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Technical Memorandum

To: Mark Adams, Washington State Department of Ecology

Copies: Grant Yang and Pricilla Tomlinson, Washington State Department of Ecology
Doug Ciserella and Mike Ciserella, Cantera Development, LLC

From: Lynn Grochala and Allison Geiselbrecht, Floyd|Snider

Date: February 6, 2019

Project No: Cantera-TOC, Time Oil Bulk Terminal PPA

Re: **Addendum to the Surface Sediment Quality Evaluation Sampling and Analysis Plan/Quality Assurance Project Plan**

This technical memorandum was prepared at the request of Cantera Development Group, LLC (Cantera) as an addendum to the *Sediment Quality Evaluation Sampling and Analysis Plan/Quality Assurance Project Plan* (SAP/QAPP) approved by the Washington State Department of Ecology (Ecology) in July 2018 (Floyd|Snider 2018). This addendum summarizes additional sediment sample collection and analysis for the former TOC Holdings Co. (TOC) Seattle Terminal Properties (the Site) located on W. Commodore Way in Seattle. Additional surface and subsurface sediment characterization will be performed on the Site property and in the vicinity of the Site in Salmon Bay.

1.0 PROPOSED ADDITIONAL SEDIMENT CHARACTERIZATION

This addendum describes the collection of eight additional discrete surface sediment grab samples and two sediment cores. Refer to the attached Figure 1 for the designated sample locations. The locations of recently collected surface sediment samples (August 2018) and historical surface sediment locations (available in the Ecology Environmental Information Management System) are also shown on Figure 1 for reference.

1.1 Surface Sediment Grab Samples

Five discrete surface sediment grab samples targeting the top 10 centimeters of surface sediments will be collected within the immediate vicinity of the Site, adjacent to the dock used for former TOC loading operations. An additional three discrete surface sediment grab samples will be collected within Salmon Bay, approximately 1,000 feet to the east of the Site, to evaluate ambient Salmon Bay concentrations. Two of these will be collocated to the extent practicable with previous sample locations to evaluate current conditions and potential variation. These

ambient Salmon Bay samples are located outside obvious potential contaminant source areas such as operational facilities, outfalls, and the shoreline.

1.2 Sediment Core Samples

Two sediment cores will be advanced in the immediate vicinity of the Site, one on-property and the second north of the dock. Both cores will be collocated with surface sediment sample locations (either existing or proposed). To the extent practicable, the cores will be advanced to confirm the depth to the native sediments. Based on average sedimentation rates in freshwater without high sediment inputs (i.e., river) and the date of historical Site development and operations (back to the late 1930s/early 1940s), we would expect native to be encountered no more than 6 feet below mudline, conservatively. Therefore, sediment cores will be advanced to a maximum depth of 6 feet below the mudline.

2.0 PERMITS AND APPROVALS

Prior to the initiation of sediment sample collection at the Site, federal, state, and local permits and approvals will need to be acquired. Permits or approvals required for this work are the following:

- Federal
  - U.S. Army Corps of Engineers: jurisdictional determination that the proposed work is not a regulated action or Nationwide Permit 6
- State
  - Washington State Department of Natural Resources: Public notice/right of entry for work conducted on state aquatic lands
  - Washington Department of Fish and Wildlife: Hydraulic Project Approval for in-water work
- City of Seattle
  - Shoreline Exemption
  - State Environmental Policy Act (SEPA) Exemption

3.0 FIELD METHODOLOGY

Sample location control and collection, processing, transportation, and field decontamination and record-keeping procedures will be conducted in accordance with the Ecology-approved SAP/QAPP (Floyd|Snider 2018) and are described in detail in Floyd|Snider's sediment grab sampling and sediment coring standard guidelines provided in Attachment 1 and Attachment 2, respectively. These field standard guidelines were developed in general accordance with agency best practices, including guidance in the Sediment Cleanup User's Manual II (Ecology 2017).

3.1 Sediment Sample Collection

Eight surface grab samples will be collected from the 0- to 10-cm biologically active zone using a vessel-based power grab sampler. Figure 1 depicts the five proposed grab samples to be collected adjacent to the Site (TOC-SS-07 to TOC-SS-11) and the three proposed grab samples to be collected in Salmon Bay (SB-SS-01 to SB-SS-03).

Two proposed subsurface core samples (identified as TOC-SC-01 and TOC-SC-02 on Figure 1) will be collected using a vessel-based vibracorer. Three sediment samples will be collected per core; generally, one will be collected from the mid-range of the core, one from just above the native interface, and one from the native material, anticipated to be no more than 6 feet below mudline. Sample depth intervals will be determined in the field based on depths of depositional versus native materials and visual and olfactory observations of contamination (e.g., staining, petroleum-odors, presence of sheen).

The Floyd|Snider field personnel will be responsible for all sample tracking and chain-of-custody procedures in the field, as well as final sample inventory and sample custody documentation. Sample collection forms, provided in Attachments 1 and 2, will be completed for each sediment sampling station. Sample station coordinates will be recorded for each sample attempt. Sample collection forms will also be used to record information regarding the date and time of each sampling attempt; weather at the time of sampling; and sample collection details, including penetration of the sampler, sample acceptance criteria, physical characteristics of the sediment, and sample laboratory analyses.

3.2 Sample Identification

Sediment samples will be identified according to their station number and depth in centimeters for surface sediments and feet for subsurface sediments. For example, the sample collected from TOC-SS-07 from 0 to 10 cm would be labeled “TOC-SS-07-0-10.” The field duplicate sample will be identified by adding a “D” to the station ID. A field duplicable from station TOC-SS-07 would be “TOC-SS-07D-0-10.” Sediment core samples will follow a similar sample nomenclature, with the sample collected from TOC-SC-01 from 5 to 6 feet labeled “TOC-SC-01-5-6.”

