City of Seattle

LOWER DUWAMISH WATERWAY SLIP 4 EARLY ACTION AREA

LONG-TERM MONITORING AND REPORTING PLAN
APPENDIX A: QUALITY ASSURANCE PROJECT PLAN
ADDENDUM 1

Submitted to
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

Submitted by
City of Seattle

Prepared by
integral consulting inc.

411 1st Avenue S.
Suite 550
Seattle, WA 98104

January 13, 2016

Title and Approval Sheet

Quality Assurance Project Plan Addendum

Approvals

EPA Remedial Project Manager:	Karen Keeley [signature]	Date: 1-13-16
EPA Quality Assurance Manager Designee:	Donald M. Brown [signature]	Date: 1/14/16
City of Seattle Project Manager:	Allison Crowley [signature]	Date: 01/15/2016
City Contractor Principal in Charge:	______________	Date: ______
City Contractor Project Manager:	______________	Date: ______
City Contractor Laboratory Coordinator and Quality Assurance Manager:	______________	Date: ______
Analytical Laboratory Project Manager:	______________	Date: ______
Analytical Laboratory Quality Assurance Manager:	______________	Date: ______

Signatures for the City's Contractor and Analytical Laboratory will be provided once those contracts are awarded.

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ACRONYMS AND ABBREVIATIONS

City	City of Seattle
EAA	Early Action Area
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
LTMRP	Long-Term Monitoring and Reporting Plan
MDL	method detection limit
MLLW	mean lower low water
MRL	method reporting limit
PSEP	Puget Sound Estuary Program
QAPP	quality assurance project plan
QA/QC	quality assurance and quality control
SOP	standard operating procedure

1 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

Title	Name
EPA Remedial Project Manager	Karen Keeley
EPA Quality Assurance Manager Designee	Donald M. Brown
City of Seattle Project Manager	Allison Crowley
City Contractor Principal in Charge	TBD[a]
City Contractor Project Manager	TBD[a]
City Contractor Database Manager	TBD[a]
City Contractor Laboratory Coordinator and Quality Assurance Manager	TBD[a]
Analytical Laboratory Project Manager	TBD[a]
Analytical Laboratory Quality Assurance Manager	TBD[a]

Notes:
TBD = to be determined
[a] City of Seattle contractor and analytical laboratory personnel may vary throughout the long-term monitoring program. Consultant names and qualifications will be independently provided to the U.S. Environmental Protection Agency for approval at least three months prior to initiation of annual monitoring work. Laboratory qualifications will include a listing of the laboratory's method detection limits and method reporting limits in order to ensure that sediment data can be compared to Washington State Sediment Quality Standards.

1.2 INTRODUCTION

This document is Addendum 1 to the 2013 QAPP that is part of the Long-Term Monitoring and Reporting Plan (LTMRP) or monitoring plan (Integral 2013) for the 3.58 acre Slip 4 Early Action Area (EAA) located within the Lower Duwamish Waterway Superfund site in Seattle, Washington. The 2013 QAPP provides the details for implementing the LTMRP including the sampling design, field procedures, analytical methods, quality assurance and quality control (QA/QC) procedures, and associated documentation and reporting. The QA/QC procedures and components presented in the 2013 QAPP are in accordance with U.S. Environmental Protection Agency (EPA) guidelines (USEPA 2012) and are designed to assure the quality and integrity of the collected samples, the representativeness of the results, the precision and accuracy of the analyses, and the completeness of the data.

The 2013 QAPP states that an addendum to the QAPP shall be submitted to EPA if major changes/updates are needed with respect to management, organization, contractors, sampling methods, and/or sample analyses. In order to maintain consistency in data collection during the long-term monitoring events at Slip 4, this QAPP addendum presents revisions to the following components of the 2013 QAPP:

- Title and approval sheet, distribution list, and project organization are revised to be nonspecific with respect to the firm that conducts the monitoring; consultant qualifications will be independently provided to EPA for approval at least three months prior to initiation of future monitoring work.[1] Figure A-1, the project organization chart, is also revised to reflect this change. As required, the City will provide EPA with an addendum including updates to the following QAPP components:
  - Title sheet
  - Approval sheet
  - Distribution list (Section 1.1)
  - Project organization (including Section 1.6 and Figure A-1)
  - Laboratory qualifications/reporting limits (including Section 2.3 and Table A-1)
- Sample location positioning—The addendum to this section provides for improved intertidal sediment station positioning accuracy where global positioning system (GPS) accuracy may be degraded, as well as confirmation of vessel positioning for subtidal sediment sampling. It requires that intertidal sampling locations be marked with rebar stakes placed by a surveyor, that sample locations be confirmed during sample collection and recorded on field forms, and that future sampling vessel contracts include requirements for vessel positioning accuracy. To support the placement of rebar stakes at intertidal sampling stations, Figure A-3 and Table A-5 are revised to show locations and target coordinates, respectively, for the slope cap composite subsamples which were established during 2013 monitoring and had therefore not been included in the 2013 QAPP, and to indicate which stations are intertidal and typically sampled on foot.
- Field quality control samples—The addendum to this section revises the requirement for the submittal of temperature blanks with sample coolers, since some laboratories use infrared thermometer guns to directly measure sample temperature. The method the analytical laboratory will use for determining sample temperature upon delivery will be determined prior to field mobilization, and temperature blanks will be used if required.
- Laboratory analytical methods—The addendum to this section adds Standard Method 2540G (APHA et al. 1997), the analytical method used for total solids analysis during Year 1 and Year 3 monitoring, to the list of approved methods for total solids. The performance of this method is equivalent to the Puget Sound Estuary Program (PSEP)

[1] Any new consultant would also need to submit a revision of the Health and Safety Plan that was included as Appendix B of the LTMRP.

method specified in the 2013 QAPP (i.e., USEPA 1986). Table A-1 is revised to include Standard Method 2540G in addition to the PSEP method (USEPA 1986). The table has also been revised to include a footnote stating that the laboratory-specific method reporting limits (MRLs) and method detection limits (MDLs) currently listed in the table will be revised via a QAPP addendum if a different laboratory is selected. Any required addenda will be submitted for EPA approval at least three months prior to any future sampling events.

- Attachment A3, standard operating procedures (SOPs)—SOP AP-02, *Field Documentation*, and SOP SD-04, *Surface Sediment Sampling*, are revised to include positional quality assurance checks with the vessel navigator while in the field. SOP AP-02 is also revised to require discussion of sampling positional accuracy at the start of each field day as part of the daily tailgate meeting.
- Attachment A4, field forms—The surface sediment sampling form is revised to include positional quality assurance information to be recorded in the field. A revised visual inspection form and photo log form that were used during Year 2 and Year 3 monitoring are also included. All field forms have also been revised to be specific to the Slip 4 LTMRP.

