Mukilteo Multimodal Project
Y-10936 TAA

Sediment Sampling Data Report

Washington State Department of Transportation

Washington State Ferries

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Acronyms and Abbreviations

ARI	Analytical Resources, Inc.
AVS	acid volatile sulfide
DGPS	differential global positioning system
DMMP	Dredged Material Management Program
EIS	Environmental Impact Statement
ERRG	Engineering/Remediation Resources Group, Inc.
FTA	Federal Transit Administration
LCS	laboratory control sample
MEC	munitions and explosives of concern
ML	maximum level
mL	milliliter
MLLW	Mean Lower Low Water
NAD83	North American Datum of 1983
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
ppt	parts per trillion
QC	quality control
RPD	relative percent difference
RSD	relative standard deviation
SAP	Sampling and Analysis Plan
SEPA	State Environmental Policy Act
SL	screening level
SMS	Sediment Management Standards
SQS	Sediment Quality Standards
TEF	toxicity equivalency factor
TEQ	toxicity equivalence
TOC	total organic carbon
VOC	volatile organic compound
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

1 INTRODUCTION

The Washington State Department of Transportation (WSDOT), Ferries Division, proposes the Mukilteo Multimodal Project to improve the operations and facilities serving the mainland terminus of the Mukilteo-Clinton ferry route in Washington State. The Federal Transit Administration (FTA) has provided funding during the project's planning phase and may be a source of construction funding.

The proposed project is located in the city of Mukilteo, Washington, in Snohomish County. The project area encompasses the Mukilteo waterfront area, east of Mukilteo Lighthouse Park, and along the former Tank Farm property.

This data report summarizes the results from sediment sampling conducted in support of an Environmental Impact Statement (EIS) that WSDOT and FTA are preparing for the project in compliance with the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA). FTA is the federal lead agency for the NEPA environmental review process. WSDOT is the state lead agency for SEPA.

There are four project alternatives that the EIS evaluates. Two of these alternatives, Elliot Point 1 and Elliot Point 2 (the preferred alternative), are located on the Mukilteo Tank Farm, which is owned by the U.S. Air Force. These two alternatives are located approximately 0.25 mile east of the existing ferry terminal in an area encumbered by the Tank Farm pier, a derelict wood and concrete pier. The project proponents determined that a general understanding of sediment characteristics is necessary within areas where sediment disturbances are likely to occur in the vicinity of the Tank Farm pier. Project-related activities may include demolishing existing structures and constructing new structures. In-water construction would involve pile removal, pier removal, installation of drilled piles or stone columns, and dredging.

1.1 Objectives for Sediment Sampling

The goal for this sediment characterization effort is to support the environmental effects analysis for the EIS, including water resources, ecosystems, and hazardous material analyses. Although sediment characterization data are compared to existing state sediment standards, including Sediment Quality Standards (SQS) as defined in the Sediment Management Standards (SMS) (Washington Administrative Code [WAC] 173-204-300 through 350) and Dredged Material Management Program (DMMP) criteria, these data are not intended to determine the suitability of

project sediments for disposal at one of the DMMP open-water dredged material disposal sites. Although the results of this sampling effort will inform subsequent regulatory decision-making processes, additional sediment characterization efforts to support design and permitting are likely to be required.

2 SAMPLE COLLECTION, PROCESSING, AND HANDLING PROCEDURES

2.1 Sampling Summary

The overall sampling strategy focused on identifying sediment characteristics along three transects across the Mukilteo Tank Farm Pier footprint. Figure 2-1 shows a conceptual cross section of the sampling strategy. Existing sea-bed elevations and conceptual dredge prism depths[1] noted below are taken from information provided by Coast & Harbor Engineering as they prepared the Hydrodynamic and Sediment Transport Modeling Study – Mukilteo Ferry Terminal, June 21, 2012.

Because of the broad area of potential sediment disturbances and sampling limitations associated with existing site infrastructure, two sampling methods were required to meet sampling objectives:

- Acquire six vibracore sediment samples (up to 12 feet in length) to characterize sediments that would be disturbed or exposed by Tank Farm Pier removal and potential dredging. These core lengths were determined based on the difference between the sediment surface elevation along the side of the pier (potentially as shallow as -18 to -20 feet Mean Lower Low Water [MLLW]) and the conceptual dredge prism elevation (approximately -28 feet MLLW). These samples will represent sediments likely to be mobilized by piling removal and/or dredging and will also characterize the conceptual post-project sediment surface.
- Acquire three diver-collected sediment cores (up to 8 feet) directly within the piling field beneath the pier to characterize sediments that may be disturbed by pier removal and potential dredging. Note that diver-collected cores were initially anticipated to be a maximum of 4 to 6 feet in depth due to the limitations of diver-operated equipment; however, the new sampling methodology developed for this sampling effort allowed for the use of longer core tubes. Collecting longer cores from beneath the pier using vessel-mounted equipment or using equipment operating on the pier deck is not safe or feasible.

Sediment samples were collected during two events. The initial sampling event was conducted on March 7, 2012, when six vibracore sediment samples (V1, V2, V3, V4, V5, and V6) were collected from a sampling vessel

[1] Note that an actual dredge prism has not been defined for the Mukilteo Multimodal Project.

immediately adjacent to the pier face. The second sampling event was conducted on April 25, 2012, following consultation with the client regarding site-specific conditions and constraints and development of an alternative method to collect sediment cores beneath the pier. During the second event, divers collected three vibracore sediment samples (D1, D2, and D3) within the piling field directly beneath the pier. Actual sampling locations are shown in Table 2-1 below.

Table 2-1. Sampling Locations

Transect	Sample	Latitude[1]	Longitude[1]	Sample	Latitude[1]	Longitude[1]	Sample	Latitude[1]	Longitude[1]
1	V1	57.079’	17.851’	D1	57.071’	17.838’	V6	57.066’	17.831’
2	V2	57.115’	17.800’	D2	57.109’	17.785’	V5	57.102’	17.776’
3	V3	57.158’	17.743’	D3	57.146’	17.732’	V4	57.139’	17.724’

[1] All sample coordinates are summarized in minutes from 47 degrees latitude and 122 degrees longitude.

Sample collection and processing generally followed the sediment Sampling and Analysis Plan (SAP), which described the sampling goal to collect cores of up to 12 feet in length from along the outside of the pier and up to 6 feet in length from directly beneath the pier. As described below, all sediment cores were cut into sections measuring up to 4 feet in length (0 to 4 feet, 4 to 8 feet, 8 to 12 feet) for compositing and analysis.

Although multiple attempts were made at each sampling location, site-specific characteristics (shell hash, wood debris, large obstructions, etc.) prevented the sampling team from collecting 12-foot sediment cores at all locations around the outside of the pier.

Figure 2-2 illustrates both proposed and actual sampling locations for both sampling methods. Table 2-2 provides a summary of station identifications, sampling date and time, sampling coordinates, water depths, mud-line elevations, and core lengths.

Table 2-2. Mukilteo Multimodal Facility Sediment Sample Collection Summary

Sampling Station	Sample Date	Sample Time (24 Hour)	Latitiude[a] (DD/MM/SS)	Longitude[a] (DD/MM/SS	Water Depth	Sediment Surface Elevation[b] (feet)	Core Length[c] (ft bgs)	Sediment Penetration Length[c] (ft bgs)	Percent Recovery[c]
V1	3/7/2012	08:40	47° 57' 04.74"	122° 17' 51.06"	35.2	30.1	11.25	12	94%
V2	3/7/2012	12:40	47° 57' 06.90"	122° 17' 48.00"	41.0	34.5	3.0	5	60%
V3	3/7/2012	16:30	47° 57' 09.48"	122° 17' 44.58"	40.6	30.4	5.25	7	75%
V4	3/7/2012	15:00	47° 57' 08.34"	122° 17' 43.44"	34.7	24.7	10.5	12	88%
V5	3/7/2012	10:03	47° 57' 06.12"	122° 17' 46.56"	30.0	26.2	11.25	12	94%
V6	3/7/2012	09:30	47° 57' 03.96"	122° 17' 49.86"	30.5	26.4	9.0	12	75%
D1	4/25/2012	09:35	47° 57' 04.24"	122° 17' 50.28"	25.0	17.8	4.0	6	67%
D2	4/25/2012	14:04	47° 57' 06.55"	122° 17' 47.11"	16.0	16.7	7.6	8	95%
D3	4/25/2012	13:05	47° 57' 08.74"	122° 17' 43.94"	17.0	17.1	7.6	8	95%

[a] Horizontal Datum: Washington State Plane, North Zone, NAD 83 (91)

[b] Vertical Datum: MLLW (Seattle (Madison Street) Elliot Bay Washington NOAA)

[c] As measured in the field

ft bgs: feet below ground surface

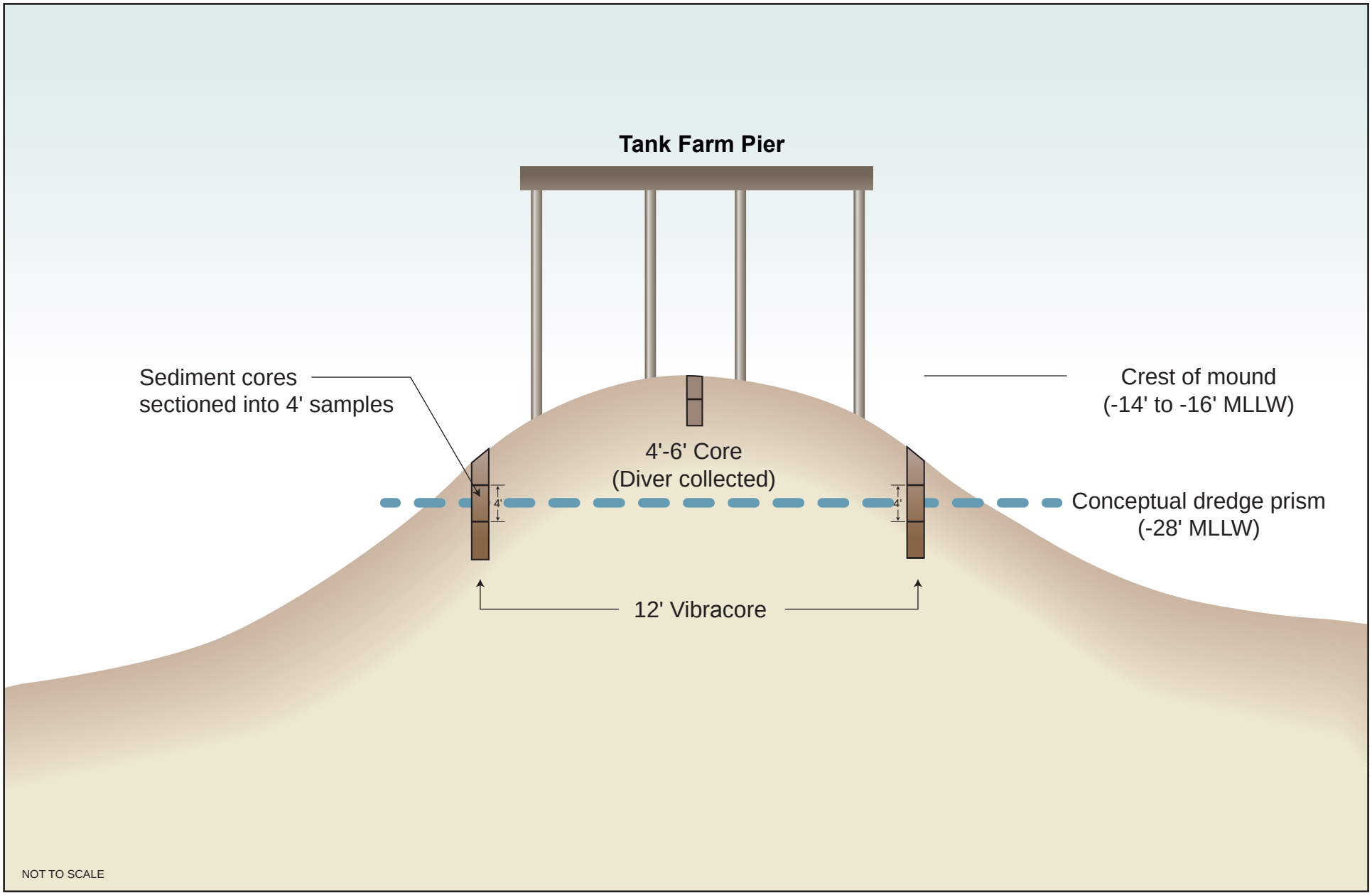
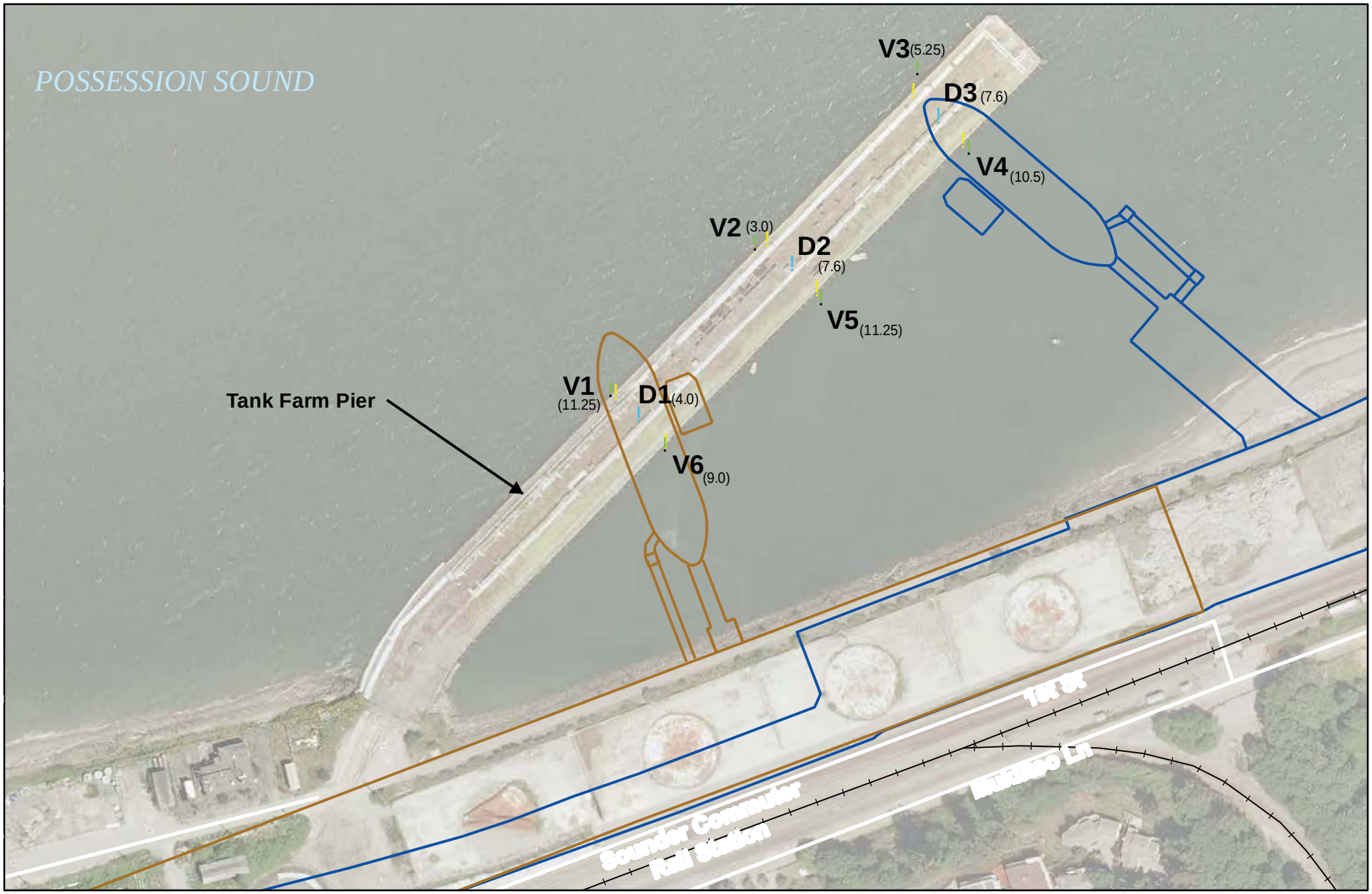


Figure 2-1.
Conceptual Cross Section of Sediment Sampling Locations



Parametrix

0 200
Feet

Planned Sampling Station
- Vibracore
- Diver Core

Actual Sampling Station
- Vibracore
- (0.0) Core Length (feet below ground surface)

Mukilteo Multimodal Project Alternative
- Elliot Point 1
- Elliot Point 2 (Preferred Alternative)

Figure 2-2.
Sediment Sampling Locations and Core Recovery Lengths

2.2 Sampling Description

2.2.1 Sampling Equipment

The first sampling event was conducted primarily from the Gravity Environmental, LLC 34-foot, shallow-draft sampling vessel (RV Selkirk). Sediment cores for chemical analysis were collected with a generator-powered, RIC 6500 vibracore assembly deployed by a hydraulic winch from the A-frame of the sampling vessel.

The first sampling event also consisted of unsuccessful attempts to collect 4- to 6-foot sediment cores with a diver-deployed piston core. Divers conducted sampling attempts from the Research Support Services 36-foot, shallow-draft sampling vessel (RV Carolyn Dow). None of the sediment samples collected from this effort was deemed suitable for analysis.

The second sampling event was conducted from the Gravity Environmental, LLC 32-foot, shallow-draft sampling vessel (RV Tahoma), using the RIC 6500 vibracore assembly with neutral-buoyancy floats attached. A gunwale-mounted winch was used sparingly to aid in removal of the vibracore head and core tube from the sediment. Cores were collected using decontaminated 4-inch-diameter Lexan (polycarbonate) core barrels (tubes). A new, decontaminated core barrel was used for each sampling station.

2.2.2 Positioning Methods

Approximate sampling location coordinates (latitude and longitude) at the project site in Possession Sound were pre-determined using CADD/GIS software. Once in the field, station positioning was accomplished using a differential global positioning system (DGPS) on board the sampling vessel. The coordinates of each sampling location were entered into the DGPS computer and displayed on screen with a real-time indicator of the position of the boat. The sampling vessel then moved into position as close to the pre-determined location as conditions would allow.

During the first mobilization (March 7, 2012), a sediment core was collected from the A-frame located on the bow of the research vessel. Actual sampling location coordinates were documented by DGPS as each sediment core was collected.

During the second mobilization (April 25, 2012), diver core positions were determined by DGPS readings made on the vessel and adjusted by an offset direction and distance. Divers used a survey tape to measure the offset from the vessel to the vibracore assembly position. For all sampling stations, latitude and longitude were recorded to the nearest 0.01 second in the North

American Datum of 1983 (NAD83). The core collection log sheets are included in Appendix A.

However, the initial DGPS coordinates provided by Gravity Environmental, LLC for the April 25 diver-collected cores plotted outside of the Tank Farm Pier footprint. To investigate these location errors, Parametrix requested all raw data from the navigation logs, including GPS satellite information and the measured PDOP. PDOP (Positional Dilution of Precision) is one component of the GPS data that can serve as an estimator of position error.

The number of satellites and their geometry overhead relative to the GPS receiver and potential obstructions play a major role in the precision of estimated positions. A low DOP value represents a better GPS positional precision. Obstructions like the Tank Farm Pier can interfere with the GPS signal, resulting in a higher DOP value. The number of satellites and associated PDOP value for each diver-core is summarized in Table 2-3 below. Table 2-4 provides a qualitative explanation of relative PDOP values.

Table 2-3: GPS Satellite and PDOP information for diver-cores.

Station	Satellites	PDOP
D1	5	4.33
D2	6	3.20
D3	5	4.62

Table 2-4: Qualitative definitions for GPS DOP values.

DOP	Rating	Description
1-2	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
5-10	Moderate	Positional measurements could be used for calculations, but the signal quality could be improved.
10-20	Fair	Represents a low confidence level. Positional measurements should be discarded or used to provide a rough estimate of the current location.

Note: Table 2-4 is adapted from en.wikipedia.org/wiki/Dilution_of_precision_(GPS).

Based upon a review of this information in consultation with Gravity Environmental, LLC and Nobletec, Inc. (makers of the navigation software used with the Trimble DGPS system), the team determined that post-processing of the raw DGPS data would be required. Technical staff at

Nobletec completed post-processing for the DGPS data[2], enabling Gravity Environmental to provide a corrected Navigation Log (Appendix A).

The post-processed diver core sampling station locations are plotted on Figure 2-2.

2.2.3 Soundings Methods

All vertical control parameters were recorded on the core collection logs at the time of sampling. These parameters included depth to sediment (mud-line) and water elevation.

During the first sampling event (March 7, 2012), the water depth at each sampling station was measured to the nearest 0.1 foot, using the calibrated fathometer on board the sampling vessel. The mud-line elevation at each sampling station was determined, relative to MLLW, by subtracting the tidal elevation at the time of sampling from the measured water depth. Tidal elevations were determined using Tides and Currents Pro (v3.6.0.115) to define the National Oceanic and Atmospheric Administration (NOAA) tide elevation data for Seattle (Madison Street), Elliott Bay, and corrected to the Everett tide gauge, nearest to the project site in Mukilteo.

During the second sampling event (April 25, 2012), the diver measured water depth at each sampling station to the nearest 1 foot, using his depth gauge.

2.2.4 Core Collection Methods

The general procedure for collecting vibracore samples was generally similar for both sampling events.

During the first sampling event (March 7, 2012), the sampling vessel moved into position on the sampling station and a 12-foot core barrel with core catcher (fingers) in place was secured to the vibracore head. All core barrels (and attached core catchers) were decontaminated prior to mobilization. The vibracore head and core barrel (together referred to as the coring assembly) were suspended from the A-frame of the vessel and the coring assembly was deployed overboard in an upright position. The coring assembly was positioned over the sampling location and lowered to the mud-line using the hydraulic winch and A-frame.

[2] Nobletec technical staff commented that they were able to post-process the data with a better differential beacon and confirmed that satellite coverage was poor at the time diver-cores were collected from beneath the Tank Farm Pier (7-20-2012. Personal Communication. S. Hinz. Gravity Environmental, LLC.)

