	P2[3]	-NA-	Post-dredge Surface
P3	-NA-	MMP-6	14-16	P3[3]	-NA-	Post-dredge Surface
23,500		Maximum Total Dredge Volume (cy)				

Notes:

1. Assumes surface material will be ranked "moderate" and subsurface material will be ranked "high."
2. Post-dredge surface samples will be collected from the upper 2-feet at the post-dredge surface depth.
3. Post-dredge surface samples will be collected from MMP-4, MMP-5 and MMP-6 only if samples representing that material cannot be collected from vibracores MMP-1 through MMP-3. Samples will be collected from the newly exposed dredge surface at locations MMP-1 through MMP-3 after dredging is completed if pre-dredge Z-samples cannot be collected.

Table 2 - DMMP and SMS Chemical Evaluation Criteria[1]

Chemical	DMMP Criteria			SMS Criteria	
	SL	BT	ML	SQS	CSL
Conventionals					
Total Solids (%)	--	--	--	--	--
Total Volatile Solids (%)	--	--	--	--	--
Total Organic Carbon (%)	--	--	--	--	--
Ammonia (mg/kg)	--	--	--	--	--
Total Sulfides (mg/kg)	--	--	--	--	--
Metals[2] mg/kg dry wt.					
Antimony	150	---	200	--	--
Arsenic	57	507.1	700	57	93
Cadmium	5.1	11.3	14	5.1	6.7
Chromium	260	260	--	260	270
Copper	390	1,027	1,300	390	390
Lead	450	975	1,200	450	530
Mercury	0.41	1.5	2.3	0.41	0.59
Nickel	--	--	--	--	--
Selenium	--	3	--	--	--
Silver	6.1	6.1	8.4	6.1	6.1
Zinc	410	2,783	3,800	410	960
Organometallic Compounds					
Tributyltin – bulk (µg/kg dry wt.)	73	73	--	--	--
Organics					
Non-chlorinated VOCs	--	--	--	--	--
Ethylbenzene	--	--	--	--	--
Total Xylenes	--	--	--	--	--
LPAH[3] µg/kg dry wt.					
Total LPAH[4]	5,200	--	29,000	370	780
Acenaphthylene	560	--	1,300	66	66
Acenaphthene	500	--	2,000	16	57
Anthracene	960	--	13,000	220	1,200
Fluorene	540	--	3,600	23	79
Naphthalene	2,100	--	2,400	99	170
Phenanthrene	1,500	--	21,000	100	480
2-Methylnaphthalene	670	--	1,900	38	64

Table 2 - DMMP and SMS Chemical Evaluation Criteria[1] (continued)

Chemical	DMMP Criteria			SMS Criteria	
	SL	BT	ML	SQS	CSL
HPAH[3] µg/kg dry wt,					
Total HPAH[5]	12,000	--	69,000	960	5,300
Benzo(a)anthracene	1,300	--	5,100	110	270
Benzo(a)pyrene	1,600	--	3,600	99	210
Total Benzofluoranthenes[6]	3,200	--	9,900	230	450
Benzo(g,h,i)perylene	670	--	3,200	31	78
Chrysene	1,400	--	21,000	110	460
Dibenzo(a,h)anthracene	230	--	1,900	12	33
Fluoranthene	1,700	4,600	30,000	160	1,200
Indeno(1,2,3-c,d)pyrene	600	--	4,400	34	88
Pyrene	2,600	11,980	16,000	1,000	1,400
Miscellaneous Extractables[3] µg/kg dry wt.					
Dibenzofuran	540	--	1,700	15	58
Hexachlorobutadiene	11	--	270	3.9	6.2
N-Nitrosodiphenylamine	28	--	130	11	11
Benzoic Acid	650	--	760	650	650
Benzyl Alcohol	57	--	870	57	73
Chlorinated Hydrocarbons[3] µg/kg dry wt.					
Hexachlorobenzene	22	168	230	0.38	2.3
1,2-Dichlorobenzene	35	--	110	2.3	2.3
1,4-Dichlorobenzene	110	--	120	3.1	9
1,2,4-Trichlorobenzene	31	--	64	0.81	1.8
Phthalates[3] µg/kg dry wt.					
Bis(2-ethylhexyl)phthalate	1,300	--	8,300	47	78
Butyl benzyl phthalate	63	--	970	4.9	64
Diethyl phthalate	200	--	1,200	61	110
Dimethyl phthalate	71	--	1,400	53	53
Di-n-butyl phthalate	1,400	--	5,100	220	1,700
Di-n-octyl phthalate	6,200	--	6,200	58	4,500
PCBs[3] µg/kg dry wt.					
Total PCBs	130	38[7]	3,100	12	65
Pesticides[3] µg/kg dry wt.					
4,4 DDD	16	--	--	--	--
4,4 DDE	9	--	--	--	--
4,4 DDT	12	--	--	--	--
Total DDT	--	50	69	--	--
Aldrin	9.5	--	--	--	--
Dieldrin	1.9	--	1700	--	--
Chlordane	2.8	37	--	--	--
Heptachlor	1.5	--	270	--	--

Table 2 - DMMP and SMS Chemical Evaluation Criteria[1] (continued)

Chemical	DMMP Criteria			SMS Criteria	
	SL	BT	ML	SQS	CSL
Phenols[3] µg/kg dry wt.					
Pentachlorophenol	400	504	690	360	690
Phenol	420	--	1,200	420	1,200
2 Methylphenol	63	--	77	63	63
4 Methylphenol	670	--	3,600	670	670
2,4-Dimethylphenol	29	--	210	29	29
PCDD/PCDF (total TEQ; ppt dry wt.)	4	10	--	--	--

Notes:

1. DMMP = Dredged Material Management Program (February 2013), SMS = Sediment Management Standards (February 2011).
2. Dry weight results are reported as milligrams per kilogram (mg/kg).
3. Dry weight results are micrograms per kilogram (µg/kg).
4. Total LPAH = The sum of acenaphthylene, acenaphthene, anthracene, fluorene, naphthalene and phenanthrene.
5. Total HPAH = The sum of benzo(a)anthracene, benzo(a)pyrene, total benzofluoanthenes, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3,-c,d)pyrene and pyrene.
6. Total benzofluoranthenes = the sum of the "b," "j" and "k" isomers. The "j" isomer co-elutes with the "k" isomer, thus the concentration of the "j" isomer is included in the "k" isomer concentration.
7. This value is normalized to total organic carbon and is expressed in mg/kg carbon.

SL = Screening Level
SQS = Sediment Quality Standards
CSL = Cleanup Screening Levels
BT = Bioaccumulation Trigger
ML = Maximum Level
LPAH = low molecular weight polynuclear aromatic hydrocarbon compounds
HPAH = high molecular weight polynuclear aromatic hydrocarbon compounds
TOC = Total organic carbon

Shading indicates that the criteria and results are TOC normalized. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.