The remainder of this QAPP Addendum 1 is organized following the section numbering of the 2013 QAPP and only includes sections where information is revised by this addendum:

- Section 1.6—This section outlines the project organization structure and details of responsibilities presented in Section 1.6.1 of the 2013 QAPP, revised to be non-specific as to City contractors and subcontractors, which will change over the course of future monitoring. No other changes have been made to this section.
- Section 1.9—This section introduces the revised SOP for field logbook documentation originally presented in Section 1.9.1.1 of the 2013 QAPP.
- Section 2—This section provides revisions to portions of the sampling design and methods discussed in Section 2.1 of the 2013 QAPP to improve sampling location positioning procedures and protocols, revision to the requirement regarding temperature blanks, revisions to the analytical methods presented in Section 2.3 and Table A-1 of the 2013 QAPP to allow an alternate but comparable method for total solids analysis, and clarification that the information in Table A-1 is laboratory-specific and will be revised as needed in a future QAPP addendum if a different laboratory is selected.

1.6 PROJECT ORGANIZATION

Section 1.6 of the 2013 QAPP addresses the organizational structure and schedule for activities associated with the LTMRP. The only change made herein is to Section 1.6.1, reproduced below, in which the text identifying the consulting firm that implements the monitoring program has been made generic. Names and qualifications of the personnel who will implement future rounds of monitoring will be submitted to USEPA under separate cover for approval prior to the initiation of those monitoring events. Figure A-1 illustrates the organization of personnel on the project and has been updated similarly.

1.6.1 City Contractor Personnel

The quality assurance responsibilities for key project personnel for the City's contractor who will be involved in the long-term monitoring activities are provided in the following table. Specific names and qualifications of these personnel will be submitted to EPA under separate cover at least three months prior to initiating annual monitoring work.

Title	Responsibility
City Contractor Principal in Charge	Provide coordination, as necessary, between the Lower Duwamish Waterway project and the Slip 4 Operations and Maintenance. Provide quality assurance for Slip 4 deliverables.
City Contractor Project Manager	Provide project oversight and direction. Ensure the monitoring work is consistent with Slip 4 EAA requirements. Project planning and implementation; liaison between respective internal and external team members. Execute the study described in the LTMRP including report preparation.
City Contractor Database Manager	Database development and data management.
City Contractor Laboratory Coordinator and Quality Assurance Manager	Completeness of quality assurance documentation and procedures; liaison between project personnel, chemical testing laboratories, and data validators. Liaison for related quality assurance communications with EPA.
City Contractor Field Coordinator	Implementation of QAPP; completeness of field documentation and procedures; liaison between support staff and field subcontractors. Implementation of the health and safety plan.

1.6.1.1 City Contractor Personnel

The contractor's principal in charge will coordinate, as necessary, between the Lower Duwamish Waterway project and the Slip 4 LTMRP work, and will provide quality assurance for Slip 4 deliverables.

Responsibilities of the contractor's project manager include, but are not limited to, the following:

- Providing project oversight and direction
- Ensuring that the monitoring work is consistent with Slip 4 EAA requirements and that QAPP addenda and health and safety plans are provided to the Agency in a timely manner.
- Implementing and ensuring effective execution of all quality assurance program activities defined in this document
- Maintaining awareness of the entire project to detect conditions that may adversely affect the quality and/or progress of the work
- Functioning as the liaison with representatives of the City, agencies, subcontractors, and others
- Reviewing all project deliverables for completeness, accuracy, and quality.

The contractor's laboratory coordinator and quality assurance manager will report to the contractor's project manager and will be responsible for the following:

- Analytical laboratory contract administration, coordination, and oversight
- Data validation and evaluation
- Communication of fast-turnaround verbal analytical results to the project manager
- Data table preparation for inclusion in the monitoring report.

The contractor's database manager will report to the contractor's project manager and will be responsible for the following:

- Developing and maintaining the integrity of the database
- Coordinating with the field coordinator to ensure that field data entries are correct and complete
- Coordinating with the laboratory and quality assurance manager to ensure that data are delivered in the correct format for entry into the database, and to ensure correct and efficient entry of data qualifiers
- Preparing data summary tables for data evaluation and reporting purposes.

The contractor's field coordinator will report to the contractor's project manager and will be responsible for implementing the sampling and analysis work including:

- Coordinating and conducting sediment sampling in accordance with this QAPP

- Maintaining records of sampling and the corresponding results, maintaining sampling equipment, and ensuring proper documentation of the samples
- Directing support staff and field subcontractors (e.g., research vessel operators)
- Implementing and overseeing the health and safety program for personnel associated with the field sampling events.

1.6.1.2 Laboratory Personnel

The analytical laboratory's project manager is responsible for the successful and timely completion of sample analyses, and for performing the following tasks:

- Ensuring that samples are received and logged in correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times
- Reviewing analytical data to ensure that procedures were followed as required in this QAPP, the cited methods, and laboratory SOPs
- Keeping the contractor's laboratory coordinator and quality assurance manager apprised of the schedule and status of sample analyses and data package preparation
- Notifying the contractor's laboratory coordinator and quality assurance manager if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met
- Taking appropriate corrective action as necessary
- Reporting data and supporting quality assurance information as specified in this QAPP.

The analytical laboratory's quality assurance manager is responsible for overseeing the quality assurance activities in the laboratory and ensuring the quality of the data for this project. Specific responsibilities include the following:

- Overseeing and implementing the laboratory's quality assurance program
- Maintaining quality assurance records for each laboratory production unit
- Ensuring that QA/QC procedures are implemented as required for each method and provide oversight of QA/QC practices and procedures
- Reviewing and addressing or approving nonconformity and corrective action reports
- Coordinating response to any quality control issues that affect this project with the laboratory's project manager.

1.9 DOCUMENTS AND RECORDS

Records will be maintained documenting all activities and data related to sample collection, laboratory analyses, and data quality analyses as specified in Section 1.9 of the 2013 QAPP and this addendum.

1.9.1 Field Records

All field documentation will follow the 2013 QAPP, with the addition of a revised SOP for field logbook records described below.

1.9.1.1 Field Logbook

Additional logbook requirements and procedures, and examples of the information to be recorded, are provided in SOP AP-02 (Attachment A3). SOP AP-02 has been revised to include a required discussion of sampling positional accuracy at the start of each field day as part of the daily tailgate meeting, and positional quality assurance checks with the sampling vessel operator while in the field.

2 DATA GENERATION AND ACQUISITION

To ensure that the data collected under the specifications of this monitoring plan achieve an acceptable level of quality, the 2013 QAPP presented QA/QC procedures to be followed at all stages of sample collection and analysis. This section presents revisions to certain components of the field sampling design and methods discussed in Section 2 of the 2013 QAPP, including the specific station locations for the composite slope cap sediment samples, revised field survey and sampling methods, field quality control samples, and analytical methods.

2.1 SAMPLING DESIGN AND METHODS

2.1.1 Station Locations

This addendum section provides details for specific slope cap composite subsample locations not provided in the 2013 QAPP. All other requirements of Section 2.1.1 as listed in the 2013 QAPP continue to apply.