3.3 Health and Safety

All field investigation activities described in this SAP/QAPP Addendum will be conducted in accordance with applicable regulations and the site-specific health and safety plan provided in Appendix B of the SAP/QAPP (Floyd|Snider 2018).

3.4 Best Management Practices

Sediment sample collection will be conducted in a manner that minimizes water quality and sediment bed disturbance by implementing the following best management practices:

- During sediment sample collection, care will be taken to minimize disturbance of sediment to minimize turbidity and to minimize impact to water quality.
- During grab sample collection, excess sediment that is not collected for sample analyses may be returned to the water at the station where it was collected if there is no visible sign of contamination (i.e., oily sheen, droplets). To minimize turbidity, excess sediment will not be released at the water surface; instead, it will be released from the grab sampler just above the mudline.
    - If oil or sheen is observed, excess sediment will not be released, but instead will be collected in buckets aboard the sampling vessel and taken upland to a secure area of the Site for temporary storage in watertight drum(s) pending the receipt of analytical results and offsite disposal coordination.
- Sediment cores will be taken to a secure upland area for sample processing, with plastic placed underneath the sample processing area to contain any spillage for disposal. Any excess sediment from cores that is not collected for sample analyses will be temporarily stored in watertight drum(s) in a secure area of the Site pending the receipt of analytical results and offsite disposal coordination.
- Investigation-derived waste including disposal materials used during field work will be managed in accordance with Section 2.1.5 of the SAP/QAPP.
- Equipment will be checked daily for leaks, and any required repairs will be completed before using the equipment in or near the water.
- Vessels will be operated with minimal propulsion power and in adequate water depth to prevent impacts from grounding and propeller wash to seagrass, kelp, and forage fish spawning beds.
- Contaminants from the project, such as petroleum products, hydraulic fluid, or any other toxic or harmful materials, will be prevented from entering or leaching into waters of the state. A spill kit will be available on the vessel.
- Samples will be collected only within the project area identified in the approved SAP/QAPP Addendum.

4.0 SAMPLE ANALYSIS

Sediment samples will be analyzed for the Sediment Management Standards freshwater sediment chemicals and dioxins/furans, consistent with the SAP/QAPP (Floyd|Snider 2018) by Fremont Analytical, Inc. The laboratory quality control (QC) and quality assurance (QA) objectives

and procedures (including data validation) are included in Section 3.0 of the Ecology-approved SAP/QAPP.

4.1 Laboratory Analytical Program

Table 1 presents the sediment quality criteria, reporting limits, and sample handling criteria for sediment sample analysis. Analyses include the following:

- Grain size by ASTM D422
- Total solids by SM 2450 modified
- Total organic carbon by U.S. Environmental Protection Agency (USEPA) Method 9060A
- Ammonia by SM 4500-NH3
- Total sulfides by SM 4500-S2-D1
- SMS metals by USEPA Method 6020A and USEPA Method 7471B (mercury only)
- Butyltin species by USEPA 8270D-SIM
- Semivolatile organic compounds (SVOCs) by USEPA 8270D
- Organochlorine pesticides by USEPA Method 8081B
- Aroclor polychlorinated biphenyls (PCBs) by USEPA Method 8082A
- Dioxins/furans by USEPA Method 1613B
- Total petroleum hydrocarbons (diesel-range and residual) by NWTPH-Dx

4.2 Quality Control Samples

There are 14 sediment samples proposed as part of this additional sediment investigation. Quality control samples will include both field and laboratory QC samples as follows:

- One field duplicate will be collected for this event and analyzed for the chemicals listed above.
- Extra volume for a matrix spike/matrix spike duplicate (MS/MSD) will be required for metals, SVOCs and PCBs.

5.0 DATA ANALYSES AND INTERPRETATION

Surface sediment data from the Site will be compared to surface sediment data elsewhere in Salmon Bay in accordance with evaluation criteria agreed to with Ecology. Generally, given

[1] Total sulfides sampling will be conducted in accordance with Section 2.1.3 of the SAP/QAPP.

apparent "patchiness" observed in existing historical sediment data, some variability may be encountered.

The core data will be used to confirm the depth to native sediments and the thickness of recent deposits. The core data will also be used to evaluate if the contaminants present in the subsurface are generally consistent with the surface sediments, to identify whether elevated concentrations, if encountered, are associated with former Site operations and whether concentrations present an immediate risk to human health or the environment.

6.0 PROJECT SCHEDULE AND REPORTING

The field investigation described in this addendum is anticipated to be conducted in March 2019. The results of this investigation will be presented in the Remedial Investigation/Feasibility Study to be prepared by Floyd|Snider.

REFERENCES

Washington State Department of Ecology. 2017. *Sediment Cleanup User's Manual II: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC.* Publication No. 12-09-057. April.

Floyd|Snider. 2018. *Surface Sediment Quality Evaluation Sampling and Analysis Plan/Quality Assurance Project Plan.* Prepared for Cantera Development Group, LLC. July.