Once the core nose was resting on the mud-line, the vibracore was triggered (from the vessel) and the core tube was vibrated into the sediment to a depth of 12 feet (or until refusal) so that a continuous sediment core was collected. The depth of core penetration and the depth of the water column were measured and recorded during the coring operation. After full penetration or refusal was reached, the core barrel was extracted from the sediment with the aid of the hydraulic winch and A-frame. The coring assembly was lifted from the water and placed on the vessel deck.

The core barrel was removed from the assembly for processing. The length of the material (sediment) remaining in the core barrel following retrieval was measured in order to determine sediment recovery. The overlying water was removed from the core barrel and the core barrel was cut into approximately 4-foot sections for transport to the onshore processing location. Every effort was made to retain as much material in the core as possible. Each section was capped at both ends with aluminum foil and core barrel caps, labeled, and placed in an upright position until transported to the core processing location.

During the second sampling event (April 25, 2012), the sampling vessel moved into the nearest possible position adjacent to the sampling station and tied up along the outside of the pier. Once the vessel was secured, an 8-foot, previously decontaminated core barrel and catcher was attached to the vibracore head. With the coring assembly suspended from the A-frame of the vessel, floats were secured to the vibracore head to achieve neutral buoyancy and the entire assembly was lowered into the water using the hydraulic winch. The diver then towed the vibracore assembly to a viable sampling location under the pier. A viable sampling location was defined as a location as near as possible to the pre-determined station coordinates but in a safe area, free of overhanging or loose materials from the pier deck and pilings. When the vibracore assembly was above the sampling location, the diver attached the vibracore assembly to an overhead or side-positioned line and pulley and removed the floats. The assembly was lowered into position from the sampling vessel under direction from the diver via a wired communication link.

The vibracore was triggered and core tube vibrated into the sediment as described for the initial sampling event. Once the core barrel was extracted from the sediment and raised to the water surface with the aid of a gunwale-mounted winch, the diver reattached the floats. Once the vibracore and core tube were re-floated, the diver directed the assembly back to the boat with handline assistance from the sampling vessel. Once back at the boat, the assembly was retrieved using the hydraulic winch and A-frame. Cores were

removed from the assembly and processed as described for the first sampling event.

2.2.5 Core Storage

Prior to processing, the core sections from the first sampling event were stored in a locked box truck in Bellevue, Washington. The capped and labeled core sections were stored in a semi-upright position, covered with ice to maintain the temperature of the sediment at 4 degrees Celsius (4°C).

Core storage during the second sampling event was not necessary because sample processing occurred on the boat as cores were collected.

2.3 Sample Compositing

2.3.1 Compositing Scheme

As described above, all cores were segmented into sections of up to 4 feet in length. For the 12-foot cores, sediments in the same depth interval for cores in each transect across the pier were composited (i.e., combined together) for a single analysis, except for ordnance samples. For example, the zero- to 4-foot sections collected from the cores obtained on the north (V1) and south (V6) sides at the west (nearshore) end of the pier were composited for a single set of analyses. Within this pair of cores, the 4- to 8-foot sections and 8- to 12-foot sections were composited similarly. These same depth intervals obtained from the other pairs of cores in the other transects were also composited similarly.

Ordnance sample composites were composed of sediments from all depth intervals of matching cores to determine the presence or absence of ordnance residues.

Diver-collected cores from beneath the pier were sectioned into two depth intervals (0 to 4 feet, and 4 to 4+ feet). The surface interval (0 to 4 feet) from each core was analyzed, while the deeper sections were archived. No multi-core composites were prepared from the diver-collected cores.

Table 2-5 identifies the sediment core compositing scheme for all analytes except ordnance samples.

Table 2-5. Mukilteo Multimodal Facility Sediment Sample Compositing

Core Section	Sediment Sample Composite					
0' – 4'	V1 / V6	D1	V2 / V5	D2	V3 / V4	D3
4' – 8'	V1 / V6	n/a[1]	V5[2]	D2[3]	V3 / V4	D3[3]
8' – 12'	V1[2]	n/a[1]	V5[2]	n/a[1]	V4[2]	n/a[1]

1 Diver-collected cores did not acquire sediment at this elevation.
2 Because 12-foot cores were not acquired at locations V2, V3, and V6 composite consists of sediment from the single vibracore cited.
3 These samples were archived for potential future analysis.

2.3.2 Compositing Methods and Dates

Core processing for the first sampling event was conducted on March 8, 2012. Sediments in the same depth interval were composited from core pairs collected in each of the three sampling transects.

Prior to processing each core, the processing table was lined with clean aluminum foil. Next, core sections were removed from 4°C storage and placed horizontally onto the core processing table. The core tube was placed at an angle to the table and the sediment was extruded by tapping on the core barrel with a dead-weight hammer, which allowed sediment to slide down the tube and onto the table for processing. The sediments were damp, generally cohesive, and easily extruded. Care was taken to prevent sediment contamination by contact with the core processors and processing equipment.

Subsamples for volatile compounds and sulfides were taken immediately from the exposed sediment as described in Section 2.3.2.1. The core section was logged and a portion of the remaining sediment was placed in a decontaminated bowl for compositing and subsampling. The compositing bowl was immediately covered with aluminum foil to prevent contamination.

The same procedure was followed for each matching core section, with sediment placed in the same compositing bowl with the sediment from the first section extruded.

These procedures were repeated for all matching pairs of core sections and for individual core sections that did not have matching core sections (12-foot cores were not collected at all stations). Individual core sections included the 4- to 8-foot section of sample V5 and the 8- to 12-foot sections of V1, V4, and V5.

The diver cores were processed on board the sampling vessel on April 25, 2012, soon after they were collected. Each zero- to 4-foot core section was extruded from the core barrel as described above. Care was taken to prevent sediment contamination by contact with the core processors and processing

equipment. Subsamples for volatile compounds and sulfides were taken immediately from the exposed sediment. The core section was logged and a portion of the remaining sediment was placed in a decontaminated bowl for compositing and subsampling. Each 4- to 8-foot core sediment section was extruded, photographed, logged, and subsampled for archiving only. Four 16-oz. jars were collected from each 4- to 8-foot core section.

All stainless-steel bowls, spoons, and utensils used for processing were decontaminated according to the procedures specified in the SAP (Section 3.5.1; FTA and WSDOT 2012) prior to use. All unused sediment from both events was placed in a 30-gallon drum for appropriate upland disposal.

2.3.2.1 Volatile Organic Compounds and Total Sulfides

Each core section was subsampled for volatile organic compounds (VOCs), acid sulfide, and total sulfide analyses. The VOC and acid sulfide subsamples collected from matching core sections were composited in the laboratory immediately before analysis.

Subsamples for VOCs, acid sulfides, and total sulfides were collected immediately upon opening the core tubes (prior to core logging and sediment homogenization) and placed in the appropriate, labeled sample containers. Subsample material was collected along the entire length of the core section. The VOC and acid sulfide jars were filled completely with sample sediment, allowing no headspace.

The total sulfides sample jar was filled to near completion and then preserved with approximately 5 milliliters (mL) of 2 *Normal* (N) zinc acetate. Compositing was accomplished by filling one half of the sample jar as soon as a core was extruded, preserving this material with approximately 2.5 mL of 2N zinc acetate, then sealing the jar until the matching core section was extruded. Immediately following extrusion of the matching core section, the sample jar was re-opened, filled to capacity, and sealed after adding the remaining 2.5 mL of 2N zinc acetate.

2.3.2.2 Composite Samples

Sediment for the remaining analyses were collected from the entire length of the sediment core section and placed into a compositing bowl using a decontaminated spoon. Care was taken to avoid collecting material that came into contact with the sides of the core barrel; however, due to sample volume requirements it is likely that a small volume of such material was sampled. Equal amounts of sediment, or as near as possible, were collected from the matching core sections and placed in the same composite bowl. When the combined volume of sediment needed for the chemical and

conventional analyses was collected, the composite sample was homogenized to a uniform appearance by stirring. Subsamples were then collected for the various analyses.

The ordnance compositing strategy was designed to evaluate the presence or absence of ordnance residue throughout the entire depth of matched cores. This was accomplished by mixing an equal volume of composited sediment subsample from each section of an individual core into a stainless steel mixing bowl. The same procedure was followed with subsamples taken from each section of the matching sediment core. The composited subsample materials from each individual core were homogenized separately (one homogenized composite for each individual core), and then mixed together and homogenized again as a combined sample composited from both matched cores.

2.3.2.3 Composite Sample Storage

All sediment samples were placed in pre-cleaned, sample containers provided by the analytical laboratories, and labeled appropriately. Holding times and preservatives for each analyte are provided in Table 4-1 of the SAP (FTA and WSDOT 2012). The filled sample containers were placed in zip-top sealable plastic bags and placed on ice in a cooler until delivery to the analytical laboratories. All samples, except nitroaromatics and nitramines (ordnance residue), were hand delivered to Analytical Resources, Inc. (ARI) on the day following core processing. Ordnance samples were delivered to ALS-Columbia by Federal Express overnight priority on the day following core processing.

2.4 Core Documentation

Core sections were described throughout the full penetration depth, prior to homogenization and after VOC and sulfides sampling (where relevant). All observations were recorded on the corresponding sediment core log sheet. The descriptions of each core sample recorded on the sediment core log sheet included (as appropriate and present):

- Physical soil description in accordance with the Unified Soil Classification System (including soil type, density/consistency of soil, and color)
- Description of any large debris/coarse gravel, including size of debris and an estimate of percent by volume in each core section
- Odor (e.g., hydrogen sulfide, petroleum)

- Vegetation
- Any other distinguishing characteristics or features

2.5 Chain of Custody

Duplicate Chain of Custody forms were used to record each sample container at the end of each sampling day. The forms identified the sample identification, collection date and times, the project name and number, the number of preserved and unpreserved sample containers, and all requested analyses. All containerized sediment samples, with the exception of those samples intended for analysis of ordnance residues (i.e., nitroaromatics and nitramines), were transferred by Parametrix staff to the primary analytical laboratory, ARI of Seattle, Washington on the day following processing (first mobilization) or sampling and processing (second mobilization). Both the ARI and Parametrix personnel signed and dated the Chain of Custody forms to acknowledge transfer of sample possession. Copies of those signed forms are included in Appendix B.

Parametrix personnel signed and dated the Chain of Custody form for the ordnance residue samples, thereby acknowledging transfer of samples, and placed the form into the sample cooler with the ordnance samples. A photocopy of the original Chain of Custody form signed by Parametrix personnel was retained by Parametrix. Chain of Custody seals were affixed over the lid openings after the cooler was taped shut for shipment, which is standard procedure for shipping Chain of Custody samples. The ordnance residue samples were shipped on the day after processing (first mobilization) or sampling and processing (second mobilization) to ALS-Columbia in Kelso, Washington (overnight priority via Federal Express). Upon delivery of the shipment, ALS-Columbia personnel signed and dated the Chain of Custody forms, thereby acknowledging receipt of the samples. Copies of the signed Chain of Custody forms and a Confirmation of Sample Receipt from ALS-Columbia are included in Appendix B.

2.6 Deviations from the Sampling and Analysis Plan

Deviations from the SAP (FTA and WSDOT 2012) were noted and are described below.

Vibracore samples V2 and V3 were collected more than 10 feet (3 meters) away from the original station locations.

The SAP specified that three attempts would be made before requesting permission from the client and agencies to move the station in order to obtain a representative and adequate sample. However, the sampling project

manager gave approval to move the sampling vessel short distances (from the original stations) to collect representative and adequate core samples as near as possible to pre-determined locations. This decision was made in the field without additional coordination based upon actual conditions encountered at V2 and V3 and daylight time constraints.

Position adjustments were required at V2 because wood debris plugged core noses, limiting recovery to less than 2 feet of sediment. After rejecting three cores collected within the desired 10-foot (3-meter) distance from the original position, the sampling team collected a fourth vibracore sample a distance of about 25 feet (7.5 meters) from the original station. This attempt yielded the best sediment core sample (3 feet) at station V2, and the sampling project manager directed the vessel captain to proceed to the next station. Once all other samples had been collected, the sampling project manager directed the team to make one more attempt at station V2; however, wood debris again plugged the core tube. The sampling team was prevented from any further sample collection attempts due to loss of daylight.

Position adjustments were required at V3 because shell hash and debris plugged the core nose in repeated attempts. After rejecting the first two core samples collected, a 2.5-foot core was acquired at a distance of about 10 feet (3.1 meters) from the original station. Based on the need to acquire the remaining sediment samples, the sampling project manager directed the vessel captain to proceed to the next station. Later, the boat returned to V3 and collected a 5.25-foot core about 35 feet (10.5 meters) east of the original MV3 station and about 20 feet (6 meters) from the face of the pier.

Vibracores did not penetrate to a depth of 12 feet at every location.

The SAP proposed to drive sediment cores to a depth of 12 feet to characterize surface and subsurface sediments. Two of the cores, V2 and V3, penetrated to estimated depths of 5 and 7 feet beneath the sediment surface, respectively. Both samples required at least four attempts to acquire a sample that was accepted. The sampling team encountered a hard refusal during each of the failed attempts, with wood waste, debris, and/or cobble blocking the core nose. The sediment recovered in the V2 and V3 cores measured 36 and 63 inches in length, respectively (60 and 75 percent recovery, based on estimated penetration). Although the depth of penetration reported for each core (5 and 7 feet) is greater than the depth of the sediments recovered, it is unlikely that the sediments collected and processed for V2 and V3 contained much, if any, of the material from sediment depths greater than 3 or 5 feet, respectively.

The primary difference between reported penetration and recovery is believed to result from continued penetration of the core barrel into the

underlying sediment, after each core nose was effectively blocked. The core noses of V2 and V3 were tightly packed with wood debris (V2) or a mixture of sand, pebbles and with some shell hash (V3).

Similar conditions may also account for the 75 percent recovery reported for V6. Full penetration was reported but recovery was reported as 9 feet. During processing, the bottom 21 inches of sediment in the 4 to 8 foot section were found to be clay with a trace of fine sand, which continued another 15 inches in the 8 to 12 foot section (the total clay layer extended 36 inches through the two core sections). The total sediment measured during processing was 109 inches or 9.1 feet. One potential explanation is that the 36 inches of clay collected in the core nose and lower barrel plugged the tube such that no additional material was collected.

The other three cores, V1, V4, and V5, were collected after full 12-foot penetration and recovery was 94, 88, and 94 percent (11.25, 10.5, and 11.25 feet of sediment), respectively. The loosely-consolidated nature of the upper 12 feet of most depositional materials in the immediate area of the pier is indicated by relative ease with which full penetration was reached. Full penetration was observed for four of the six vibracores collected along the faces of the pier and two of the three diver-vibracores collected under the pier.

Diver-deployed piston core samples were not collected from beneath the pier.

During the initial sampling event, the maximum sediment depth penetrated by the diver-deployed piston corer beneath the pier was approximately 2 feet. Divers reported an inability to achieve greater penetration due to a surface layer of shell hash with underlying debris. When removed from the water, core noses were plugged by wood waste and debris; the maximum amount of sediment in any of the core tubes was approximately 10 inches. This volume of sediment is inadequate for sample analysis.

In an attempt to collect some under-pier sediment for analysis, the dive team deployed a larger diameter stainless-steel “push core” device (35 centimeters long and 14 centimeters in diameter). Divers collected surface sediment samples, which were archived pending the decision to implement a supplemental sampling event by applying an experimental, diver-deployed vibracore sampling method beneath the pier.

The second sampling event produced acceptable sediment core samples from beneath the pier; therefore, the initial surface “push core” samples were not analyzed.

Triplicate Chain of Custody forms were not used.

Chemistry laboratories provided duplicate Chain of Custody forms, as opposed to the triplicate forms indicated in the SAP. Sediment samples were hand delivered to ARI and a copy of the Chain of Custody form, signed by Parametrix personnel relinquishing the samples and ARI personnel accepting the samples, were retained by each party (signed original to ARI, signed duplicate to Parametrix). Samples were shipped to ALS-Columbia with the intact Chain of Custody form, signed by Parametrix personnel relinquishing the samples, included in the shipping container. A photocopy of the original Chain of Custody form, signed by Parametrix personnel, was retained by Parametrix. On receipt of the samples, ALS-Columbia personnel signed to indicate acceptance of the samples. A copy of the completed Chain of Custody form, with both signatures, and a Confirmation of Sample Receipt were sent to Parametrix by ALS-Columbia. Copies of all Chain of Custody forms and Confirmation of Sample Receipt forms are included in Appendix B.

Core tube sections were not opened with a skill saw or box cutter knife.

The sediments were generally damp and cohesive. It was not necessary to cut the core tube sections in order to extrude sediments for sample preparation.

Some core sections were not processed within 24 hours of collection.

Executing the sampling and compositing scheme took longer than required to meet the 24-hour processing window. As a result, processing some of the core sections exceeded the 24-hour guideline. However, processing for all core sections was complete by the end of the day (March 8, 2012) following core collection (March 7, 2012). The core sections were stored undisturbed, under appropriate holding conditions (capped and refrigerated at 4°C) until processed; therefore, this deviation was judged not to have adversely affected the samples collected.

3 CHEMICAL AND CONVENTIONAL ANALYSIS

Samples collected from around and under the pier were subject to testing for "conventional" parameters, all chemical analytes on the DMMP Chemicals of Concern list (updated in June 2011), and ordnance residue (nitroaromatics and nitramines). The results of these analyses will be used in support of an EIS that WSDOT and FTA are preparing for the Mukilteo Multimodal Project in compliance with NEPA and SEPA. Sediment sampling results are compared below to both DMMP criteria and Washington State SMS; however, they are not suitable for the purposes of evaluating sediment suitability for open-water disposal or for potential beneficial use.

3.1 Summary of Chemical and Conventional Analytical Results

Tables 3-1 to 3-5 summarize the chemical and conventional results from analyses completed on sediment samples collected around and under the pier.

3.2 Qualitative Summary of Physical Sediment Characteristics

It appears that the upper 8 to 12 feet of depositional materials along the inside face of the Tank Farm Pier consist primarily of loosely-consolidated shell hash, silty fines, medium to coarse sand or clay, and some cobbles and pebbles. At all sampling locations, masses of woody-debris, larger shells and other debris were observed. However, other than the generally ubiquitous surface layer of shell hash, there were no clear patterns or layers observed from location to location.

The greatest masses of woody debris were observed in cores V2, V3 and V6. The core noses of the vibracores collected at V2 and V3 were tightly packed with wood debris (V2) or a mixture of sand, pebbles and with some shell hash (V3), which obstructed sediment collection from 4 to 12 feet at the V2 station and 8 to 12 feet at the V3 station. Both vibracores required at least four attempts to acquire a sample that was accepted.

Other debris observed in cores V4, V5, V6 included small pockets of blackened material surrounding what appeared to be a cobble or a small rock. These pockets of blackened material resembled asphalt and exhibited a petroleum odor. No other sediments in any core exhibited this petroleum odor. One such pocket and apparent cobble was found in the bottom horizon of the 0 to 4 foot segment of the V6 sediments, while two others

Table 3-1. Conventional Parameters

		0' - 4' intervals												4' - 8' intervals						8' - 12' intervals					
ANALYTE	UNITS	V1/V6	Q[1]	D1	Q[1]	V2/V5	Q[1]	D2	Q[1]	V3/V4	Q[1]	D3	Q[1]	V1/V6	Q[1]	V5	Q[1]	V3/V4	Q[1]	V1	Q[1]	V5	Q[1]	V4	Q[1]
CONVENTIONALS																									
Total Solids	%	68.7		69.8		55.8		59.6		65.4		85.2		76.1		68.3		66.9		92.9		87.6		64.7	
Preserved Total Solids	%	67.7		75.7		55.0		69.3		67.6		80.7		77.9		68.5		75.6		86.2		84.1		71.1	
Total Volatile Solids	%	2.94		2.6		5.31		5.5		2.72		1.45		1.88		2.72		2.68		0.68		0.67		3.71	
N-Ammonia	mg-N/kg dw	12.2		2.92		6.5		3.36		8.2		2.30		16.7		2.5		13.9		0.7		0.6		28.5	
Sulfide	mg/kg dw	218		153		376		159		409		6.99		32		402		246		6.8		1.19	U	530	
Acid Volatile Sulfide	mg/kg dw	231		173		15.6		18.8		12		56		126		707		136		6.2		1.14	U	474	
Total Organic Carbon	%	1.32		1.75		2.40		1.77		1.12		1.72		1.05		1.26		1.35		0.339		0.104		1.34	
GRAIN SIZE																									
Gravel	**%**	**16.5**		**25.1**		**25.6**		**26.5**		**30.5**		**30.7**		**6.7**		**16.6**		**34.2**		**4.2**		**26.2**		**34.5**	
Very Coarse Sand	%	14.2		16.5		20.9		16.7		22.0		14.9		11.0		15.3		22.3		14.5		19.0		14.3	
Coarse Sand	%	24.6		21.2		13.0		14.8		14.9		21.3		25.8		18.8		16.1		37.2		25.0		10.3	
Medium Sand	%	22.2		18.1		10.0		17.4		9.9		20.3		22.9		17.3		9.5		34.2		22.9		9.1	
Fine Sand	%	7.2		6.4		7.7		7.0		5.7		6.0		7.0		7.8		3.6		6.8		4.8		6.8	
Very Fine Sand	%	3.6		2.9		5.4		2.2		3.5		1.5		6.9		5.3		2.3		1.4		0.5		4.1	
Total Sand	**%**	**71.8**		**65.1**		**57.0**		**58.1**		**56.0**		**64.0**		**73.6**		**64.5**		**53.8**		**94.1**		**72.2**		**44.6**	
Coarse Silt	%	1.4		1.1		2.4		2.3		0.7		0.2		6.0		3.9		0.9		1.6	U	1.6	U	4.9	
Medium Silt	%	1.2		0.9		1.7		1.5		1.2		0.4		3.8		2.2		1.1		1.6	U	1.6	U	1.9	
Fine Silt	%	1.5		1.6		5.0		3.5		4.0		0.5		2.3		2.6		2.0		1.6	U	1.6	U	3.3	
Very Fine Silt	%	2.7		2.0		3.5		3.1		3.3		1.0		1.8		3.0		2.9		1.6	U	1.6	U	3.9	
8-9 Phi Clay	%	1.7		1.3		1.5		1.8		1.5		0.8		1.5		2.2		1.7		1.6	U	1.6	U	2.5	
9-10 Phi Clay	%	1.5		1.3		1.0		1.1		0.9		0.8		1.5		2.2		1.5		1.6	U	1.6	U	2.0	
> 10 Phi Clay	%	1.8		1.7		2.3		2.1		1.8		1.4		2.9		2.9		1.9		1.6	U	1.6	U	2.3	
Total Fines	**%**	**11.8**		**9.9**		**17.4**		**15.4**		**13.4**		**5.3**		**19.8**		**19.0**		**12.0**		**1.6**	**U**	**1.6**	**U**	**20.9**	

1) Qualifier (Q)

U - The target analyte was not detected at the reported concentration.