Composite Slope Cap Sediment Samples

Long-term monitoring includes the collection of a three-to-one composite sample of surface sediment (0–10 cm sediment horizon) from two stations on the riverbanks in the Slip 4 EAA (i.e., stations SC-2 and SC-3). Section 2.1.1 of the 2013 QAPP specified that the three-point composite samples for each location were to be collected at approximately +2, +8, and +12 ft mean lower low water (MLLW), and presented central locations for stations SC-2 and SC-3 in Table A-5 and Figure A-3. The actual locations of the subsamples contributing to the composites were to be determined during Year 1 monitoring in 2013. During post-construction confirmation sampling it was noted that sediment from the +2 ft MLLW elevation was located within the waterway cap area and did not represent slope cap material, therefore the sediment location at +2 MLLW elevation was revised to +4 MLLW during post-construction confirmation sampling (Integral 2012). Slope cap material for the three-point composite was collected from approximately +4, +8, and +12 ft MLLW during Year 1 and Year 3 long-term monitoring sampling, and will be collected at these elevations in future monitoring sampling events. Table A-5 and Figure A-3 from the 2013 QAPP are herein revised to include the target locations of these subsamples.

2.1.2 Field Survey and Sampling Methods

The field surveys, sediment sampling equipment, sampling methods, and sample handling and shipping procedures that will be used during each monitoring event are discussed in the 2013 QAPP. Addenda to visual survey and sediment sampling forms, sampling vessel contracting requirements, and sediment sample station positioning procedures are presented in this section.

2.1.2.1 Visual Survey of Cap at Low Tide

The long-term monitoring visual surveys are conducted from land at low tide to document any visible changes to the cap's integrity. The condition of the cap is recorded by taking photographs at specific vantage points, and field observations are made in conjunction with photographs to note evidence of disturbance, erosion, sedimentation, breaches in cap integrity, or other changes in the conditions of the exposed portion of the intertidal and shoreline caps (Integral 2013). The visual inspection form presented in Attachment A4 of the 2013 QAPP was revised during Year 2 monitoring to improve its ease of use in the field. The revision reorganized entries for information regarding the areas observed, and removed entries for information specific to the photographs; instead, this latter information was recorded on a new visual monitoring photo log form. Both the revised visual inspection form and photo log form are presented in Attachment A4. The coordinates provided in the photo log form reflect updated locations for stations F and I, as presented in the Year 3 long-term monitoring report (Integral 2015). All visual survey photo stations are marked in the field with rebar stakes as required by the 2013 QAPP.

2.1.2.3 Sediment Sampling Procedures

The 2013 QAPP calls for samples to be collected within ± 2 meters of the target location. During the Year 3 sampling event, three samples in the waterway cap and one subsample of a slope cap composite sample were collected at distances greater than 2 meters from their target locations. Possible explanations for this discrepancy include lack of experience on the part of the boat captain, lack of communication between the boat captain and the sampling team regarding actual sample distances from target stations and, in the case of the slope cap subsample, lack of an accurate handheld GPS location due to poor satellite alignment and signal reflection. New procedures for sample location positioning for intertidal on-foot sampling and additional requirements for vessel-based sampling have been developed to minimize the chance for navigational error during future sampling events. These changes are discussed below.

Sample Location Positioning

Slope cap and intertidal waterway cap locations were sampled on-foot during the Year 1 (2013) and Year 3 (2015) long-term monitoring sediment sampling events. To avoid potential GPS positioning error during future sampling events, sample location positioning methodology in Section 2.1.2.3 of the 2013 QAPP is revised. Each of the intertidal sampling stations will be located by a surveyor and marked with a rebar stake prior to the next sampling event. In addition, the surveyor will locate and mark at least two permanent shoreline reference locations near each set of stakes, and will document the distance between the reference locations and the stakes. During subsequent sampling efforts, distance measurements using tape measures may be used to locate the correct sampling stations if the rebar stakes cannot be located.

For samples collected from boats using vessel-based navigation, two revisions are made to the 2013 QAPP. First, the sampling team shall verbally confirm the vessel's sampling position relative to the target location with the vessel operator once the sampler is on the bottom but prior to sampler retrieval. To ensure this step is taken, the surface sediment sampling form has been revised to state the acceptable target location tolerance (±2 meters) and include documentation of this verbal confirmation step (Attachment A4). Additionally, SOP SD-04, *Surface Sediment Sampling*, has been revised to require that confirmation of a grab sample location's distance from the target is to be made with the vessel operator upon deployment of the sampler to the bottom, prior to sampler retrieval. The revised SOP SD-04 is included in Attachment A3.

The second revision to the 2013 QAPP regarding vessel-based navigation is the requirement that contracts with sampling vessels to perform sediment sampling shall require that samples are collected within ±2 meters of target station coordinates.

Slope Cap Sediment Sample Collection

As mentioned in Section 2.1.1 above, the target elevations of subsamples contributing to the two slope cap sediment samples has been revised from approximately +2, +8, and +12 ft MLLW to approximately +4, +8, and +12 ft MLLW. The target locations of these subsamples are shown in the revised Table A-5 and Figure A-3 presented in this QAPP addendum.

2.1.3 Field Quality Control Samples

The 2013 QAPP included the use of temperature blanks as field quality control samples to verify the temperature of the samples upon receipt at the testing laboratory. It is increasingly common for laboratories to use an infrared thermometer gun to determine sample temperature upon delivery. Either method is acceptable. The contractor's quality assurance manager is responsible for determining, prior to field mobilization, how temperature will be evaluated upon sample receipt at the laboratory. If required, the temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. At least one temperature blank will be placed in each sample cooler shipped to the testing laboratory.

2.3 LABORATORY ANALYTICAL METHODS

Sediment samples collected during Year 1 and Year 3 monitoring were analyzed for total solids in accordance with Standard Method 2540G (SM2540G; APHA et al. 1997) rather than the PSEP method (USEPA 1986) referenced in Section 2.3 and Table A-1 of the 2013 QAPP. The explanation from the laboratory was that the SM2540-G method and PSEP method are identical and interchangeable. The laboratory used in Years 1 and 3 defaulted to the SM2540-G method for which they are accredited. Both methods utilize a drying temperature of 103˚C, and are considered comparable for the determination of total solids in sediments; thus, the deviation did not adversely impact the quality or representativeness of the total solids results. Table A-1 is herein revised to allow use of either method for total solids analysis.

Table A-1 has also been revised to note that the MDLs and MRLs listed in the table are laboratory-specific. The information in this table will be revised as needed via a QAPP addendum if a different laboratory is selected. Any required addenda will be submitted for EPA approval at least three months prior to any future sampling events.

5 REFERENCES

APHA et al. 1997. Standard Method 2540G. Total, Fixed, and Volatile Solids in Solid and Semisolid Samples. Standard Methods for the Examination of Water & Wastewater. American Public Health Association.

Integral. 2012. Lower Duwamish Waterway Slip 4 Early Action Area: Removal Action Completion Report. Prepared for the City of Seattle. Integral Consulting Inc., Seattle, WA. July 26.

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Integral. 2015. Lower Duwamish Waterway Slip 4 Early Action Area: Long-Term Monitoring Data Report Year 3 (2015). Prepared for the City of Seattle. Integral Consulting Inc., Seattle, WA. In preparation.