LIST OF ATTACHMENTS

Table 1 Analytes, Methods, Target Quantitation Limits, and Sample Handling Criteria

Figure 1 Proposed Sediment Sample Locations

Attachment 1 Standard Guideline for Sediment Grab Sample Collection and Surface Sediment Sample Collection Form

Attachment 2 Standard Guideline for Sediment Coring and Subsurface Sediment Core Collection Form

Table

Table 1
Analytes, Methods, Target Quantitation Limits, and Sample Handling Criteria

Chemical	Unit [1]	Freshwater SMS Criteria [2]		Analytical Method	Method Reporting Limit	Bottle Type	Preservative	Holding Time	Turnaround Time
		SCO	CSL						
Conventionals									
Grain size	%	--	--	ASTM D422	NA	One 32-oz WMG	None, cool to <6 °C	None	Approximately 2+ weeks [3]
Total solids	%	--	--	SM 2540 (Mod)	0.5	One 4-oz WMG	None, cool to <6 °C	28 days	5 days
Total organic carbon	%	--	--	USEPA 9060A	0.075	One 4-oz WMG	None, cool to <6 °C	28 days	5 days [3]
Ammonia	mg/kg	230	300	SM 4500-NH3	1	One 4-oz WMG	None, cool to <6 °C	28 days	5 days
Sulfides	mg/kg	39	61	SM 4500-S2-D	1	One 2-4-oz WMG	Zinc acetate, cool to <6 °C	7 days	14 days
Metals									
Arsenic	mg/kg	14	120	USEPA 6020A	0.25	One 4-oz WMG	None, cool to <4 °C	Metals: 6 months Mercury: 28 days	5 days
Cadmium	mg/kg	2.1	5.4	USEPA 6020A	0.2				
Chromium	mg/kg	72	88	USEPA 6020A	0.1				
Copper	mg/kg	400	1,200	USEPA 6020A	0.2				
Lead	mg/kg	360	>1,300	USEPA 6020A	0.2				
Mercury	mg/kg	0.66	0.8	USEPA 7471B	0.25				
Nickel	mg/kg	26	110	USEPA 6020A	0.5				
Selenium	mg/kg	11	>20	USEPA 6020A	0.5				
Silver	mg/kg	0.57	1.7	USEPA 6020A	0.1				
Zinc	mg/kg	3,200	>4,200	USEPA 6020A	0.5				
Organometallic Compounds									
Dibutyltin	µg/kg	910	130,000	USEPA 8270D-SIM	5.78	One 4-oz WMG	None, cool to <4 °C	14 days to extract, then 40 days to analyze	14 days
Monobutyltin	µg/kg	540	>4,800	USEPA 8270D-SIM	4.08				
Tetrabutyltin	µg/kg	97	>97	USEPA 8270D-SIM	5				
Tributyltin	µg/kg	47	320	USEPA 8270D-SIM	3.89				
Semivolatile Organic Compounds									
2-Methylnaphthalene	µg/kg	--	--	USEPA 8270D	40	One 4-oz WMG	None, cool to <4 °C	14 days to extract, then 40 days to analyze	10 days
Acenaphthene	µg/kg	--	--	USEPA 8270D	40				
Acenaphthylene	µg/kg	--	--	USEPA 8270D	40				
Anthracene	µg/kg	--	--	USEPA 8270D	40				
Benzo(a)anthracene	µg/kg	--	--	USEPA 8270D	40				
Benzo(a)pyrene	µg/kg	--	--	USEPA 8270D	40				
Benzo(g,h,i)perylene	µg/kg	--	--	USEPA 8270D	40				
Chrysene	µg/kg	--	--	USEPA 8270D	40				
Dibenzo(a,h)anthracene	µg/kg	--	--	USEPA 8270D	40				
Fluoranthene	µg/kg	--	--	USEPA 8270D	40				
Fluorene	µg/kg	--	--	USEPA 8270D	40				
Indeno(1,2,3-c,d)pyrene	µg/kg	--	--	USEPA 8270D	40				
Naphthalene	µg/kg	--	--	USEPA 8270D	40				
Phenanthrene	µg/kg	--	--	USEPA 8270D	40				
Pyrene	µg/kg	--	--	USEPA 8270D	40				
Total benzofluoranthenes	µg/kg	--	--	USEPA 8270D	40				
Total PAHs	µg/kg	17,000	30,000	USEPA 8270D	--				
4-Methylphenol	µg/kg	260	2,000	USEPA 8270D	100				
Benzoic Acid	µg/kg	2,900	3,800	USEPA 8270D	500				
Bis(2-ethylhexyl)phthalate	µg/kg	500	22,000	USEPA 8270D	100				
Carbazole	µg/kg	900	1,100	USEPA 8270D	75				
Dibenzofuran	µg/kg	200	680	USEPA 8270D	75				
Di-n-butyl phthalate	µg/kg	380	1,000	USEPA 8270D	100				
Di-n-octyl phthalate	µg/kg	39	>1,100	USEPA 8270D	100 (MDL = 10.7)				
Pentachlorophenol	µg/kg	1,200	>1,200	USEPA 8270D	100				
Phenol	µg/kg	120	210	USEPA 8270D	100				
Pesticides									
beta-Hexachlorocyclohexane	µg/kg	7.2	11	USEPA 8081B	1.7	One 4-oz WMG	None, cool to <4 °C	14 days to extract, then 40 days to analyze	14 days
Dieldrin	µg/kg	4.9	9.3	USEPA 8081B	3.3				
Total DDDs	µg/kg	310	860	USEPA 8081B	3.3				
Total DDEs	µg/kg	21	33	USEPA 8081B	3.3				
Total DDTs	µg/kg	100	8,100	USEPA 8081B	3.3				
Endrin ketone	µg/kg	8.5	>8.5	USEPA 8081B	3.3				
Polychlorinated Biphenyls (PCBs)									
PCB-aroclor 1016	µg/kg	--	--	USEPA 8082A	10	One 4-oz WMG	None, cool to <4 °C	None	5-7 days [4]
PCB-aroclor 1221	µg/kg	--	--	USEPA 8082A	10				
PCB-aroclor 1232	µg/kg	--	--	USEPA 8082A	10				
PCB-aroclor 1242	µg/kg	--	--	USEPA 8082A	10				
PCB-aroclor 1248	µg/kg	--	--	USEPA 8082A	10				
PCB-aroclor 1254	µg/kg	--	--	USEPA 8082A	10				
PCB-aroclor 1260	µg/kg	--	--	USEPA 8082A	10				
PCB-aroclor 1268	µg/kg	--	--	USEPA 8082A	10				
Total PCB Aroclors	µg/kg	110	2,500	USEPA 8082A	--				