Table 3-2. Comparison to DMMP Criteria

	DMMP Screening Criteria			0' - 4' intervals												4' - 8' intervals						8' - 12' intervals					
ANALYTE	SL	ML	UNITS	V1/V6	Q[11]	D1	Q[11]	V2/V5	Q[11]	D2	Q[11]	V3/V4	Q[11]	D3	Q[11]	V1/V6	Q[11]	V5	Q[11]	V3/V4	Q[11]	V1	Q[11]	V5	Q[11]	V4	Q[11]
METALS (mg/kg)																											
Antimony	150	200	mg/kg dw	20	U	20	U	40	U	20	U	40	U	6	U	6	U	20	U	30	U	5	U	5	U	20	U
Arsenic	57	700	mg/kg dw	20	U	20	U	40	U	20	U	40	U	6	U	6	U	20	U	30	U	5	U	5	U	20	U
Cadmium	5.1	14	mg/kg dw	0.7	U	0.6	U	2	U	0.8	U	2	U	0.3		0.2	U	0.7	U	1	U	0.2	U	0.2	U	0.7	U
Chromium	260	- - -	mg/kg dw	31		23		15		51		22		24		35.2		33		23		21.3		22.9		25	
Copper	390	1300	mg/kg dw	12.8		11.9		12		13.3		10		10.2		17		17.9		20		6.1		7.7		22	
Lead	450	1200	mg/kg dw	7	U	6	U	20	U	8	U	20	U	14		4		10		20		2	U	2	U	25	
Mercury	0.41	2.3	mg/kg dw	0.03	U	0.04		0.03	U	0.05		0.03		0.03		0.08		0.07		0.03		0.02	U	0.03	U	0.25	
Nickel	- - -	- - -	mg/kg dw	29		27		16		36		21		27		34		35		24		26		38		26	
Selenium[1]	- - -	- - -	mg/kg dw	20	U	20	U	40	U	20	U	40	U	6	U	6	U	20	U	30	U	5	U	5	U	20	U
Silver	6.1	8.4	mg/kg dw	1.0	U	1.0	U	3	U	1.0	U	2	U	0.4	U	0.4	U	1	U	2	U	0.3	U	0.3	U	1.0	U
Zinc	410	3800	mg/kg dw	52		32		40		33		32		28		32		50		96		23		29		100	
ORGANOMETALLIC COMPOUNDS																											
Tributyltin ion (bulk)[2]	73	- - -	ug/kg dw	3.8	U	- - -		3.6	U	- - -		3.5	U	- - -		3.5	U	3.5	U	22.0		3.4	U	3.6	U	3.4	U
PAHs																											
Naphthalene	2100	2400	ug/kg dw	41		170		100		160		120		45		98		99		36		20	U	18	U	240	
Acenaphthylene	560	1300	ug/kg dw	20		43		45		65		35		24		22		41		25		20	U	18	U	53	
Acenaphthene	500	2000	ug/kg dw	26		110		23		41		37		36		46		30		16	J	20	U	18	U	160	
Fluorene	540	3600	ug/kg dw	28		100		42		55		64		47		54		50		29		20	U	18	U	150	
Phenanthrene	1500	21000	ug/kg dw	210		260		260		170		340		150		170		160		160		20	U	18	U	430	
Anthracene	960	13000	ug/kg dw	50		140		93		120		120		110		70		94		82		20	U	18	U	250	
Total LPAHs	**5200**	**29000**	**ug/kg dw**	**375**		**823**		**563**		**611**		**716**		**412**		**460**		**474**		**348**		**20**	**U**	**18**	**U**	**1283**	
2-Methylnaphthalene[3]	670	1900	ug/kg dw	20	U	32		15	J	42		25		11	J	25		22		10	J	20	U	18	U	50	
Fluoranthene	1,700	30000	ug/kg dw	550		340		980		360		1600		200		260		220		690		20	U	18	U	1200	
Pyrene	2,600	16000	ug/kg dw	760		1900		1000		1900		1900		1800		630		1200		1300		20	U	27		4700	
Benzo(a)anthracene	1300	5100	ug/kg dw	99		260		300		290		350		240		120		150		200		20	U	18	U	550	
Chrysene	1,400	21000	ug/kg dw	220		480		600		560		780		540		180		300		420		20	U	18	U	1000	
Total Benzofluoranthenes[4,5]	3200	9900	ug/kg dw	320		1600		870		1400		1400		1800		400		900		900		20	U	11	J	2700	
Benzo(a)pyrene	1,600	3600	ug/kg dw	140		690		330		590		570		820		200		420		370		20	U	18	U	1300	
Indeno(1,2,3-cd)pyrene	600	4400	ug/kg dw	60		310		160		310		290		340		87		170		180		20	U	18	U	530	
Dibenz(a,h)anthracene	230	1900	ug/kg dw	23		120		58		120		97		140		33		67		63		4.9	U	4.6	U	180	
Benzo(g,h,i)perylene	670	3200	ug/kg dw	61		300		150		320		280		340		94		170		180		20	U	18	U	570	
Total HPAHs	**12000**	**69000**	**ug/kg dw**	**2233**		**6000**		**4448**		**5850**		**7267**		**6220**		**2004**		**3597**		**4303**		**20**	**U**	**38**		**12730**	
CHLORINATED HYDROCARBONS																											
1,3-Dichlorobenzene	- - -	- - -	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	J	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
1,4-Dichlorobenzene	110	120	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
1,2-Dichlorobenzene	35	110	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
1,2,4-Trichlorobenzene	31	64	ug/kg dw	5	U	4.6	U	4.7	U	4.9	U	4.8	U	4.7	U	4.8	U	4.7	U	4.6	U	4.4	U	4.4	U	4.8	U
Hexachlorobenzene (HCB)	22	230	ug/kg dw	0.47	U	0.48	U	0.48	U	0.49	U	0.48	U	0.47	U	0.48	U	0.47	U	0.47	U	0.47	U	0.47	U	4.7	U
PHTHALATES[6]																											
Dimethyl phthalate	71	1400	ug/kg dw	5	U	4.6	U	4.7	U	4.9	U	4.8	U	4.7	U	4.8	U	4.7	U	4.6	U	4.9	U	4.6	U	4.8	U
Diethyl phthalate	200	1200	ug/kg dw	50	U	46	U	47	U	49	U	48	U	47	U	48	U	47	U	46	U	49	U	46	U	48	U
Di-n-butyl phthalate	1400	5100	ug/kg dw	20	U	19	U	19	U	20	U	19	U	19	U	19	U	19	U	18	U	20	U	18	U	19	U
Butyl benzyl phthalate	63	970	ug/kg dw	5	U	4.6	U	5.1	Q	3.3	J	2.8	J	4.7	U	4.8	U	4.7	U	4.6	U	3.4	J	4.6	U	4.8	U
Bis(2-ethylhexyl) phthalate	1300	8300	ug/kg dw	25	U	27		24	U	17	J	24	U	17	J	24	U	24	U	23	U	25	U	23	U	24	U
Di-n-octyl phthalate	6200	6200	ug/kg dw	20	U	19	U	19	U	20	U	19	U	19	U	19	U	19	U	18	U	20	U	18	U	19	U
PHENOLS																											
Phenol	420	1200	ug/kg dw	20		23		37		30		21		19	U	12	J	14	J	18	U	20	U	18	U	13	J
2-Methylphenol	63	77	ug/kg dw	5.0	U	5.9		3.6	J	24		4.8	U	4.7	U	4.8	U	4.7	U	4.6	U	4.9	U	4.6	U	4.8	U
4-Methylphenol	670	3600	ug/kg dw	40	U	16	J	13	J	23	J	32	J	37	U	27	J	11	J	37	U	40	U	36	U	22	J
2,4-Dimethylphenol	29	210	ug/kg dw	20	U	6.8	J	4.3	J	21		19	U	19	U	3.8	J	3.3	J	18	U	20	U	18	U	3.4	J
Pentachlorophenol	400	690	ug/kg dw	50	U	46	U	47	U	49	U	48	U	47	U	48	U	47	U	46	U	49	U	46	U	48	U
MISCELLANEOUS EXTRACTABLES																											
Benzyl alcohol	57	870	ug/kg dw	20	U	19	U	19	U	7.5	J	19	U	19	U	19	U	19	U	18	U	20	U	18	U	19	U
Benzoic acid	650	760	ug/kg dw	400	U	370	U	110	J	390	U	380	U	370	U	380	U	380	U	370	U	400	U	360	U	380	U
Dibenzofuran	540	1700	ug/kg dw	19	J	80		28		43		40		29		40		38		17	J	20	U	18	U	100	
Hexachloroethane	- - -	- - -	ug/kg dw	20	U	19	U	19	U	20	U	19	U	19	U	19	U	19	U	18	U	20	U	18	U	19	U
Hexachlorobutadiene	11	270	ug/kg dw	0.47	U	0.48	U	0.48	U	0.49	U	0.48	U	0.47	U	0.48	U	0.47	U	0.47	U	0.47	U	0.47	U	4.8	U
N-Nitrosodiphenylamine	28	130	ug/kg dw	20	U	19	U	19	U	20	U	19	U	4.8	J	19	U	19	U	18	U	20	U	18	U	6.7	J
VOCs																											
Trichloroethene	- - -	- - -	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
Tetrachloroethene	- - -	- - -	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
Ethylbenzene	- - -	- - -	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
m,p-Xylene	- - -	- - -	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
o-Xylene	- - -	- - -	ug/kg dw	1.1	U	1.2	U	1.3	U	1.4	U	1.1	U	1.2	U	1	U	1.1	U	0.9	U	0.9	U	0.9	U	1.1	U
Total Xylene[7]	- - -	- - -	**ug/kg dw**	**2.2**	**U**	**2.4**	**U**	**2.6**	**U**	**2.7**	**U**	2.3	U	**2.4**	**U**	**1.9**	**U**	**2.2**	**U**	1.9	U	**1.7**	**U**	**1.8**	**U**	**2.3**	**U**
PESTICIDES & PCBs																											
4,4'-DDD	16	- - -	ug/kg dw	1.5		0.96	U	0.96	U	0.97	U	0.96	U	0.95	U	1.8		0.93	U	0.94	U	0.94	U	0.93	U	9.5	U
4,4'-DDE	9	- - -	ug/kg dw	0.93	U	0.96	U	0.96	U	0.97	U	0.96	U	0.95	U	0.95	U	0.93	U	0.94	U	0.94	U	0.93	U	9.5	U
4,4'-DDT	12	- - -	ug/kg dw	1.4	UY	0.96	U	2.7	UY	0.97	U	2.6	UY	0.95	U	0.95	U	0.93	U	1.7	UY	0.94	U	0.93	U	9.5	U
Total DDT[8]	- - -	**69**	**ug/kg dw**	**1.5**		**0.96**	**U**	**2.7**	**UY**	**0.97**	**U**	**2.6**	**UY**	**0.95**	**U**	**1.8**		**0.93**	**U**	**1.7**	**UY**	**0.94**	**U**	**0.93**	**U**	**9.5**	**U**
Aldrin	9.5	- - -	ug/kg dw	0.47	U	0.48	U	0.48	U	0.49	U	0.48	U	0.47	U	0.48	U	0.47	U	0.47	U	0.47	U	0.47	U	4.7	U
cis-Chlordane	- - -	- - -	ug/kg dw	0.47	U	0.48	U	0.48	U	0.49	U	0.48	U	0.47	U	0.48	U	0.47	U	0.47	U	0.47	U	0.47	U	4.7	U
trans-Chlordane	- - -	- - -	ug/kg dw	1.1	UY	1.9	U	0.48	U	1.9	U	0.94	UY	1.9	U	0.48	U	0.47	U	0.61	UY	0.5	U	0.47	U	4.7	U
cis-Nonachlor	- - -	- - -	ug/kg dw	1.9	U	0.48	U	1.9	U	0.68	UY	1.9	U	0.47	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	19	U
trans-Nonachlor	- - -	- - -	ug/kg dw	7.1		1.9	U	11		2.2	UY	8.6		1.9	U	1.9	U	2.7		4.6		1.9	U	1.9	U	19	U
oxy Chlordane	- - -	- - -	ug/kg dw	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	1.9	U	19	U
Total Chlordane[4,9]	**2.8**	**- - -**	**ug/kg dw**	**7.1**		**1.9**	**U**	**11**		**2.2**	**UY**	**8.6**		**1.9**	**U**	**1.9**	**U**	**2.7**		**4.6**		**1.9**	**U**	**1.9**	**U**	**19**	**U**
Dieldrin	1.9	1700	ug/kg dw	0.93	U	0.96	U	0.96	U	0.97	U	0.96	U	0.95	U	0.95	U	0.93	U	0.94	U	0.94	U	0.93	U	9.5	U
Heptachlor	1.5	270	ug/kg dw	0.47	U	0.48	U	0.60	UY	0.49	U	0.63	UY	0.47	U	0.48	U	0.47	U	0.47	U	0.47	U	0.47	U	4.7	U
gamma-BHC (Lindane)	**- - -**	- - -	ug/kg dw	0.47	U	0.48	U	0.48	U	1.2	UY	0.48	U	0.47	U	0.48	U	0.47	U	0.47	U	0.47	U	0.47	U	4.7	U
Aroclor 1016	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Aroclor 1221	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Aroclor 1232	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Aroclor 1242	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Aroclor 1248	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Aroclor 1254	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Aroclor 1260	- - -	- - -	ug/kg dw	9.5	U	9.5	U	9.6	U	9.4	U	9.6	U	9.2	U	9.5	U	9.5	U	9.7	U	9.6	U	9.4	U	9.4	U
Total PCBs[10]	**130**	**3100**	**ug/kg dw**	**9.5**	**U**	**9.5**	**U**	**9.6**	**U**	**9.4**	**U**	**9.6**	**U**	**9.2**	**U**	**9.5**	**U**	**9.5**	**U**	**9.7**	**U**	**9.6**	**U**	**9.4**	**U**	**9.4**	**U**
PETROLEUM HYDROCARBONS																											
Gasoline Range Hydrocarbons	- - -	- - -	mg/kg dw	11	U	- - -		15	U	- - -		12	U	- - -		9.5	U	12	U	9	U	6.3	U	6.6	U	11	U
Diesel Range Hydrocarbons	- - -	- - -	mg/kg dw	44		- - -		37		- - -		24		- - -		17		34		25		5.4	U	5.6	U	120	
Motor Oil	- - -	- - -	mg/kg dw	100		- - -		46		- - -		28		- - -		33		72		39		11	U	11	U	300	

Non-Detect SL Exceedance U

SL Exceedance

1) As no SL value exists to trigger toxicity testing, this chemical will only be evaluated for its bioaccumulative potential.
2) Bulk sediment measurement of TBT is used only when porewater extraction cannot be accomplished.
3) 2-Methylnaphthalene is not included in the summation for total LPAH.
4) Components of benzofluoranthenes and chlordane were clarified at the 2007 SMARM.
5) Sum of b,j, k-Benzofluoranthenes.
6) Based on 1998 LAET/HAET's; see http://www.nws.usace.army.mil/PublicMenu/Doc_list.cfm?sitename=dmmo&pagename=17th_ARM_MAy_5_2004.
7) Sum of m,p and o-Xylenes.
8) Sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT.
9) Sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor and oxychlordane.
10) Sum of Aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260.
11) Qualifier (Q)
U - The target analyte was not detected at the reported concentration.
J - Estimated concentration when the value is less than the laboratory's established reporting limits.
UY - Compound not detected at or above reported concentration. However, the analyte reporting limit is raised due to a positive chromatographic interference thus the analyte may be present below the increased limit.
JM - Estimated (Maximum Possible) Concentration is less than the laboratory's established reporting limits