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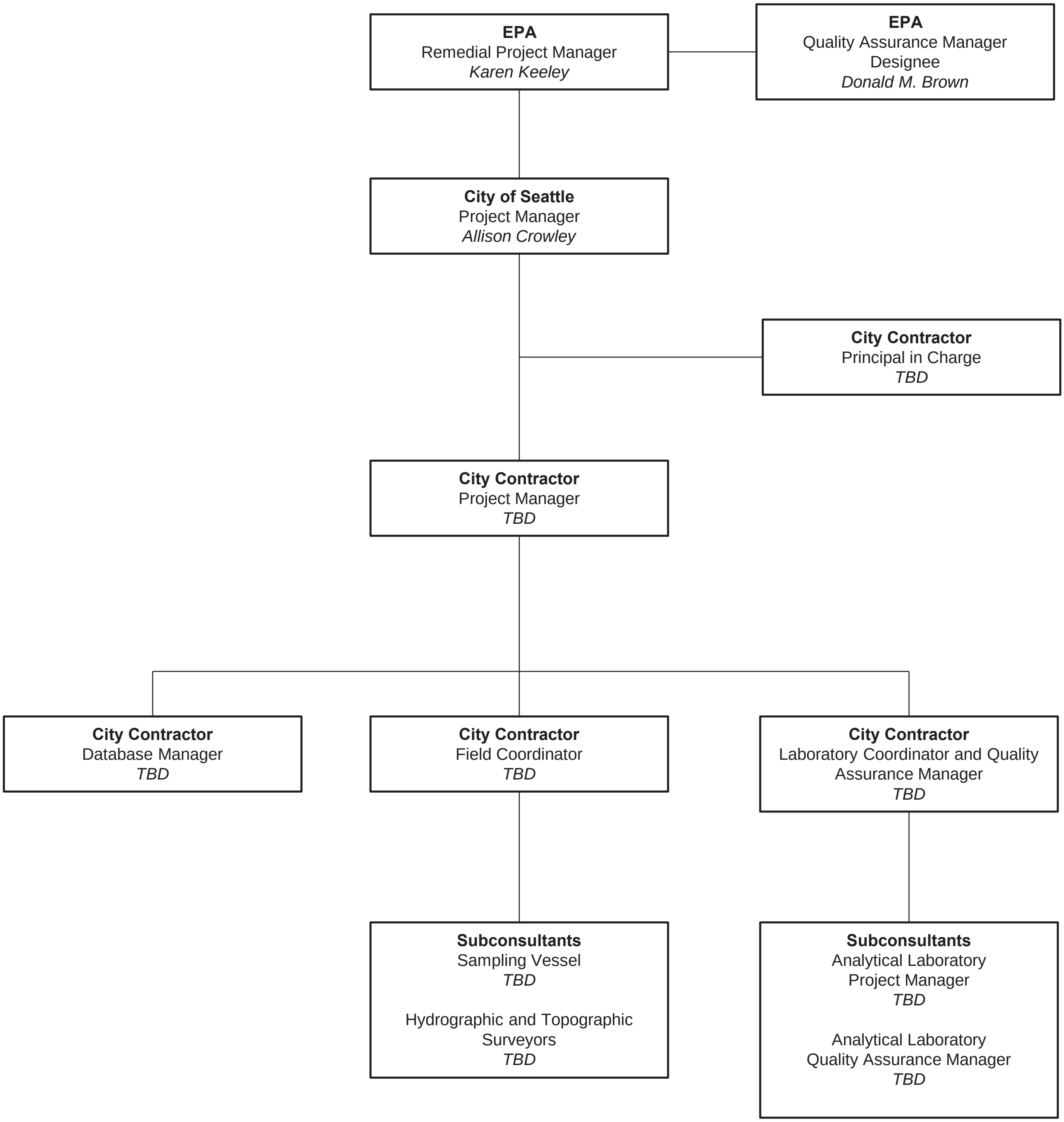
USEPA. 1986. Puget Sound Estuary Program: Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Final Report. Prepared for U.S. EPA, Region 10, Office of Puget Sound, Seattle, WA and the U.S. Army Corps of Engineers, Seattle District, Seattle, WA. Tetra Tech, Inc., Bellevue, WA.

USEPA. 1997. Recommended Guidelines for Measuring Organic Compounds in Puget Sound Water, Sediment, and Tissue Samples. In: Recommended protocols for measuring selected environmental variables in Puget Sound. U.S. Environmental Protection Agency, Puget Sound Estuary Program, Seattle WA.

USEPA. 2012. Guidance on Quality Assurance Project Plans. COI 2106-G-05 QAPP. U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC.

Windward. 2004. Data Report: Survey and Sampling of Lower Duwamish Waterway Seeps. Prepared for Lower Duwamish Waterway Group for submittal to U.S. Environmental Protection Agency and Washington State Department of Ecology. Windward Environmental LLC, Seattle, WA.