Table 1
Analytes, Methods, Target Quantitation Limits, and Sample Handling Criteria

Chemical	Unit [1]	Freshwater SMS Criteria [2] SCO	Freshwater SMS Criteria [2] CSL	Analytical Method	Method Reporting Limit	Bottle Type	Preservative	Holding Time	Turnaround Time
Dioxins/Furans									
2,3,7,8-TCDD	ng/kg	--	--	USEPA 1613B	0.5	One 4-oz amber WMG	None, cool to <4 °C	1 year	15 days
1,2,3,7,8-PeCDD	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,4,7,8-HxCDD	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,6,7,8-HxCDD	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,7,8,9-HxCDD	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,4,6,7,8-HpCDD	ng/kg	--	--	USEPA 1613B	2.5				
Total OCDD	ng/kg	--	--	USEPA 1613B	5				
2,3,7,8-TCDF	ng/kg	--	--	USEPA 1613B	0.5				
1,2,3,7,8-PeCDF	ng/kg	--	--	USEPA 1613B	2.5				
2,3,4,7,8-PeCDF	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,4,7,8-HxCDF	ng/kg	--	--	USEPA 1613B	2.5				
2,3,4,6,7,8-HxCDF	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,7,8,9-HxCDF	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,4,6,7,8-HpCDF	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,6,7,8-HxCDF	ng/kg	--	--	USEPA 1613B	2.5				
1,2,3,4,7,8,9-HpCDF	ng/kg	--	--	USEPA 1613B	2.5				
Total OCDF	ng/kg	--	--	USEPA 1613B	5				
Summed dioxin/furan TEQ [5]	ng/kg	--	--	USEPA 1613B	--				
Total Petroleum Hydrocarbons (TPHs)									
TPH (diesel)	mg/kg	340	510	NWTPH-Dx	20	One 4-oz WMG	None, cool to <4 °C	14 days to extract, then 40 days to analyze	5 days
TPH (residual)	mg/kg	3,600	4,400	NWTPH-Dx	50				

Notes:

-- Not applicable.
1 Dry weight.
2 Freshwater SCO and CSL chemical criteria, SMS (WAC 173-204-563).
3 Sediment samples have to be air dried prior to analysis. Time to dry varies depending on moisture of sample and the consistency of the matrix.
4 Additional time may be required for cleanup procedures.
5 Calculated using the World Health Organization re-evaluation of Toxic Equivalency Factors for dioxins performed in 2005 (Van den Berg et al. 2006), as presented in Table 6-3 of the Dredged Material Management Program's Users' Manual (USACE 2008).

Abbreviations:

°C Degrees Celsius
CSL Cleanup Screening Level
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethylene
DDT Dichlorodiphenyltrichloroethane
HpCDD Heptachlorodibenzo-p-dioxin
HpCDF Heptachlorodibenzofuran
HxCDD Hexachlorodibenzo-p-dioxin
HxCDF Hexachlorodibenzofuran
MDL Method detection limit
µg/kg Micrograms per kilogram
mg/kg Milligrams per kilogram
ng/kg Nanograms per kilogram
OCDD Octachlorodibenzodioxin
OCDF Octachlorodibenzofuran
PAH Polycyclic aromatic hydrocarbon
PeCDD Pentachlorodibenzo-p-dioxin
PeCDF Pentachlorodibenzofuran
SCO Sediment Cleanup Objective
SMS Sediment Management Standards
TCDD Tetrachlorodibenzo-p-dioxin
TCDF Tetrachlorodibenzofuran
TEQ Toxic equivalent
WMG Widemouth glass

Figure

Legend

- August 2018 Surface Sediment Sample
- Historical Surface Sediment Sample
- Proposed Surface Sediment Sample
- Proposed Sediment Core
- Property Boundary for the Seattle Terminal Properties

TOC-SS-08
DNR AQUATIC LEASE LAND PROPERTY
TOC-SS-09
TOC-SC-01
TOC-SS-07
TOC-SS-10
TOC-SC-02
TOC-SS-11
SB-SS-01
SB-SS-02
SB-SS-03
Salmon Bay
WEST WATERFRONT PROPERTY
EAST WATERFRONT PROPERTY
W. Commodore Way
27th Ave W
ASKO HYDRAULIC PROPERTY
BNSF Railway
BULK TERMINAL PROPERTY

Notes:
· Parcel boundaries obtained from King County Geographic Information Systems Center, 2011.
· Orthoimagery obtained from Nearmap, 2017.

Abbreviation:
DNR = Washington State Department of Natural Resources

0 80 160 320
Scale in Feet

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Surface Sediment Quality Evaluation SAP/QAPP Addendum
Former Time Oil Company Seattle Terminal
Seattle, Washington

Figure 1
Proposed Sediment Sample Locations

I:\GIS\Projects\Cantera-TOC\MXD\Surface Sediment\Sediment Investigation\Figure 1 Proposed Sediment Sample Locations.mxd
2/6/2019

Attachment 1
Standard Guideline for Sediment Grab Sample Collection and Surface Sediment Sample Collection Form

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F|S STANDARD GUIDELINE

Sediment Grab Sample Collection

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

These sediment grab standard guidelines should be used by the field staff performing sediment grab sampling via a grab type sampler (e.g., van Veen, Power Grab) or a diver-collected hand core (i.e., cookie cutter) sampler for sediment sampling in freshwater or marine environments. The van Veen grab and diver-collected hand core samplers are two of the most commonly used to collect surface sediment. Power Grab samplers are often used when requiring collection of sediment deeper than 10 cm (4 in.) or in areas with debris.