Table 3-3. Comparison to Washington State SMS

	SMS Screening Criteria			0' - 4' intervals												4' - 8' intervals						8' - 12' intervals					
ANALYTE	SQS	CSL	UNITS	V1/V6	Q[11]	D1	Q[11]	V2/V5	Q[11]	D2	Q[11]	V3/V4	Q[11]	D3	Q[11]	V1/V6	Q[11]	V5	Q[11]	V3/V4	Q[11]	V1	Q[11]	V5	Q[11]	V4	Q[11]
METALS (mg/kg)																											
Arsenic	57	93	mg/kg dw	20	U	20	U	40	U	20	U	40	U	6	U	6	U	20	U	30	U	5	U	5	U	20	U
Cadmium	5.1	6.7	mg/kg dw	0.7	U	0.6	U	2	U	0.8	U	2	U	0.3		0.2	U	0.7	U	1	U	0.2	U	0.2	U	0.7	U
Chromium	260	270	mg/kg dw	31		23		15		51		22		24		35.2		33		23		21.3		22.9		25	
Copper	390	390	mg/kg dw	12.8		11.9		12		13.3		10		10.2		17		17.9		20		6.1		7.7		22	
Lead	450	530	mg/kg dw	7	U	6	U	20	U	8	U	20	U	14		4		10		20		2	U	2	U	25	
Mercury	0.41	0.59	mg/kg dw	0.03	U	0.04		0.03	U	0.05		0.03		0.03		0.08		0.07		0.03		0.02	U	0.03	U	0.25	
Silver	6.1	6.1	mg/kg dw	1.0	U	1.0	U	3	U	1.0	U	2	U	0.4	U	0.4	U	1	U	2	U	0.3	U	0.3	U	1.0	U
Zinc	410	960	mg/kg dw	52		32		40		33		32		28		32		50		96		23		29		100	
PAHs																											
Naphthalene	99	170	mg/kg oc	3.1		9.7		4.2		9.0		10.7		2.6		9.3		7.9		2.7		5.9	U	17.3	U	17.9	
Acenaphthylene	66	66	mg/kg oc	1.5		2.5		1.9		3.7		3.1		1.4		2.1		3.3		1.9		5.9	U	17.3	U	4.0	
Acenaphthene	16	57	mg/kg oc	2.0		6.3		1.0		2.3		3.3		2.1		4.4		2.4		1.2	J	5.9	U	17.3	U	11.9	
Fluorene	23	79	mg/kg oc	2.1		5.7		1.8		3.1		5.7		2.7		5.1		4.0		2.1		5.9	U	17.3	U	11.2	
Phenanthrene	100	480	mg/kg oc	15.9		14.9		10.8		9.6		30.4		8.7		16.2		12.7		11.9		5.9	U	17.3	U	32.1	
Anthracene	220	1200	mg/kg oc	3.8		8.0		3.9		6.8		10.7		6.4		6.7		7.5		6.1		5.9	U	17.3	U	18.7	
Total LPAHs	**370**	**780**	**mg/kg oc**	**28**		**47**		**23**		**35**		**64**		**24**		**44**		**38**		**26**		**5.9**	**U**	**17.3**	**U**	**96**	
2-Methylnaphthalene[3]	38	64	mg/kg oc	1.5	U	1.8		0.6	J	2.4		2.2		0.6	J	2.4		1.7		0.7	J	5.9	U	17.3	U	3.7	
Fluoranthene	160	1200	mg/kg oc	41.7		19.4		40.8		20.3		142.9		11.6		24.8		17.5		51.1		5.9	U	17.3	U	89.6	
Pyrene	1,000	1400	mg/kg oc	57.6		108.6		41.7		107.3		169.6		104.7		60.0		95.2		96.3		5.9	U	26.0		350.7	
Benzo(a)anthracene	110	270	mg/kg oc	7.5		14.9		12.5		16.4		31.3		14.0		11.4		11.9		14.8		5.9	U	17.3	U	41.0	
Chrysene	110	460	mg/kg oc	16.7		27.4		25.0		31.6		69.6		31.4		17.1		23.8		31.1		5.9	U	17.3	U	74.6	
Total Benzofluoranthenes[4,5]	230	450	mg/kg oc	24.2		91.4		36.3		79.1		125.0		104.7		38.1		71.4		66.7		5.9	U	10.6	J	201.5	
Benzo(a)pyrene	99	210	mg/kg oc	10.6		39.4		13.8		33.3		50.9		47.7		19.0		33.3		27.4		5.9	U	17.3	U	97.0	
Indeno(1,2,3-cd)pyrene	34	88	mg/kg oc	4.5		17.7		6.7		17.5		25.9		19.8		8.3		13.5		13.3		5.9	U	17.3	U	39.6	
Dibenz(a,h)anthracene	12	33	mg/kg oc	1.7		6.9		2.4		6.8		8.7		8.1		3.1		5.3		4.7		1.4	U	4.4	U	13.4	
Benzo(g,h,i)perylene	31	78	mg/kg oc	4.6		17.1		6.3		18.1		25.0		19.8		9.0		13.5		13.3		5.9	U	17.3	U	42.5	
Total HPAHs	**960**	**5300**	**mg/kg oc**	**169**		**343**		**185**		**331**		**649**		**362**		**191**		**285**		**319**		**5.9**	**U**	**37**		**950**	
CHLORINATED HYDROCARBONS																											
1,4-Dichlorobenzene	3.1	9	mg/kg oc	0.08	U	0.07	U	0.05	U	0.08	U	0.10	U	0.07	U	0.10	U	0.09	U	0.07	U	0.27	U	0.87	U	0.08	U
1,2-Dichlorobenzene	2.3	2.3	mg/kg oc	0.08	U	0.07	U	0.05	U	0.08	U	0.10	U	0.07	U	0.10	U	0.09	U	0.07	U	0.27	U	0.87	U	0.08	U
1,2,4-Trichlorobenzene	0.81	1.8	mg/kg oc	0.38	U	0.26	U	0.20	U	0.28	U	0.43	U	0.27	U	0.46	U	0.37	U	0.34	U	1.30	U	4.23	U	0.36	U
Hexachlorobenzene (HCB)	0.38	2.3	mg/kg oc	0.04	U	0.03	U	0.02	U	0.03	U	0.04	U	0.03	U	0.05	U	0.04	U	0.03	U	0.14	U	0.45	U	0.35	U
PHTHALATES[6]																											
Dimethyl phthalate	53	53	mg/kg oc	0.4	U	0.3	U	0.2	U	0.3	U	0.4	U	0.3	U	0.5	U	0.4	U	0.3	U	1.4	U	4.4	U	0.4	U
Diethyl phthalate	61	110	mg/kg oc	3.8	U	2.6	U	2.0	U	2.8	U	4.3	U	2.7	U	4.6	U	3.7	U	3.4	U	14.5	U	44.2	U	3.6	U
Di-n-butyl phthalate	220	1700	mg/kg oc	1.5	U	1.1	U	0.8	U	1.1	U	1.7	U	1.1	U	1.8	U	1.5	U	1.3	U	5.9	U	17.3	U	1.4	U
Butyl benzyl phthalate	4.9	64	mg/kg oc	0.4	U	0.3	U	0.2	Q	0.2	J	0.3	J	0.3	U	0.5	U	0.4	U	0.3	U	1.0	J	4.4	U	0.4	U
Bis(2-ethylhexyl) phthalate	47	78	mg/kg oc	1.9	U	1.5		1.0	U	1.0	J	2.1	U	1.0	J	2.3	U	1.9	U	1.7	U	7.4	U	22.1	U	1.8	U
Di-n-octyl phthalate	58	4500	mg/kg oc	1.5	U	1.1	U	0.8	U	1.1	U	1.7	U	1.1	U	1.8	U	1.5	U	1.3	U	5.9	U	17.3	U	1.4	U
MISCELLANEOUS EXTRACTABLES																											
Dibenzofuran	15	58	mg/kg oc	1.4	J	4.6		1.2		2.4		3.6		1.7		3.8		3.0		1.3	J	5.9	U	17.3	U	7.5	
Hexachlorobutadiene	3.9	6.2	mg/kg oc	0.04	U	0.03	U	0.02	U	0.03	U	0.04	U	0.03	U	0.05	U	0.04	U	0.03	U	0.14	U	0.45	U	0.36	U
N-Nitrosodiphenylamine	11	11	mg/kg oc	1.5	U	1.1	U	0.8	U	1.1	U	1.7	U	0.3	J	1.8	U	1.5	U	1.3	U	5.9	U	17.3	U	0.5	J
Total PCBs[10]	**12**	**65**	**mg/kg oc**	**0.72**	**U**	**0.54**	**U**	**0.40**	**U**	**0.53**	**U**	**0.86**	**U**	**0.53**	**U**	**0.90**	**U**	**0.75**	**U**	**0.72**	**U**	**2.8**	**U**	**9.0**	**U**	**0.70**	**U**
Aroclor 1016	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
Aroclor 1221	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
Aroclor 1232	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
Aroclor 1242	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
Aroclor 1248	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
Aroclor 1254	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
Aroclor 1260	- - -	- - -	mg/kg oc	0.72	U	0.54	U	0.40	U	0.53	U	0.86	U	0.53	U	0.90	U	0.75	U	0.72	U	2.8	U	9.0	U	0.70	U
IONIZABLE ORGANIC COMPOUNDS																											
Phenol	420	1200	ug/kg dw	20		23		37		30		21		19	U	12	J	14	J	18	U	20	U	18	U	13	J
2-Methylphenol	63	63	ug/kg dw	5.0	U	5.9		3.6	J	24		4.8	U	4.7	U	4.8	U	4.7	U	4.6	U	4.9	U	4.6	U	4.8	U
4-Methylphenol	670	670	ug/kg dw	40	U	16	J	13	J	23	J	32	J	37	U	27	J	11	J	37	U	40	U	36	U	22	J
2,4-Dimethylphenol	29	29	ug/kg dw	20	U	6.8	J	4.3	J	21		19	U	19	U	3.8	J	3.3	J	18	U	20	U	18	U	3.4	J
Pentachlorophenol	360	690	ug/kg dw	50	U	46	U	47	U	49	U	48	U	47	U	48	U	47	U	46	U	49	U	46	U	48	U
Benzyl alcohol	57	73	ug/kg dw	20	U	19	U	19	U	7.5	J	19	U	19	U	19	U	19	U	18	U	20	U	18	U	19	U
Benzoic acid	650	650	ug/kg dw	400	U	370	U	110	J	390	U	380	U	370	U	380	U	380	U	370	U	400	U	360	U	380	U
CONVENTIONALS																											
Total Solids	- - -	- - -	%	68.7		69.8		55.8		59.6		65.4		85.2		76.1		68.3		66.9		92.9		87.6		64.7	
Preserved Total Solids	- - -	- - -	%	67.7		75.7		55.0		69.3		67.6		80.7		77.9		68.5		75.6		86.2		84.1		71.1	
Total Volatile Solids	- - -	- - -	%	2.94		2.6		5.31		5.5		2.72		1.45		1.88		2.72		2.68		0.68		0.67		3.71	
N-Ammonia	- - -	- - -	mg-N/kg dw	12.2		2.92		6.5		3.36		8.2		2.30		16.7		2.5		13.9		0.7		0.6		28.5	
Sulfide	- - -	- - -	mg/kg dw	218		153		376		159		409		6.99		32		402		246		6.8		1.19	U	530	
Acid Volatile Sulfide	- - -	- - -	mg/kg dw	231		173		15.6		18.8		12		56		126		707		136		6.2		1.14	U	474	
Total Organic Carbon	- - -	- - -	%	1.32		1.75		2.40		1.77		1.12		1.72		1.05		1.26		1.35		0.339		0.1		1.34	
GRAIN SIZE																											
Gravel	- - -	- - -	%	**16.5**		**25.1**		**25.6**		**26.5**		**30.5**		**30.7**		**6.7**		**16.6**		**34.2**		**4.2**		**26.2**		**34.5**	
Total Sand	- - -	- - -	%	71.8		65.1		57.0		58.1		56.0		64.0		73.6		64.5		53.8		94.1		72.2		44.6	
Total Fines	- - -	- - -	%	11.8		9.9		17.4		15.4		13.4		5.3		19.8		19.0		12.0		1.6	U	1.6	U	20.9	

1) As no SL value exists to trigger toxicity testing, this chemical will only be evaluated for its bioaccumulative potential.

Non-Detect SQS Exceedance — U

SQS Exceedance

2) Bulk sediment measurement of TBT is used only when porewater extraction cannot be accomplished.

3) 2-Methylnaphthalene is not included in the summation for total LPAH.

4) Components of benzofluoranthenes and chlordane were clarified at the 2007 SMARM.

5) Sum of b,j, k-Benzofluoranthenes.

6) Based on 1998 LAET/HAET's; see http://www.nws.usace.army.mil/PublicMenu/Doc_list.cfm?sitename=dmmo&pagename=17th_ARM_MAy_5_2004.

7) Sum of m,p and o-Xylenes.

8) Sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT.

9) Sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor and oxychlordane.

10) Sum of Aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260.

11) Qualifier (Q)

U - The target analyte was not detected at the reported concentration.

J - Estimated concentration when the value is less than the laboratory's established reporting limits.

UY - Compound not detected at or above reported concentration. However, the analyte reporting limit is raised due to a positive chromatographic interference thus the analyte may be present below the increased limit.

JM - Estimated (Maximum Possible) Concentration is less than the laboratory's established reporting limits

Table 3-4. Dioxin/Furan Results

				0' - 4' Interval								
	ANALYTE	TEF	Units	V1/V6	TEQ	Q	V2/V5	TEQ	Q	V3/V4	TEQ	Q
Dioxins	2,3,7,8-TCDD	1	pg/g dw	0.166	0.166	JM	0.168	0.168	JM	0.157	0.157	JM
	1,2,3,7,8-PeCDD	1	pg/g dw	0.535	0.535	J	0.585	0.585	J	0.52	0.52	J
	1,2,3,4,7,8-HxCDD	0.1	pg/g dw	0.6	0.06	J	0.737	0.0737	J	0.33	0.033	JM
	1,2,3,6,7,8-HxCDD	0.1	pg/g dw	1.69	0.169	J	3.16	0.316		1.9	0.19	J
	1,2,3,7,8,9-HxCDD	0.1	pg/g dw	1.19	0.119	J	1.65	0.165	J	1.02	0.102	JM
	1,2,3,4,6,7,8-HpCDD	0.01	pg/g dw	48.8	0.488		150	1.5		36.5	0.365	
	OCDD	0.0003	pg/g dw	479	0.1437		2400	0.72		342	0.1026	
Furans	2,3,7,8-TCDF	0.1	pg/g dw	1.09	0.109		1.44	0.144		1.4	0.14	
	1,2,3,7,8-PeCDF	0.03	pg/g dw	0.284	0.00852	JM	0.275	0.00825	J	0.247	0.00741	J
	2,3,4,7,8-PeCDF	0.3	pg/g dw	0.355	0.1065	J	0.355	0.1065	J	0.3	0.09	J
	1,2,3,4,7,8-HxCDF	0.1	pg/g dw	0.529	0.0529	J	0.699	0.0699	J	0.393	0.0393	J
	1,2,3,6,7,8-HxCDF	0.1	pg/g dw	0.367	0.0367	JM	0.361	0.0361	J	0.347	0.0347	J
	2,3,4,6,7,8-HxCDF	0.1	pg/g dw	0.452	0.0452	J	0.351	0.0351	J	0.402	0.0402	J
	1,2,3,7,8,9-HxCDF	0.1	pg/g dw	0.296	0.0296	J	0.178	0.0178	JM	0.104	0.0104	JM
	1,2,3,4,6,7,8-HpCDF	0.01	pg/g dw	6.36	0.0636		11.8	0.118		6.01	0.0601	
	1,2,3,4,7,8,9-HpCDF	0.01	pg/g dw	0.592	0.00592	J	0.964	0.00964	J	0.296	0.00296	JM
	OCDF	0.0003	pg/g dw	19.5	0.00585		49.2	0.01476		15.9	0.00477	
			Total TEQ		**2.14449**			**4.08775**			**1.89944**	

Qualifier (Q)

U - The target analyte was not detected at the reported concentration.

J - Estimated concentration when the value is less than the laboratory's established reporting limits.

UJY - Compound not detected at or above reported concentration but may be present below that limit because the analyte reporting limit is raised due to a positive chromatographic interference.

JM - Estimated (Maximum Possible) Concentration is less than the laboratory's established reporting limits

Table 3-5. Ordnance Residue

Analyte	Units	0' - 12' intervals (March 7, 2012)						0' - 4' intervals (April 25, 2012)					
		V1/V6	Q[1]	V2/V5	Q[1]	V3/V4	Q[1]	D1	Q[1]	D2	Q[1]	D3	Q[1]
Total Solids	%	80.7		69.7		70.9		69.7		62.6		81	
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
1,3,5-Trinitrobenzene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
1,3-Dinitrobenzene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
3,5-Dinitroaniline	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
Nitrobenzene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
4-Amino-2,6-dinitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
2-Amino-4,6-dinitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
2,4,6-Trinitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
2,6-Dinitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
2,4-Dinitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
2-Nitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
3-Nitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
4-Nitrotoluene	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
Nitroglycerin	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.28	U	0.25	U	0.31	U
Pentaerythritol Tetranitrate	mg/Kg dw	0.33	U	0.38	U	0.38	U	0.4	U	0.4	U	0.4	U

1) Qualifier (Q)

U - The target analyte w as not detected at the reported concentration

were found in the middle of the 4 to 8 foot sections of V5 and V6 and one was found at the bottom of the 8 to 12 foot section of the V4 core. These areas of cobbles or rocks appear to be an aggregate of asphalt and small gravel. Parts of the pier deck were paved and it is likely that chunks of asphalt and gravel broke apart and settled into the sediments as the deck deteriorated with age.

3.3 Summary of Data Quality Assurance Review

3.3.1 Volatiles

Percent recoveries for the surrogates were not within control limits following initial analysis for one sample. The sample was re-analyzed within the hold time and the re-analysis proceeded without incident of note. The results of the re-analysis have been reported.

The laboratory control sample duplicate percent recovery for 1,2,4-trichlorobenzene was not within control limits. Because this compound was not detected in the equipment rinsate sample (M_Cores_RB), the high bias does not compromise any reporting limit. No corrective actions were taken.

3.3.2 Semi-Volatile Compounds

3.3.2.1 Semi-Volatile Compound Analyses

These analyses proceeded without incident of note.

The percent difference for the surrogate, 2,4,6-tribromophenol, was high for the CCAL that bracketed the analysis of this sample. Because no target compounds were detected in sample M_Cores_RB (equipment rinsate), the high bias does not compromise any reporting limit. No corrective actions were taken.

3.3.2.2 SIM Semi-Volatile Analyses

These analyses proceeded without incident of note.

The phenanthrene, 2-methylnaphthalene, 4-methylphenol, and 2,4-dimethylphenol duplicates had high relative percent differences (RPDs) attributed to sample non-homogeneity.

3.3.3 Pesticides

One sample was pre-diluted prior to initial analysis due to the dark color of the extract. Based on the chromatography, the sample was not analyzed at a lower dilution factor.

3.3.4 Polychlorinated Biphenyls

These analyses proceeded without incident of note.

3.3.5 Metals

A matrix spike was prepared and analyzed in conjunction with sample V1/V6_4-8. The matrix spike percent recovery for antimony was low. Because the percent recovery for all elements were within acceptable quality control (QC) limits for the corresponding laboratory control sample (LCS) and SRM, it was concluded that the sample matrix was the cause of the low matrix spike recovery. No corrective actions were taken.

A matrix spike was prepared and analyzed in conjunction with sample D1_0-4. The matrix spike percent recovery for antimony was low. Because the percent recovery for all elements were within acceptable QC limits for the corresponding LCS and SRM, it was concluded that the sample matrix was the cause of the low matrix spike recovery. No corrective actions were taken.

A matrix duplicate was prepared and analyzed in conjunction with sample D1_0-4. The RPD for chromium was high following the analysis. Because the percent recoveries for all elements were within acceptable QC limits for the corresponding LCS and SRM, it was concluded that a lack of sample homogeneity was the cause of the high RPD. No corrective actions were taken.

3.3.6 Butyltin

These analyses proceeded without incident of note.

3.3.7 Dioxins/Furans

These analyses proceeded without incident of note.

3.3.8 Conventionals

A matrix triplicate was prepared and analyzed for total volatile solids in conjunction with sample V1/V6_4-8. The relative standard deviation (or %RSD) was high following the analysis of the triplicate. The high %RSD was attributed to lack of sample homogeneity. No corrective actions were taken.

A matrix spike was prepared and analyzed for acid volatile sulfide (AVS) in conjunction with sample V1/V6_4-8. The matrix spike percent recovery for AVS was low; it was re-colored and re-analyzed and was found to be low for the re-analysis. Because the percent recovery for AVS was within acceptable

QC limits for the corresponding LCS, it was concluded that the sample matrix was the cause of the low matrix spike recovery. No further corrective actions were taken. The results of the re-analysis have been reported.

The AVS duplicate had a high RPD, which was attributed to sample non-homogeneity.

3.3.9 Ordnance

The matrix spike recovery of nitroglycerin and pentaerythritol tetranitrate for sample V3/V4_0-12 was outside control criteria. Recovery in the LCS was acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential low bias in this matrix. No further corrective action was taken.

The matrix spike recovery of nitroglycerin and pentaerythritol tetranitrate for sample D3_0-4 was outside control criteria. Recovery in the LCS was acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential low bias in this matrix. No further corrective action was taken.

4 LESSONS LEARNED

There were several lessons learned from the two vibracoring events that should inform the design of any subsequent sediment sampling intended for permitting and design.

4.1 Station Positioning in Proximity to Large Piers and Other Structures

There are two components to the positioning problems encountered during the second mobilization to collect diver vibracores: elevation of the GPS antenna with respect to the pier and GPS satellite locations.

Low tides on the day of sampling caused the pier to interfere with GPS signal reception from the ship-mounted GPS antenna, which was much lower than the deck of the pier for most of the day. The tide dropped from 7.2 feet above MLLW to -0.7 feet below MLLW over the course of the day.

The second component of the positioning problems encountered was the number and positions of satellites acquired during the second mobilization to collect diver vibracores. Nobletec, Inc. (makers of the navigation software used with the Trimble DGPS system) commented that the number of satellites and their positions were very poor on the day the diver cores were collected, after they completed post-processing for the DGPS data necessary to provide a corrected Navigation Log for that day.

As a result of the positioning problems encountered, the following procedures should be evaluated for subsequent sampling events adjacent to the Mukilteo Tank Farm Pier:

- If practical, the “Station Positioning Methods” section of subsequent sampling plans should account for both tidal elevation and the expected number and positions of satellites.
- A secondary DGPS unit and antenna (potentially hand-held) would allow the sampling team to collect positioning information from the pier deck, which would alleviate pier interference with the GPS signal.
- The vessel provider must observe and record GPS Satellite and PDOP information prior to sample collection, which will enable the sampling team to evaluate whether GPS signal quality is sufficient.

- Potential corrective measures to consider when the GPS signal quality is low (PDOP is greater than 10[3]) include:
  - Relocate the sampling vessel to the opposite side of the pier (if collecting under-pier samples).
  - Elevate the GPS antenna (a long section of PVC pipe, or equivalent) above the pier deck.
  - Use a supplemental GPS unit stationed on the pier deck to supplement positioning information provided by the sampling vessel GPS.
  - Prior to sample collection, tag the closest piling and note the vessel position on a figure of the pier so that the sample location can be re-occupied and recorded at a later time when signal strength is more reliable.

4.2 Sampling at or Near Stations with 75 Percent or Lower Recovery

Repeated vibracoring attempts at the V2 and V3 stations were unsuccessful due to plugging of the core nose with wood waste, debris, and/or cobble. A barge-mounted drill rig may be one sampling method to reduce the risk of low recoveries, however this will increase sampling costs significantly. Instead, it may be advisable to budget for additional sampling days, which would allow for additional sampling attempts at each location.

Another piece of vibracoring equipment that should be considered includes a stabilizer to insure that the core barrel does not lean over as it drives into the sediment. However, subsequent sampling design should also recognize that a significant amount of large debris (broken pilings, slabs on concrete, etc.) is present around the pier. Such debris could interfere with the larger footprint required by a stabilizer.

4.2.1 Reducing Sample Non-Homogeneity

Due to the substantial degree of sediment complexity around the Mukilteo Tank Farm Pier (debris, shell hash, cobbles, sands, silts, etc.), non-homogenous samples should be expected. Although subsequent sampling events should address the lack of sample homogeneity by implementing robust compositing procedures, high RPDs should be anticipated when compositing complex sediment mixtures.

[3] A PDOP greater than 10 represents a low confidence level. Positional measurements should be not be used for precise location of sampling stations or calculations. They should only be used to provide a rough estimate of the current location.

Shell hash was a significant component of many samples and may be one source of the sample non-homogeneity described in section 3.2. Although large fragments of wood, large pieces of gravel/pebbles, intact shells or shell halves, living organisms and vegetation (terrestrial debris/aquatic algae) are removed before sediments are homogenized, shell hash was included in sample composites.

In general, shell hash layers contained a small mass of sediment relative to the mass of shell fragments. These layers are composed of small shell fragments and dark, sediment-laden fluids. The largest shell fragments are less than 1/2 inch in length and width, with the vast majority in the 1/4 inch or less category. Given that shell fragments are so small, it would be impractical to remove individual pieces.

Subsequent sediment sampling events should address how layers of shell hash will be processed and analyzed. Depending upon the specific sampling objectives, it may be desirable to exclude shell hash layers from sample composites. However, it is important to note that in some sections of the sediment cores collected, removal of the shell hash layer would leave little or no sample. A final recommendation and/or decision to remove shell hash layers from samples can only be made once the specific design objectives for subsequent sampling are known.

4.2.2 Data Quality Assurance Review Procedures for Dioxins/Furans in Future Project Work

If future sampling will be completed under the DMMP framework, Puget Sound Sediment Reference Material must be used for evaluations of PCBs and dioxins/furans. Additionally, the DMMP framework requires that Stage IV data validation be performed.

5 SUMMARY OF SAMPLING AND ANALYSIS RESULTS

This section summarizes the results from chemical testing conducted on sediment samples collected around the pier perimeter on March 7, 2012 and within the piling field directly beneath the pier on April 25, 2012. As stated previously, the goal for this sediment characterization effort is to support the environmental effects analysis for the EIS. It is not intended to determine the suitability of project sediments for beneficial reuse or for disposal at one of the DMMP open-water dredged material disposal sites. Additional sediment characterization efforts to support design and permitting are likely to be required.

5.1 Comparison to DMMP Screening Criteria

Comparison of chemical testing results for all analytes to DMMP screening criteria suggest that the sediments under and around the pier are generally clean, with the exceptions described below. No chemicals exceeded DMMP maximum level (ML) screening criteria in any samples. However, some chemical concentrations in samples collected around the pier exceeded DMMP screening level (SL) criteria. None of the samples collected beneath the pier (all 0 – 4 foot samples) exceeded DMMP SL criteria for any chemicals.

Table 5-1 lists the DMMP SL exceedances measured for both detected and non-detected (U) chemicals. U-flagged results indicate that the analyte was not detected, therefore the detection limit is reported to indicated that the analyte could be present at this concentration.

Surface sediment samples collected around the outside of the pier were also analyzed for dioxins/furans. DMMP dredged material dioxin/furan suitability guidelines for non-dispersive sites include the screening criteria described below.

Dredged material management units with dioxin concentrations below 10 parts per trillion (ppt) toxic equivalents (TEQs) will be allowed for open-water disposal as long as the volume-weighted average concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 ppt TEQ.