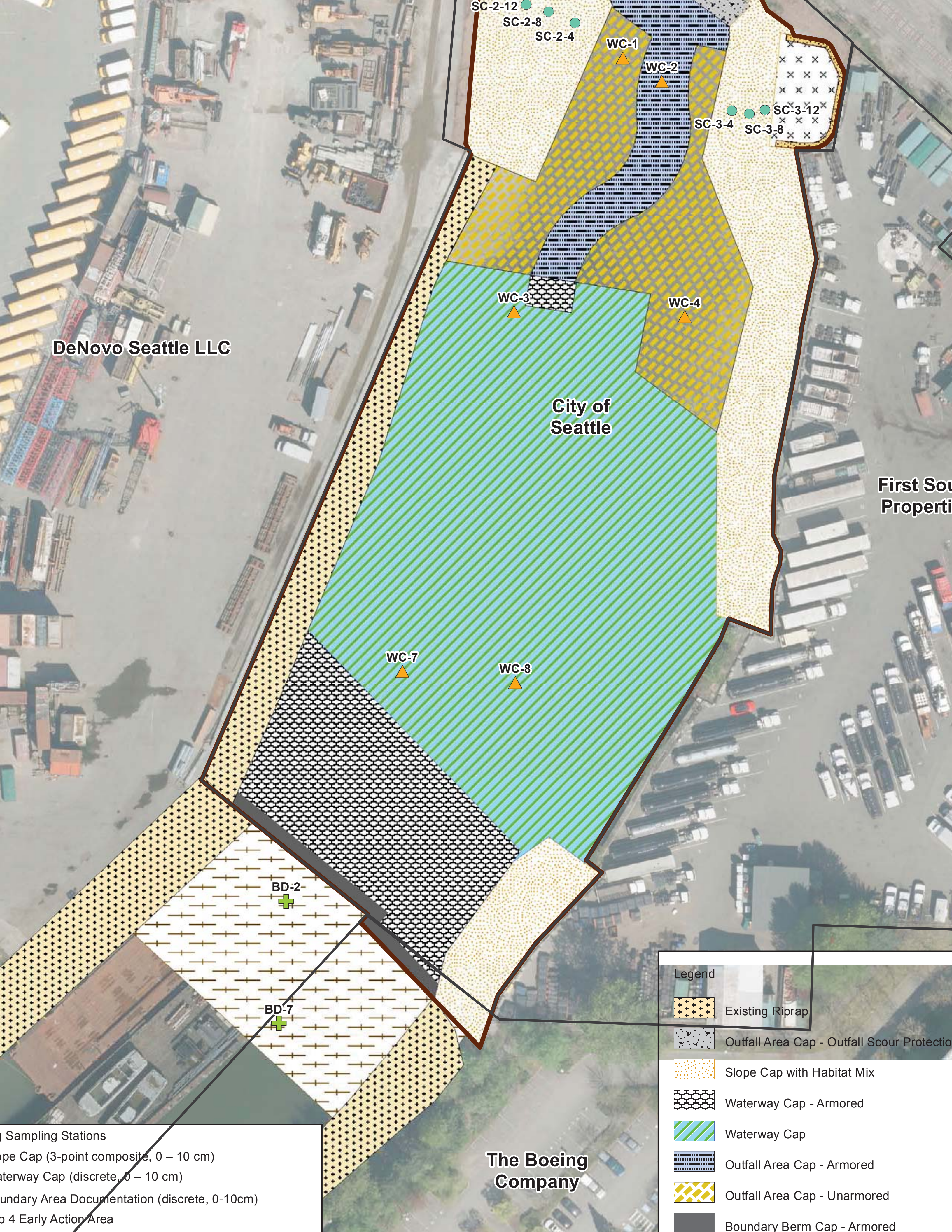
FIGURES



TBD = To be determined. Specific names and qualifications of these personnel will be submitted to the U.S. Environmental Protection Agency (EPA) under separate cover at least three months prior to initiating annual monitoring work.

integral consulting inc

Figure A-1.
Project Organization Chart


SC-2-12
SC-2-8
SC-2-4
WC-1
WC-2
SC-3-12
SC-3-4
SC-3-8
WC-3
WC-4
DeNovo Seattle LLC
City of Seattle
First Sou
Properti
WC-7
WC-8
BD-2
BD-7
The Boeing Company
g Sampling Stations
ope Cap (3-point composite, 0 – 10 cm)
aterway Cap (discrete, 0 – 10 cm)
undary Area Documentation (discrete, 0-10cm)
o 4 Early Action Area
Legend
Existing Riprap
Outfall Area Cap - Outfall Scour Protectio
Slope Cap with Habitat Mix
Waterway Cap - Armored
Waterway Cap
Outfall Area Cap - Armored
Outfall Area Cap - Unarmored
Boundary Berm Cap - Armored

TABLES

able A-1. Target Analytes, Methods, and Method Reporting Limits for Sediment Samples

Analyte	Sample Preparation Method	Sample Cleanup Method[a]	Analysis Method	MDL[b]	MRL[b]
Conventional Analytes					
Total solids	--	--	PSEP (USEPA 1986) or SM2540G (APHA et al. 1997)	--	0.01%
Grain size	--	--	PSEP (USEPA 1986)	--	0.1%
TOC (% dry weight)	--	--	Plumb (1981)	0.018	0.02
Metals (mg/kg-dry weight)					
Arsenic	EPA 3050	--	EPA 6010B	0.78	5.0
Cadmium	EPA 3050	--	EPA 6010B	0.04	0.2
Chromium	EPA 3050	--	EPA 6010B	0.09	0.5
Copper	EPA 3050	--	EPA 6010B	0.06	0.2
Lead	EPA 3050	--	EPA 6010B	0.11	2.0
Mercury	EPA 7471A	--	EPA 7471A	0.003	0.05
Silver	EPA 3050	--	EPA 6010B	0.04	0.3
Zinc	EPA 3050	--	EPA 6010B	0.34	0.6
PCB Aroclors (µg/kg-dry weight)	EPA 3550B-modified	EPA 3660B (sulfur) optional[c] EPA 3665A (acid) optional[c]	GC/ECD (EPA 8082)[d]	0.967	4.0
Semivolatile Organic Compounds (µg/kg-dry weight)					
Benz[a]anthracene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	3.29	20
Benzo[a]pyrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	5.45	20
Benzo[ghi]perylene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	4.40	20
Benzo[b+j+k]fluoranthene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	6.67	40
Chrysene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	3.75	20
Dibenz[a,h]anthracene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	4.31	20
Fluoranthene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	2.91	20
Indeno[1,2,3-cd]pyrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	4.68	20
Pyrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	1.94	20
Total HPAH	--	--	Calculation	--	--
Phenanthrene	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	3.64	20
Benzoic acid	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	89.00	200
Benzyl alcohol	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	14.70	20
Bis[2-ethylhexyl]phthalate	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	14.6	25

able A-1. Target Analytes, Methods, and Method Reporting Limits for Sediment Samples

Analyte	Sample Preparation Method	Sample Cleanup Method[a]	Analysis Method	MDL[b]	MRL[b]
Butyl benzyl phthalate	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	6.14	20[e]
Di-*n*-octyl phthalate	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	5.84	20
N-nitrosodiphenylamine	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	14.1	100[e]
Phenol	EPA 3550B	EPA 3640A	EPA 8270C - PSEP (USEPA 1997)	8.65	20

otes:
 = not applicable
PA = U.S. Environmental Protection Agency
C/ECD = gas chromatography/electron capture detection
PAH = high molecular weight polycyclic aromatic hydrocarbon
DL = method detection limit
RL = method reporting limit
CB = polychlorinated biphenyl
SEP = Puget Sound Estuary Program
QS = sediment quality standards
OC = total organic carbon

Gel permeation chromatography is required for organics analyses under PSEP. Additional cleanups will be used as required to meet MRLs.

The MDLs and MRLs listed in this table are specific to Analytical Resources, Inc. in Tukwila, Washington. The information in this table will be revised via a QAPP addendum if a fferent laboratory is selected.

The need for cleanup to be based on screens and the color of extracts (Windward 2004).

f more than one Aroclor is detected in a sample, the laboratory will choose unique peaks to quantitate each individual Aroclor (i.e., a peak can only be used in the quantitation of one roclor; Windward 2004).

For selected analytes, method reporting limits of nondetects may exceed carbon normalized SQS values when sample TOC content is between 0.5% and 1.0%. These are butyl enzyl phthalate and N-nitrosodiphenylamine.

Table A-5. Station Coordinates for Slip 4 Early Action Area Long-Term Monitoring

Station Identification[a]	Northing[b]	Easting[b]	Cap Thickness and Material Type
Boundary Area Documentation[c]			
BD-2	198871.43	1273256.97	NA
BD-7	198792.66	1273252.33	NA
Slope Cap[d,e]			
SC-2			24–33 in. slope cap and habitat mix
SC-2-4	199437.24	1273443.05	
SC-2-8	199444.40	1273426.03	
SC-2-12	199449.10	1273411.69	
SC-3			24–33 in. slope cap and habitat mix
SC-3-4	199380.61	1273544.05	
SC-3-8	199378.60	1273555.46	
SC-3-12	199381.17	1273565.44	
Waterway Cap[f]			
WC-1[e]	199414.43	1273474.09	30–54 in. unarmored outfall area cap
WC-2[e]	199399.42	1273499.06	30–54 in. armored outfall area cap
WC-3	199251.02	1273403.73	30 in. waterway cap
WC-4[e]	199247.87	1273513.70	30–54 in. unarmored outfall area cap
WC-7	199019.44	1273332.04	30 in. waterway cap
WC-8	199012.05	1273404.64	60 in. waterway cap

Notes:

NA = not applicable

[a] See Figure A-3.

[b] Washington state plane coordinate system, north zone (NAD-83/91), U.S. feet.