It is important that the field staff completing the sediment sample collection discusses the sediment logging needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about sediment logging and sampling, and should happen prior to entering the field, with additional follow-up before finalizing the field forms, after the investigation is complete.

2.0 Equipment and Supplies

Logging Equipment and Tools:

- Tape measure (at least 1 foot long)
- Lead line (if not provided by vessel operator)
- Soil/sediment logging kit containing:
  - Small and Large Ziploc bags
  - Note cards
  - Field guide for soil and stratigraphic analysis
  - Optional items from kit including: Munsell color chart, sieves, white and grayscale color cards for photographs
- Large stainless steel bowls for homogenizing
- Large stainless steel spoons or mixer (as an alternative, disposal spoons or spatulas can be used)
- Small stainless steel spoon
- Trash bags
- Decontamination equipment including:
  - Pump sprayer for tap water or site water
  - Spray bottles filled with alconox (or other soap) solution
  - Distilled or deionized water
  - Scrub brushes
  - Paper towels
  - 5-gallon buckets
- Siphoning hose (usually on board vessel)
- Camera
- Hand-held global positioning system (GPS; if GPS not on board vessel)
- Coolers, sample jars, labels, chain-of-custody forms, ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Key figures/coordinate table with sampling locations
- Tide prediction tables
- Health and Safety Plan (HASP)

- Sediment grab sampling forms, printed in Rite in the Rain paper, and optional bound field notebook
- Permanent markers and pencils

Personal Equipment:

- Steel-toed boots
- Hard hat
- Life vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves
- First aid kit

3.0 Standard Procedures

3.1 PREPARATION

First, meet with the project manager to identify key information and goals of the sediment sampling investigation. These may include fill/capping/dredging history, known or suspected sources of contamination and potential field indications of these contaminants, and identification of specific units, if applicable.

Next, review the work plan and existing materials such as surface sediment grab forms or sediment core logs from previous investigations to familiarize yourself with the site geology. If site-specific information about geology is not available, or in addition to site-specific information, a geologic map of the area from a reputable source such as the U.S. Geological Survey (USGS) may also be reviewed.

3.2 COLLECTING SEDIMENT SAMPLES

Sediment grab samples will be processed on board the sampling vessel or shoreline (if diver assisted). All working surfaces and instruments will be thoroughly cleaned and decontaminated between sample locations.

1. Before starting, record the following information on each field form:
    a. Sample Method (i.e., Van Veen Surface Grab, Power Grab, or Diver Cookie Cutter) and Sample Type/Depth (e.g., 0 to 10 cm).
    b. Your name, date, project, weather, subcontractor (if applicable), sample location ID name and approximate descriptive location (if possible or applicable).

2. Have the boat operator maneuver the sampling vessel to the proposed sample location. Locations will be, in most situations, pre-determined in northings and eastings (to the nearest US survey foot) referenced to the appropriate state plane system for the site, using the vessel mounted Digital Global Positioning System (DGPS) receiver referenced to North American Datum of 1983 (NAD 83). If collecting a cookie cutter sample, the diver will need to get on location. If there is no vessel mounted DGPS available, a handheld portable GPS may be used.
3. Record the time, depth to mudline below water surface, actual sample location coordinates (get from vessel operator), and estimated tide elevation (can be determined in the office prior to sampling) on the field form as the sample is collected.
4. Once the sampler or cookie cutter has been retrieved, examine the sample for the following sediment acceptance criteria and include on field form:
    a. Sampler jaw or bottom lid (if cookie cutter) is closed.
    b. The sample does not contain foreign objects.
    c. The sampler is not overfilled so that the sediment surface presses against the top of the sampler.
    d. Leakage has not occurred, as indicated by overlying water on the sediment surface (not relevant with cookie cutter).
    e. Sample disturbance has not occurred, as indicated by limited turbidity in the overlying water (not relevant with cookie cutter).
    f. Winnowing has not occurred, as indicated by a relatively flat undisturbed surface (not relevant with cookie cutter).
    g. A penetration depth of at least 1 inch greater than desired sample depth has been achieved for grabs, and at least the depth of the desired sample for cookie cutter sampling. If after four attempts, the penetration depth has not been achieved, accept the sample as is.
5. If sample acceptance criteria are not achieved, the sample will be rejected and the location resampled after rinsing the sampler. If the proposed sample location cannot be achieved (within ±10 feet, or within a distance specified in the sampling plan), notify the Floyd|Snider Project Manager to determine an appropriate alternate location.
6. Siphon off any standing water from the surface of the sediment using a hose primed with site water. Care should be taken not to disturb the integrity of the sediment surface (not relevant with cookie cutter).
7. If using the cookie cutter, position the cookie cutter over a large stainless steel bowl and carefully slide out the bottom lid of the sampler so the sediment falls into the bowl.

8. Take a digital photograph of the sediment surface prior to removal from the sampler (not relevant with cookie cutter). Write the sample location ID and grab replicate or run number (e.g., Run #1) with a large felt-tip marker on a sheet of paper, or index card (or similar) and photograph next to, but not touching, the sediment sample.
9. Visually classify the surface (and subsurface, if collecting) sediment characteristics according to the American Society for Testing and Materials (ASTM) standards using the Unified Soil Classification System (USCS). Refer to the Floyd|Snider Soil Logging Standard Guideline for additional details regarding logging and classification. In addition to the visual classification, qualitative descriptive parameters, including biota (e.g., worms, crabs, and seaweed), debris (e.g., shells, wood, concrete, and glass), staining, sheen, and other observations (including olfactory if relevant) should also be recorded.
10. Collect the surface sediment sample over the desired surface sediment sampling depth (e.g., 0 to 10 cm) using a clean, stainless steel spoon and place the sample material into a clean stainless steel bowl. If collecting a subsurface sediment sample as well, then collect sediment for this sample over the desired sampling depth (e.g., 10 to 20 cm) using a clean, stainless steel spoon and place this sample material in a separate clean stainless steel bowl. To prevent possible cross-contamination, do not collect sediments that are in direct contact with the margins of the sampler.
11. Take a digital photograph of each sediment interval collected while in the bowl. Write the sample location name, grab replicate number, and sample depth interval with a large felt-tip marker on a sheet of paper or index card (or similar) and photograph next to, but not touching, the sediment sample.
12. Homogenize until the sediment appears uniform in color and texture and distribute to appropriate sample containers and ensure that sample labels are completely filled out and affixed to the containers. If collecting sample volume for volatile organic carbons (VOCs), collect prior to homogenizing. If there isn't enough sediment volume to fill sample containers, repeat Steps 1 through 11 at a new location within 5 to 10 feet of current location and label as subsequent Run # or Grab #.
13. Clean the exterior of all sample containers and store them in a cooled ice chest away from the immediate work area. The cooled ice chest should be maintained at 4 degrees Celsius (°C).
14. Thoroughly rinse the interior of the sampler until all loose sediment has been washed off, and decontaminate the sampler by following the procedures provided in Section 4.0.
15. Ensure that sediment descriptions and supporting field form entries are complete.
16. Complete filling out chain-of-custody and transport samples to analytical laboratory under standard chain-of-custody procedures.

4.0 Decontamination

All reusable equipment that comes into contact with sediment should be decontaminated as follows prior to moving to the next sampling location.

Stainless steel bowls and spoons, sediment samplers, and any other tools used for sampling must be decontaminated between grab sample locations. Equipment decontamination will consist of a preliminary water rinse using water from the site to remove sediment particles, followed by scrubbing with brushes and an alconox (or other soap)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste sediment and decontamination water and rinse water generated during sediment grab sample activities may be returned to the site by disposing of material overboard the vessel, as close to the sample location as possible. If using an uplands processing area, waste sediment should be containerized in 55-gallon drums approved by the Washington State Department of Transportation pending profiling and disposal. Each container holding investigation-derived waste (IDW) will be sealed and labeled as to its contents (e.g., “sediments”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e. site dumpster).

6.0 Field Documentation

All observations should be recorded on the surface sediment sample collection form (attached) and/or in a bound field notebook. Field staff should make an effort to record as much detail as possible.

Enclosure: Surface Sediment Sample Collection Form

SURFACE SEDIMENT SAMPLE COLLECTION FORM

Date/Time Collected: _____

Weather: _____

Field Personnel: _____

Sample Type:

☐ 1. Surface Sample (0-10 cm)

Sample ID/Design. _____

Sample Method (Van Veen Surface Grab/Diver Core-Cookie Cutter)

Datum (Horizontal/Vertical) _____

Leadline Water Dept: _____ (A)

Predicted Tide Elevation _____ (B)

Mudline Elevation _____ (B-A)

Actual Tide Elevation _____

Run # or Composite Pt	Time	Latitude (Northing)	Longitude (Easting	Sample Criteria (Surface Grab Only)					Accept Sample Y/N	Comments (Include depth of sample)
				1	2	3	4	5		

Acceptance criteria: 1 Overlying water is present, 2 Water has low turbidity, 3 Sampler is not over filled, 4 Sample surface is flat, 5 Desired sample depth is reached

Decon Procedure (Alconox Wash, DI water rinse, other):_____

Sediment Sample Description

Sediment Sample Description (density, moisture, color, minor constituents, major constituents, other observations - *see field ref cards):

Sample containers filled (number and type):

Laboratory analysis:

Diver Comments (if applicable) etc:

Attachment 2
Standard Guideline for Sediment Coring and Subsurface Sediment Core Collection Form

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F|S STANDARD GUIDELINE

Sediment Coring

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

These sediment coring standard guidelines should be used by the field staff performing sediment coring via vibracoring or Mud Mole for sediment sampling in freshwater or marine environments. The vibracore method works in a wide range of sediments but does not work as well in locations with known debris. The vibracore method assumes uniform recovery throughout the core. The Mud Mole method is diver-assisted and was initially developed to sample sediment containing wood debris. The Mud Mole method can provide a more accurate representation of stratification and reduce the chances of underestimating or overestimating contaminant depth, as it can use incremental interpolation to determine recovery in the core based on diver measurements recorded during the coring.

It is important that the field staff completing the sediment sample collection discusses the sediment logging needs for a particular investigation with the project geologist or the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about sediment logging and sampling, and should happen prior to entering the field, with additional follow-up before finalizing the field forms and logs, after the investigation is complete.

2.0 Equipment and Supplies

Coring/Logging Equipment and Tools:

- Tape measures (one for on board vessel and one for processing on shore)
- Lead line (if not provided by vessel operator)
- Duct tape and aluminum for sealing core tubes (if caps not provided by vessel operator)
- Soil/sediment logging kit containing:
  - Small and Large Ziploc bags
  - Note cards
  - Field guide for soil and stratigraphic analysis
  - Optional items from kit including: Munsell color chart, sieves, white and grayscale color cards for photographs
- Large stainless steel bowls for homogenizing
- Large stainless steel spoons or mixer (as an alternative, disposal spoons or spatulas can be used)
- Small stainless steel spoon
- Aluminum for covering bowls
- Folding table (if not provided by subcontractor), plastic sheeting to cover sampling table and uplands processing area (if using), 5-gallon buckets for collecting excess sediment, metal scraper to clear core surface, and duct tape or clamps
- Extension cord and generator (if needed) for core cutting equipment (typically assumed by subcontractor)
- Trash bags
- Investigation-derived waste (IDW) drums
- Decontamination equipment including:
  - Pump sprayer for tap water or site water
  - Spray bottles filled with alconox (or other soap) solution
  - Distilled or deionized water
  - Scrub brushes
  - Paper towels
  - 5-gallon buckets
- Siphoning hose (usually on board vessel)
- Camera

- Hand-held global positioning system (GPS; if GPS not on board vessel)
- Coolers, sample jars, labels, chain-of-custody forms, ice

Paperwork/Misc.:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Key figures/coordinate table with sampling locations
- Tide prediction tables
- Calculator for determining percent recoveries
- Health and Safety Plan (HASP)
- Subsurface sediment core collection and sampling forms, printed in Rite in the Rain paper and optional bound field notebook
- Permanent markers and pencils

Personal Equipment:

- Steel-toed boots
- Hard hat
- Life vest
- Safety glasses
- Earplugs
- Nitrile gloves
- Coveralls, Tyvek, or rain gear
- Work gloves
- First aid kit

3.0 Standard Procedures

3.1 OFFICE PREPARATION

First, meet with the project manager to identify key information and goals of the sediment sampling investigation. These may include fill/capping/dredging history, known or suspected sources of contamination and potential field indications of these contaminants, and identification of specific units, if applicable. Select a coring log template that is appropriate for the method (i.e., vibracore or Mud Mole, note that Mud Mole logs are typically produced by the subcontractor after the core has been driven).

Next, review the work plan and existing materials such as cross-sections, surface sediment grab forms, or sediment core logs from previous investigations to familiarize yourself with the site geology. If site-specific information about geology is not available, or in addition to site-specific information, a geologic map of the area from a reputable source such as the U.S. Geological Survey (USGS) may also be reviewed.

3.2 COLLECTING SEDIMENT CORES

Processing of sediment cores may occur on the vessel if there is adequate space or at an uplands processing location. All working surfaces and instruments will be thoroughly cleaned and decontaminated prior to core or sample collection and between coring locations.

1. Before starting, record the following information on the appropriate field form(s) or in the field notebook:
    a. Vessel operator's name and company, coring method (i.e., vibracore or Mud Mole), equipment make/model, equipment measurements (i.e., sampler length and diameter).
    b. Your name, date, project, weather, coring location ID name and approximate descriptive location (if possible or applicable).
2. Have the boat operator maneuver the vessel to the proposed coring location. Locations will be, in most situations, pre-determined in northings and eastings (to the nearest US survey foot) referenced to the appropriate state plane system for the site, using the vessel mounted Digital Global Positioning System (DGPS) receiver referenced to North American Datum of 1983 (NAD 83).
3. Record the time, depth to mudline below water surface, and estimated tide elevation on the field form or in the field notebook as the core is collected.
4. Also, record the actual sample location coordinates and note the angle of the sampling device relative to the boat as the core is collected.
5. The vessel operator will advance the core sampler to the target depth as directed by the Floyd|Snider Field Manager or Project Manager or until refusal. If using the diver-assisted Mud Mole, the diver will relay measurements of recovered sediment in the core tube as the core is being driven to the vessel operator. Record the core tube drive depth on the field form.
6. The vessel operator will retrieve the core by raising the sampler at a slow and controlled rate and guide the core sampler on board without disturbing the integrity of the core.
7. Once on board the vessel, the recovered length of the core in the core tube is measured and recorded on the field form to calculate the estimated recovery. The average percent recovery is estimated as the core length recovered divided by the core tube penetration depth.

8. Cores will be accepted based on the following criteria:
    a. The core does not contain significant debris material or obstructions that may have blocked the subsequent entry of sediment into the core tube and resulted in incomplete core collection.
    b. Core recovery is acceptable (typically 50 to 75 percent) for testing purposes, or as specified in the sampling plan. It is important to note that for characterization of sediments at a targeted elevation, and especially for characterization of a post-dredge z-layer, core recovery should be at least 75 percent. If core recovery is consistently less than 75 percent, adjustment to the acceptable recovery range should be coordinated with the project PM and/or overseeing agency for approval.
    c. Cored material does not extend out the top of the core tube or contact any part of the sampling apparatus at the top of the core tube.
    d. A core depth acceptable to the field manager or project-specific work plan has been achieved.
9. If the core criteria are not achieved, the core will be rejected and another core will be performed adjacent to the original sample location. The core tube from the rejected sample may be decontaminated and re-used unless otherwise specified in the sampling plan. Repeat the core sampling process within a 10-foot radius of initial coring location (or within a radius specified in the sampling plan) until sufficient sample volume is obtained for chemical and/or biological analyses at each location.
10. If refusal is encountered, relocate the core within a 10-foot radius of the target location, or within a radius specified in the sampling plan.
11. Care should be taken during sampling to avoid contact of the sample tube with potentially contaminated surfaces. Extra sample core tubes and/or liners will be available during sampling operations for uninterrupted sampling in the event of a potential core tube/liner breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used.
12. Upon bringing the core barrel on board the vessel, the core tube is stored vertically or angled upward until suspended sediments above the sample have settled and the excess water has been siphoned from the top of the core. Watertight caps are used to prevent sample loss when transporting or opening core tubes; longer cores that need to be transferred to an uplands processing location may be segmented on board the vessel and the segments capped at each end. The intact core or core sections (if cut into sections on board the vessel) will be capped, taped, and labeled with the station ID, section name (if applicable), and “top” and/or “bottom”.

3.3 SEDIMENT CORE SAMPLE PROCESSING

The procedures for core processing vary depending on the coring method. For example, AMEC's proprietary Mud Mole and any vibracoring that does not utilize an inner liner require that the aluminum core tube be processed onshore in order to cut the core tube open to extract the sediment. For vibracoring that does use a liner a metal core barrel is lined with a butyrate liner and the liner is removed from the core barrel by pulling it out. The procedures that follow have been generalized to apply to all coring methods; however, method-specific coring procedures should be detailed in the project SAP.

1. Depending on the coring method, either cut the aluminum core tube longitudinally using a circular saw, or cut the liner longitudinally with power shears, taking care not to penetrate the sediment while cutting.
2. Measure the total core tube length and the length of recovered sample to calculate sample recovery to verify that an acceptable core has been obtained (i.e., sufficient material is present for characterization). For example, for a five-foot core, if you have 4 feet of recovery, your recovery is 80 percent (4/5). If the core recovery is not acceptable, the material from the failed core will be discarded and an alternate core will be used.
3. Adjust the recovery intervals based on the calculated recovery percentages (e.g. for a core with 80 percent recovery, 1 foot of penetrated depth would correspond to 0.8 feet of recovered sediment) and mark these intervals on the core tube barrel or next to the liner.
4. Take a digital photograph of the sediment prior to removal from the core tube. Write the core location name and core replicate number with a large felt-tip marker on a sheet of paper (or similar) and photograph next to, but not touching, the sediment.
5. Record the description of the core sample on the sediment core processing log form for the following parameters as appropriate and present:
    a. Sample recovery (depth in feet of penetration and length of recovered sediment).
    b. Visual classification according to the American Society for Testing and Materials (ASTM) standards using the Unified Soil Classification System (USCS). Refer to the Floyd|Snider Soil Logging Standard Guideline.
    c. Odor (e.g., hydrogen sulfide, petroleum, etc.).
    d. Vegetation.
    e. Debris.
    f. Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms).
    g. Depth of contact with native material, if distinguishable.
    h. Presence of oil sheen or obvious contamination.
    i. Any other distinguishing characteristics or features.

6. Using a clean stainless steel spoon, place material from the desired sample interval into a cleaned stainless steel bowl (taking care not to collect sediment from the sides of the core—even if using a plastic liner), homogenize using a stainless steel spoon until a consistent color and texture are achieved. Using a clean, stainless steel spoon, completely fill pre-labeled sample containers. Immediately place screw caps on containers and tighten.
7. Clean the exterior of all sample containers and store them in a cooled ice chest. The cooled ice chest will be maintained at 4°C.
8. Thoroughly rinse the sampler until all loose sediment has been washed off and decontaminate the sampler by following the procedures provided in Section 4.0.
9. Ensure that sediment descriptions and supporting field form entries are complete.
10. Complete filling out chain-of-custody and transport samples to analytical laboratory under standard chain-of-custody procedures.

4.0 Decontamination

All reusable equipment that comes into contact with sediment should be decontaminated as follows prior to moving to the next sampling location.

Stainless steel bowls and spoons, sediment samplers, and any other tools used for sampling must be decontaminated between sample locations. Equipment decontamination will consist of a preliminary water rinse using water from the site to remove sediment particles, followed by scrubbing with brushes and an alconox (or other soap)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste sediment and decontamination water and rinse water generated during sediment coring activities may be returned to the site by disposing of material overboard the vessel, as close to the sample location as possible. If using an uplands processing area, waste sediment should be containerized in 55-gallon drums approved by the Washington State Department of Transportation pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “sediments”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW containerized within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e. site dumpster).

6.0 Field Documentation

All observations should be recorded on the appropriate sediment sample forms and/or in a bound field notebook. Field staff should make an effort to record as much detail as possible.

Enclosures: Subsurface Sediment Core Collection Form
Subsurface Sediment Core Sampling Form

SUBSURFACE SEDIMENT CORE COLLECTION FORM

Sampling Contractor: _____ Date/Time Collected: _____

Weather: _____

Field Personnel: _____

Sampling Location: _____

Sampling Method: Vibracore or Mud Mole

Datum (Horizontal/Vertical): _____

Attempt	Time	Latitude (Northing)	Longitude (Easting)	Sediment Collection Criteria			Accept Sample Y/N	Comments
				1	2	3		

Acceptance criteria: 1. Recovery at least 50% of drive length; 2. Core tube is not over filled; 3. Desired sampling depth is reached

Leadline Water Depth (A): _____ ft Core Tube Length: _____ ft

Predicted Tide Elevation (B): _____ ft Drive Length (C): _____ ft

Mudline Elevation (B-A): _____ ft Recovered Length (D): _____ ft

% Recovery (E): (E = D/C x 100) _____

Subsurface Sediment Collection Notes and Description:

SUBSURFACE SEDIMENT CORE SAMPLING FORM

Project: _____ Sampling Location: _____

Date: _____ Time: _____ Drive Method: Vibracore

Field Personnel: _____ Photograph: ☐ Yes ☐ No

Weather:

Tube Length/Diameter: _____ (B) Recovered Length: _____ ft

(A) Drive Length: _____ ft (C) % Recovery (B/A x 100): _____ ft