Table 5-1. DMMP SL Exceedances for Detected and Non-Detected Chemicals

Core Section	Sample	SL Exceedance (Sample Concentration, DMMP SL)
0' – 4'	V1/V6	Total Chlordane[1] (7.1 ug/kg, SL = 2.8 ug/kg)
	V2/V5	Total Chlordane[1] (11 ug/kg, SL = 2.8 ug/kg) Dioxin (4.09 pptr TEQ)
	V3/V4	Total Chlordane[1] (8.6 ug/kg, SL = 2.8 ug/kg)
4' – 8'	V3/V4	Total Chlordane[1] (4.6 ug/kg, SL = 2.8 ug/kg)
8' – 12'	V4	Pyrene (4700 ug/kg, SL = 2,600 ug/kg) Total HPAHs[2] (12,730 ug/kg, SL = 12,000 ug/kg) 4',4'-DDE (9.5 ug/kg U, SL = 9 ug/kg) Total Chlordane[1] (19 ug/kg U, SL = 2.8 ug/kg) Dieldrin (9.5 ug/kg U, SL = 1.9 ug/kg) Heptachlor (4.7 ug/kg U, SL = 1.5 ug/kg)

[1] Total Chlordane is defined as the sum of cis-Chlordane, trans-Chlordane, cis-Nonachlor, trans-Nonachlor, and oxy Chlordane.

[2] Total HPAHs are defined as the sum of Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, and Benzo(g,h,i)perylene.

Dioxin concentration measured in surface sediments around the pier ranged from 4.09 ppt TEQ to 1.9 ppt TEQ; however, without a defined dredging prism it is inappropriate to provide a volume-weighted average concentration for project sediments.

5.2 Comparison to Washington State Sediment Management Standards (WAC 173-204)

Comparison of chemical testing results to Washington State Sediment Management Standards (SMS) showed that no tested sediments exceeded Cleanup Screening Levels (CSL), which are established in WAC 173-204-520 as concentration at which minor adverse effects should be expected.

Chemical analysis of the sediments sampled under and around the Pier in the 0' – 4' surface interval and in the 4' – 8' subsurface interval are generally clean. There were no reported chemical concentrations that exceeded Sediment Quality Standards (SQS), suggesting that exposure to these sediments will have no adverse effects on biological resources, and corresponds to no significant health risks to humans, as described in WAC 173-204-300.

However, some chemical concentrations in sediments in the deeper 8' – 12' subsurface interval exceeded SQS criteria. The following SQS exceedances were measured for both detected and non-detected (U) chemicals:

Table 5-2. SQS Exceedances for Detected and Non-Detected Chemicals

Core Section	Sample	SQS Exceedance (Sample Concentration, SQS)
0' – 4'	na	No chemicals exceeded SQS.
4' – 8'	na	No chemicals exceeded SQS.
8' – 12'	V1	1,2,4-Trichlorobenzene (1.3 mg/kg oc U, SQS = 0.81 mg/kg oc)
	V5	Acenaphthene (17.3 mg/kg oc U, SQS = 16 mg/kg oc) 1,2,4-Trichlorobenzene (4.23 mg/kg oc U, SQS = 0.81 mg/kg oc) Hexachlorobenzene (0.45 mg/kg oc U, SQS = 0.38 mg/kg oc) Dibenzofuran (17.3 mg/kg oc U, SQS = 15 mg/kg oc) N-Nitrosodiphenylamine (17.3 mg/kg oc U, SQS = 11 mg/kg oc)
	V4	Indeno(1,2,3-cd)pyrene (39.6 mg/kg oc, SQS = 34 mg/kg oc) Dibenz(a,h)anthracene (13.4 mg/kg oc, SQS = 12 mg/kg oc) Benzo(g,h,i)perylene (42.5 mg/kg oc, SQS = 31 mg/kg oc)

5.3 Evaluation of Ordnance Data

An independent technical evaluation of likely munitions and explosives of concern (MEC) contamination for the Mukilteo Multimodal Project was completed, based on laboratory analysis of nitroaromatics and nitramines concentrations measured in six samples (three composite samples collected along the pier perimeter, and three samples collected by divers from directly beneath the pier).

Ordnance samples were composited from sediments collected from the full core length of matched cores, as described above in Section 2.3.1. The purpose for analyzing full core length composite samples was to determine the presence or absence of ordnance residue.

All samples resulted in non-detect for munitions-related analytes (Table 3-5). Detection limits were sufficient for the purpose of determining whether potential MEC contamination warranted further investigation. Lack of detectable munitions-related analytes indicates that the potential for personnel associated with the Mukilteo Multimodal Project and/or civilians to encounter munitions items at this project site is unlikely during standard construction activities or customary uses of the site.

The technical memorandum that details these findings is provided in Appendix C. This analysis was conducted by the MEC Division of Engineering/Remediation Resource Group, Inc. (ERRG).

6 REFERENCES

Coast & Harbor (Coast & Harbor Engineering). 2012. Draft: Hydrodynamic and Sediment Transport Modeling Study – Mukilteo Ferry Terminal. June 21, 2012.

FTA and WSDOT (Federal Transit Administration and Washington State Department of Transportation). 2012. Sediment Sampling and Analysis Plan. Washington State Ferries Mukilteo Multimodal Project. Prepared by Parametrix, Inc. Bellevue, Washington. February 2012.

APPENDIX A

Core Collection Log Sheets

MUKILTEO MULTIMODAL PROJECT

SEDIMENT SAMPLING

FIELD LOGS

CORE COLLECTION LOGS[1]

NAVIGATION LOGS AND COMMUNICATIONS[1]

CORE PROCESSING LOGS[1]

MARCH 7, 2012

APRIL 25, 2012

[1] **Sediment collected by divers on March 7, 2012 was archived but not analyzed.**

Parametrix

DAILY OBSERVATION REPORT

Job No.: 554-1631-088 Phase: 01 Task: 7B Report No. 1

Project: Mukilteo Multimodal Project/

Owner: N/A Page 1 of 1

Contractor: Gravity Consulting, LLC and Research Support Services Date: 3/17/12

Contractor's Rep./Title: Steve Saugen and Eric Parker, respectively Day: Wednesday / Day 1

Weather A.M.: Clear Cold Sunny °F P.M.: clear warmer °F Site Conditions: (Good) (Fair) (Poor) Fair/Tank Farm Pier

Location and Type of Work:
Mukilteo/Tank Farm Pier Sediment vibracoring + Diver Coring

Number and Classification of Contractors, Men, and Equipment (include condition of equipment):
Parametrix, Inc - 2 men / supplies + documentation
Gravity ~~Environmental~~ JB 3/17/12 Consulting LLC - 2 men / 1 boat / 1 vibracore / generator Drive rig Winch - Good
Research Support Services - 3 men / 1 boat / Dive Gear / Piston corer / Good.

Work in Progress (include report of operations, materials received and condition, work start/stop time, and any unusual conditions):
1) Vibra cores - 08:00

2) Diver Cores - Setting up @ 0800 - Diver in water at D3 ≅ 0940

Work Completed:
① Collected vibracores at V1, V2, V3, V4, V5 & V6 - Partial cores at V2 & V3 otherwise good recovery at all other stations.
②. Diver cores - piston corer not successful. Took a push core (15" long) & 2" in diameter at each location. Cannot be considered cores - they are equivalent to ~~a~~ JB 3/18/12 grab samples.

Discussions with Contractor (include orders given and received): Diver Cores (RSS) - at least 4 ft cores - can be in outer 20 ft under dredge gather side if problem w/ in center of dredge. Mun'tlins reminder
▷ @ D3 RSS reports 18" penetration before refusal. Instructed to make 1 more try.
▷ @ D3 RSS reports refusal - shell hash & debris
D @ D1 " " " - Directed to collect grab sample

Any Cause for Dispute, Change Orders, or Delays, and Reasons:
None

Extra Work in Progress–Description (include Extra Work Report Form):
None.

Items for Office Action:
None

Visitors:
None

Notes:
See above

H Jesse Bennett
Signature

PARAMETRIX SEDIMENT CORE COLLECTION LOG

Project Number: 554-1631-088 (01/7B)

SEDIMENT CORE SAMPLING:

Date/Time: 3/7/2012 / 08:40 AM

Samplers: J. Bennett / P. Leon

Station Location: Mukilteo Tank Farm ~~Bulkd~~ Pier WE/JB 3/7/12

Station ID: MV1

Coordinate System: _____ Coordinates:

Latitude/Northing	Longitude/Easting
47° 57.079' N	122° 17.851 W

Measured Water Depth: 35.2' (Leadline / Sounder / Other _____)

Vertical Datum: 5.033' (MLLW) / MLW / (Other) Tide Height) NOAA

Mudline Elevation: 30.12'

Estimated Penetration: 12+ ft.

Refusal: No refusal Full Penetration

Total Core Length: 12' / ~~11'6"~~ 11'3" WE/JB 3/7/12 Final was cm of water

Percent Recovery 93.8 % (%)

Core/Drive Comments: T1 - 0818 6' Drive/Plugged Nose - 11" - Smell noise / Stinky H_2S - 35.7'
T2 - 35.2' - 1 Boat width out pumpier - 09:40 - 12 ft drive good recovery - ~~[illegible]~~ ~~[illegible]~~ neck of H_2S. Note Top section was not cut correctly - ended up with less than 4' will need to take that into consideration when ~~section~~ processing core sections. Total length = 39" - core section 1 (still in core barrel) WE/JB 3/8/12

S. Contractors - S. Hinz / S. Sumgen

SEDIMENT CORE SAMPLING:

Date/Time: 3/7/2012 / 09:30

Samplers: P. Leon / J. Bennett

Station Location: Mukilteo ~~Tank~~ Farm Pier

Station ID: MV6

Coordinate System: _____ Coordinates:

Latitude/Northing	Longitude/Easting
47° 57.066 N	122° 17.831 W

Measured Water Depth: 30.5' (Leadline / Sounder / Other _____)

Vertical Datum: ~~26.4~~ 4.1' EWP/JB 3/7/12 (MLLW) / MLW / (Other) Tide Height) NOAA

Mudline Elevation: 26.4'

Estimated Penetration: 12 ft.

Refusal: No refusal Full Penetration

Total Core Length: 12' / ~~11'3"~~ 9' WE/JB 3/7/12

Percent Recovery ~~73.0%~~ 75.0 % (%) WE/JB 3/8/12

Core/Drive Comments: T1 - 30.5' - 09:30 AM - Successful drive -
Section 1 - 0-4 ft
Section 2 - 4-8 ft
Section 3 - 8-12 ft - 10" only

SubCont. S. Hinz / S. Sumgen

PARAMETRIX SEDIMENT CORE COLLECTION LOG

Project Number: 554-1631-088 (01/7B)

SEDIMENT CORE SAMPLING:

Date/Time: 3/7/2012 / 10:03 Samplers: J. Bennett / P. Leon

Station Location: Mulkiteo Tank Farm Pier Station ID: MV5

Coordinate System: Coordinates:

Latitude/Northing	Longitude/Easting
47° 57.102' N	122° 17.776' W

Measured Water Depth: 30.0 (Leadline / Sounder / Other)

Vertical Datum: 3.8' (MLLW / MLW / Other Tide Height) ~~MLLW = 0'~~ 9:03 3/7/12 NOAA

Mudline Elevation: 26.2'

Estimated Penetration: 12 ft. Refusal: No refusal Full Penetration

Total Core Length: 12' / 11' 3" Percent Recovery 93.8% (%)

Core/Drive Comments: T1 - 30.0 ft. - 10:03 - successful drive
Section 1 - 0-4 ft. Section 2 - 4-8 ft. Section 3 - 8-12 = 39" long
~~Section 4 - lost 1 3/4" shell hash at bottom~~ lost some shell hash from ~~4 ft.~~ end of core (8-12 section) WE/JA 3/7/12

Sub Cont. - S. Hinz / S. Sawgen

SEDIMENT CORE SAMPLING:

Date/Time: 3/7/2012 / 12:40 Samplers: J. Bennett / P. Leon

Station Location: Mukilteo Tank Farm Pier Station ID: MV2

Coordinate System: Coordinates:

Latitude/Northing	Longitude/Easting
47° 57.115' N	122° 17.800' W

Measured Water Depth: 41.0' (Leadline / Sounder / Other)

Vertical Datum: 6.43' (MLLW / MLW / Other Tide Height) NOAA

Mudline Elevation: 34.5'

Estimated Penetration: 5 ft. Refusal: 5' drive Hard Refusal Wood waste in core nose

Total Core Length: 12 ft. / 5" penetration / 36" in barrel Percent Recovery 60% (%)

Core/Drive Comments: T1 - 34.8 ft. - 11:34 - LOST core fingers - core not intact.
T2 - 34.8 ft. - core blocked just above nose - full penetration but mostly water in barrel @ 12:00
T3 - 41.0 ft - 12:24 - boat swung out + 3/4' boat length (bint = 34'). Maybe 2-3 ft. of sediment
T4 - 41.0 ft. adj boat position. - 12:40 pm - approx = 3-3½ ft. sediment in tube (Nose blocked by wood debris)
Surface sediment still settling. T5 ~~moved 16ft~~ 16:00 42.8 ft. - moved 49 ft to west of V2 (formerly V1) 36" after settling
34" sediment - poor quality core. - 9½ ft drive WE/JA 3/7/12

Sub-Cont. - S. Hinz / S. Sawgen NOTE: stopped work to switch to double pully (2:1) system + tighten hydraulic belt.
NOTE 2: T2 + T3 - had wood debris in them at core nose.

PARAMETRIX SEDIMENT CORE COLLECTION LOG

Project Number: 554-1631-088 (01/7B)

SEDIMENT CORE SAMPLING:

Date/Time: 3/7/12 / 1630 Samplers: J. Bennett / P. Lem.

Station Location: Mukilteo Tank Farm Pier Station ID: MV3

Coordinate System: Coordinates:

Latitude/Northing	Longitude/Easting
47° 57.158' N	122° 17.743' W

Measured Water Depth: 40.6 ft. (Leadline / Sounder / Other _____)

Vertical Datum: 10.2' (MLLW / MLW / Other Tide Height)

Mudline Elevation: 30.4'

Estimated Penetration: 7' STET JB 3/8/12 Refusal: ~~No Refusal~~ JB 3/7/12 Refusal / Hard

Total Core Length: 12' / 7.0' penetration / 63" sediment Percent Recovery 75% (%)

Core/Drive Comments: T_1 - 37.5 ft. - 13:40 - one barrel plugged at nose & shell hash - otherwise full penetration.
T_2 - Boat swung out. ~~boat length~~ ≈ 9 ft. - 14:00 - one barrel plugged at nose & shell hash. - 36 ft.
T_3 - Boat swung out - ½ boat length - ≈ 20 ft. - 14:20 - about 2-3 ft sediment - ~~36~~ 32" after settling.
T_4 - 40.6 ft 16:30 - 33 ft. east of V3 location - about 5 ft in tube after settling.
Section 1 - 0-4 ft. Section 2 - 4-8 ft ~~&~~ only 15" - 63" total =
JB 3/7/12
NOTE: V3 coordinates - In SAP Table (Deviation) are for D3
We are in correct location (by eyeball) for V3.

Sub-Cont. / S. Hinz / S. Sanger.

SEDIMENT CORE SAMPLING:

Date/Time: 3/7/12 / 15:00 Samplers: P. Lem / J. Bennett

Station Location: Mukilteo Farm Pier Station ID: MV4

Coordinate System: Coordinates:

Latitude/Northing	Longitude/Easting
47° 57.139' N	122° 17.724' W

Measured Water Depth: 34.7' (Leadline / Sounder / Other _____)

Vertical Datum: 10.0' (MLLW / MLW / Other Tide Height) NOAA

Mudline Elevation: 24.7'

Estimated Penetration: 12 ft. + Refusal: No Refusal Full Penetration

Total Core Length: 12 ft. / 10.6" Percent Recovery 87.5% (%)

Core/Drive Comments: T_1 - 33.4 ft. - 15:00 - Full Tube / Good Core.
Section 1 - 0-4 ft.
Section 2 - 4-8 ft.
Section 3 - 8-12 ft ~~&~~ 30" only

Sub-Cont. - S. Hinz / S. Sanger.

GRAVITY ENVIRONMENTAL L.L.C.

Gravity Navigation Log

Project: MUKILTEO
Task: CORE SAMPLING
Client: PARAMETRIX

Location	Date	Time	Actual X	Actual Y	Water Depth	Tide Height	Description
V1_3.7.2012_1ST	3.7.2012	816	47 57.079 N	122 17.850 W	35	5.6	6' DRIVE - 0.9' RECOVERY HARD BOTTOM ELECTRICAL SUPPLY DISCONNECTED
V1_3.7.2012_2ND	3.7.2012	850	47 57.079 N	122 17.851 W	35	4.8	12' DRIVE - 11' RECOVERY SUSPENDED MATERIAL AT SURFACE WITH COURSE SANDS THROUOUGHT
V6_3.7.2012	3.7.2012	940	47 57.066 N	122 17.831 W	30.5	4	NOT COLLECTED
V5_3.7.2012	3.7.2012	1003	47 57.102 N	122 17.776 W	30	3.8	NOT COLLECTED
V2_3.7.2012_1ST	3.7.2012	1142	47 57.114 N	122 17.799 W	35	4.6	REFUSAL DUE TO "HANZ" LOSS
V2_3.7.2012_2ND	3.7.2012	1210	47 57.115 N	122 17.799 W	35		NOT COLLECTED
V2_3.7.2012_3RD	3.7.2012	1224			41		NOT COLLECTED/2-3ft recovery
V2_3.7.2012_4TH	3.7.2012	1240	47 57.115 N	122 17.800 W	41	6.4	5' DRIVE - 4' RECOVERY DROVE TO HARD REFUSAL FOUND WOOD IN BARREL
V3_3.7.2012	3.7.2012	1400	47 57.154 N	122 17.749 W	36	9.3	NOT COLLECTED
V3_3.7.2012_2ND	3.7.2012	1420	47 57.155 N	122 17.748 W	38	9.4	NOT COLLECTED
V3_3.7.2012_3RD	3.7.2012	1436	47 57.155 N	122 17.750 W	42	9.4	NOT COLLECTED
V4_3.7.2012	3.7.2012	1508	47 57.139 N	122 17.724 W	34.7	10.3	
V2_3.7.2012_5TH	3.7.2012	1607	47 57.110 N	122 17.809 W	37.8	10.5	NOT COLLECTED
V3_3.7.2012_4TH	3.7.2012	1622	47 57.158 N	122 17.743 W	40.6	10.4	7' DRIVE - 5' RECOVERY

Tides:Everett

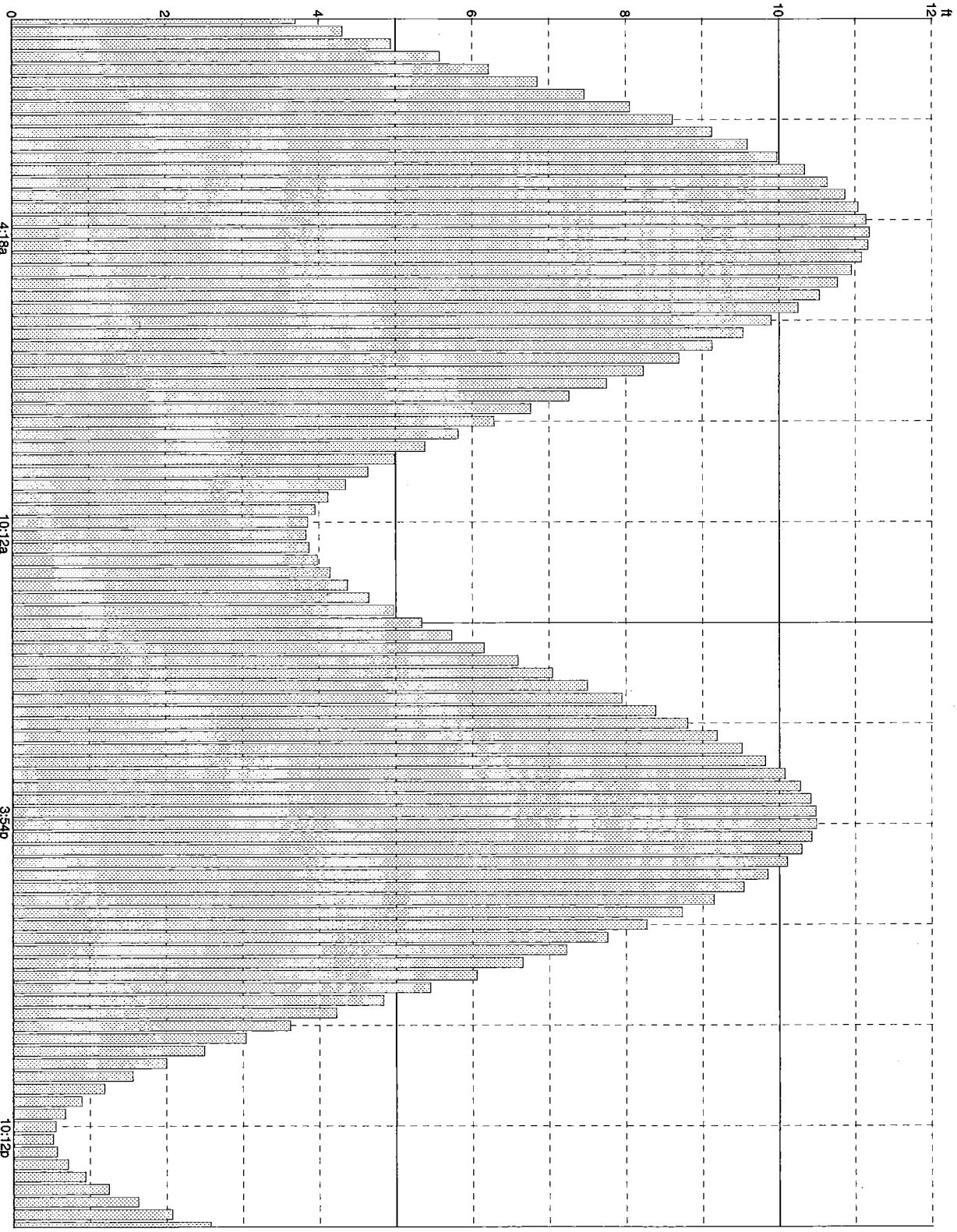
based on Seattle (Madison St), Elliot Bay Washington (NOAA)
47° 58 48 N 122° 13 24 W

Wednesday, March 7, 2012

Average Tides	
Mean Range:	7.4 ft
MHHW:	11.1 ft
Mean Tide:	6.5 ft

Daily Highs & Lows		
4:18a	11.2 ft	High
10:12a	3.8 ft	Low
3:54p	10.5 ft	High
10:12p	0.5 ft	Low

(PST)	Tide
12:00a	3.7 ft
12:15a	4.3 ft
12:30a	4.9 ft
12:45a	5.6 ft
1:00a	6.2 ft
1:15a	6.9 ft
1:30a	7.5 ft
1:45a	8.1 ft
2:00a	8.6 ft
2:15a	9.1 ft
2:30a	9.6 ft
2:45a	10.0 ft
3:00a	10.3 ft
3:15a	10.6 ft
3:30a	10.9 ft
3:45a	11.0 ft
4:00a	11.1 ft
4:15a	11.2 ft
4:30a	11.2 ft
4:45a	11.1 ft
5:00a	11.0 ft
5:15a	10.8 ft
5:30a	10.5 ft
5:45a	10.3 ft
6:00a	9.9 ft
6:15a	9.5 ft
6:30a	9.1 ft
6:45a	8.7 ft
7:00a	8.2 ft
7:15a	7.7 ft
7:30a	7.3 ft
7:45a	6.8 ft
8:00a	6.3 ft
8:15a	5.8 ft
8:30a	5.4 ft
8:45a	5.0 ft
9:00a	4.6 ft
9:15a	4.3 ft
9:30a	4.1 ft
9:45a	4.0 ft
10:00a	3.9 ft
10:15a	3.8 ft
10:30a	3.9 ft
10:45a	4.0 ft
11:00a	4.2 ft
11:15a	4.4 ft
11:30a	4.7 ft
11:45a	5.0 ft
12:00p	5.3 ft
12:15p	5.7 ft
12:30p	6.2 ft
12:45p	6.6 ft
1:00p	7.0 ft
1:15p	7.5 ft
1:30p	7.9 ft
1:45p	8.4 ft
2:00p	8.8 ft
2:15p	9.2 ft
2:30p	9.5 ft
2:45p	9.8 ft
3:00p	10.1 ft
3:15p	10.3 ft
3:30p	10.4 ft
3:45p	10.5 ft
4:00p	10.5 ft
4:15p	10.4 ft
4:30p	10.3 ft
4:45p	10.1 ft
5:00p	9.9 ft
5:15p	9.5 ft
5:30p	9.1 ft
5:45p	8.7 ft
6:00p	8.3 ft
6:15p	7.8 ft
6:30p	7.2 ft
6:45p	6.7 ft
7:00p	6.1 ft
7:15p	5.4 ft
7:30p	4.8 ft
7:45p	4.2 ft
8:00p	3.6 ft
8:15p	3.0 ft
8:30p	2.5 ft
8:45p	2.0 ft
9:00p	1.6 ft
9:15p	1.2 ft
9:30p	0.9 ft
9:45p	0.7 ft
10:00p	0.6 ft
10:15p	0.5 ft
10:30p	0.6 ft
10:45p	0.7 ft
11:00p	0.9 ft
11:15p	1.3 ft
11:30p	1.6 ft
11:45p	2.1 ft
12:00a	2.6 ft



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Parametrix — Coring Log

Core ID: MV1

Project Name: Mukilteo Multi Modal Sediment Coring

Project #: 555-1631-088 (01/78)

Location: Mukilteo TFP

Coring Company: Gravity

Coring Method: Vibracore

Logged by: JB

Coordinates: 47°57.079' N 122°17.851' W

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 0-12' (12' penetr)

Depth of Water: 35.2'

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
		~~0-4" fine wood waste dark gray to black~~ - Strong H_2S odor	1600	
1		~~4-10" (6" total) shell hash + wood waste - dark olive to dark gray~~	MV1/V6_0-4	1
2	48"	10"-48" (38" total) med. to coarse sand % coarse > % med. dark gray appearance but white grains, gray grains + black grains present.	also MV1/V6_0-4AB field dup for Dioxins + Grain Size dup. + trip.	2
3				3
4				4
5	48"	very uniform. Strong H_2S odor - Throughout med. to coarse grain sand / % coarse > % med. some silty fines ~~present~~ present + mixed in but not very much JB 3/8/12 dark gray color in appearance but white grains, gray grains + black grains present	MV1/V6_4-8	5
6			1710 also	6
7				7
8			MV1/V6_4-8CD field dups for all VOAs but TPH-G + Dioxins	8
9	43"	very uniform. med. to coarse dark gray sand. (same as described above from about 10" below surface to bottom of core.	MV1_8-12	9
10			1830 also	10
11			MV1_8-12EF field dups for VOAs, TPH-G Total Sulfides	11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MV 2

Project Name: Mukilteo Multimodal Sediment Coring

Project #: 555-1631-088(01/7B)

Location: Mukilteo TFP

Coring Company: Gravity

Coring Method: Vibracore

Logged by: JB

Coordinates: 47° 57.115' N 122° 17.800' W

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 15' (penetration) 0 - 12 ft

Depth of Water: 41.0

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
		1" surface layer – fines/silty, mod H_2S odor – dark gray almost black		
1		36" field measured; 34" lab measured; 7" fines transitioning into shell hash + fine		1
2		15" shell hash + fines – mod. H_2S odor. dark gray to black		2
		large pieces of wood jammed into sediment v. firm.	MV2/V5_0-4	
3		11" – wood debris wood waste – red brown.	1500	3
4		core nose jammed with wood debris		4
5		None collected.		5
6				6
7				7
8				8
9		None collected		9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MV 3

Project Name: Mukilteo Multimodal Sediment Coring

Project #: 555-1631-088 (01/70)

Location: Mukilteo TFP

Coring Company: Gravity

Coring Method: Vibracore

Logged by: JB

Coordinates: 47° 57.158' N 122° 17.743' W

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 0-12 ft (7' penetration)

Depth of Water: 40.0'

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
1		48" approx 36" after settling. Surface > 10" fines/silt + clay very soft - small % fine sand. and wet dark olive to dark gray transitions to 10 - 36" weak H_2S odor - shell hash - silty fines - fine to ~~coa~~ coarse sand dark olive to dark gray, shell hash thickens with depth	MV3/V4_0-4 1245	1
2				2
3				3
4				4
5		Wet core, generally homogenous mixture 15" only - shell hash - coarse sand - shell fragments - pebbles dark olive to dark gray	MV3/V4_4-8 1100	5
6				6
7				7
8				8
9		None Collected.		9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MV4

Project Name: Mukilteo Multimodal Sediment Cleanup

Project #: 555-1631-085 (01/7B)

Location: Mukilteo TFP

Coring Company: Gravity

Coring Method: Vibracore

Logged by: JB

Coordinates: 47°57.139'N 122°17.724'W

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 0-12 ft. (12' Pipe)

Depth of Water: 34.7'

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
1		48" approx. 36" after settling — Surface → 6" ~~silty clay~~ fines/silt + clay; dark olive to dark gray; transitions to shell hash mixture; weak H2S odor; - Shell hash (thickens with depth); - fines; - some finest coarse sand. dark olive to dark gray	MV3/V4_0-4 1245	1
2				2
3				3
4				4
5		48" Generally homogenous mix - wet (poured of water @ top) o shell hash o coarse sand o fines/silts o some plastic debris; dark olive to gray	MV3/V4_4-8 ~~1245~~ JB 3/9/12 11:00	5
6				6
7				7
8				8
9		33" · shell hash · coarse sand · fines/silts > dark olive to dark gray. H2S odor	MV4_8-12 12:10	9
10				10
11		10" - silty clay with rounded gravel/pebbles, not much shell debris > black. Petroleum odor. 1 rock? - or pavement fan with gravel in it		11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MV5

Project Name: Mukilteo Multimodal Sediment Coring

Project #: 555-1631-055 (01/7B)

Location: Mukilteo TFP

Coring Company: Gravity

Coring Method: Vibracore

Logged by: JB

Coordinates: 47°57.102'N 122°17.776'W

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 12 (Pen) 0-12

Depth of Water: 30.0

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
		surface — fines/silty 0.5m — dark gray, mod. H_2S odor.	MV2/MS-0-4 1500	
1		shell hash — not as thick		1
		fines/silty — dark olive to dark gray		
2	39"	shell hash yellow gray in color — 8"		2
3		shell hash — thick 13" silty fine material mixed in		3
4		— shell hash — mod H_2S odor at surface		4
5		— fines/silty/wet — shell hash thickens with depth	1430 MV5-4-8	5
6	42"	change to dark olive to ~~black~~ gray 6" pocket of dark black surrounded by clay, olive, large chunks of aggregate		6
7		10" med-coarse grain sand olive to gray		7
8			1400 MV5-8-12	8
9	46"	18" med grain - coarse grain sand olive gray		9
10		18" ~~Sand~~ ~~transition~~ transitioning to higher % med grain sand coarse sand — olive to gray		10
11		39-46" last 7" — coaser material including rounded gravel + pebbles — coarse sand — some almost cobble size		11
12				12
13				13
14				14
15				15
16				16

Parametrix — Coring Log

Core ID: MV6

Project Name: Mukilteo Multimodal Sediment Coring

Project #: 554-1631-088 (01/7B)

Location: Mukilteo TFP

Coring Company: Gravity

Coring Method: Vibracore

Logged by: JB

Coordinates: 47°57.066'N 122°17.831'N

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 0-12' (12' penetr.)

Depth of Water: 30.5'

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
		0-4" fine to med. sand mixed with some shell fragments, dark olive, strong H_2S odor		
1		4"-13" (9" total) shell hash with wood debris mixed in, also fines - silty mixed in, mod. H_2S odor; drab olive outside but dark olive to dark gray inside		1
2	48"	13"-48" (35" Total) shell hash with silty fines mixed in, shell hash thickens with depth, faint H_2S odor; looks like material pouring material i.e., mixed with asphalt; found large chunks of aggregate material in this section	MV1/V6-0-4 also MV1/V6-0-4-B field dup for Dioxins	2
3				3
4			1600	4
5	core wet 46" but cohesive.	19" - shell hash/wood debris mixed in; - 1 cobble ≈ 1½" to 2" in diameter; note: dark material - pocket of black - PET odor ≈ 11" from top of core	1710	5
6		4" of clay & some wood fibers; 2" of shell fragments/wood fibers & silty fines	MV1/V6-4-8 also 4-8 CP MV1/V6-4-8 field dups	6
7		21" clay - dark olive to black & trace of fine sand		7
8				8
9	only 15" total	primarily clay - dark olive to black with a trace of fine sand.		9
10	46	This materials was not composited with the V1_8-12 material because of difference in volume of material collected		10
11		That is: V1_8-12 ≈ 93" but V6_8-12 = 15"		11
12				12
13				13
14				14
15				15
16				16

PARAMETRIX SEDIMENT CORE COLLECTION LOG

Project Number: 554-1631-088 (01/7B)

SEDIMENT CORE SAMPLING:

Date/Time: MARCH 7, 2012 / 16:12

Samplers: PARKER, SYLVESTER

Station Location: WESTERNMOST OF 3

Station ID: D1

Coordinate System: USSP WA N, FT.

Coordinates:

Latitude/Northing	Longitude/Easting
350385.2	1281679.6

Measured Water Depth: 37 FT (Leadline / Sounder / Other DIVER GAUGE

Vertical Datum: 7.7' (MLLW) / MLW / (Other) Tide Height) NOAA

Mudline Elevation: 29.3'

Estimated Penetration: 20 CM

Refusal:

Total Core Length: 20 CM

Percent Recovery (%)

Core/Drive Comments: SEDIMENT PROBED AND JUDGEMENT MADE NOT TO ATTEMPT PISTON CORE BASED ON EXPERIENCE AT D3 AND D8.

SURFACE SAMPLE COLLECTED TO 20CM, MIDDLE OF BENT, APPROX. CENTER OF PIER.

SURFACE SEDIMENT SILTY SANDY SHELL HASH.
SAMPLE TRANSFERRED TO CORE LINERS APPROX. 16:40

SEDIMENT CORE SAMPLING:

Date/Time: MARCH 7, 2012 / 1437

Samplers: PARKER, SYLVESTER

Station Location: MIDDLE STATION OF 3

Station ID: D2

Coordinate System: USSP WA N, FT.

Coordinates:

Latitude/Northing	Longitude/Easting
350615.5	1281902.6

Measured Water Depth: 25 FT (Leadline / Sounder / Other DIVER GAUGE

Vertical Datum: 9.5' (MLLW) / MLW / (Other) Tide Height) NOAA

Mudline Elevation: 15.5'

Estimated Penetration: 20 CM

Refusal:

Total Core Length: 20 CM

Percent Recovery (%)

Core/Drive Comments: ONE PISTON CORE ATTEMPTED, PENETRATION < 1 FT. COLLECTED 20CM HAND CORE.

STATION MOVED APPROX 7' ALONG ℄ TOWARD NORTH TO AVOID SECTION OF FALLEN DECKING.

SURFACE SEDIMENT SILTY, SANDY SHELL HASH
SAMPLE TRANSFERRED TO CORE LINERS APPROX. 15:15

PARAMETRIX SEDIMENT CORE COLLECTION LOG

Project Number: 554-1631-088 (01/7B)

SEDIMENT CORE SAMPLING:

Date/Time: MARCH 7, 2012 / 17:25

Samplers: EP PARKER, SYLVESTER

Station Location: EASTERNMOST OF 3

Station ID: D3

Coordinate System: USSP WA N, FT.

Coordinates:

Latitude/Northing	Longitude/Easting
350829.8	1282116.5

Measured Water Depth: 27 FT (Leadline / Sounder / Other DIVER GAUGE)

Vertical Datum: 4.9' (MLLW / MLW / Other) Tide Height NOAA

Mudline Elevation: 22.1'

Estimated Penetration: 20CM

Refusal:

Total Core Length: 20CM

Percent Recovery (%)

Core/Drive Comments: PISTON CORES ATTEMPTED TWICE. PENETRATION < 2 FT, SAMPLE NOT RETAINED (CORE CATCHER DID NOT CLOSE AROUND SAMPLE AND SHELL DEBRIS.

RETURNED WITH 20CM HAND CORE TO OBTAIN SAMPLE. LOCATION OF SAMPLE MOVED APPROX. 5' TOWARD NORTH ALONG ℄ TO AVOID FALLEN PILE
SURFACE SEDIMENT MEDIUM SAND AND SHELL HASH
SAMPLE TRANSFERRED TO CORE LINERS APPROX. 18:00

SEDIMENT CORE SAMPLING:

Date/Time: MARCH /

Samplers:

Station Location:

Station ID: D2

Coordinate System:

Coordinates:

Latitude/Northing	Longitude/Easting

Measured Water Depth: (Leadline / Sounder / Other)

Vertical Datum: (MLLW / MLW / Other)

Mudline Elevation:

Estimated Penetration:

Refusal:

Total Core Length:

Percent Recovery (%)

Core/Drive Comments:

COORDINATE LOG
RESEARCH SUPPORT SERVICES

Project MUKILTEO MULTIMODAL PROJECT, FUEL PIER DIVER SAMPLES
Date 3/7/12
Client PARAMETRIX
Personnel EP, DS, AM
Project No. 554-1631-088 MUKILTEO
Page 1 of 1
DGPS Datum and Coordinate System: US STATE PLANE, WASHINGTON NORTH, FEET
DGPS: Trimble TSC-1/Pro XRS

STATION	ATTEMPT	NORTHING	EASTING	DESCRPTION
D1	TARGET	350386.98	1281681.54	
D1	SOUTH EDGE	350338.4	1281724.3	APPROXIMATE CENTERLINE OF BENT CONTAINING SAMPLE TARGET, SOUTHERNMOST SIDE
D1	NORTH EDGE	350426.3	1281640.2	APPROXIMATE CENTERLINE OF BENT CONTAINING SAMPLE TARGET, NORTHERNMOST MOST SIDE
D1	SAMPLE	350385.2	1281679.6	APPROXIMATELY PIER CENTER, MIDDLE OF BENT
D2	TARGET	350609	1281906.38	
D2	SOUTH EDGE	350573.9	1281952.2	APPROXIMATE CENTERLINE OF BENT CONTAINING SAMPLE TARGET, SOUTHERNMOST SIDE
D2	NORTH EDGE	350646.3	1281865.9	APPROXIMATE CENTERLINE OF BENT CONTAINING SAMPLE TARGET, NORTHERNMOST MOST SIDE
D2	SAMPLE	350615.5	1281902.6	MOVED TOWARD NORTHERNMOST EDGE TO AVOID FALLEN DECKING
D3	TARGET	350826.44	1282120.89	
D3	SOUTH EDGE	350785.7	1282162	APPROXIMATE CENTERLINE OF BENT CONTAINING SAMPLE TARGET, SOUTHERNMOST SIDE
D3	NORTH EDGE	350866.7	1282078.6	APPROXIMATE CENTERLINE OF BENT CONTAINING SAMPLE TARGET, NORTHERNMOST MOST SIDE
D3	SAMPLE	350829.8	1282116.5	SAMPLE MOVED TOWARD NORTHERNMOST EDGE TO AVOID FALLEN PILE

Parametrix

Coring Log

Core ID: ~~MDG~~ MDIG_0-1_030712	**Coring Company:** RSS/Diver	**Sheet** 1 of 1
Project Name: Mukilteo Multimodal Sediment Coring	**Coring Method:** Grab 0-1	**Coring Date:** 3/7/12
Project #: 554-1631-088 (01/78)	**Logged by:** JB	**Coring Depth:** 0-1
Location: Mukilteo TFP	**Coordinates:**	**Depth of Water:**

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
1		shell hash		1
2		course sand } dark gray		2
3		med sand		3
4		fines/silty – olive green to black.		4
5		1 empty clam shell.		5
6		H_2S odor.		6
7				7
8				8
9				9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MD2_~~surface~~ 0-1

Project Name: MD2G-0-1_030712

Project #:

Location: Mukilteo Tank Farm Fuel Pier

Coring Company: RSS

Coring Method: Grab 0-1 ft.

Logged by: JB

Coordinates:

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 0-1

Depth of Water:

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
1		medium grain sand > gray to dark gray		1
		Coarse grain sand		
2		shell hash (exclusive)		2
3		clam		3
		wood debris		
4				4
5		some mucky silty material mixed in ≈ shell hash		5
6		dark Olive		6
		no noticeable odor at present.		
7				7
8				8
9				9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MD3G_0-1_030712

Coring Company: RSS

Project Name:

Coring Method: Grab 0-1

Project #:

Logged by:

Location: Mukilteo TFP

Coordinates:

Sheet 1 of 1

Coring Date: 3/7/12

Coring Depth: 0-1'

Depth of Water:

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
1		medium grain sand > dark gray		1
2		Coarse grain sand		2
3		some shell hash		3
4		small clam		4
5				5
6				6
7				7
8				8
9				9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix

DAILY OBSERVATION REPORT

Job No.: 554-1631-088 Phase: 01 Task: 7B Report No. 1

Project: Mukilteo Multimodal Project/Under-Pier Sediment Core Collection

Owner: N/A Page 1 of 1

Contractor: Gravity Consulting, LLC Date: 4/25/2012

Contractor's Rep./Title: Shawn Hinz Day: Wednesday

Weather A.M.: 50+ °F P.M.: °F Site Conditions: (Good) (Fair) (Poor)

Overcast / Drizzling / no rain / offshore

Location and Type of Work: Mukilteo, WA Tank Farm Pier

Number and Classification of Contractors, Men, and Equipment (include condition of equipment):

1 ~~sub~~ contractor - Boat/Vibracore/floats, etc., Diver equipment
~~4/25/12~~ 2 crew / Boat Captain / 2 divers.
Parametrix (Contractor) - 2 crew / Sample jars, coolers, misc. supplies + equipment

Work in Progress (include report of operations, materials received and condition, work start/stop time, and any unusual conditions):

Collecting diver vibracores under Tank Farm ~~Ink~~ Pier JB/4/25/12

Work Completed:

Collected 4-8 foot vibracores at all 3 stations

Discussions with Contractor (include orders given and received):

(1) Health + Safety / Boat / Diver cores, etc
(2) Returned to station D2 and tried another core successfully.

Any Cause for Dispute, Change Orders, or Delays, and Reasons:

None

Extra Work in Progress–Description (include Extra Work Report Form):

None

Items for Office Action:

None

Visitors:

None

Notes:

See above.

H Jesse Bennett

Signature

PARAMETRIX SEDIMENT CORE COLLECTION LOG

Project Number: 554-1631-088 (01/7B)

SEDIMENT CORE SAMPLING:

Date/Time: 4/25/2012 , 0935 Samplers: J. Bennett/B. Lon

Station Location: Mukilteo Tank Farm Pier Station ID: MD1_0-4

Coordinate System: NAD 83 Coordinates:

Latitude/Northing	Longitude/Easting
47° 57' 03.78"	122° 17' 49.50"

Measured Water Depth: 25' (Leadline / Sounder / Other) Dive Computer

Vertical Datum: 7.19' @ 0935 (MLLW) / MLW / Other Tide Height - NOAA

Mudline Elevation: 17.8'

Estimated Penetration: 4 ft Refusal: @ 6 ft

Total Core Length: 8 ft (tube) Percent Recovery 50 % (%)

Core/Drive Comments: T_1 = 25 ft @ 0935 - Drive to 8 ft. - 41 ft. offset
Strong H_2S odor, mixed shell hash with silty fines 0-17", 17-34" coarse to med sand; 34-36 2" shell hash; 38-40 coarse to med sand 4"; 38-40-42 1½-2" lay layer; 42-46 4" - cobble + coarse sand; 46-47" (Total) 0-4 ft section only; no 4-8 ft section.

Samples collected @ 10:15
Note: temp. trip blanks - prep. on 4/16/12 1 mea. = HCl.

SEDIMENT CORE SAMPLING:

Date/Time: 4/25/2012 , 1404 Samplers: PL/JB

Station Location: Mukilteo Tank Farm Pier Station ID: MD2_0-4

Coordinate System: NAD 83 Coordinates:

Latitude/Northing	Longitude/Easting
47° 57' 06.24"	122° 17' 46.08"

Measured Water Depth: 16' (Leadline / Sounder / Other) Dive Computer

Vertical Datum: -0.7' @ 14:04 (MLLW) / MLW / Other Tide Height - NOAA

Mudline Elevation: 16.7

Estimated Penetration: 4 ft / 31" recovery - T_3 T_4 = ~~8~~ 7.6 ft Refusal: at 4' - T_1 / None - T_4

Total Core Length: 8 ft - T_3 / T_4 = 8 ft. Percent Recovery 95 % (%)

Core/Drive Comments: T_1 = failure. T_3 = 12:10 Same offset as previous; 19 ft. depth
T_2 = plugged end. T_4 = 14:04 16 ft water depth. offset = 34½ ft.

T_1 was plugged with cobble/coarse materials

Project Number: 554-1631-088 (01/7B)

PARAMETRIX SEDIMENT CORE COLLECTION LOG

SEDIMENT CORE SAMPLING:

Date/Time: 4/25/2012 / 13:05 Samplers: JB/PL

Station Location: Mukilteo Tank Farm Pier Station ID: MD3_D-4

Coordinate System: NAD 83 Coordinates:

Latitude/Northing	Longitude/Easting
47° 57' 08.04"	122° 17' 43.74"

Measured Water Depth: 17 ft. (Leadline / Sounder / Other) Dive Computer

Vertical Datum: -0.1 ft @ 13:05 (MLLW / MLW / Other Tide Height - gross

Mudline Elevation: ~~16.9~~ 17.1 - WS/JB 4/26/12

Estimated Penetration: ~~8 ft~~ / 91" - 7.6' / JB 4/26/12 Refusal: None

Total Core Length: 8 ft. Percent Recovery 95% (%)

Core/Drive Comments: T_1 = 13:05; 17' depth; T, ≈ 8 ft. core; 91" in core tube.

Offset is 38 ft (FOR DETERMINATION OF GPS COORDINATES)

SEDIMENT CORE SAMPLING:

Date/Time: / Samplers:

Station Location: Station ID:

Coordinate System: Coordinates:

Latitude/Northing	Longitude/Easting

Measured Water Depth: (Leadline / Sounder / Other)

Vertical Datum: (MLLW / MLW / Other)

Mudline Elevation:

Estimated Penetration: not used JB 4/25/12 Refusal:

Total Core Length: Percent Recovery (%)

Core/Drive Comments:

GRAVITY ENVIRONMENTAL L.L.C.

Gravity Navigation Log

ORIGINAL 4/30/2012 JB

Project: Mukilteo
Task: Diver Vibracoring
Client: PMX

Location	Date	Time	Actual X	Actual Y	Water Depth	Description
Diver core 1 near v6	4/25/2012	n	47 57.063 N	122 17.825 W	28	6ft drive
Diver core 2 near v5	4/25/2012	n	47 57.101 N	122 17.772 W	26 ft	bad recovery rejected
Diver Core 3 near v4	4/25/2012	n	47 57.134 N	122 17.729 W	24	8 ft drive and 80% recovery
Diver core 4 near v5	4/25/2012	n	47 57.104 N	122 17.768 W	26 ft	8 ft drive and almost full recovery

Jesse Bennett

From: Shawn Hinz <shawn@gravityenv.com>
Sent: Monday, April 30, 2012 11:46 AM
To: Jesse Bennett
Subject: Re: Gravity Invoice - Mukilteo Diver Core Sampling
Attachments: GravityNavLog_MukilteoDiverCoring.xlsx

On Mon, Apr 30, 2012 at 9:42 AM, Jesse Bennett <JBennett@parametrix.com> wrote:
> Hi Shawn -
>
> Thanks for the invoice. We will get it into the system for payment.
>
> When will you be able to send me the coordinates file? Please include the original coordinates as well as the coordinates corrected for the offsets.
>
> Thanks,
>
> Jesse
> Parametrix
> inspired people - inspired solutions - making a difference
>
> Harrison Jesse Bennett
> Scientist
> phone: 425.458.6239
> fax: 425.458.6363
> cell: 206.794.4084
> jbennett@parametrix.com
>
> -----Original Message-----
> From: Shawn Hinz [mailto:shawn@gravityenv.com]
> Sent: Monday, April 30, 2012 8:21 AM
> To: Jesse Bennett; Jean Johnson
> Subject: Gravity Invoice - Mukilteo Diver Core Sampling
>
> See attached invoice for the Mukilteo Diver coring.
>
> Thanks again for the work!
>
> --
> Shawn Hinz
> Managing Partner
> Gravity Environmental Consulting LLC
> 425.281.1471
>

--
Shawn Hinz

GRAVITY ENVIRONMENTAL L.L.C.

Gravity Navigation Log

Project: Mukilteo
Task: Diver Vibracoring
Client: PMX

AMENDED 7/18/2012 QB
Added satellites and PDOP

Location	Date	Time	Actual X	Actual Y	Water Depth	Description	Satelites/PDOP
Diver core Field#1 near v6	4/25/2012	n	47 57.063 N	122 17.825 W	28	6ft drive	5 satelites/4.33 PDOP
Diver core Field#2 near v5	4/25/2012	n	47 57.101 N	122 17.772 W	26 ft	bad recovery rejected	6 Satelites/3.20 PDOP
Diver core Field#3 near v4	4/25/2012	n	47 57.134 N	122 17.729 W	24	8 ft drive and 80% recovery	5 satelites/4.62 PDOP
Diver core Field#4 near v5	4/25/2012	n	47 57.104 N	122 17.768 W	26 ft	8 ft drive and almost full recovery	6 Satelites/3.20 PDOP

Received
7/15/2012 JB

Table1. Actual Diver Sediment Sample Location Coordinates

Sample Station	Northing	Easting
D3	47° 57' 8.74"N	122° 17' 43.94"W
D2	47° 57' 6.55"N	122° 17' 47.11"W
D1	47°57' 4.24"N	122° 17' 50.28"W

* corrected based on USCG differential beacon - post processed in Nobeltec Odyssey

Jesse Bennett

From: Shawn Hinz <shawn@gravityenv.com>
Sent: Sunday, July 15, 2012 10:27 PM
To: Jesse Bennett
Cc: Peter Leon (peter@leon-environmental.com)
Subject: Updated coordinates for diver cores at Mukilteo
Attachments: Sample Coordinates_DiverCores_corrected.xlsx

Hi Jesse,

Nobeltec came through for me late Friday with some corrections. They have a bit of a black box for doing Differential corrections in the new Odyssey software so I requested the tech guys to look over our problems. This is the best estimate from them and the most accurate we can probably get for that day and the dock coverage.

Call me anytime this week to discuss

--
Shawn Hinz
Managing Partner
Gravity Environmental Consulting LLC
425.281.1471

Jesse Bennett

From: Shawn Hinz <shawn@gravityenv.com>
Sent: Friday, July 20, 2012 12:43 PM
To: Jesse Bennett
Subject: Re: FW: FW: Gravity Invoice - Mukilteo Diver Core Sampling
Attachments: GravityNavLog_MukilteoDiverCoring_CorrectedV3.xlsx

I don't have anything further from Nobletec other than the comment that they were able to post-process with a better differential beacon and that the satellite coverage was definitely not ideal in our pier locations.

See attached updates with attempt at 5 included.

Shawn

Tides:Everett

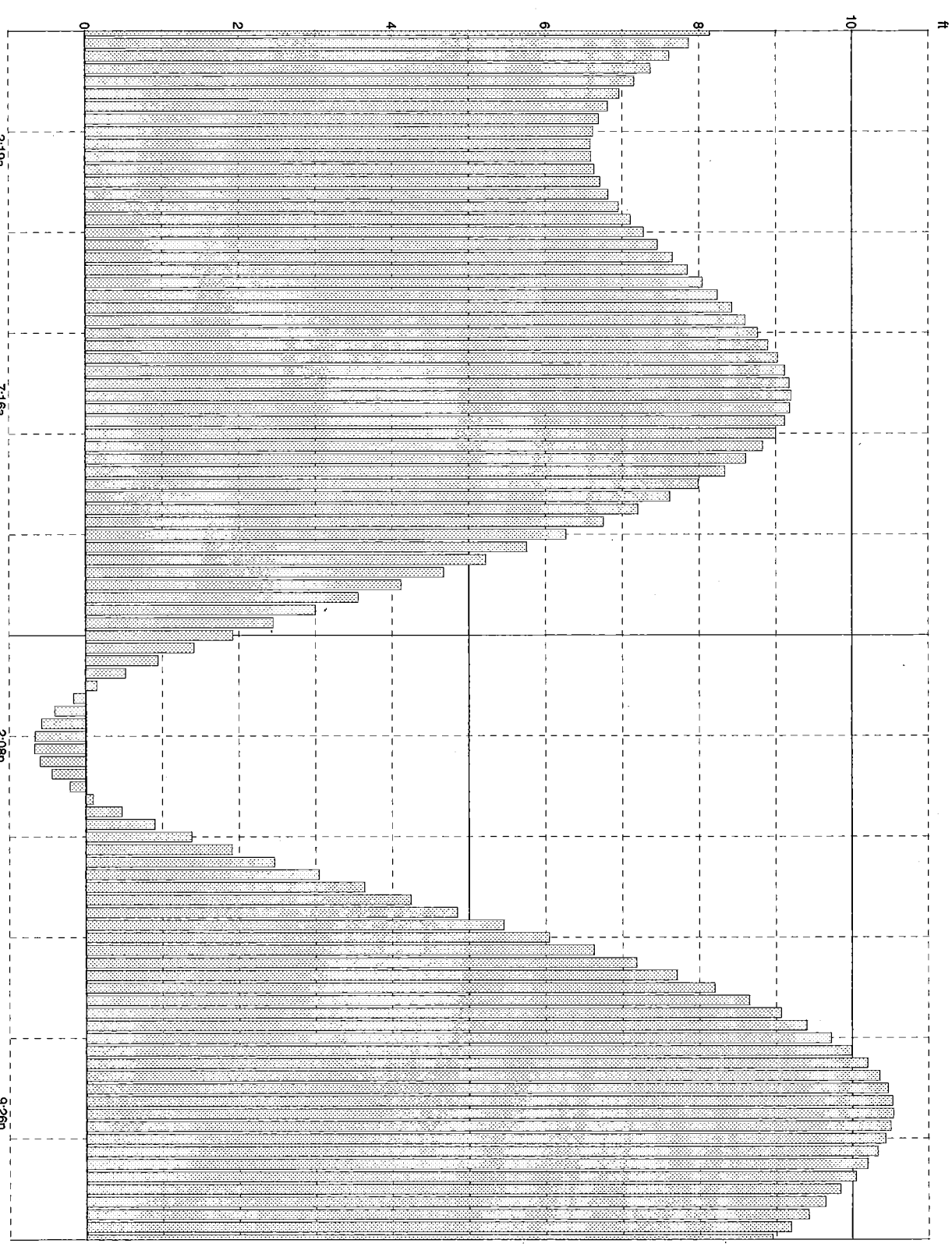
based on Seattle (Madison St), Elliot Bay Washington (NOAA)
47° 58 48 N 122° 13 24 W

Wednesday, April 25, 2012

Average Tides	
Mean Range:	7.4 ft
MHHW:	11.1 ft
Mean Tide:	6.5 ft

Daily Highs & Lows		
2:19a	6.6 ft	Low
7:16a	9.2 ft	High
2:08p	-0.7 ft	Low
9:26p	10.5 ft	High

(PDT)	Tide
12:00a	8.1 ft
12:15a	7.9 ft
12:30a	7.6 ft
12:45a	7.4 ft
1:00a	7.1 ft
1:15a	7.0 ft
1:30a	6.8 ft
1:45a	6.7 ft
2:00a	6.6 ft
2:15a	6.6 ft
2:30a	6.6 ft
2:45a	6.6 ft
3:00a	6.7 ft
3:15a	6.8 ft
3:30a	7.0 ft
3:45a	7.1 ft
4:00a	7.3 ft
4:15a	7.5 ft
4:30a	7.7 ft
4:45a	7.8 ft
5:00a	8.0 ft
5:15a	8.2 ft
5:30a	8.4 ft
5:45a	8.6 ft
6:00a	8.8 ft
6:15a	8.9 ft
6:30a	9.0 ft
6:45a	9.1 ft
7:00a	9.2 ft
7:15a	9.2 ft
7:30a	9.2 ft
7:45a	9.1 ft
8:00a	9.0 ft
8:15a	8.8 ft
8:30a	8.6 ft
8:45a	8.3 ft
9:00a	8.0 ft
9:15a	7.6 ft
9:30a	7.2 ft
9:45a	6.7 ft
10:00a	6.3 ft
10:15a	5.8 ft
10:30a	5.2 ft
10:45a	4.7 ft
11:00a	4.1 ft
11:15a	3.6 ft
11:30a	3.0 ft
11:45a	2.5 ft
12:00p	1.9 ft
12:15p	1.4 ft
12:30p	0.9 ft
12:45p	0.5 ft
1:00p	0.1 ft
1:15p	-0.2 ft
1:30p	-0.4 ft
1:45p	-0.6 ft
2:00p	-0.7 ft
2:15p	-0.7 ft
2:30p	-0.6 ft
2:45p	-0.4 ft
3:00p	-0.2 ft
3:15p	0.1 ft
3:30p	0.5 ft
3:45p	0.9 ft
4:00p	1.4 ft
4:15p	1.9 ft
4:30p	2.5 ft
4:45p	3.0 ft
5:00p	3.6 ft
5:15p	4.2 ft
5:30p	4.9 ft
5:45p	5.5 ft
6:00p	6.0 ft
6:15p	6.6 ft
6:30p	7.2 ft
6:45p	7.7 ft
7:00p	8.2 ft
7:15p	8.7 ft
7:30p	9.1 ft
7:45p	9.4 ft
8:00p	9.7 ft
8:15p	10.0 ft
8:30p	10.2 ft
8:45p	10.4 ft
9:00p	10.5 ft
9:15p	10.5 ft
9:30p	10.5 ft
9:45p	10.5 ft
10:00p	10.4 ft
10:15p	10.3 ft
10:30p	10.2 ft
10:45p	10.0 ft
11:00p	9.8 ft
11:15p	9.6 ft
11:30p	9.4 ft
11:45p	9.2 ft
12:00a	9.0 ft



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Parametrix

Coring Log

Core ID: MDL-0-4

Project Name: Mukilteo Multimodal

Project #: 554-1631-088 (01/23)

Location: Mukilteo TFP

Coring Company: Gravity Environmental LLC

Coring Method: Vibracore

Logged by: Jesse Burnett

Coordinates: 47°57'03.78" 122°17'49.50"

Sheet 1 of 1

Coring Date: 4/25/12

Coring Depth: 8 ft.

Depth of Water: 25'

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0		Ground (Benthic) Surface		0
		0-15" ~~sandy bact~~ / mixed shell hash & silty fines. H_2S odor dark/grey to black. JB 4/25/12		
1		15"-34". 1st 2" = mixed shell hash / silty fines as above volume. remainder is coarse to medium sand / coarse > medium. dark gray		1
2				2
3		34"-36" 2" of shell hash dark gray to black.		3
		36"-40" 4" of coarse to med sand / coarse > volume. medium. dark gray		
4		40-42½" 2½" of clay gray		4
		42½-47. ≈ 4" of cobble + coarse sand. sand - dark gray.	MDL 0-4 collected @ 10:15	
5	≈47"	of sediment total		5
6		No 4-6' or 4-8' section.		6
7				7
8				8
9				9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix — Coring Log

Core ID: MD2-0-4	**Coring Company:** Gravity Environmental, LLC	**Sheet** 1 of 1
Project Name: Mukilteo Mattimoduo	**Coring Method:** Vibracore	**Coring Date:** 4/25/12
Project #: ~~555~~ 534-1631-088 (01/7B) WE/9B 9/29/12	**Logged by:** J. Bennett	**Coring Depth:** 8 ft.
Location: Mukilteo TFP	**Coordinates:** 47° 57' ~~03.78"~~ 06.24" 122° 17' ~~46.08"~~ 4/25/12 WE/9B	**Depth of Water:** 16 ft.

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0	0-4	Ground (Benthic) Surface		0
		0-12" soupy, mixed fines/silt & shell hash	+8" shell hash + fines	
1		12-20 ~~dry~~ " " 24" " strong H_2S		1
		20-40" - mixed fines and shell hash grading into coarse and medium sand with depth; coarse sand > medium sand. odor.		
2				2
3				3
4	40" Total 4-8	Sample collected @ 1445		4
5		31" - coarse to medium sand. Coarse > medium. white particles/black ~~[illegible]~~ mixed. - some cobbles + shells		5
6				6
7	35" Tot.	4" - cobbles ~~& coarse sands~~ + materials		7
		Sample collected @ 1505 MD2-4-6 actually MD2-4-8		
8	40 +35 75"			8
9		6.25" Sediment		9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

Parametrix

Coring Log

Core ID: MD3_ 0-4

Project Name: Mukilteo Multimodal

Project #: ~~555~~ 534-1631-088 (01/07B) WE/9B 4/29/12

Location: Mukilteo TFP

Coring Company: Gravity Environmental

Coring Method: Vibracore.

Logged by: Jesse Bennett

Coordinates: 47° 57' 08.04" 122° 17' 43.74"

Sheet 1 of 1

Coring Date: 4/25/12

Coring Depth: 8 ft.

Depth of Water: 17'

Depth (ft)	Recovery	Description/Classification of Materials: Soil: Group Name, Group Symbol, Color, Plasticity, Grain Size, Moisture, Density, Misc.	Sample ID & Time	Depth (ft)
0	0-4'	Ground (Benthic) Surface		0
		0-1.5" fines / mostly silt - stringy organic debris some fine sand (*)	(*) line clam with broken shell	
1		1.5"-30" Shell hash - mixed - silty fines + coarse to med.		1
		28.5"		
2				2
3		30"-48" Sand - coarse to medium sand coarse > medium, -18" some gravel in the bottom layer - ~~Sample collected at 16:45~~		3
4	48"	48- large shells		4
		5" coarse sand to med, sand coarse to med.		
5		mixed with gravel + cobble.		5
		20" " " " "		
6		shell "fragments" Chunks (chunks)	EFC 9B 4/28/12	6
7	Total 35"			7
	measured after extension 7'2"	10" very coarse sand -		
8			Sample collected @ 16:40	8
9	91" sediment measured in tube.	83" Total 6.91' sediment	MD3_4-6 actually MD3_4-8	9
10				10
11				11
12				12
13				13
14				14
15				15
16				16

APPENDIX B

Chain of Custody Forms

MUKILTEO MULTIMODAL PROJECT

SEDIMENT VIBRACORE SAMPLES

CHAIN OF CUSTODY RECORDS[1]

MARCH 9, 2012

APRIL 26, 2012

[1] Sediment collected by divers on March 7, 2012 was archived but not analyzed.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: PMX	Phone: (425) 458-6200
Client Contact: Jesse Bennett (x-6239)	
Client Project Name: Mukilteo Multimodal Project	
Client Project #: 554-1631-088	Samplers: PL/JB

Page: 1 of 6	
Date: 3/9/12	Ice Present? N
No. of Coolers: 1	Cooler Temps: 8.4

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Metals	SVOAs	Pesticides	PCBs	TBT	Dioxins Furans	TPH-Dx	VOAs TPH-G	Notes/Comments
M_Cores_RB	3/9/12	1215	Water	18	X	X	X	X	X	X	X	~~X~~ X	

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) H. Jesse Bennett	(Signature)	(Signature)	(Signature)
	Printed Name: H. JESSE BENNETT	Printed Name: Taylor Streeter	Printed Name:	Printed Name:
	Company: Parametrix	Company: ARI	Company:	Company:
	Date & Time: 3/9/12 1215	Date & Time: 3-9-12 1215	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: Parametrix, Inc	Phone: (425) 458-6200
Client Contact: Jesse Bennett (x-6239)	
Client Project Name: Mukilteo Multimodal Project (MMP)	
Client Project #: 555-1631-068	Samplers: JB/PL

Page: 2 of 6

Date: 3/9/12 Ice Present? Y

No. of Coolers: 3 Cooler Temps: 4.8, 5.6, 3.6

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	SVOAs	Pesticides + PCBs	Metals	Conventionals	Conv Sup	TBT/TBH-OX	Dioxins/Furans		Notes/Comments
MV1/V6_0-4	3/8/12	1600	Sediment	8	X	X	X	X	X	X	X		3 GS - for Triplicate
MV1/V6_4-8	3/8/12	1710		5	X	X	X	X	X	X	—		
MV1_8-12	3/8/12	1830		5	X	X	X	X	X	X	—		
MV1/V6_0-4_AB	3/8/12	1600		1	—	—	—	—	—	—	X		
MV1/V6_4-8_CD	3/8/12	1710		5	X	X	X	X	X	X	—		
MV2/V5_0-4	3/8/12	1500		6	X	X	X	X	X	X	X		
MV3/V4_0-4	3/8/12	1245		6	X	X	X	X	X	X	X		
MV3/V4_4-8	3/8/12	~~1210~~ 1100		5	X	X	X	X	X	X	—		
MV4_8-12	3/8/12	1210		5	X	X	X	X	X	X	—		
MV5_4-8	3/8/12	1430		5	X	X	X	X	X	X	—		

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) H. Jesse Bennett	(Signature)	(Signature)	(Signature)
	Printed Name: H. JESSE BENNETT	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: Parametrix, Inc.	Company: ARI	Company:	Company:
	Date & Time: 3/9/12 13:55	Date & Time: 3/9/12 1355	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: Parametrix, Inc	Phone: (425) 458-6200
Client Contact: Jesse Bennett (x-6239)	
Client Project Name: MMP	
Client Project #: 554-1631-088	Samplers: JB/PL

Page: 3 of 6

Date: 3/9/12 | Ice Present? Y

No. of Coolers: 3 | Cooler Temps: 4.8, 5.6, 3.6

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	VOAs Pesticides PCBs	Metals	Conventional	Grain Size	TPH-Dx	Dioxins Furans	VOAs TPH-G	Total Solids	Notes/Comments
~~MV5_8-12~~ revised 3/12/12 JB													
~~MV4_8-12~~	3/8/12	~~1210~~ 1400	Sediment	5	X	X	X	X	X	~~X~~			(1) No Dioxins
MV1/V6_4-8	3/8/12	1710		3									For MS/MSD
MV3/V4_0-4	3/8/12	1245		5	—	—	—	—	—	—	~~2~~ 4	1	Composite VOAs + TPH-G Samples
MV3/V4_4-8	3/8/12	10:40		5	—	—	—	—	—	—	4	1	" "
MV2/V5_0-4	3/8/12	1500		5	—	—	—	—	—	—	4	1	" "
MV1/V6_0-4	3/8/12	1600		5	—	—	—	—	—	—	4	1	" "
MV1/V6_4-8 CD	3/8/12	1710		1	—	—	—	—	—	—	—	1	
MV5_4-8	3/8/12	1430		3	—	—	—	—	—	—	2	1	Do not composite VOAs or TPH-G
MV5_8-12	3/8/12	1400		3	—	—	—	—	—	—	2	1	" "
MV4_8-12	3/8/12	1210		3	—	—	—	—	—	—	2	1	" "

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) H. Jesse Bennett	(Signature)	(Signature)	(Signature)
	Printed Name: H. Jesse Bennett	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: Parametrix, Inc	Company: ARI	Company:	Company:
	Date & Time: 3/9/12 1355	Date & Time: 3/9/12 1355	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: Parametrix, Inc	Phone: (425) 458-6200
Client Contact: Jesse Bennett (x-6329)	
Client Project Name: MMP	
Client Project #: 554-1631-088	Samplers: JB/PL

Page: 4 of 6

Date: 3/9/12 | Ice Present? Y

No. of Coolers: 3 | Cooler Temps: 4.8, 5.6, 3.6

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	VOAs	TPH-G	Total Sulfides						Notes/Comments
MV1_8-12	3/8/12	1830	Sediment	3	X	X	X						DO NOT COMPOSITE VOAs or TPH-G
MV1_8-12_EF	3/8/12	1830	↓	~~3~~ 2	X	X	~~X~~	revised 3/13/12 JB					~~"There are"~~ "also Total Sulfides for MV1_8-12_EF"
~~MV3_0-4~~ JB 3/9/12	~~3/8/12~~	~~1245~~	~~↓~~	~~—~~									
~~MV3_4-8~~ 3/9/12	~~3/8/12~~	~~1100~~	~~↓~~	~~—~~								JB 3/13/12	
MV1/V6_4-8	3/8/12	1710	↓	5	~~2~~	~~2~~	~~1~~						"The Composite" the VOAs + TPHs before analyzing.
Revised 3/12/12 JB												Revised 3/13/12 JB	

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) H. Jesse Bennett	(Signature)	(Signature)	(Signature)
	Printed Name: H. Jesse Bennett	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: Parametrix, Inc	Company: ARI	Company:	Company:
	Date & Time: 3/9/12 13:55	Date & Time: 3/9/12 1355	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: Parametrix	Phone: (425) 458-6200
Client Contact: Jesse Bennett (X-6239)	
Client Project Name: Mukilteo Multi Modal Project (MMP)	
Client Project #: 554-1631-088	Samplers: PL/JB

Page: 5 of 6

Date: 3/9/12 | Ice Present? Y

No. of Coolers: 3 | Cooler Temps: 4.8, 5.6, 3.6

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Archive								Notes/Comments
MV1_0-4	3/8/12	1600	Sediment	1	X								Freeze
MV1_4-8		1710		1	X								"
MV1_8-12		1830		1	X								"
MV6_0-4		1600		1	X								"
MV6_4-8		1710		1	X								"
MV6_8-12		1830		1	X								"
MV5_0-4		1500		1	X								"
MV5_4-8		1430		1	X								"
MV5_8-12		1400		1	X								"
MV2_0-4		1500		1	X								"

Comments/Special Instructions				
	Relinquished by: (Signature) H. Jesse Bennett	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: H. Jesse Bennett	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: Parametrix, Inc	Company: ARI	Company:	Company:
	Date & Time: 3/9/12 1355	Date & Time: 3/9/12 1355	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:
ARI Client Company: Parametrix, Inc.	Phone: (425) 458-6200
Client Contact: Jesse Bennett (x-6239)	
Client Project Name: MMP	
Client Project #: 554-1631-058	Samplers: JB/PL

Page: 6 of 6

Date: 3/9/12 | Ice Present? Y

No. of Coolers: 3 | Cooler Temps: 4.8, 5.6, 3.6

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Archive	Archive 6							Notes/Comments
MV3_0-4	3/8/12	1245	Sediment	1	X								Freeze
MV3_4-8		1100		1	X								"
MV4_0-4		1245		1	X								"
MV4_4-8		1100		1	X								"
MV4_8-12		1210		1	X								"
MD1G_0-1				2		X							Keep Cold (°6)
MD2G_0-1				2		X							" "
MD3G_0-1				2		X							" "

Analysis Requested

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Jesse Bennett	(Signature)	(Signature)	(Signature)
	Printed Name: H. Jesse Bennett	Printed Name: A. Volgardsen	Printed Name:	Printed Name:
	Company: Parametrix, Inc.	Company: ARI	Company:	Company:
	Date & Time: 3/9/12 13:55	Date & Time: 3/9/12 1355	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

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Columbia Analytical Services

30141 CHAIN OF CUSTODY

SR#_____

COC Set 1 of 1

Page 1 OF 1 COC#_____

1317 South 13th Ave, Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

Project Name: Mukilteo Multimodal
Project Number: 554-1631-088
Project Manager: Jesse Bennett for Daryl Wendle
Company Name: Parametrix, Inc.
Comany Address: 411 108th Ave NE, Suite 1800
City/State/Zip: Bellevue, WA 98004
E-Mail Address: jbennett@parametrix.com
Phone #: (425) 458-6239 FAX #: (425) 458-6363
Sampler Signature: H Jesse Bennett

	Sample ID	Date	Time	Lab ID	Matrix	Number of Containers	8330B / NitramAroEsters (7D)	TS-MET / Total Solids (7D)	8330B / NitramAroEsters (14D)				Remarks
1	MV1/V6_0-12	3/8/12	1920		Sed				1				
2	MV2/V5_0-12	3/8/12	1920		"				1				
3	MV3/V4_0-12	3/8/12	1920		"				1				
4													
5													
6													
7													
8													
9													
10													
11													

Report Requirements

- X I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- X III. Data Validation Report (includes all raw data)
- ___ IV. CLP Deliverable Report
- X V. EDD

Invoice Information

P.O.#_____

Bill To: Parametrix as above attn: Jesse Bennett

Turnaround Requirements

- ___ 24 hr. ___ 48 hr.
- ___ 5 Day
- X Standard (10-15 working days)
- ___ Provide Fax Results

Requested Report Date

Circle which metals are to be analyzed

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Special Instructions/Comments:

*Indicate State Hydrocarbon Procedure: AK CA WI Northwest Other_____(Circle One)

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

Relinquished By:	Received By:	Relinquished By:	Received By:
H Jesse Bennett / 3/9/12 1740 (Signature / Date/Time)	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
H. Jesse Bennett / Parametrix (Printed Name / Firm)	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

Columbia Analytical Services

30141 CHAIN OF CUSTODY

SR# 1C1202212

COC Set 1 of 1

Page 1 OF 1 COC#

1317 South 13th Ave, Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

Project Name: Mukilteo Multimodal
Project Number: 554-1631-088
Project Manager: Jesse Bennett for Darryl Wendlke
Company Name: Parametrix, Inc.
Comany Address: 411 108th Ave NE, Suite 1800
City/State/Zip: Bellevue, WA 98004
E-Mail Address: jbennett@parametrix.com
Phone #: (425) 458-6239 FAX#: (425) 458-6363
Sampler Signature: H Jesse Bennett

	Sample ID	Date	Time	Lab ID	Matrix	Number of Containers	8330B / NitramAroEsters 7D	TS-MET / Total Solids	8330B / NitramAroEsters 14D				Remarks
1	MV1/V6_0-12	3/8/12	1920		Soil				1				
2	MV2/V5_0-12	3/8/12	1920		"				1				
3	MV3/V4_0-12	3/8/12	1920		"				1				
4													
5													
6													
7													
8													
9													
10													
11													

Report Requirements

- X I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- X III. Data Validation Report (includes all raw data)
- ___ IV. CLP Deliverable Report
- X V. EDD

Invoice Information

P.O.#
Bill To: Parametrix as above attn: Jesse Bennett

Turnaround Requirements

- ___ 24 hr. ___ 48 hr.
- ___ 5 Day
- X Standard (10-15 working days)
- ___ Provide Fax Results

Requested Report Date

Circle which metals are to be analyzed

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Special Instructions/Comments:

*Indicate State Hydrocarbon Procedure: AK CA WI Northwest Other____(Circle One)

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

Relinquished By:		Received By:		Relinquished By:		Received By:	
H Jesse Bennett	3/9/12 1740	[signature]	3/10/12 0945				
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
H. Jesse Bennett	Parametrix	[signature]	CAS				
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm

Columbia Analytical Services, Inc.
Cooler Receipt and Preservation Form

PC 03

Client / Project: Parametrix Service Request K12 02212

Received: 3/10/12 Opened: 3/10/12 By: JA Unloaded: 3/10/12 By: JA

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? 1 front / Side
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Cooler Temp °C	Temp Blank °C	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
5.4	5.6	300	30141		✓

7. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* Cardboard
8. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
9. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
10. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
11. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
12. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
13. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
14. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
15. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Page ____ *of* ____

ACCREDITED IN ACCORDANCE WITH nelac

Columbia Analytical Services™

Now part of the ALS Group

1317 South 13th Avenue
Kelso, WA 98626

Confirmation of Sample Receipt

To:	Jesse Bennett	**From:**	Ed Wallace
Email:	jbennett@parametrix.com	**Email:**	EWallace@caslab.com
Fax:	425-458-6363	**Fax:**	360-636-1068
Phone:	425-458-6200	**Phone:**	360-577-7222 x3291

Samples for analysis have been received by Columbia Analytical Services on 3/10/12 and assigned our Service Request number **K1202212**. **Please verify the following information and notify me of any corrections as soon as possible.**

The estimated completion date for this work is: **3/31/12**

Client: Parametrix, Inc.
Project: Mukilteo Multimodal/554-1631-088

PO Number: 554-1631-088

EDD Required: Yes

Tier: IV

Report To: Jesse Bennett
Parametrix, Inc.
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004

Billing Address: Jesse Bennett
Parametrix, Inc.
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004

Comments: MIS not needed for this marine sediment.

Thank you for your business!

A - Test is Authorized H - Test is On Hold P - Test is Authorized for Prep Only C - Test has been Cancelled * - Test has assigned QC

				8330B NitramAroEsters	Subsample Sub Sample	TS-MET Total Solids
K1202212-001	MV1/V6_0-12	Marine Sediment	3/ 8/12 1920	A	C	A
K1202212-002	MV2/V5_0-12	Marine Sediment	3/ 8/12 1920	A	C	A
K1202212-003	MV3/V4_0-12	Marine Sediment	3/ 8/12 1920	A	C	A

Test Comments:

Group	Test/Method	Samples	Comments
Organic LC	8330B/NitramAroEsters	1	Full List

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Parametrix, Inc.	Phone: (425) 458-6200
Client Contact: Jesse Bennett (425) 458-6239 (206) 794-4084 (cell)	
Client Project Name: Mukilteo Multimodal NEPA / Sediment Core Collection	
Client Project #: 554-1631-088	Samplers: J. Bennett / P. Lem

Page: 1 of 1	
Date: 4/26/12	Ice Present?
No. of Coolers:	Cooler Temps:

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	SVOCs Pesticides PCB	Metals	VOCs	AVS	Total Sulfide	Conventionals NH_3, TOC, TS, TVS	Grain Size	Archive	Notes/Comments
MD1_0-4	4/25/12	10:15	Sed	11	X	X	X	X	X	X	X	2	+2 for MS/MSD
MD2_0-4		14:45		9	X	X	X	X	X	X	X	2	
MD3_0-4		15:45		11	X	X	X	X	X	X	X	2	+2 for Grain Size Dup/Trip
Rinsate Blank		0:850	Water	10	X	X	X						
MD2_4-6		15:05	Sed	4								X	Archive Only
MD3_4-6		16:40		4								X	Archive Only
Trip Blanks	4/16/12	-	Water	2			X						

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Jesse Bennett	(Signature) Mark D. Harris	(Signature)	(Signature)
	Printed Name: H. Jesse Bennett	Printed Name: Mark D. Harris	Printed Name:	Printed Name:
	Company: Parametrix Inc.	Company: ARI	Company:	Company:
	Date & Time: 4/26/12 10:35	Date & Time: 4/26/12 1035	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

TRACKING #874 785548695

Columbia Analytical Services

CHAIN OF CUSTODY

1317 South 13th Ave, Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR#: _____

PAGE 1 OF 1 COC # 1

PROJECT NAME: Murre TEO Multimodal Sediment Cores
PROJECT NUMBER: 354-1631-088
PROJECT MANAGER: Jesse Bennett for Daryl Wendle
COMPANY/ADDRESS: Parametrix, Inc
411 108th Ave. NE, Suite 1800
CITY/STATE/ZIP: Bellevue, WA 98004
E-MAIL ADDRESS: jbennett@parametrix.com
PHONE #: (425) 458-6239 | FAX #: (425) 458-6363
SAMPLER'S SIGNATURE: Jesse Bennett

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	☐ Fuel Fingerprint (FIQ) ☐ NW-HCID Screen	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCB's Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081A☐ 8141A☐ 8151A☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	PAHS 8310☐ SIM☐	Metals, Total or Dissolved (See list below)	Cyanide☐ Hex-Chrom☐	pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS (circle)	NH_3-N, COD, Total-P, TKN, TOC, DOC (circle) NO_2+NO_3	TOX 9020☐ AOX 1650☐ 506☐	8330B/Nitram ARO Esters 14D				REMARKS
MD1_0-4	4/25/12	10:15		Sed	1															X				
MD2_0-4	4/25/12	14:45		Sed	1															X				
MD3_0-4	4/25/12	15:45		Sed	1															X				

REPORT REQUIREMENTS

X I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
X III. Data Validation Report (includes all raw data)
___ IV. CLP Deliverable Report
X V. EDD

INVOICE INFORMATION

P.O. #
Bill To: Parametrix as above / attn: Jesse Bennett

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 Day
X Standard (10-15 working days)
___ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER:_____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Jesse Bennett Date/Time: 4/26/12 - 12:00	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name: H. Jesse Bennett Firm: Parametrix	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

RCOC #1 03/10

Columbia Analytical Services™

CHAIN OF CUSTODY

SR#: K1203964

1317 South 13th Ave, Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE 1 OF 1 COC # 1

PROJECT NAME: MUK IL TEC MULTIMODAL Sediment Cores
PROJECT NUMBER: 559-1631-088
PROJECT MANAGER: Jesse Bennett for Daryl Wendle
COMPANY/ADDRESS: Parametrix, Inc
411 108th Ave. NE, Suite 1800
CITY/STATE/ZIP: Bellevue, WA 98004
E-MAIL ADDRESS: jbennett@parametrix.com
PHONE #: (425) 458-6239 | FAX #: (425) 458-6363
SAMPLER'S SIGNATURE: Jesse Bennett

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625 ☐ 8270 ☐ 8270LL ☐	Volatile Organics 624 ☐ 8260 ☐	Hydrocarbons (*see below) Gas ☐ Diesel ☐ Oil ☐	BTEX ☐ 8021 ☐	Fuel Fingerprint (FIQ) NW-HCID Screen	Oil & Grease/TRPH 1664 HEM ☐ 1664 SGT ☐	PCB's Aroclors ☐ Congeners ☐	Pesticides/Herbicides 608 ☐ 8081A ☐ 8141A ☐ 8151A ☐	Chlorophenolics - 8151M Tri ☐ Tetra ☐ PCP ☐	PAHS 8310 ☐ SIM ☐	Metals, Total or Dissolved (See list below)	Cyanide ☐	Hex-Chrom ☐	pH, Cond, Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS (circle)	NH_3-N, COD, Total-P, TKN, TOC, DOC (circle) NO_2+NO_3	TOX 9020 ☐ AOX 1650 ☐ 506 ☐	8330 B/N, Trans ARO (5 Tests 14 Days)				REMARKS
MD1_0-4	4/25/12	10:15		Sed	1																	X					
MD2_0-4	4/25/12	14:45		Sed	1																	X					
MD3_0-4	4/25/12	15:45		Sed	1																	X					

REPORT REQUIREMENTS

- X I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- X III. Data Validation Report (includes all raw data)
- ___ IV. CLP Deliverable Report
- X V. EDD

INVOICE INFORMATION

P.O. #
Bill To: Parametrix as above / attn: Jesse Bennett

TURNAROUND REQUIREMENTS

- ___ 24 hr. ___ 48 hr.
- ___ 5 Day
- X Standard (10-15 working days)
- ___ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER:_____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Jesse Bennett	Signature: [illegible]	Signature	Signature
Date/Time: 4/26/12 - 12:00	Date/Time: 4/27/12 0910	Date/Time	Date/Time
Printed Name: H. Jesse Bennett	Printed Name: Les Kennedy	Printed Name	Printed Name
Firm: Parametrix	Firm: ALS	Firm	Firm

RCOC #1 03/10

PC Ed

Cooler Receipt and Preservation Form

Client / Project: Parametrix Service Request K12 03944

Received: 4/27/12 Opened: 4/27/12 By: UU Unloaded: 4/27/12 By: UU

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? 1 on each side
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Cooler Temp °C	Temp Blank °C	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
0.5	5.2	315		8747 8554 8695	

7. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
8. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
9. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
10. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
11. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
12. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
13. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
14. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
15. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Page ____ *of* ____

ACCREDITED IN ACCORDANCE WITH nelac

Columbia Analytical Services™

Now part of the ALS Group

1317 South 13th Avenue
Kelso, WA 98626

Confirmation of Sample Receipt

To:	Jesse Bennett	**From:**	Ed Wallace
Email:	jbennett@parametrix.com	**Email:**	EWallace@caslab.com
Fax:	425-458-6363	**Fax:**	360-636-1068
Phone:	425-458-6200	**Phone:**	360-577-7222 x3291

Samples for analysis have been received by Columbia Analytical Services on 4/27/12 and assigned our Service Request number **K1203966. Please verify the following information and notify me of any corrections as soon as possible.**

The estimated completion date for this work is: **5/18/12**

Client: Parametrix, Inc.
Project: Mukilteo Multimodal Sediment Cores/554-1631-088

PO Number: 554-1631-088

EDD Required: Yes

Tier: IV

Report To: Jesse Bennett
Parametrix, Inc.
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004

Billing Address: Jesse Bennett
Parametrix, Inc.
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004

Comments:

Thank you for your business!

A - Test is Authorized H - Test is On Hold P - Test is Authorized for Prep Only C - Test has been Cancelled * - Test has assigned QC

				8330B NitramAroEsters	Subsample Sub Sample	TS-MET Total Solids
K1203966-001	MD1_0-4	Marine Sediment	4/25/12 1015	A	C	A
K1203966-002	MD2_0-4	Marine Sediment	4/25/12 1445	A	C	A
K1203966-003	MD3_0-4	Marine Sediment	4/25/12 1545	A	C	A

Test Comments:

Group	Test/Method	Samples	Comments
Organic LC	8330B/NitramAroEsters	1-3	MIS not needed

APPENDIX C

ERRG Technical Memorandum

ERRG

Engineering/Remediation Resource Group, Inc.
9950 W Ban Buren, Suite 136
Avondale, AZ 85323

P: 623.266.9532
F: 623.266.9532
www.errg.com

May 30, 2012 Ref.: 2012-022

Daryl Wendle
Parametrix
411 108th Avenue NE, Suite 1800
Bellevue, WA 98004

Mukilteo Multimodal Project
Soil Sediment Analysis Review

Dear Mr. Wendle:

This technical memorandum provides a technical review of likely munitions and explosives of concern (MEC) contamination for the Mukilteo project, based upon data analysis of samples returned from the lab. In total 6 samples were analyzed (3 composite samples collected along the pier perimeter, and 3 samples collected by divers from directly beneath the pier). All samples resulted in non-detect for munitions-related analytes. Lack of detectable munitions-related analytes indicates that the potential for personnel associated with the Mukilteo Multimodal Project and/or civilians to encounter munitions items at this project site during standard construction activities or customary uses of the site is unlikely. Based upon these non-detect readings we do not recommend the need for subsequent sediment sampling events, that will be required for project design and permitting, to include testing for munitions-related chemical signatures.

Sampling Locations

- Three composite samples taken along perimeter of the pier.
- Three samples collected by divers directly beneath the pier.

Laboratory Analysis

- Performed on March 8, 2012 for composite pier perimeter samples.
- Performed on April 24, 2012 for diver collected samples.

Constituents Tested

1. Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
2. Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
3. 1,3,5-Trinitrobenzene
4. 1,3-Dinitrobenzene
5. 3,5-Dinitroaniline
6. Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
7. Nitrobenzene

8. 4-Amino-2,6-dinitrotoluene
9. 2-Amino-4,6-dinitrotoluene
10. 2,4,6-Trinitrotoluene
11. 2,6-Dinitrotoluene
12. 2,4-Dinitrotoluene
13. 2-Nitrotoluene
14. 4-Nitrotoluene
15. 3-Nitrotoluene
16. Nitroglycerin
17. Pentaerythritol Tetranitrate

Conclusion

Based on the site history and the non-detect analytical data, we conclude that munitions are not likely to be present in site sediments and the likelihood of encountering munitions-related hazards as a result of sediment disturbances such as dredging, pile removal and/or installation, and other in-water work associated with construction of the Mukilteo Multimodal Project at the location of the Tank Farm Pier is very low.

Sincerely,

David Williams
Senior UXO Supervisor
MEC Division Manager

DOW/aac

Enc: Summary Data Tables