[c] Boundary area documentation samples are part of Year 1 (2013) monitoring only.

[d] Three-point composite sample collected at +4, +8, and +12 ft mean lower low water, 0–10 cm horizon. Target coordinates are the actual sampling locations from Year 1 (2013) monitoring.

[e] These intertidal stations were sampled on foot during Year 1 (2013) and Year 3 (2015) monitoring events.

[f] Discrete sample, 0–10 cm horizon.

ATTACHMENT A3

REVISED STANDARD OPERATING PROCEDURES

-SOP AP-02 FIELD DOCUMENTATION
-SOP SD-04 SURFACE SEDIMENT SAMPLING

STANDARD OPERATING PROCEDURE (SOP) AP-02

FIELD DOCUMENTATION

SCOPE AND APPLICATION

This SOP describes the procedure for accurate record-keeping in the field for the purposes of ensuring that samples can be traced from collection to final disposition.

Document all information relevant to field operations properly to ensure that activities are accounted for in written records to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. Several types of field documents are used for this purpose and should be consistently used by field personnel. Field documentation should include only a factual description of site-related activities and observations. Field personnel should not include superfluous comments or speculation regarding the field activities or observations.

FIELD LOGBOOKS

During field sampling events, field logbooks must be used to record all daily activities. The purpose of the field logbook is to document events and record data measured in the field to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. The project manager (or designee) should issue a field logbook to the appropriate site personnel for the direction of onsite activities (e.g., reconnaissance survey team leader, sampling team leader). It is this designee's responsibility to maintain the site logbook while it is in his or her possession and return it to the project manager or turn it over to another field team.

Make entries in the field logbook as follows:

1. Document all daily field activities in indelible ink in the logbook and make no erasures. Make corrections with a single line-out deletion, followed by the author's initials and the date. The author must initial and date each page of the field logbook. The author must sign and date the last page at the end of each day, and draw a line through any blank space remaining on the page below the last entry.

2. Write the project name, dates of the field work, site name and location (city and state), and job number on the cover of the field logbook. If more than one logbook is used during a single sampling event, then annotate the upper right-hand corner of the logbook (e.g., Volume 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Secure all field logbooks when not in use in the field. The following is a list of the types of information that is appropriate for entry in the field notebook:

   – Project start date and end date
   – Date and time of entry (24-hour clock)
   – Time and duration of daily sampling activities
   – Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, rain, thunder, wave action, current, tide, vessel traffic, air and water temperature, thickness of ice if present)
   – Topics of daily "tailgate" meetings prior to the beginning of field work each day; tailgate meetings with the field crew including the vessel operator must include project-specific positional accuracy for sampling (required)
   – Name and affiliation of person making entries and other field personnel and their duties, including what times they are present
   – The location and description of the work area, including sketches, map references, and photograph log, if appropriate
   – Level of personal protection being used
   – Onsite visitors (names and affiliations), if any, including what times they are present
   – The name, agency, and telephone number of any field contacts
   – Notation of the coordinate system used to determine the station location
   – Required documentation of quality assurance check of station positioning within the accuracy tolerance stated in the quality assurance project plan, including verbal confirmation with vessel navigator in the case of vessel-based sampling
   – The sample identifier and analysis code for each sample to be submitted for laboratory analysis, if not included on separate field data sheets
   – All field measurements made (or reference to specific field data sheets used for this purpose), including the time of collection and the date of calibration, if appropriate
   – The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates, if not included on separate field data sheets
   – For aquatic sampling, the type of vessel used (e.g., size, power, type of engine)

- Specific information on each type of sampling activity
- The sample type (e.g., groundwater, soil, surface sediment), sample number, sample tag number, and any preservatives used, if not included on separate field data sheets
- Sample storage methods
- Cross-references of numbers for duplicate samples
- A description of the sample (source and appearance, such as soil or sediment type, color, texture, consistency, presence of biota or debris, presence of oily sheen, changes in sample characteristics with depth, presence/location/thickness of the redox potential discontinuity layer, and odor) and penetration depth, if not included on separate field data sheets
- Estimate of length and appearance of recovered cores, if not included on separate field data sheets
- Photographs (uniquely identified) taken at the sampling location, if any
- Details of the work performed
- Variations, if any, from the project-specific sampling and analysis plan (SAP) or standard operating protocols and reasons for deviation
- Details pertaining to unusual events that might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity, control of vertical descent of the sampling equipment)
- References to other logbooks or field forms used to record information (e.g., field data sheets, health and safety log)
- Any field results not appearing on the field data sheets (if used), including station identification and location, date, and time of measurement
- Sample shipment information (e.g., shipping manifests, chain-of-custody [COC] form numbers, carrier, air bill numbers, time addresses)
- A record of quantity of investigation-derived wastes (if any) and storage and handling procedures.

3. During the field day, as listed above, record in the logbook a summary of all site activities. Provide a date and time for each entry. The information need not duplicate anything recorded in other field logbooks or field forms (e.g., site health and safety officer's logbook, calibration logbook, field data sheets), but should summarize the contents of the other logbooks and refer to the pages in these logbooks for detailed information.

4. If measurements are made at any location, record the measurements and equipment used, or refer to the logbook and page number(s) or field forms on which they are recorded. All maintenance and calibration records for equipment should be traceable through field records to the person using the instrument and to the specific piece of instrumentation itself.
5. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., groundwater monitoring form, sediment core profile form, water quality measurement form) to record the relevant sample information collected. For instructions regarding the proper identification of field data forms, sampling personnel should consult the project-specific SAP.

Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

PHOTOGRAPHS

In certain cases, photographs (print or digital) of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Ensure that photographs include a measured scale in the image, when practical. If you take photographs of sample characteristics and routine sampling activities, avoid using telephoto or wide-angle shots, because they cannot be used in enforcement proceedings. Record the following items in the field logbook for each photograph taken:

1. The photographer’s name or initials, the date, the time of the photograph, and the general direction faced (orientation)
2. A brief description of the subject and the field work shown in the picture
3. For print photographs, the sequential number of the photograph and the roll number on which it is contained
4. For digital photographs, the sequential number of the photograph, the file name, the file location, and back-up disk number (if applicable).

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all photographic materials to be developed (prints) or copied (disks). Place the prints or disks and associated negatives in the project files (at the project manager's location). Make photocopies of photo logs and any supporting documentation from the field logbooks, and place them in the project files with the prints or disks.

EQUIPMENT CALIBRATION RECORDS

Record in the field logbook all equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration. Calibrate all equipment used during the investigation daily, at a minimum, in accordance with the manufacturers' recommendations.

DISTRIBUTION OF COPIES

When the field team has returned from the sampling event, the field team leader is responsible for making sure that 1) the field documentation is scanned and placed into the project file on the portal (in a subfolder named Field under Working_Files), and 2) a copy of all field logbooks and additional field data forms is made and placed into the project file. Both the scanned copy and the hard copy will be available for general staff use.

The original field logbooks and forms will be placed in a locked file cabinet for safekeeping. The original field documentation will be filed at the project manager's office location.

SETUP OF LOCKING FILE CABINET

Place each project in its own file folder in a locking file cabinet. On the folder label, include the project name and contract number. Each project folder will include up to six kinds of files:

- Field logbook(s)
- Additional field data forms
- Photographs
- COC forms
- Acknowledgment of sample receipt forms
- Archive record form (to be completed only if samples are archived at a field storage facility or laboratory).

STANDARD OPERATING PROCEDURE (SOP) SD-04

SURFACE SEDIMENT SAMPLING

SCOPE AND APPLICATION

This SOP defines and standardizes the methods for collecting surface sediment samples from freshwater or marine environments. Surface sediments are defined as those from 0 to at most 10 cm below the sediment-water interface. The actual definition of surface sediments is typically program-specific and depends on the purpose of the study and the regulatory criteria (if any) to which the data will be compared.

This SOP utilizes and augments the procedures outlined in USEPA (1997) and ASTM (2003) guidelines. A goal of this SOP is to ensure that the highest quality, most representative data are collected, and that these data are comparable to data collected by different programs that follow the USEPA (1997) guidelines.

SUMMARY OF METHOD

Sediment samples for chemical and toxicity analysis are collected using a surface sediment sampling device (e.g., grab sampler) or hand implements (i.e., spoons, scoops, shovels, or trowels). If a sample meets acceptability guidelines, overlying water is carefully siphoned off the surface in a grab sampler, and the sediment is described in the field logbook. Depending upon the type of analysis to be performed, sediment samples for chemical analysis may be collected directly from an undisturbed surface (e.g., volatile organic compounds and sulfides), or may be homogenized using decontaminated, stainless-steel containers and utensils prior to being placed in sample jars. Sediment from several sampler casts or exposed sediment locations may also be composited and homogenized prior to being placed in sample jars.

SUPPLIES AND EQUIPMENT

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device
  - Grab sampler or box corer (see examples below in procedures for "Sediment Sample Collection")

  - Stainless-steel spoon, scoop, shovel, or trowel
- Field equipment
  - Siphoning hose
  - Stainless-steel bowls or containers
  - Stainless-steel spoons, spatulas, and/or mixer
  - Stainless-steel ruler
  - Project-specific decontamination supplies (e.g., Alconox™ detergent, 0.1 N nitric acid, methanol, hexane, distilled/deionized water)
  - Personal protective equipment for field team (e.g., rain gear, safety goggles, hard hats, nitrile gloves)
  - First aid kit
  - Cell phone
  - Camera
  - Sample containers
  - Ziploc® bags
  - Bubble wrap
  - Sample jar labels
  - Clear tape
  - Permanent markers
  - Indelible black-ink pens
  - Pencils
  - Coolers
  - Ice
- Documentation
  - Waterproof field logbook
  - Field sampling plan
  - Health and safety plan
  - Correction forms
  - Request for change forms
  - Waterproof sample description forms.

PROCEDURES

Sediment Sample Collection with a Grab Sampler

Use a sampler that obtains a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical and biological analyses. The sampler should be composed of a material such as stainless steel or aluminum, or have a noncontaminating coating such as Teflon™. Samplers capable of providing high-quality sediment samples include grab-type samplers (e.g., van Veen, Ekman, Smith-McIntyre, Young grab, Power Grab and modified-ponar grab) and box cores (Soutar, mini-Soutar, Gray-O'Hara, spade core). Some programs require a sampler that collects from a specific area (e.g., 0.1 m^2). Most sampling devices are typically a standard size; however, some non-standard sizes are available to meet the requirements of specific programs. Grab samplers, especially van Veen grab and Ekman grab, are the most commonly used samplers to collect surface sediment. Power Grab samplers are often used for programs requiring collection of sediment deeper than 10 cm (4 in.) or in areas with debris.

Depending on grab weight and water depth, use a hydraulic winch system to deploy the heavier samplers at a rate not exceeding 1 m/second to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, close the jaws slowly and bring the sampler to the deck of the vessel at a rate not exceeding 1 m/second to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, record the time, water depth, and location of sample acquisition in the field logbook. Confirm with the vessel operator that the sample location is within the project location tolerance from the target sample location (i.e., ±2 m from the target), and record the actual distance in the field logbook and sampling form. If the location is within the tolerance distance, retrieve the sampler and collect the sample.

Retrieve and secure the sampler, and carefully siphon off any overlying water. Inspect the sample to determine acceptability using the criteria detailed in USEPA (1997), except when noted in the project-specific field sampling plan. These criteria include but are not limited to the following:

- There is minimal or no excessive water leakage from the jaws of the sampler
- There is no excessive turbidity in the water overlying the sample
- The sampler is not over-penetrated
- The sediment surface appears to be intact with minimal disturbance
- There is no anthropogenic (i.e., man-made) debris in the sampler
- The program-specified penetration depths are attained.

If the sample meets acceptability criteria, record the sample collection location using a global positioning system (GPS) and enter observations onto a sample collection form or the field logbook. Depending on programmatic goals, remove the sampling interval specified in the field sampling plan. Use a decontaminated stainless-steel ruler to measure the sample collection depth (0 to 10 cm) within the sampler. To prevent possible cross-contamination, do not use sediments touching the margins of the sampler.

Take a photograph of the sediment in the grab sampler and in the stainless-steel bowl in the field. Verify that the station number or sample ID, time, and date are shown in the photograph.

Typically, sediment from a minimum of three separate casts of the sampler is composited at each station (see project-specific field sampling plan). Once the sample has been characterized, subsample the sediment for chemical and biological analyses using a decontaminated stainless-steel spoon.

Sediment Sample Collection with Hand Implements

Obtain a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical and biological analyses. Hand implements (e.g., spoons, scoops, shovels, or trowels) must be composed of stainless steel.

Approach the sampling location carefully to avoid disturbing the area of sediment to be sampled. Prior to sample collection, describe and characterize the undisturbed surface sediment in the field logbook. If necessary, expose the sediment surface by clearing an approximately 1-ft^2 area at the sampling site of any rocks greater than approximately 5 in. Remove any anthropogenic (i.e., man-made) debris and organic material on the sediment surface. Note any material removed from the sampling site in the field logbook.

Using a decontaminated, stainless-steel hand implement (i.e., spoon, scoop, shovel, or trowel), excavate the sediment to 10 cm. Place the sediment in a decontaminated stainless-steel bowl and use a decontaminated stainless-steel ruler to confirm that the correct sampling interval has been collected. If the full sample collection interval (i.e., 10 cm) has not been reached, collect additional sediment, place it in the stainless-steel bowl, and reconfirm the sampling interval. Continue this process until the full sample collection interval (0 to 10 cm) has been reached.

Take a photograph of the excavated hole from where the sediment sample was removed. Verify that the station number or sample ID, time, and date are shown in the photograph.

Sample Processing

Complete all sample collection forms, labels, custody seals, and chain-of-custody forms, and record sample information in the field logbook.

Collect samples for volatile compounds (either organics or sulfides) using a decontaminated stainless-steel spoon while sediment is still in the grab sampler or, if the sample is collected using a hand implement, in the stainless-steel bowl. Sediments for volatile analysis are not homogenized. Tightly pack the volatile organics sample jar with sediment (to eliminate obvious air pockets) and fill it so that no headspace remains in the jar. Alternatively, if there is adequate water in the sediment, fill the container to overflowing so that a convex meniscus forms at the top, and then carefully place the cap on the jar. Once sealed, the jar should contain no air bubbles.

Place the remaining sediment in the grab sampler in a precleaned, stainless-steel bowl; sediment collected using hand implements are already in a stainless-steel bowl. Once a sufficient amount of sediment has been collected, mix the sediment using a decontaminated stainless-steel spoon until it is of uniform color and texture throughout.

If required for analysis, collect samples for grain-size tests before any large rocks are removed from the homogenized sediment. Identify any rocks that are greater than 0.5 in. in diameter. Determine their percentage contribution to the homogenized sediment volume, note it on the sediment field collection form or in the field logbook, and then discard the rocks.

Dispense the sediment into precleaned sample jars for the various chemical or biological analyses. For toxicity testing, fill sample jars to the top with sediment to minimize available headspace. This procedure will minimize any oxidation reactions within the sediment. For chemical analysis, sample containers may be frozen for storage. Leave enough headspace to allow for sediment expansion.

After dispensing the sediment, place the containers into coolers with ice and either ship them directly to the analytical laboratories or transport them to a storage facility.

REFERENCES

ASTM. 2003. *Standard Practice for Collecting Benthic Macroinvertebrates with Ekman Grab Sampler*. ASTM Standards on Disc, Volume 11.05.

USEPA. 1997. Recommended protocols for sampling marine sediment, water column, and tissue in Puget Sound. Prepared for Puget Sound Estuary Program, U.S. Environmental Protection Agency, Seattle, WA, and Puget Sound Water Quality Action Team, Olympia, WA. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

Attachment A4

Revised Field Forms

- Visual Inspection Form
- Visual Inspection Photo Log
- Surface Sediment Collection Form

SLIP 4 EARLY ACTION AREA VISUAL INSPECTION FORM

Project Name: ____________________ **Project No.:** ____________ **Pg.** ___**of** ___

Date: ______________ **Weather:** ____________________

Crew: ____________________

Area Observed: ____________________ **Time:** ________

Substrate Classification: ☐ cobble ☐ gravel ☐ sand [coarse / medium / fine] ☐ silt / clay ☐ organic matter ☐ wood/shell fragments

Estimated thickness of fine sediment deposit: ____________________

Stratification: ____________________

Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface ☐ other ____________

Evidence of Pollution (sheen, etc.): ____________________

Organic matter accumulation (e.g., leaf litter, logs, woody debris): ____________________

Presence/description of debris/litter/garbage: ____________________

Assessment of the re-establishment of intertidal aquatic habitat: ____________________

Observations of wildlife use (including avifauna and macroinvertebrates): ____________________

Observations of cap disturbance / erosion / changed conditions: ____________________

Assessment of the cap integrity: ____________________

Other observations /Notes: ____________________

Observer:

Area Observed: ____________________ **Time:** ________

Substrate Classification: ☐ cobble ☐ gravel ☐ sand [coarse / medium / fine] ☐ silt / clay ☐ organic matter ☐ wood/shell fragments

Estimated thickness of fine sediment deposit: ____________________

Stratification: ____________________

Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface ☐ other ____________

Evidence of Pollution (sheen, etc.): ____________________

Organic matter accumulation (e.g., leaf litter, logs, woody debris): ____________________

Presence/description of debris/litter/garbage: ____________________

Assessment of the re-establishment of intertidal aquatic habitat: ____________________

Observations of wildlife use (including avifauna and macroinvertebrates): ____________________

Observations of cap disturbance / erosion / changed conditions: ____________________

Assessment of the cap integrity: ____________________

Other observations /Notes: ____________________

Observer:

Slip 4 Early Action Area Visual Inspection Photo Log

Date: **Photographer:** **Equipment:**

Photo Station ID	Target Coordinates Northing[a]	Target Coordinates Easting[a]	Marker Type/ Condition	Target Photo Orientation (True North)	Actual Photo Orientation	Photo ID	Photo Numbers	Photo Time	Photo Target Area Description	Notes
A	199125[b]	1273323[b]		55°		A1			East-Central Sediment Cap	
B	199292	1273396		48° □		B1			North Sediment Cap	
C	199499	1273484		178°		C1			Northwest Slope Cap, South Sediment Cap	
				217°		C2			Northwest Slope Cap	
D	199432	1273403		24°		D1			Northwest Beach/Anchored Logs	
E	199486	1273441		102°		E1			North Slope Cap, Outfalls	
				144°		E2			Northeast Slope Cap, North Rip Rap Slough	
F	199338	1273418		133°		F1			East Slope Cap, East Sediment Cap, Central Riprap Slough	
				160°		F2			Southeast Slope and Sediment Cap	
G	199355	1273491		200°		G1			South Riprap Slough	
				27°		G2			North Riprap Slough, Sediment Cap, North Slope Cap	
				0-360°		G3			Entire Slip 4 Early Action Area	
H	199378	1273570		306°		H1			Northwest Slope Cap, Beach Cap, Sediment Cap	
I	199177	1273570		278°		I1			West Sediment Cap	
J	199002[b]	1273268[b]		130°		J1			Southeast Slope Cap	

Notes:
[a] Washington state plane coordinate system, north zone (NAD-83/91), U.S. feet.
[b] These coordinates are approximate; the stations were relocated close to the upland sheetpile bulkhead during Year 1 (2013) monitoring to allow for on-foot access. The locations are marked with rebar stakes and marking paint on the sheetpile wall.

SLIP 4 EARLY ACTION AREA SURFACE SEDIMENT COLLECTION FORM

Project Name: ____________________ **Project No.:** __________ pg ___of_____
Date: ____________ **Crew:** ____________________
Weather: ____________________
Sampling Method: ____________________

Time: __________ **Station:** __________ **Replicate:** __________ **Acceptable Grab:** ☐ Yes ☐ No
Target Coordinates: ____________________
Actual "On Bottom" Coordinates: ____________________
Distance from Target Station: ____________________ **(Tolerance is +/- 2 meters)**
Bottom Depth:__________ **Penetration Depth:** ______(cm) **Photo ID:** __________
Fines Overlying Cap Material: ☐ Yes ☐ No **Fines Thickness:** ______(cm)
Sample ID: ____________________
Type: ☐ cobble ☐ gravel ☐ sand [coarse / medium / fine] ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface **Redox Discontinuity Depth:** ______(cm)
Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other
Comments/Description:

Time: __________ **Station:** __________ **Replicate:** __________ **Acceptable Grab:** ☐ Yes ☐ No
Target Coordinates: ____________________
Actual "On Bottom" Coordinates: ____________________
Distance from Target Station: ____________________ **(Tolerance is +/- 2 meters)**
Bottom Depth:__________ **Penetration Depth:** ______(cm) **Photo ID:** __________
Fines Overlying Cap Material: ☐ Yes ☐ No **Fines Thickness:** ______(cm)
Sample ID: ____________________
Type: ☐ cobble ☐ gravel ☐ sand [coarse / medium / fine] ☐ silt clay ☐ organic matter ☐ wood/shell fragments
Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface **Redox Discontinuity Depth:** ______(cm)
Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other
Comments/Description: