Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

PRE-DESIGN INVESTIGATION QUALITY ASSURANCE PROJECT PLAN ADDENDUM NO. 3 FOR THE LOWER DUWAMISH WATERWAY MIDDLE REACH – PHASE III SAMPLING

FINAL

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

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FINAL

TITLE AND APPROVAL PAGE

Remedial Design of Middle Reach
Pre-Design Investigation Quality Assurance Plan
Addendum for Phase III Sampling

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ACRONYMS AND ABBREVIATIONS

BBP	butyl benzyl phthalate
cm	centimeter
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
D-tape	diameter tape
DQO	data quality objective
DSH	diameter at standard height
Ecology	Washington State Department of Ecology
EF	exceedance factor
EGL	Environmental Geochemistry Laboratory
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
FNC	Federal Navigation Channel
g	gram
ID	identification
LDW	Lower Duwamish Waterway
MLLW	mean lower low water
MNR	monitored natural recovery
NWI	National Wetlands Inventory
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	Pre-Design Investigation
PM	project manager
QAPP	quality assurance project plan
QA	quality assessment
QC	quality control
RAA	remedial action area
RAL	remedial action level
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
RM	river mile
ROD	Record of Decision
SCO	sediment cleanup objective
SMA	sediment management area
SOP	standard operating procedure

Spheros	Spheros Environmental
SPT	standard penetration test
SVOC	semivolatile organic compound
TCLP	toxicity characteristic leaching procedure
VHG	vertical hydraulic gradient
WAC	Washington Administrative Code

1 Introduction

This document is the third addendum to the Pre-Design Investigation (PDI) quality assurance project plan (QAPP) for the middle reach of the Lower Duwamish Waterway (LDW), which includes the area from river mile (RM) 1.6 to RM 3.0 (Map 1-1) (Windward and Anchor QEA 2022). This work supports remedial design (RD) for the middle reach per the Fifth Amendment to the Administrative Order on Consent for the LDW (EPA 2021a), in accordance with the U.S. Environmental Protection Agency's (EPA's) November 2014 Record of Decision (ROD) (EPA 2014).

This QAPP addendum presents a detailed study design for PDI Phase III sediment sampling within the middle reach (Section 4), including sampling locations, intervals, and analytes, as well as updates to laboratory analysis methods and reporting requirements. This QAPP addendum also describes additional engineering data needs (Section 5). In addition, Appendix D of this QAPP addendum covers data gaps and sampling to be conducted for sediment management area (SMA) 10 in the upper reach. At the time of the final (100%) RD for the LDW upper reach (Anchor QEA and Windward 2024a), SMA 10 was deferred to a later stage in the overall Superfund site cleanup for design and construction; this deferment was due to EPA's determination that sources were not sufficiently controlled, based on the Washington State Department of Ecology's (Ecology's) source control evaluation.

All aspects of PDI sampling not addressed herein are the same as those specified in the middle reach PDI QAPP (Windward and Anchor QEA 2022) or the Phase II PDI QAPP Addenda (Anchor QEA and Windward 2024b, c) and are not repeated in this document. Table 1-1 provides an overview of key information provided in the original PDI QAPP, as well as key updates provided in each QAPP Addendum.

Table 1-1
Overview of Middle Reach PDI QAPP and QAPP Addenda

Section[1]	Key Information and Updates Provided by QAPP or QAPP Addendum (Date Finalized)			
	PDI QAPP (October 2022)	**PDI QAPP Addendum No. 1 (June 2024)**	**PDI QAPP Addendum No. 2 (June 2024)**	**PDI QAPP Addendum No. 3 (TBD; Spring 2026)**
2 – Project Objectives and Description	• PDI DQOs • Project description and schedule	Update on DQO status and schedule after Phase I PDI	None	Update on DQO status after Phase II PDI and 30% RD
3 – Project Organization and Responsibilities	• Project organizational chart • Description of key roles and responsibilities	Updates to key personnel and laboratories	None	Updates to key personnel and laboratories
4 – Data Generation and Acquisition of Sediment and Bank-area Sediment Samples	• Sampling design for Phase I PDI (including understructure areas) • Sediment sampling methods, processing, and handling • Laboratory methods and sample analysis details	• Sampling design for Phase II PDI (including toxicity testing) • Minor updates regarding sample collection/processing, analysis, and sample chemistry QA/QC • Updates to processes regarding field-generated waste disposal	Sampling design for Inlet at RM 2.2W	• Identification of Phase III PDI samples to fill data gaps for RAL exceedance areas • Minor updates regarding sample analysis
5 – Data Generation and Acquisition of Engineering PDI Elements	Sampling design and methods for the following Phase I engineering data elements: • Bank inspections/surveys • Structure inspections • Geotechnical investigation • Specialized survey	Sampling design and methods for the following Phase II engineering data elements: • Topographic survey and bank features • Geotechnical investigation details • Approach for gathering other engineering data (i.e., structure inspection and sediment thickness)	Sampling design and methods for the following engineering data elements for the Inlet at RM 2.2W (same items as for QAPP Addendum No. 1)	Identification of data gaps and methods for the following Phase III engineering data elements: • Geotechnical investigations • Surveys/inspections • Waste characterization • Cap design • Water quality evaluations • Sheen testing • Precipitate layer (Inlet at RM 2.2W)
6 – Data Validation and Usability	Data validation process	None	None	None
7 – Assessment and Oversight	• Compliance assessments and response actions • Details regarding reporting	Information regarding reporting for Phase II data	None	Information regarding reporting for Phase III data

Notes:

1. Table is organized based on the sections in the original middle reach PDI QAPP (Windward and Anchor QEA 2022).
DQO: data quality objective
PDI: Pre-Design Investigation
QAPP: quality assurance project plan
QA/QC: quality assurance/quality control
RAL: remedial action level
RD: remedial design
RM: river mile

The remainder of this QAPP Addendum is organized as follows:

- Section 2 – Project Objectives and Description
- Section 3 – Project Organization and Responsibilities
- Section 4 – Data Generation and Acquisition for Sediment and Bank Analytical Samples
- Section 5 – Data Generation and Acquisition of Engineering PDI Elements
- Section 6 – Assessment and Oversight
- Section 7 – References

In addition, this QAPP Addendum is supported by the following appendices:

- Appendix A – Updated Analytical Methods, DQIs, and Requirements
- Appendix B – Phase III Sampling Location Details
- Appendix C – Updated Standard Operating Procedures
- Appendix D – Data Generation and Acquisition for SMA 10
- Appendix E – Updated Site-specific Dive Safety and Work Plan
- Appendix F – Updated Field Forms
- Appendix G – Tier 2b and Tier 2c Memoranda

2 Project Objectives and Description

2.1 Data Quality Objectives

Phase III sampling is being conducted to address data gaps remaining after the Phases I and II PDI sampling. Phase I and II results, as well as the initial identification of Phase III data gaps, were presented in the PDI data evaluation report (Anchor QEA and Windward 2025a).

Middle reach PDI data quality objectives (DQOs) for Phases I and II, including components consistent with EPA's DQO process (EPA 2006), are provided in the PDI QAPP (Windward and Anchor QEA 2022). Table 2-1 summarizes the status of each DQO from Phases I and II using the following categories:

- DQO has been met – Indicates that sufficient data have been collected to inform the finalization of RD.
- DQO has been largely met – Indicates that most of the data needed to inform RD have been collected; however, some additional Phase III data are needed to fully inform the finalization of RD.

DQOs 1 through 8 have been fully met, and DQOs 9 through 14 have been largely met. After the completion of Phase III sampling activities, DQOs will be reviewed to confirm that all have been met (i.e., sufficient information is available to inform RD). Table 2-1 summarizes the status of each DQO and the Phase III activities planned to complete the data collection necessary to fully address DQOs 9 through 14.

Table 2-1
DQOs for Phase I and II PDI in the Middle Reach

DQO	DQO Description	DQO Status and Activities Conducted to Address DQO (Anchor QEA and Windward 2025a)	Phase III Activities to Address Remaining Data Gaps and Fully Meet DQO
DQO 1	Delineate 0–10-cm RAL exceedances in Recovery Category 2/3.	DQO was met through the Phase I collection and chemical analysis of 259 surface sediment (0–10-cm) samples (as well as Phase II samples identified under DQO 10).	None
DQO 2	Delineate 0–10-cm RAL exceedances in Recovery Category 1.		
DQO 3	Delineate 0–45-cm intertidal RAL exceedances in Recovery Category 2/3.	DQO was met through the Phase I collection and chemical analysis of 69 subsurface intertidal sediment (0–45-cm) samples (as well as Phase II samples identified under DQO 10).	None
DQO 4	Delineate 0–45-cm intertidal RAL exceedances in Recovery Category 1.		
DQO 5	Delineate 0–60-cm PCB RAL exceedances in potential vessel scour areas in Recovery Category 2/3	DQO was met through the Phase I collection and chemical analysis of 129 subsurface subtidal sediment (0–60-cm) samples (as well as Phase II samples identified under DQO 10).	None
DQO 6	Delineate 0–60-cm RAL exceedances in Recovery Category 1		
DQO 7	Delineate RAL exceedances in shoaling areas	DQO was met through the Phase I collection and chemical analysis of 62 shoaling interval samples from 39 locations.	None
DQO 8	Conduct a visual inspection of the banks in the middle reach to identify features relevant to design, such as the presence/absence of bank armoring, and to plan how to access banks and areas under structures for sampling purposes.	DQO was met through the Phase I visual bank inspection conducted in June 2023 and the visual structures inspection conducted in August 2023 throughout the middle reach.	None
DQO 9	If feasible, delineate RAL exceedances in areas under over-water structures	DQO was largely met using Phase I and II surface and subsurface sediment samples from 30 under-structure locations.	Conduct Phase III sampling at locations under or adjacent to overwater structures to improve delineation of RAL exceedances in select areas and reduce interpolation uncertainty.

DQO	DQO Description	DQO Status and Activities Conducted to Address DQO (Anchor QEA and Windward 2025a)	Phase III Activities to Address Remaining Data Gaps and Fully Meet DQO
DQO 10	Further delineate RAL exceedances, as needed for unbounded areas	DQO was largely met using further Phase II samples for horizonal delineation of RAL exceedance areas, including: 140 surface sediment samples (0–10 cm), 91 intertidal subsurface samples (0–45 cm), 52 subtidal subsurface samples (0–60 cm), and 22 shoaling interval samples at 12 locations.	Conduct Phase III sampling at locations (including in bank areas) to improve delineation of RAL exceedances in select areas and reduce interpolation uncertainty.
DQO 11	Assess chemical and physical characteristics of banks (including topographic survey), as needed, depending on remedial technology selected for adjacent sediment and whether bank is erosional.	DQO was largely met through Phase II topographic surveying to obtain elevation data and define bank features within Phase I RAL exceedance areas.	Phase III topographic and outfall location data will also be collected. Additional topographic surveying will be needed where data collected using the photogrammetric method were obscured by dense vegetation.
DQO 12	Delineate vertical elevation of RAL exceedances in dredge (and partial dredge and cap) areas and collect subsurface sediment chemistry data in cap areas where contamination under caps will remain	DQO was largely met through Phase II collection and analysis of 1,507 vertical extent samples collected among 197 locations.	Conduct Phase III sampling at locations to improve delineation of vertical extent of contamination in select areas where additional information is needed for RD.
DQO 13	Collect geotechnical data as needed depending on technology proposed and/or physical characteristics of RAL exceedance areas.	DQO was largely met through Phase II geotechnical investigations at 42 locations.[1]	Conduct Phase III geotechnical investigations at select locations where data is needed for RD. Investigations will include upland and in-water borings, as well as vane shear testing.

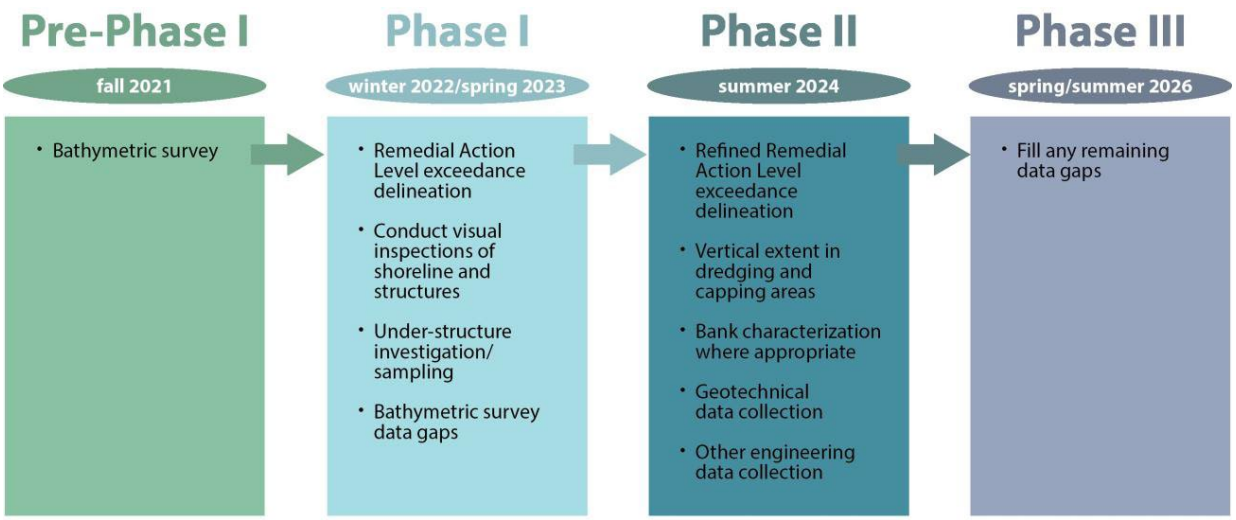
DQO	DQO Description	DQO Status and Activities Conducted to Address DQO (Anchor QEA and Windward 2025a)	Phase III Activities to Address Remaining Data Gaps and Fully Meet DQO
DQO 14	Collect other engineering-applicable data as needed (e.g., structures inspection, utility location verification, thickness of sediment on top of riprap layers, groundwater velocities).	DQO was largely met during Phase I and II PDI engineering-applicable data collection efforts, including the Phase II structures and outfalls inspection, investigation of sediment thickness, assessment of vegetation extent along banks, and utility location verification.	Collect additional engineering data during Phase III at select RAAs to fully meet this DQO and provide the information needed for RD. Phase III activities will include the following: • Inspect and survey structures and outfalls that were not previously inspected. • Conduct sediment probing to delineate extents of armored slopes and other bank features. • Assess extent of vegetation along banks to inform engineering design. • Analyze archived Phase II samples for waste characterization to inform disposal options for engineering design. • Collect field data and perform laboratory testing to support cap design. • Conduct water quality elutriate testing. • Characterize the precipitate layer. • Conduct sheen testing.

Notes:
1. The data evaluation report (Anchor QEA and Windward 2025a) indicated that there were no remaining data gaps for DQO 13; however, some further geotechnical data were recommended by the design team to better inform the finalization of remedial design. DQO: data quality objective
PCB: polychlorinated biphenyl
PDI: pre-design investigation
RAA: remedial action area
RAL: remedial action level
RD: remedial design

2.2 Project Description and Schedule

Phase III sampling, as presented in this addendum, will involve the collection and chemical analysis of sediment and bank samples to further refine the delineation of remedial action level (RAL)[1] exceedances, and to further assess the vertical extent of contamination in dredging or partial dredging and capping areas to fill remaining data gaps after Phase II sampling (Figure 2-1). The results from these analyses will further refine RAL exceedance areas and subsequently, remedial action areas (RAAs) defined in preliminary 30% RD (Anchor QEA and Windward 2025b). Specifically, the Phase III results will be used to update the interpolations used to define RAL exceedance areas as part of 90% RD. The updated RAL exceedance areas will then be used to refine the RAAs developed during preliminary 30% RD. Depending on context and purpose, this document uses either RAL exceedance area numbering (i.e., in Section 4, where chemistry data gaps are discussed) or RAA numbering (i.e., in most of Section 5, where specific engineering data gaps are discussed).[2]

Figure 2-1
Design Sampling Phases



Phase III sampling will begin in May/June 2026 upon approval of this QAPP addendum. Sampling and analysis in earlier phases involved archiving some of the collected intervals for potential analysis

[1] As stated in the ROD (EPA 2014), a RAL is a contaminant concentration above which active remediation is required. RALs for the LDW are defined in ROD Table 28, titled *Remedial Action Levels, ENR Upper Limits, and Areas and Depths of Application*. EPA has updated the carcinogenic polycyclic aromatic hydrocarbon (cPAH) RALs, target tissue levels, and cleanup levels presented in ROD Table 28 in an explanation of significant differences for the LDW (EPA 2021b). The explanation of significant differences RALs are used in this addendum.

[2] As described in the preliminary (30%) RD and earlier documents, a RAL exceedances area defines the horizontal extent of contamination and is represented with numbering only. RAAs generally expand and subdivide a RAL exceedance area when engineering considerations are applied. RAAs include capital lettering when a RAL exceedance area is divided into two or more areas (e.g., RAL exceedance area 1 has been subdivided into RAAs 1A and 1B).

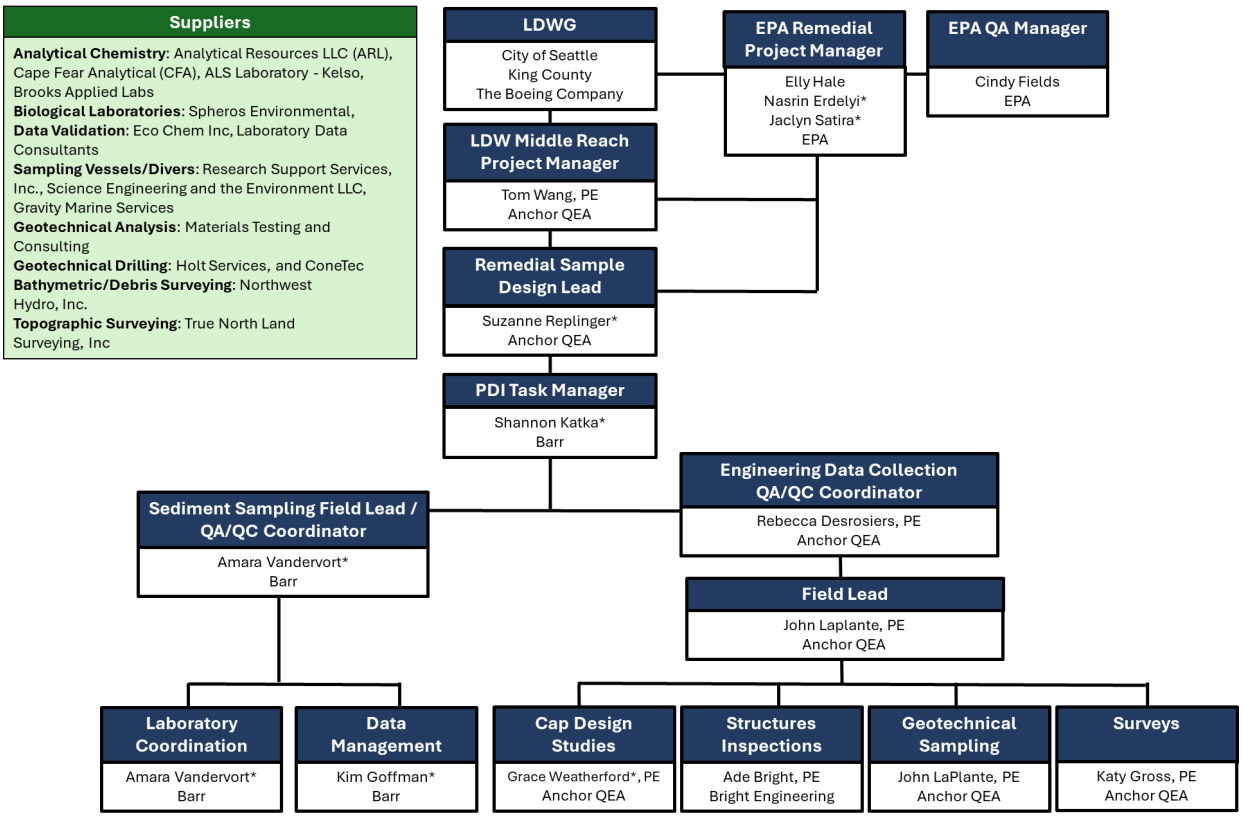
pending initial results (i.e., tiering). Sample analysis for Phase III will not be tiered; however, the analysis of some samples will be contingent on preliminary results, as described in Section 4.

3 Project Organization and Responsibilities

Details regarding overall project organization, individuals responsible for various tasks required for PDI sampling and analysis, and documentation and records keeping protocols are provided in Section 3 of the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c), except as described herein.

Figure 3-1 presents overall project organization and individuals responsible for various tasks required for PDI sampling and analysis.

Figure 3-1
Project Organization and Team Responsibilities



*Indicates individuals for which roles or contact information has changed since the PDI QAPP or Phase II QAPP.

Individuals for who roles or contact information has changed since the PDI QAPP (Windward and Anchor QEA 2022) or Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c) are noted in Figure 3-1. Two EPA project managers (PMs) for the project, Nasrin Erdelyi and Jaclyn Satira, have been added for Phase III, in addition to Elly Hale. The contact information for specific individuals has

changed relative to what was provided in the middle reach PDI QAPP (Windward and Anchor QEA 2022) or QAPP Addenda (Anchor QEA and Windward 2024b, c) for the following individuals:

- Suzanne Replinger (Anchor QEA) is the Remedial Sample Design Lead. She can be reached at sreplinger@anchorqea.com or 206.709.6850.
- Shannon Katka (Barr Engineering Co. [Barr], formerly Windward Environmental LLC) is the PDI Task Manager. She can be reached at skatka@barr.com or 206.812.5427.
- Amara Vandervort (Barr) is the Sediment Sampling Field Lead and quality assessment (QA)/Coordinator. She can be reached at avandervort@barr.com or 206.812.5415.
- Kim Goffman (Barr) is the Data Management Lead. She can be reached at kgoffman@barr.com or 206.812.5414.

The following laboratories have been updated since the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c):

- EcoAnalysts is now Spheros Environmental (Spheros). Spheros will perform Phase III biological testing. The laboratory PM at Spheros can be reached as follows:

  Ms. Michelle Knowlen
  Spheros Environmental (formerly EcoAnalysts, Inc.)
  4729 Northeast View Drive
  PO Box 216
  Port Gamble, WA 98364
  Telephone: 360.297.6040 ext 6056
  Email: michelle.knowlen@spherosenvironmental.com

- Cape Fear Analytical, LLC (CFA) was added as an analytical laboratory during Phase II and will be used for analysis of dioxins/furans for Phase III. The laboratory PM at CFA can be reached as follows:

  Ms. Cynde Larkins
  Cape Fear Analytical, LLC
  3306 Kitty Hawk Road
  Suite 120
  Wilmington, NC 28405
  Telephone: 910.795.0421
  Email: cynde.larkins@cfanalytical.com

- ALS Environmental was added as an analytical laboratory during Phase II and will be used for analysis of polycyclic aromatic hydrocarbons (PAHs) and semivolatile organic compounds (SVOCs) for Phase III. The laboratory PM at ALS Environmental can be reached as follows:

  Ms. Sydney Wolf
  ALS Environmental
  1317 13th Avenue South
  Kelso, WA 98626-2845
  Telephone: 360.501.3377
  Email: sydney.wolf@alsglobal.com

- Brooks Applied Laboratories will be used as an analytical laboratory for Phase III. The laboratory PM at Brooks Applied Laboratories can be reached as follows:

  Ms. Amy Goodall
  Brooks Applied Labs
  13751 Lake City Way NE, Suite 108
  Seattle, WA 98125-3004
  Telephone: 206.632.6206
  Email: amy@brooksapplied.com

- Geotechnical laboratory analysis for Phase III will be conducted by Materials Testing and Consulting, as described in the middle reach PDI QAPP (Windward and Anchor QEA 2022). If additional geotechnical testing support is needed, Cooper Testing Laboratory has been added as a backup geotechnical laboratory.

4 Data Generation and Acquisition for Sediment and Bank Analytical Samples

This section presents the design for Phase III sampling and sample collection identification (ID) protocols. Information regarding the following topics is presented in the middle reach PDI QAPP (Windward and Anchor QEA 2022) and/or Phase II PDI QAPP Addenda (Anchor QEA and Windward 2024b, c):

- Sample collection methods, custody, and shipping requirements
- Decontamination procedures
- Field-generated waste disposal
- Laboratory methods
- Sediment chemistry analytical DQOs and criteria and QA/quality control (QC)
- Instrument/equipment testing, inspection, maintenance, and calibration
- Analytical data management

Tables with minor revisions to laboratory methods and QA/QC requirements are provided in Appendix A.

4.1 Sampling Design

To further address DQOs 9 through 12, this section discusses the design for sediment and bank sampling, including approaches and rationale for depth intervals,[3] analytes, and sampling locations.[4] Many of these elements are consistent with those in the Phase I and II PDI sampling designs, as described in the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Phase II PDI QAPP Addenda (Anchor QEA and Windward 2024b, c).

4.1.1 Phase III Sampling Locations and Analytes

An initial identification of Phase III data gaps was presented in preliminary 30% RD for the middle reach (Anchor QEA and Windward 2025b). To determine specific locations for Phase III sampling, the following three general principles were considered to identify Phase III data needs for sediment analytical sampling in the middle reach:

- **Principle 1: Refine horizontal boundaries of RAL exceedance areas (DQOs 9 and 10)** – Where needed, collect additional sediment data around the RAL exceedance areas in RAAs defined in 30% RD (Anchor QEA and Windward 2025b). Sampling locations are based on

[3] The term "depth" is used throughout this document to refer to the depth of the samples to be collected below the mudline.
[4] Throughout this document, the term "sampling location" is used to refer to a distinct station where one or more samples may be collected. The term "sample" is used to refer to individual sediment samples collected for analysis. For example, a sampling location where a vertical extent core is collected may include more than 10 sediment samples.

improving the bounding of RAL exceedance areas and reducing uncertainty in data interpolations. This principle also includes the collection of samples in polychlorinated biphenyl (PCB) "interpolation-only" RAL exceedance areas.[5]

- **Principle 2: Bound vertical extent (DQO 12)** – Collect additional samples from locations adjacent to or within RAAs, as needed for design (e.g., dredging or partial dredging/capping areas) to determine the vertical extent of contamination where it was not bounded adequately in Phase II, or where additional coverage is needed within RAAs.
- **Principle 3: Investigate locations in "monitored natural recovery (MNR) to benthic sediment cleanup objective (SCO)" area as appropriate** – Reoccupy locations that meet the following three conditions: 1) data are 10 or more years old, 2) locations are not within 30% RAA boundaries, and 3) chemical concentrations are greater than the remedial action objective (RAO) 3 cleanup level (i.e., the benthic SCO) but less than the RAL in Recovery Category 2/3 areas.

Based on these principles, Phase III sediment sampling is proposed at 71 locations, many of which have more than 1 sampling interval. Counts by sample type are provided in Table 4-1. Of these 71 locations, 67 are related to refining the horizontal and/or vertical extent of contamination (principles 1 and 2; Section 4.1.1.1). The remaining four Phase III locations were identified to evaluate MNR to benthic SCO areas (principle 3; Section 4.1.1.2). Phase III sampling locations are shown on the Map 4-1 series;[6] different symbols are used to indicate the type(s) of samples to be collected at each location (as described in Table 4-1). Details regarding each sampling location, the sample intervals to be collected at that location, and the applicable analytes for each sample are presented in Appendix B.

Table 4-1
Summary of Phase III Middle Reach Sampling Locations

Sample Type	Count of Phase III Locations[1]	Map 4-1 Series Symbology
Surface (0–10 cm)	29	Indicated on maps by orange circles
Intertidal subsurface (0–45 cm)	13	Indicated on maps by orange pentagons (in some cases, these samples will be collected as part of a vertical extent core)

[5] PCB interpolation-only areas are those that do not contain any sampling locations with RAL exceedances but have been identified as RAL exceedance areas, because interpolated PCB concentrations exceed RALs as the interpolation crosses recovery category or shoaling area boundaries that have different RALs.

[6] Preliminary Tier 2b and Tier 2c data are presented as part of the Map 4-1 series to inform the Phase III sampling design. These data are preliminary and unvalidated. PCB interpolations and non-PCB chemical polygons used to define RAL exceedance areas have not been updated at this time (these updates will occur as part of 60% RD once validated data are available).

Sample Type	Count of Phase III Locations[1]	Map 4-1 Series Symbology
Subtidal subsurface (0–60 cm and shoaling [depths variable])	20	Indicated on maps by orange squares (in some cases, these samples will be collected as part of a vertical extent core)
Vertical extent cores	32	Indicated on maps by orange Vs

Notes:
1. Counts presented herein do not include the four archived PDI 0–10-cm samples collected near RAL exceedance area 20 (SS1166, SS1475, SS1473, and SS1474) being analyzed for dioxins/furans, nor the one 0–60-cm sample collected near RAL exceedance area 15 (SC1500) being analyzed for PCBs.

cm: centimeter
PDI: Pre-Design Investigation
PCB: polychlorinated biphenyl
RAL: remedial action level

4.1.1.1 Identification of Sampling Locations by RAL Exceedance Area for Horizontal and Vertical Delineation

For each RAL exceedance area, data needs related to horizontal and vertical delineation (i.e., principles 1 and 2, defined in Section 4.1.1) were evaluated. Preliminary Phase III data needs were identified as part of 30% RD (Anchor QEA and Windward 2025b). Since that time, the results for archived PDI sediment samples (referred to as Tier 2b and 2c samples) have become available.[7] In addition, as part of the development of this QAPP Addendum, additional data needs for each RAL exceedance area have been considered relative to the information in Table 17-1 of the 30% RD report. Specifically, for each RAL exceedance area, the following factors were considered in defining Phase III data needs:

- **Horizontal delineation** – With regard to principle 1 (refine horizontal boundaries of RAL exceedance areas [DQOs 9 and 10]), specific considerations for determining Phase III sampling locations included the following:
  - *Refinement of PCB interpolation* – For PCBs, RAL exceedance area boundaries are defined as the 50th percentile probability band from the PCB indicator kriging. In areas where the probability bands outside of the RAL exceedance areas are wider (particularly the 40th to 50th percentile range), additional sampling to better define the horizontal extent of contamination for PCBs was considered along with the RAA boundary[8] (e.g., between RAL exceedance areas 7 and 9). In addition, samples have been added per EPA request to assess PCB concentrations outside of the probability bands in specific areas (e.g., east of RAL exceedance area 27).

[7] Details regarding the Tier 2b and 2c samples were provided in separate memoranda provided to EPA (LDWG 2025a, b). These memoranda are provided in Appendix G.

[8] RAA boundaries, which are typically larger than the RAL exceedance area boundaries, are an important consideration for determining data gaps relative to horizontal delineation. In some cases, the larger RAA boundaries may encompass areas of uncertainty associated with horizontal delineation, thus making additional sampling unnecessary.

  - *Refinement for non-PCB chemicals* – For non-PCB chemicals, RAL exceedance area boundaries are defined using Thiessen polygons. To evaluate the horizontal extents of contamination for these chemicals, available data were reviewed for each area to evaluate whether additional sampling is needed for horizontal delineation. Particular attention was paid to areas with large Thiessen polygons spanning intertidal and subtidal areas (e.g., RAL exceedance area 17), which may indicate uncertainty in the area represented by the RAL exceedance.
  - *Refinement along banks*[9] – For some areas (e.g., the northern portion of RAL exceedance area 9 [RAA 9I]), Phase III samples are being collected along banks to further refine the horizontal extents of RAL exceedances.
- **Vertical delineation** – With regard to principle 2 (bound vertical extent [DQO 12]), specific considerations for determining where Phase III vertical extent cores are needed included the following:
  - *Areas where no vertical extent information is available* – For areas where no vertical extent information is available (e.g., RAL exceedance areas 2 and 4, which are based on new Phase II sampling locations), Phase III vertical extent cores will be collected.
  - *Refinement of design details* – For some areas, as RD has progressed, the design team has identified vertical extent information that would be useful in refining RD details. An example of such information would be results from refining the depth of contamination, which could change the dredge elevation or refine the extents to which a cap would be required after partial dredging (e.g., RAL exceedance area 14).
  - *Areas where Phase II data collection was not successful* – For some areas (e.g., RAL exceedance area 12), Phase III sampling is planned where sufficient vertical extent information could not be collected during Phase II (i.e., because of refusal or because deeper information is now needed to support RD than was anticipated during Phase II). Note that if vibracoring is not successful in collecting the needed vertical extent information during Phase III, sonic drilling methods will be used to collect these samples, as feasible.

Table 4-2 provides a summary of the Phase III sediment chemistry data needs and describes the planned Phase III sampling that will be conducted to address those data needs. The analyte list for each Phase III sample was determined following the same approach used for the Phase II PDI sampling (Anchor QEA and Windward 2024b, c). Analytes for each sample are dependent on an evaluation of nearby samples with RAL exceedances in the design dataset (including contaminants

[9] As described in the Middle Reach PDI data evaluation report (Anchor QEA and Windward 2025a), LDW banks are defined as the transitional area from the LDW subtidal or intertidal sediment bed to the upland areas above mean higher high water. A bank is typically delineated as starting at the toe, where the relatively flat waterway bed (which varies in elevation) begins to slope steeply to the top of bank (i.e., above MHHW).

with nearby exceedance factors [EFs] > 0.9), and on which RALs are applicable at a given location and interval.[10]

[10] Locations where RALs apply are summarized in Figure 4-2 of the PDI QAPP (Windward and Anchor QEA 2022) for the middle reach and Table 28 in the ROD (EPA 2014); RAL applicability is based on bathymetry (e.g., intertidal or subtidal), sample interval, recovery category, shoaling area, and other location-specific factors.

Table 4-2
Summary of Phase III Sediment Chemistry Data Needs by RAL Exceedance Area

RAL Exceedance Area	Phase III Chemistry Data Needs		Tier 2b/2c Data?	Notes
	Horizontal Delineation (PDI QAPP DQOs 9 and 10)	Vertical Delineation (PDI QAPP DQO 12)		
1	Three 0–60-cm samples within FNC to refine PCB interpolation to the west of the current RAL exceedance area (Map 4-3)	One vertical extent core to refine transition between RAA 1A and RAA 1B; target elevation of -26 feet MLLW.	-	-
2	One 0–60-cm sample within FNC to refine PCB interpolation to the west of the current RAL exceedance area (Map 4-3)	One vertical extent core near location with Phase II exceedance (SC1577); target elevation of -26 feet MLLW.	Yes (vertical)	-
3	None	None	-	-
4	One 0–60-cm sample to the east of the current RAL exceedance area per EPA request to assess PCB concentrations outside of the probability bands (Map 4-3).	One vertical extent core near location with Phase II exceedance (SC1573); target depth of 10 feet.	-	-
5	RAA 5A: One 0–10-cm sample along edge of structure to refine PCB interpolation (Map 4-2) RAA 5B: One 0–60-cm sample (collected as part of vertical core) to refine PCB interpolation (Map 4-3)	RAA 5B: One vertical extent core offshore of IT1560. Target location is in shallow subtidal area; attempting to get deeper information relative to data from core at IT1560, which hit refusal during Phase II and is unbounded for PCBs. Target depth of 10 feet.	-	-
6	None	One vertical extent core near Phase I location with SVOC exceedance (SS1235); target depth of 7.5 feet.	-	-
7	Two shoal area cores between Areas 7 and 9 to refine PCB interpolation (one location collected as part of vertical core) (Map 4-3)	One vertical extent core (analysis contingent on results of RAL interval samples); target elevation of -31 feet MLLW.	-	Contingent vertical; sample collection will occur at the beginning of the Phase III field effort (Section 4.1.2).
8	RAA 8B: One 0–60-cm sample and one 0–45-cm sample (both collected as part of vertical cores) to refine SVOC polygon RAA 8D: Three 0–10-cm samples to refine dioxin polygon (Map 4-4)	RAA 8B: Two vertical extent cores upstream and downstream of IT1562; attempting to get deeper information relative to data from core IT1562, which hit refusal during Phase II and is unbounded for SVOCs. Target depth of 7.5 feet (intertidal) or 10 feet (subtidal).	Yes (0–10 cm, vertical)	-

RAL Exceedance Area	Phase III Chemistry Data Needs		Tier 2b/2c Data?	Notes
	Horizontal Delineation (PDI QAPP DQOs 9 and 10)	Vertical Delineation (PDI QAPP DQO 12)		
9	RAA 9A: One 0–45-cm sample (collected as part of vertical core) to refine arsenic polygon RAA 9F: One 0–10-cm and one 0–45-cm sample to refine PCB interpolation (Map 4-3). RAA 9I: Three 0–45-cm samples along shoreline to refine dioxin/furan polygon (Map 4-4)	RAA 9A/9B: Two vertical extent cores upstream and downstream of IT1556, pending additional information regarding utility corridor and clearance to collect these samples; target depth of 7.5 feet. RAA 9G/9K: Two vertical extent cores to refine depth of contamination; target elevation of -31 feet MLLW (pending utility clearance). RAA 9J: One vertical extent core along the west edge of the FNC; target elevation of -31 feet MLLW.	Yes (0–45 cm, 0–60 cm)	-
10	One shoal area core to evaluate PCB interpolation-only area (collected as part of vertical core) (Map 4-3)	One vertical extent core (analysis contingent on results of RAL interval samples); target elevation of -31 feet MLLW.	-	Contingent vertical; sample collection will occur at the beginning of the Phase III field effort (Section 4.1.2).
11	One shoal area core located between Areas 9, 10, and 11 to refine PCB interpolation (Map 4-3)	None	Yes (shoal, vertical)	-
12	One 0–45-cm sample (collected as part of vertical core) to refine PCB interpolation (Map 4-3)	One vertical extent core upstream of IT1508 (which hit refusal during Phase II); target depth of 7.5 feet.	-	-
13	One 0–60-cm sample to evaluate PCB interpolation-only area (collected as part of vertical core) (Map 4-3)	One vertical extent core (analysis contingent on results of RAL interval sample); target depth of 10 feet.	-	Contingent vertical; sample collection will occur at the beginning of the Phase III field effort (Section 4.1.2).
14	None	Two vertical extent cores to refine depth of contamination in the upstream end of this area only; target elevation of -31 feet MLLW	Yes (vertical)	-
15	Analysis of archived 0–60-cm sample SC1500 to refine PCB interpolation south of the current RAL exceedance area (Map 4-2).	One vertical extent core to refine depth of contamination within the 10-foot buffer outside the FNC; target depth of 10 feet	Yes (vertical)	-
16	None	None	-	-
17	Two 0–10-cm samples to refine dioxin/furan polygon (Map 4-4)	None	Yes (0–45 cm)	-

RAL Exceedance Area	Phase III Chemistry Data Needs		Tier 2b/2c Data?	Notes
	Horizontal Delineation (PDI QAPP DQOs 9 and 10)	Vertical Delineation (PDI QAPP DQO 12)		
18	None	None	-	-
19	One 0–10-cm sample north of the current RAL exceedance area per EPA request to assess PCB concentrations outside of the probability bands (Map 4-2).	None	-	-
20	Two 0–10-cm samples, one 0–45-cm sample in intertidal area (collected as part of vertical core), and one 0-60-cm sample in subtidal area to refine dioxin/furan polygon (Map 4-4). In addition, four archived PDI 0-10-cm samples are being analyzed.	One vertical extent core to define depth of contamination; target depth of 7.5 feet.	Yes (0–10 cm, 0–45 cm, 0–60 cm, vertical)	These samples will also be analyzed for PAHs to support RD for the cPAH-only areas (see Appendix E to 30% RD).
21	None	One vertical extent core in this high-elevation intertidal area (RAA 21A); target depth of 7.5 feet.		Based on high elevation and presence of debris, this core will be collected from land (pending access) using an alternate approach (e.g., sonic).
22	None	None (Tier 2b/2c results confirmed that there are no vertical extent data gaps in this area).	Yes (vertical)	-
23	RAA 23A: One 0–60-cm sample southeast of the current RAL exceedance area per EPA request to assess PCB concentrations outside of the probability bands (Map 4-3).	None (Tier 2b/2c results confirmed that there are no vertical data gaps in this area).	Yes (vertical)	-
24a	None	None	-	-
24b	None	Additional vertical extent information for the area under the precipitate layer is needed for RD. During Phase III, work will be conducted to evaluate layer thickness. Vertical extent cores will be collected in this area if feasible.	-	See Section 5.10 for more details regarding the planned Phase III precipitate layer investigation.
25	None	None	-	-
26	Three 0–10-cm samples and two 0–45-cm samples in intertidal area to refine non-PCB polygons (samples will also support development of cap design)	None	-	Sample collection will occur at the beginning of the Phase III field effort to guide the cap investigation evaluation.

RAL Exceedance Area	Phase III Chemistry Data Needs		Tier 2b/2c Data?	Notes
	Horizontal Delineation (PDI QAPP DQOs 9 and 10)	Vertical Delineation (PDI QAPP DQO 12)		
27	RAA 27A: Two 0–10-cm samples in intertidal area to refine PCB interpolation near Areas 24 and 27 and one 0–10-cm sample in subtidal area per EPA request to assess PCB concentrations outside of the probability bands (Map 4-2). RAA 27B: One 0–10-cm sample to refine PCB interpolation east of RAA 27B in an area of higher interpolation uncertainty (Map 4-2). RAA 27C: One 0–10-cm sample east of RAA per EPA request to assess PCB concentrations outside of the probability bands (Map 4-2).	None	Yes (vertical)	-
28	None	None	-	-
29	One 0–10-cm sample for toxicity testing (at Phase I location with BBP exceedance)	None	-	-
30	RAA 30F: Two shoal area samples to refine PCB interpolation on the east side of the FNC (collected as part of vertical extent cores) (Map 4-2).	RAA 30C/D/E: Three vertical extent cores, two along the western edge of the FNC and one in the central channel within the utility corridor; target elevation of -37 feet MLLW (pending utility clearance). RAA 30F: Two vertical extent cores along the eastern edge of the FNC; target elevation of -41 feet MLLW.	Yes (vertical)	Specific intervals to be analyzed for some of these cores will depend on review of core details following collection (Section 4.1.2).
31	RAA 31A: Two 0–10-cm samples and one 0–45-cm sample in intertidal area to refine dioxin/furan polygon (Map 4-4) RAA 31C: Two 0–10-cm samples downstream of SS1351 in intertidal area to refine PCB interpolation (Map 4-2) and confirm extent of dioxin/furan contamination (Map 4-4)	RAA 31B: Two vertical extent cores in utility corridor; target depth of 19 feet (pending utility clearance). RAA 31C: One vertical extent core to the east of the FNC; target depth of 19 feet. Additional vertical extent information is needed for cap design. However, based on frequent refusal during Phase II sampling and access limitations, this information will be collected after upland building demolition.	Yes (0–10 cm)	Specific intervals to be analyzed for some of these cores will depend on review of core details following collection (Section 4.1.2).
32	None	None	Yes (0–10 cm)	-
33	None	None	-	-

RAL Exceedance Area	Phase III Chemistry Data Needs		Tier 2b/2c Data?	Notes
	Horizontal Delineation (PDI QAPP DQOs 9 and 10)	Vertical Delineation (PDI QAPP DQO 12)		
34	Two 0–60-cm samples along structure and one 0-45-cm sample in intertidal area to refine PCB interpolation (all collected as part of vertical cores) (Map 4-3)	Three vertical extent cores near SC1312 (which hit refusal during Phase II); target elevation of -21 feet MLLW for subtidal cores and 7.5 feet for intertidal core (pending additional information regarding berth depth).	-	-
35	One 0–10-cm sample northwest of current RAL exceedance area per EPA request to assess PCB concentrations outside of the probability bands and one 0–10-cm sample in riprap (if possible pending results of sediment probing) to refine PCB interpolation (Map 4-2).	None	-	-
36	None	None	Yes (vertical)	-

Notes:
Green shading indicates a Phase III data need identified in Table 17-1 of 30% RD.
Blue shading indicates a Phase III data need identified as part of this QAPP Addendum (i.e., data need was identified after 30% RD).
BBP: butyl benzyl phthalate
cm: centimeter
cPAH: carcinogenic polycyclic aromatic hydrocarbon
DQO: data quality objective
FNC: federal navigation channel
MLLW: mean lower low water
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PDI: Pre-Design Investigation
QAPP: quality assurance project plan
RAA: remedial action area
RAL: remedial action level
RD: remedial design
SVOC: semivolatile organic compound

4.1.1.2 MNR to Benthic SCO Locations

Based on the rationale described for principle 3 (Section 4.1.1), the locations being sampled to investigate MNR to benthic SCO are summarized in Table 4-3 and Map 4-5. For locations that are geographically close to one another and have the same contaminant(s) of concern (COC[s]), a single location will be selected to characterize a given area (e.g., only the location within Slip 4 with the highest benzoic acid benthic SCO exceedance will be sampled during Phase III). These locations will be reoccupied during Phase III to evaluate current conditions at these locations relative to the benthic SCO. Samples will be analyzed for the COC with previous concentrations greater than the benthic SCO.

Table 4-3
Summary of Phase III Locations and Analytes for 0–10-cm MNR to Benthic SCO Reoccupation Samples

Location	Existing Sample (Year)	Benthic SCO Exceedance	Reoccupy During Phase III?
RM 1.9W	LDW-SS2122-U (2011)	BBP (SCO EF = 1.1)	**Yes**
RM 2.0E	SS4-PG (2016)	Mercury (SCO EF = 1.1)	No – sediment in this area removed as part of construction of the Georgetown Wet Weather Treatment System
RM 2.1W	LDW-SS2512-A (2011)	BBP (SCO EF = 1.3)	**Yes**
RM 2.3E	LDW-SS2029-D (2011)	Benzoic acid[1] (SCO EF = 1.0)	**Yes**
Slip 4	DENW6721-SSED-03-2014 (2014)	Benzoic acid[1] (SCO EF = 1.4)	**Yes** (only one location with the highest benthic SCO EF [SSED-07] will be reoccupied)
Slip 4	DENW6721-SSED-05-2014 (2014)	Benzoic acid[1] (SCO EF = 1.2)	
Slip 4	DENW6721-SSED-06-2014 (2014)	Benzoic acid[1] (SCO EF = 1.1)	
Slip 4	DENW6721-SSED-07-2014 (2014)	Benzoic acid[1] (SCO EF = 1.8)	

Notes:

1. Benzoic acid is a benthic COC similar to phenol in that it appears to be transient in nature. Benzoic acid is readily biodegradable and does not have a strong affinity for particulate organic carbon.

BBP: butyl benzyl phthalate
COC: contaminant of concern
EF: exceedance factor
MNR: monitored natural recovery
RM: river mile
SCO: sediment cleanup objective

4.1.2 Analytical Approach

As described in the PDI Work Plan for the LDW middle reach (Windward and Anchor QEA 2023), Phase III of the PDI will not involve tiered sample analysis (as was done for Phases I and II of the PDI),

because of the compressed timeline for incorporating Phase III PDI results into 90% RD. However, there are two situations wherein samples will initially be submitted to the laboratory on hold:

- There are three locations (in RAL exceedance areas 7, 10, and 13) from which vertical extent samples will be submitted to the laboratory on hold pending preliminary RAL interval results (Table 4-2 and Appendix B). For samples from these locations (referred to as "contingent" samples), vertical extent information will only be needed if the RAL interval has an exceedance. Thus, the analysis of these vertical extent samples is contingent on the RAL interval results. RAL interval samples for these locations will be collected early during the Phase III PDI, and analysis of these samples will be expedited.
- There are some vertical extent cores (in RAL exceedance areas 30 and 31) where samples from specific locations (i.e., intervals) to be analyzed will be determined after collection following a review of core details (Table 4-2 and Appendix B). The samples from these locations will be submitted to the analytical laboratory on hold; specific samples to be analyzed will be dependent on the field-measured mudline elevations, core depth, and actual sampling location relative to the RAA-specific design details. This information will be reviewed by the design team, typically within 1 week of sample collection, to identify samples for analysis.

4.1.3 Depth Intervals

Depth intervals to be sampled during Phase III are the same as those described in the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c). A brief summary of these intervals is provided here for horizontal and vertical delineation:

- **Horizontal delineation** – To refine the horizontal extent of RAL exceedance areas, samples will be collected from one or more of the RAL exceedance intervals, which include the following:
  - Intertidal areas – 0–10- and 0–45-centimeter (cm) intervals
  - Subtidal areas – 0–10- and 0–60-cm intervals
  - Shoaling areas – the 0–10-cm interval and sediment down to 2 feet below the authorized depth; intervals will vary depending on the depth of the shoaled material and the authorized navigation depth. An overview of the sampling design in shoaled areas is provided in Figure 4-1 of the PDI QAPP (Windward and Anchor QEA 2022).
- **Vertical delineation** – As described in middle reach PDI QAPP Addendum No. 1 (Anchor QEA and Windward 2024b), cores extending below the RAL intervals (referred to herein as vertical extent cores) are collected to determine the depth of contamination below the sediment surface where needed for RD. Samples will be collected from RAAs with the potential for dredging or partial dredging and capping technology remedies. The basis for the target

elevations or depths for vertical cores are discussed in detail in Section 4.1.2.2 in middle reach PDI QAPP Addendum No. 1 (Anchor QEA and Windward 2024b).

While the horizontal and vertical extent of contamination is well defined in most areas of the middle reach, Phase III sampling will target additional sampling where more information is needed for RD. Tables in Appendix B and the Map 4-1 series show the intervals to be sampled and the depths of the vertical extent cores to be collected at each location. Targeted core lengths for the 32 vertical extent cores range from approximately 7.5 to 21 feet (actual depths will depend on field conditions).

4.2 Sample Identification

Unique alphanumeric IDs will be assigned to each sample and recorded on the collection and processing forms from the middle reach PDI QAPP (Windward and Anchor QEA 2022) or Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c). The sample IDs for Phase III samples will use the same convention as the Phase I and II sample IDs, except for the year, as follows:

- Project area ID (i.e., LDW) and two-digit year (i.e., 26 for Phase III samples)
- Sample type:
  - SS – surface sediment samples (0–10 cm)
  - IT – intertidal subsurface samples, including 0–45-cm and deeper vertical extent samples
  - SC – subtidal subsurface samples, including 0–60-cm, shoaling, and deeper vertical extent samples
  - PL – subsurface samples collected under the precipitate layer in the Inlet at RM 2.2W
- Location number (see Appendix B); location numbers will start at 1650.
- For subsurface cores (i.e., SC and IT), a sequential letter (e.g., A, B, C) will be used to identify the sample interval if there is more than one. The letter A will be used to indicate the targeted interval closest to the surface (i.e., 0–45- or 0–60-cm interval), while B, C, etc., will be used to indicate each subsequently deeper interval.

For example, a surface sample from location 1650 collected from the LDW in 2026 would be labeled LDW26-SS1650. The first core interval sample (e.g., the 0–60-cm sample) from the subtidal core samples from location 1653 would be labeled LDW26-SC1653A, the next core interval sample would be labeled LDW26-SC1653B, and so on.

4.3 Sample Analysis

Analytical laboratory methods and requirements are generally the same as those outlined in Section 4.9 of the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Section 4.4 of the Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c). As noted in Section 3, CFA will

perform the dioxin/furan analysis for Phase III and ALS Kelso will perform SVOC/PAH analysis for Phase III. Updated information (including methods, data quality indicators, reporting limits, and laboratory QC samples) is presented in Appendix A.

5 Data Generation and Acquisition of Engineering PDI Elements

This section describes the Phase III activities that will occur to fill engineering data gaps identified during and after preliminary 30% RD (Anchor QEA and Windward 2025b). Collection of the data to address these data gaps will meet DQOs 11, 13, and 14. Table 5-1 summarizes planned Phase III activities and their specified DQOs.

Additionally, ongoing work to ascertain information related to two major utility crossing corridors will be completed ahead of Phase III PDI activities. These are as follows:

- A corridor near the 1st Avenue South Bridge, including the following crossings: an active City of Seattle water line in the concrete utilidor, inactive/abandoned City of Seattle water line, and abandoned Lumen telecommunication line.
- A corridor along the alignment of 8th Avenue South, including an active AT&T telecommunication line.

Table 5-1
Summary of Phase III Engineering Data Investigations

RAL Exceed. Area	Geotech (DQO 13)	Sediment Thickness (DQO 14)	Topographic Survey (DQO 11)	Structures (DQO 14)	Habitat (DQO 14)	Waste Profiling (DQO 14)	Other Investigations[1]
3				X			
5	X	X	X	X			
8		X	X	X		X	Data for cap design (DQO 12)
9	X	X		X	X	X	Data for cap design (DQO 12)
14							Information to inform sunken barge removal evaluation (DQO 14)
17		X	X				
20		X	X	X		X	
21	X	X	X	X			
23	X	X	X	X			
24	X	X	X	X	X	X	Data for water quality evaluations and precipitate layer investigation (DQOs 11 and 14)
25				X			
26	X	X	X	X			Data for cap design (DQO 12)
27		X	X	X			
29		X					

RAL Exceed. Area	Geotech (DQO 13)	Sediment Thickness (DQO 14)	Topographic Survey (DQO 11)	Structures (DQO 14)	Habitat (DQO 14)	Waste Profiling (DQO 14)	Other Investigations[1]
30	X			X			
31		X	X	X			Data for water quality evaluations (DQO 14)
34	X			X			
35		X			X		
36	X						

Notes:

1. Sheen testing (DQO 14) will be conducted for all RAAs where dredging is planned (Section 5.9).

DQO: data quality objective
RAA: remedial action area
RAL: remedial action level

5.1 Geotechnical Investigation

Phase III geotechnical investigations will include both upland and in-water borings, in addition to vane shear testing. Methods for upland and in-water geotechnical explorations and vane shear testing are outlined in Section 5.3 and Appendix E of the middle reach Phase I PDI QAPP (Windward and Anchor QEA 2022). A summary of the planned Phase III explorations and their specified objectives can be found in Table 5-2 and on Map 5-1. The data resulting from these explorations will be used to further refine geotechnical analyses as part of 90% RD.

Table 5-2
Summary of Planned Phase III Geotechnical Explorations

RAA	Location Type		Type		Count	Rationale
	In-Water	Upland	SPT Boring	Vane Shear		
5B	X		X		1	To inform slope stability for partial dredge and cap
9M		X	X		1	To inform slope stability for area-specific technology design
9I		X	X		2	To inform slope stability for dredging
21A		X	X		1	To inform slope stability for dredging
23A	X		X		2	To inform slope stability for partial dredge and cap
		X	X		2	To inform slope stability for partial dredge and cap
24F	X		X		1	Near cofferdam alignment to determine soil properties and contacts
26	X			X	3	To measure sediment shear strength for area-specific technology design
30F	X		X		1	To inform slope stability for partial dredge and cap

RAA	Location Type		Type		Count	Rationale
	In-Water	Upland	SPT Boring	Vane Shear		
34A, 34B	X		X		1	To inform slope stability for dredging
		X	X		1	To inform slope stability for dredging
36	X		Vibra-core		1	To identify layer contacts and inform slope stability for dredging

Notes:
RAA: remedial action area
SPT: standard penetration test

5.2 Sediment Thickness Probing

Phase III will include focused sediment thickness probing in the RAAs identified in Table 5-3 and Maps 5-2a through 5-2h. The methods to conduct sediment thickness probing—described in standard operating procedure (SOP) E27 of the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Section 5.3.2 of the middle reach Phase II PDI QAPP Addendum No. 1 (Anchor QEA and Windward 2024b)—have been updated to better align with design needs identified in preliminary 30% RD (Anchor QEA and Windward 2025b). The updated SOP (E27 Rev. 1) is included in Appendix C. Methods may be adjusted in the field to achieve the RAA-specific objectives detailed in Table 5-3. The results of these inspections will be used to refine RAAs as part of 90% RD.

Table 5-3
Summary of Planned Sediment Thickness Probing

RAA	Objective
5A, 5B	Probing to verify interface of riprap
8A, 8F	Probing for debris/bank armoring delineation
9A, 9C, 9F, 9I, 9M	Probing for debris/bank armoring delineation
17	Probing for debris/bank armoring delineation
20A	Probing to verify toe of armored slope
21A	Probing for debris/bank armoring delineation
23A	Diver-assisted probing to verify toe of riprap
24C, 24D	Probing to verify edge of precipitate layer
26	Probing for debris delineation
27A, 27D	Probing to help define interface of dredging and ENR
29	Probing to verify location of boat ramp
31D	Probing for debris/bank armoring delineation
35A, 35B	Probing to verify interface of riprap[1]

Notes:
1. Diver-assisted probing may be used to verify the toe of riprap if it is not accessible by foot.

ENR: enhanced natural recovery
RAA: remedial action area

5.3 Surveying

Additional topographic surveying is needed in select locations where data collected using the photogrammetric method were obscured by dense vegetation, and to collect additional bank feature location data to supplement the project basemap. Several structures and outfalls will also be surveyed. Two methods will be used, including traditional ground surveying techniques and 3D field scanning techniques. Data will be collected in accordance with the Survey QAPP Addendum (Anchor QEA and Windward 2024b) Areas where topographic surveying is planned are listed in Table 5-4, along with features to be surveyed, and shown on Maps 5-2a through 5-2h.

Table 5-4
Summary of Planned Surveying

RAA	Approximate RM	Survey Features
5A, 5B	2.8E	Bank features, adjacent structures (ST09), and outfall OF19 (2042)
8A, 8F, 8G	2.7–2.8W	Bank features, adjacent structures (ST11), and outfall OF23 (2112)
9A-D, 9I, 9L, 9M	2.7–2.8E	Supplemental shoreline topographic survey, adjacent structures (ST10), nearshore pilings, bank features, and outfalls (OF17 [CleanScapes B] and OF18 [DuwReload])
16	2.5E	Adjacent structure (ST08)
17	2.5W	Bank features
20A, 20B	2.4E	Bank features, adjacent structure (ST07), and outfalls (OF09 [SBW-B], OF10 [2028], OF11 [2027], and OF12 [2026])
21A, 21B	2.4W	Bank features, adjacent structure (ST-14), and outfall (OF26 [Boyer-1])
23A, 23B	2.3E	Outfall OF08 (Dawn Foods)
24B, 24C, 24D	2.2W	Supplemental shoreline topographic survey, bank features, adjacent structures (ST16), and outfalls (OF27 [2118] and OF28 [2120])
25	2.1E	Adjacent structure (ST04)
26	2.1E	Supplemental shoreline topographic survey, bank features, adjacent structure (ST04), and outfall (OF07 [2025])
27B, 27D	2.2W	Bank features and adjacent structure (ST17)
31B, 31C, 31D	1.9E	Supplemental shoreline topographic survey, nearshore piling, bank features, outfalls (OF 01 [DuwMetalFab], OF02 [2502] and OF03 [2501]), and adjacent structures
32	1.8E	Adjacent structures (ST01)
34A	1.8E	Adjacent structure (ST01)

Notes:
RAA: remedial action area
RM: river mile

5.4 Structure Documentation and Inspections

During the Phase II PDI, inspection and evaluation activities were conducted for 12 structures and 24 outfalls within and adjacent to RAL exceedance areas. Efforts to obtain as-built documentation began during the Phase II PDI. For structures with as-built drawings that could not be obtained, field survey measurements and 3D field scans will be performed to document the structures (e.g., location surveys of decking, pile spacing). Similarly, 16 outfalls require detailed surveys to complete RD. These structures and outfalls are listed in Table 5-4 and shown on Maps 5-2a through 5-2h.

In addition to surveying, the remaining Phase III structure inspection activities will be conducted (Table 5-5). Supplemental structural inspections are required during Phase III for RAAs 20A and 24B through 24G. These inspection activities will be conducted in accordance with American Society of Civil Engineers manual of practice No. 130.

The sunken barge located within RAA 14 will be evaluated by a specialty marine contractor with experience in salvaging derelict barges. The contractor will provide a report with a recommendation for an approach to remove the barge and an estimated cost. This work will be conducted during summer 2026.

Table 5-5
Summary of Planned Phase III Structure Inspections

RAA	Structure Name (ID No.)	Structural Type(s)	Notes
20A	ST-07	Wharf	Supplemental inspections are necessary.
24B-G	ST-16	Retaining walls, timber piles, outfalls	Supplemental inspections are necessary.

Notes:
ID: identification
RAL: remedial action level

5.5 Habitat Investigations

A visual inspection of shoreline vegetation was conducted by boat on July 22, 2024, and from shore on August 18, 2024, as part of the Phase II PDI; this information is summarized in the Phase II data evaluation report (Anchor QEA and Windward 2025a). Additional Phase III field investigations are necessary to complete the assessments of potential impacts on regulated trees and wetlands caused by the cleanup work.

5.5.1 Tree Surveying

To document existing conditions and support analysis of potential impacts related to tree removal for upland access areas, laydown areas, and bank remediation areas, an initial desktop analysis using aerial imagery and oblique photographs was conducted to determine potential presence of trees

upslope from RAAs. Based on the results of the desktop analysis, a tree survey would be conducted adjacent to RAAs 9C, 9I, 24B through 24G, and 35A (Maps 5-3a and 5-3b). The tree survey will document the species and location of any tree 6 inches or more in diameter at standard height (DSH) (i.e., diameter of tree approximately 4.5 feet above ground) using a handheld differential global positioning system unit that provides approximately submeter accuracy. DSH data will be collected as a direct diameter reading using a diameter tape (D-tape), or a normal tape measure will be used to find the circumference to calculate DSH. The tree survey will include photographs of surveyed trees, an assessment of general tree health, and area estimates of canopy cover extending over the water (if applicable). The tree survey will be conducted in accordance with Seattle Municipal Code 25.09.070 and 25.11.050 and the following categorized tree tiers (Seattle Municipal Code 25.11.050):

- Tier 1 – Includes trees designated as heritage trees as defined in Seattle Municipal Code
- Tier 2 – Includes trees 24 inches or more in DSH, tree groves, each tree comprising a tree grove, and specific tree species less than 24 inches in DSH as provided by the Seattle Department of Construction and Inspections Director's Rule[11]
- Tier 3 – Includes trees 12 inches or more in DSH but less than 24 inches in DSH that are not considered Tier 1 or Tier 2 trees
- Tier 4 – Includes trees at least 6 inches in DSH but less than 12 inches in DSH that are not considered Tier 1 or Tier 2 trees

An example field form for the tree survey is provided in Appendix F. As remedial design progresses, potential effects to regulated trees from remedial activities will be evaluated. Any potential tree removal or tree work would be reviewed by a certified arborist and approved by the Seattle Department of Construction and Inspections Director.

5.5.2 Wetland Delineation

To document existing conditions and support analysis of potential impacts related to wetlands, an initial desktop analysis was conducted using the National Wetlands Inventory (NWI) online mapper (USFWS 2026). The NWI uses the biological definition of wetlands, which may not be consistent with the regulatory definition of wetlands under Section 404 of the Clean Water Act (USFWS 2026) and as defined in the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987). In general terms, wetlands are transitional areas between terrestrial and aquatic systems, where the water table is usually at or near the surface or the area is covered by shallow water at some time during the growing season. Under Section 404, positive wetland indicators of all three environmental parameters (hydrophytic vegetation, hydric soil, and wetland hydrology) are normally present in

[11] The City of Seattle's Director Rules are administrative rules adopted according to the Administrative Code. The most current Seattle Department of Construction and Inspections Director's Rule for the Designation of Tier 2 Trees (effective November 7, 2024) is provided in DR 7-2024 (City of Seattle 2024). This rule interprets the City's Tree Protection code (Ch. 25.11).

wetlands. Based on USACE guidance, wetlands are vegetated systems that are not included in the definition of deepwater habitats (Environmental Laboratory 1987).

The NWI maps subtidal and intertidal estuarine wetland systems with unconsolidated bottom or unconsolidated shoreline (beach) classes in and adjacent to all RAAs (USFWS 2026). These NWI-mapped estuarine wetland systems include both tidal wetlands and regularly flooded deepwater habitats. Accessing RAAs during construction could disturb these NWI-mapped aquatic systems. The potential presence of vegetated wetlands (as defined by USACE; Environmental Laboratory 1987) in or adjacent to RAAs will be determined through the following stepwise assessment:

- **Step 1:** Identify RAAs that overlap with potential wetlands (as identified on NWI mapping) by answering the following question:
  - Will remediation construction (i.e., soil removal, fill, or other disturbance such as vegetation removal) potentially impact mapped NWI wetlands?
    - If yes, go to Step 2.
    - If no, remove area from evaluation.
- **Step 2:** Confirm potential wetland presence in NWI-mapped areas through the following desktop exercise:
  - Follow USACE wetland determination guidelines (*Corps of Engineers Wetland Delineation Manual* [Environmental Laboratory 1987] and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region [USACE 2010]).
    - Review available data (e.g., aerial photographs, site photographs, soil surveys, topography) to determine whether available data are sufficient for the wetland determination.
    - Evaluate available data for the potential presence of hydrophytic vegetation, hydric soils, and wetland hydrology.
    - Substrate – if impervious surface, bulkhead, or unvegetated riprap/armoring is present, the presence of a wetland can be ruled out
    - Vegetation – lack of annual or perennial vegetation throughout the growing season (as evident through aerial imagery and site photos) does not support wetland presence.
  - Determine whether the desktop exercise confirms potential wetland presence.
    - If yes, go to Step 3.
    - If no, remove area from evaluation.
- **Step 3:** Visit the site to conduct a wetland determination, confirm wetland presence, and conduct wetland delineation.

  - Follow USACE wetland determination guidelines (Environmental Laboratory 1987; USACE 2010) and delineate any wetlands in or adjacent to RAAs.
  - Determine whether the wetland determination and delineation confirms wetland presence.
    - If yes, go to Step 4.
    - If no, remove area from evaluation.
- **Step 4:** Determine whether the wetlands and their buffers can be avoided (i.e., discuss with design engineers).
  - If no, go to Step 5.
  - If yes, remove area from evaluation.
- **Step 5:** Conduct functional assessment using Ecology's Washington State Wetlands Rating System (Washington State Wetland Rating System for Western Washington: 2014 Update [Version 2] [Hruby and Yahnke 2023]) for all wetlands that would be impacted.
- **Step 6:** Prepare report documenting the wetlands evaluation and include it as an attachment to the Clean Water Act Sections 404/401 and Rivers and Harbors Act Section 10 Substantive Compliance Report (to be submitted as part of Pre-Final [90%] RD).

Steps 1 and 2 of the stepwise assessment were completed during the Phase I and Phase II PDI field efforts (Phase I in June 2023, and Phase II in July 2024). Potential wetlands overlapping with remedial activities may be within or adjacent to RAAs 8A, 9C, 24A through 24G, 27B, and 31D (Maps 5-3a through 5-3b). Field wetland presence verification and subsequent wetland delineations (Step 3) will be conducted during Phase III sampling.

Wetland delineations will be conducted during the growing season (late spring or summer) according to the methods defined in the *U.S. Army Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) and *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Version 2.0) (USACE 2010), as well as the following guidance:

- *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979; FGDC 2013)
- *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils, Version 8.2, 2018* (USDA and NRCS 2018)
- *2022 National Wetland Plant List (Western Mountains, Valleys, and Coast Region), Version 3.6* (USACE 2023)
- *Munsell Soil Color Charts, 2012 Revised Edition* (Munsell 2012)

Wetland functional values and ratings will be determined using the most current version of Ecology guidance in the Washington State wetland rating system (Hruby and Yahnke 2023). An example rating form for the wetland delineation is provided in Appendix F.

Using the described guidance, the method for delineating wetlands is typically based on the presence of three parameters: hydrophytic vegetation, hydric soils, and wetland hydrology. Hydrophytic vegetation is "the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present" (Environmental Laboratory 1987). Hydric soils are "formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (USDA and NRCS 2018). Wetland hydrology "encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season" (Environmental Laboratory 1987). Sample plots will be collected to determine wetland absence or presence, and paired sample plots (i.e., one "wetland" plot paired with one "upland plot") will be collected to delineate wetland boundaries. At each sample plot, vegetation, soil, and hydrology data will be collected as described in the following sections.

To determine the presence of hydrophytic vegetation in the RAAs, percent cover for each plant species will be estimated in each plot, and dominant plant species will be identified and recorded. The presence of wetland hydrology in the RAAs will be evaluated through surface observations and recorded at each plot; both primary wetland hydrology indicators—such as saturation and inundation—and secondary wetland hydrology indicators—such as water-stained leaves, drainage patterns, and geomorphic position—will be noted. Typically, to determine the presence of wetland hydrology and hydric soils, soil pits are dug to a depth of 18 inches (unless prevented by impenetrable substrate) and evaluated for subsurface wetland hydrology and hydric soil indicators, such as low soil matrix chroma, gleying, and redoximorphic (or "redox") features. Due to the presence of highly contaminated soils within RAAs 24B through 24D, and to protect wetland biologists, digging for hydrology or soil examination will not be conducted if the hydrophytic vegetation and surface wetland hydrology evaluation is sufficient to establish wetland absence or presence and delineate wetland boundaries. If pits are necessary, the field crew will follow health and safety protocols described in the HASP Addendum (Appendix D of the QAPP Addendum No. 2; Anchor QEA and Windward 2024c).

5.6 Waste Profiling

A preliminary waste characterization was presented in the preliminary 30% RD (Anchor QEA and Windward 2025b). In the preliminary waste characterization, samples were identified as containing concentrations greater than 50 parts per million total PCBs (i.e., PCB remediation waste under the Toxic Substances Control Act), potentially Washington Dangerous Waste based on the book

designation procedure (Washington Administrative Code [WAC] 173-303-100[5][b]), or potentially characteristically toxic waste (Resource Conservation and Recovery Act hazardous waste) based on the bulk concentrations of constituents exceeding 20 times the toxicity characteristic leaching procedure (TCLP) regulatory levels. Follow-up testing will be performed to more conclusively determine if sediment should be identified as potentially Washington Dangerous Waste based on the book designation or 20 times the TCLP regulatory levels. Follow-up testing for determining if the material is regulated under the Toxic Substances Control Act will not be required for PCB exceedances, because the determination is based on in situ characterization and will be conclusive.

Based on the preliminary waste characterization, static acute fish toxicity testing is required to complete the waste profile within 11 RAAs. Testing will be performed by Spheros as specified in *Biological Testing Methods 80-12 for the Designation of Dangerous Waste, Static Acute Fish Toxicity Test* (Ecology 2021), which complies with WAC 173-303-110. The data quality objectives and QA/QC requirements for toxicity testing are provided in SOP E32 (Appendix C). TCLP testing will be performed as specified in WAC 173-303-090(8) for the 11 RAAs where the "20 times rule" indicated the sediment may fail the TCLP test. TCLP testing will be performed in accordance with Appendix A of the upper reach preliminary waste determination (Anchor QEA and Windward 2024a, Vol. II, Part V).

The select intervals from Phase II PDI cores that will be composited and analyzed for TCLP and/or toxicity testing are summarized in Table 5-6.

Table 5-6
Summary of Testing for Waste Profiling

RAA	Sample Location and Composite Intervals	Toxicity Testing[1]	TCLP Testing[2]
8B	LDW24-IT1562 (A, B and C intervals)	X	
8F	LDW24-IT1527 (A, B and C intervals)	X	X (mercury)
9A	LDW24-IT1556 (A, B, C, and D intervals)	X	X (arsenic, lead)
9B	LDW24-IT1555 (A and B intervals)	X	X (arsenic, lead)
9C	LDW24-SS1552 (A and B intervals)	X	X (arsenic, lead)
9D	LDW24-SS1551 (A interval)	X	X (arsenic, lead)
20B	LDW24-IT1469 (A interval)	X	X (lead)
24B	LDW24-IT1609 (A and B intervals)	X	
24C	LDW24-IT1601 (A, B and C intervals) LDW24-IT1601 (D, E, and F intervals) LDW24-IT1603 (A, B and C intervals) LDW24-IT1607 (A, B and C intervals)		X (lead, chromium, mercury, cadmium)
24D	LDW24-IT1599 (A, B and C intervals)		X (lead, chromium, mercury, cadmium)

RAA	Sample Location and Composite Intervals	Toxicity Testing[1]	TCLP Testing[2]
24E	LDW24-IT1595 (A, B and C intervals)	X	X (cadmium, lead)
24F	LDW24-IT1593 (A interval)	X	X (lead)
24G	LDW24-IT1594 (A, B and C intervals)	X	X (lead)
31B	LDW23-SS1066 (0–10-cm sample)		X (lead)

Notes:

1. Toxicity testing will be performed by Spheros as specified in *Biological Testing Methods 80-12 for the Designation of Dangerous Waste, Static Acute Fish Toxicity Test* (Ecology 2021) (SOP E32; Appendix C). A total of 8 oz of sediment is required for this test.
2. The metals included in parentheses exceeded the 20x rule. TCLP testing will be conducted by ARL for the RCRA 8 metals (SOP E33; Appendix C). A total of 100 g of sediment is required for this test.

cm: centimeter
g: gram
RAA: remedial action area
RCRA: Resource Conservation and Recovery Act
SOP: standard operating procedure
Spheros: Spheros Environmental
TCLP: toxicity characteristic leaching procedure

5.7 Data for Cap Modeling Evaluation and Design

As part of the Intermedial (60%) RD currently underway, partial dredge and capping is the selected remedial technology in 21 areas, which include RAAs 1B, 5B, 8B, 9A, 9B, 9C, 9D, 9J,14,15B, 20C, 22, 23A, 24I, 30B, 30D, 30E, 30F, 31B, 31C, and 31D.[12] Capping, without prior dredging, is the selected remedial technology for RAA 30A. An area-specific technology that includes capping, without dredging, is the selected remedial technology for RAA 26. For all cap areas, the following data gaps related to cap design were considered:

- Vertical delineation of COCs exceeding RALs within RAAs where cores were terminated at refusal
- Data at depth to confirm the absence of secondary COCs in RAAs designated for capping
- Location-specific physical and chemical analyses for areas where the preliminary thickness of the chemical isolation layer was modeled in Preliminary (30%) RD as greater than 12 inches and potentially requiring treatment additives. Specifically:
  - Location-specific groundwater seepage rate information to complete cap modeling
  - Porewater and geochemistry data to complete cap modeling
  - Treatability studies to specify treatment additives in the isolation layer design

Location-specific data to refine the isolation cap model input parameters are required in the following areas: RAAs 8B, 9A through 9D, and 26. Location-specific data are not needed for the other RAAs. This is because location-specific seepage measurements are only necessary for cap design in

[12] Note: This list differs from the final list presented in the Preliminary (30%) RD and will continue to be refined as the design progresses. For example, Phase III data may indicate in select RAAs the vertical extent of contamination that can be addressed with dredging without the need for cap. Such changes would be reflected in the Pre-Final (90%) RD.

middle reach RAAs where 30% RD modeling predicted preliminary cap isolation layer thicknesses greater than 12 inches and which may require potential treatment amendments. Additionally, geochemical data collection is focused on RAAs that have arsenic and other metal RAL exceedances (RAAs 9A through 9D). The results of the Phase III analyses summarized in Section 5.7.2 will be used to confirm that no other cap or partial dredge and cap areas require a cap due to newly identified metal concentrations higher than surface RALs. A summary of the location-specific cap design data gaps is provided in Table 5-7.

Table 5-7
Summary of Location-Specific Cap Design Data Gaps

RAA	Map	Confirmation of COC Delineation	Seepage Rates	Porewater Concentrations	Treatability Studies for Cap Amendment
8B	5-2h	1,4-DCB	Yes	N.R.	isotherm
9A – 9D	5-2g	Arsenic	Yes	Yes	TBD
26	5-2d	BBP	Yes	N.R.	isotherm

Notes:
COC: contaminant of concern
N.R.: not required at this location
RAA: remedial action area
TBD: to be determined

Field collection and laboratory analyses for general and location-specific cap design data gaps are described in the following subsections.

5.7.1 Vertical Delineation in Refusal Areas

Table 4-2 provides a summary of all locations where a Phase III vertical core will be collected. Delineation of vertical extent of contamination for COCs exceeding RALs within RAAs 5B, 8B, and 9A through 9D, where cores were terminated at refusal, is required to evaluate if it is feasible to dredge the full extent of contamination in these areas in lieu of placing a modified cap after dredging. It should be noted that some of the activities described in Sections 5.7.3 through 5.7.4 (e.g., seepage measurements and porewater collection) will be initiated prior to receiving the preliminary results of vertical coring in these locations to optimize work during the low tide periods in June and July 2026. If preliminary Phase III vertical core analyses provide timely data to support a remedial technology change that excludes capping, any remaining activities described in Section 5.7 will not be implemented in those RAAs, as no further data gaps related to capping would remain.

5.7.2 Secondary COC Analyses to Inform Cap Modeling

As described in the PDI QAPP and QAPP Addenda for the middle reach, sampling to define vertical extent of contamination focuses on COCs for which there are RAL exceedances (e.g., in areas such as RAA 1B where there are only PCB RAL exceedances, vertical extent samples have only been analyzed for PCBs). To confirm that there are no secondary COCs at depth above levels of concern in areas where capping is planned, samples collected from a core interval below the cap will be analyzed for additional COCs. For each RAA where capping is planned, the specific archived PDI samples or Phase III samples to be analyzed are presented in Table 5-8. Existing data are noted by a green shaded "X"; an unshaded "P" indicates that either an archived interval will be analyzed or a new Phase III interval will include the expanded COC analyses. In total, an additional (i.e., not already analyzed or planned) 13 archive and 4 Phase III samples will be analyzed for 1 or more analyte to support this evaluation, per Table 5-8.

Table 5-8
Selected Samples and Secondary COC Analyses for Areas Where Caps Are Anticipated

RAA(s)	Planned Dredge Depth	Type	Selected Representative Sample (Elevation [ft MLLW] or Depth)	Analytes[1]						
				PCBs	Dioxins/ Furans[2]	Metals	Mercury	PAHs	Phth-alates	Other SVOCs
1B	-24 ft MLLW	Archive	1582G (-25.3 to -26.3 ft)	X		P	P	P	P	P
5B	3-ft thickness	Phase III	1719 (interval TBD[3])	P		P	P	P	P	P
8B	4.5-ft thickness	Phase III	1711 (interval TBD[3])	P	P	P	P	P	P	P
9A / 9D 9B / 9C	4-4.5-ft thickness TBD	Phase III	1717 (interval TBD[3])	P		P	P	P	P	P
9J	-29 ft MLLW	Archive	1542K (-29.9 to -30.9 ft)	X	X	P	P	P	P	P
14 15B	-29 ft MLLW -26 ft MLLW	Archive	1493H (-26.7 to -27.7 ft)	X		P	P	P	P	P
20C	3-ft thickness	Archive	1470E (-8.2 to -9.2 ft)	X	X	P	P	P	X	P
22	-29 ft MLLW	Archive	1431L (-30.9 to -32.2 ft)	X		P	X	P	P	P
		Archive	1451M (-30.9 to -31.8 ft)	X		P	P	P	P	P
23A	-20 ft MLLW; side slope	Archive	1424C (-21.6 to -22.5 ft)	X		P	P	P	P	P
		Archive	1453E (-19.7 to -20.7 ft)	X		P	P	P	P	P
24I	4-ft thickness	Archive	1428 E (-7.3 to -8.3 ft)	X	P	P	X	P	P	P
26	0 ft (cap only)	Phase III	1672, 1673, 1674	P	P	P	P	P	P	P
30A	0 ft (cap only)	Existing/ Archive	SC1084 (0–60 cm), SC1386 (0–60 cm)	X	P[4]	X	X	X	X	X
30B	-29 ft MLLW	Archive	1382C (-30.3 to -31.2 ft)	X	X	P	X	P	P	P
30D/30E	-35 ft MLLW	Archive	1341J (-36.9 to -37.9 ft)	X	X	P	P	P	P	P

RAA(s)	Planned Dredge Depth	Type	Selected Representative Sample (Elevation [ft MLLW] or Depth)	Analytes[1]						
				PCBs	Dioxins/ Furans[2]	Metals	Mercury	PAHs	Phth-alates	Other SVOCs
30F	-39 ft MLLW	Archive	1328M (-40.9 to -41.8 ft)	X		P	P	P	P	P
31B/31C 31D	side slope; 3-ft thickness	Phase III	1662 (interval TBD[3])	P	P	P	P	P	P	P
Total Additional Analyses Planned for this Evaluation				**0**	**4**	**14**	**13**	**14**	**15**	**15**

Notes:

1. Analytes for which data are already available in the design dataset are indicated with an "X" (with green shading). Analytes for which analysis is planned to provide information are indicated with a "P" (a "P" with blue shading indicates that these analyses are already accounted for in Appendix B). The frequency of QA/QC samples for these archive and existing samples will be the same as that for other Phase III samples, as specified in the PDI QAPP for the middle reach (Windward and Anchor QEA 2022).
2. As done for the sediment chemistry samples in Section 4, samples for a subset of areas were identified for dioxin/furan analysis based on a review of areas with dioxin/furan RAL exceedances (Map 4-4 series).
3. An interval at least 1 foot below the dredge depth will be selected for analysis. The specific elevation will depend on field collection details (e.g., collection location and elevation of specific intervals) and Phase III sampling results. Analyses of the TBD intervals are in addition to the analyses identified in Table B-1 of this Phase III QAPP.
4. Core SC1084 was from the Phase I investigation and not available for analysis. The "A" 0–60-cm interval from SC1386 will be analyzed for dioxins/furans.

cm: centimeter
ft: foot
MLLW: mean lower low water
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PDI: Pre-Design Investigation
QAPP: quality assurance project plan
QA/QC: quality assurance/quality control
RAA: remedial action area
RAL: remedial action level
SVOC: semivolatile organic compound
TBD: to be determined

5.7.3 Seepage Rates

The Preliminary (30%) RD evaluation for the engineered cap chemical isolation design presented in Appendix H of Anchor QEA and Windward (2025b) used a range of seepage rates (400 to 800 centimeters per year [cm/yr]) in intertidal areas (based on regional groundwater models). To support Pre-Final (90%) RD, RAA-specific seepage rates will be calculated using co-located vertical hydraulic head data and vertical hydraulic conductivity data collected within three intertidal areas: RAAs 8B, 9A through 9D, and 26. The specific sampling locations within each area are shown on Maps 5-4a through 5-4c.

At each location, hydraulic head data will be measured at two depths using specialized piezometers known as vertical hydraulic gradient (VHG) devices. These hydraulic head data will be used to calculate the vertical hydraulic gradient. Vertical hydraulic conductivity (Kv) will be measured empirically using sediment cores collected at the locations where VHGs are installed. To measure

sediment Kv in the field, sediment cores will be collected in rigid, plastic core liners from the existing sediment surface, as described in Standard Operating Procedure (SOP) E19, to a depth of approximately 5 feet below the mudline if the sediment is at least 5 feet thick, or to the bottom of the sediment if it is less than 5 feet thick. This depth interval will approximately match the separation between the screens of the collocated VHGs.

To minimize the influence of consolidation on the measured Kv values, no less than 80% recovery is required for Kv cores. Recovery rates for Kv cores will be documented and used to calculate an adjustment factor that can be used to estimate an error range for the Kv value. Procedures are described in SOP E38 (Appendix C). VHGs will be deployed for 6 weeks to capture a range of water levels, which will be used to calculate seepage rates over a range of tidal conditions.

As an additional line of evidence to validate the seepage rate calculations, seepage rings will also be installed in RAAs 8B, 9A through D, and 26, at locations co-located with VHG measurements. Depending on the tidal conditions, the following seepage ring locations will be attempted: four at RAA 8B, six at RAAs 9A through D, and one at RAA 26. The expected low-tide elevation during seepage ring deployment is approximately -3 feet mean lower low water (MLLW). Because the rings must not be located in areas of overlying water, the rings will not be placed below an elevation of 0 feet MLLW which limits the areas suitable for deployment within each RAA. Figures 5-4a through 5-4c show the target locations of the seepage rings relative to the existing bathymetry.

Seepage rings will be deployed during low-tide conditions when the sediment surface is accessible to field personnel. As described in SOP E38, seepage rings will be driven a few inches into the exposed sediment surface to ensure that the ring stays in place during data collection. Water discharging upwards across the sediment interface within the ring will be contained, collected, and measured over a minimum of a four-hour period starting at least two hours before low tide to provide an empirical measurement of seepage rates. Any visible accumulation of water within the ring will be removed approximately every 15 minutes using a peristaltic pump, or more frequently to prevent accumulation of water greater than 2 inches in height. For areas with suspected low seepage rates, a bulb baster or similar equipment may be used in place of a peristaltic pump. Seepage measurements during three separate low-tide events, when hydraulic gradients are highest, provide empirical data to validate the upper range of seepage rates calculated from VHG data collected over a longer time period.

Although the investigations are focused on three specific intertidal cap areas, seepage measurement results will be used to inform the design for all cap areas. The seepage data collected from intertidal areas will be compared against the regional groundwater discharge rates and publicly available information from groundwater wells adjacent to the LDW middle reach. The results of this comparison will be considered and, as appropriate, potential adjustments to the seepage rate used

in the isolation layer design for caps located in subtidal areas may be made. A draft memorandum will be submitted to EPA 30 days after receipt of related preliminary Phase III results (i.e., the results of testing described in Sections 5.7.3).

5.7.4 Porewater and Geochemistry Data (RAA 9A Through 9D)

Both dredging and partial dredging and capping are planned within RAAs 9A through 9D. The final delineation of areas requiring a post-dredge cap will be based on Phase III supplemental core data and analysis. To further support the design in these areas, additional data are needed based on a preliminary model evaluation completed as part of the progressive design process, which predicted arsenic exceedances of the 0- to 45-cm RAL in RAAs 9A through 9D. As such, geochemical parameters and arsenic speciation data will be collected in parallel with the supplemental coring program described in Section 4.

At RAAs 9A through 9D, porewater testing will be conducted to characterize arsenic speciation and sediment testing will be conducted to characterize subsurface geochemical conditions. Arsenic is redox sensitive and commonly occurs in aquatic systems in a trivalent (arsenic [III] or arsenite) and/or pentavalent (arsenic [V] or arsenate) oxidation state. The distribution of arsenic between arsenic (V) and arsenic (III) influences arsenic mobility and is strongly dependent on redox and other geochemical conditions (e.g., presence of iron or sulfide minerals). For example, the oxidized form (arsenic [V]) tends to adsorb more strongly to mineral surfaces (e.g., iron oxides), which control its mobility. The reduced form (arsenic [III]) is more weakly adsorbed on mineral surfaces but can be incorporated in sulfide phases under strongly reducing conditions; its mobility in sediments can therefore be more variable and dependent on site-specific geochemical conditions.

If capping is the selected technology, analysis of arsenic concentrations and speciation in porewater and subsurface geochemical parameters (iron, sulfide, dissolved oxygen [DO], oxidation reduction potential [ORP]) at RAAs 9A through 9D will provide RAA-specific data that can be used to refine the modeling evaluation and design. Specifically, porewater arsenic concentrations will be used to confirm model-predicted porewater concentrations calculated using partitioning coefficients from the literature (see discussion in Appendix H of the BODR). The results of selective sequential extraction (SSE) testing will be used to understand the forms of arsenic present in the sediment (e.g., loosely adsorbed on solid surfaces, associated with iron oxides), which will inform amendment selection.

Sediment and porewater samples will be collected from the locations shown on Map 5-4c. To preserve in situ conditions, it is important that the sample materials are packaged and handled without exposure to air. Sample handling and analyses are described in the following subsections.

5.7.4.1 Sediment Sampling and Analyses

Subsurface sediment collection methods for geochemistry testing of sediment within RAAs 9A through 9D will follow the same procedures described in QAPP SOP E19 using a 4-inch Lexan core barrel or similar (length to be dependent on the target core depth). Accepted cores will be processed using the following procedures:

- Per SOP E19, evaluate any additional amount of compaction that may have occurred after core acceptance and prior to core processing, calculate the adjusted recovery percentage to be applied during core processing.
- While still contained within the rigid, plastic core tube or liner, the core will be cut in the field into separate segments carefully using a decontaminated pipe cutter, saw, or something similar and immediately re-capped. Tape will be placed around the edge of the cap.
- The core will be processed into 1-foot segments prior to shipment to Anchor QEA's Environmental Geochemistry Laboratory (EGL) in Portland, Oregon. These core segments will be labeled and placed in mylar bags with oxygen absorbers. Each bag will be partially sealed, leaving a small hole for air to escape, and the top will be rolled down, slowly pushing as much air out of the bag as possible prior to sealing the bag. Tape will be placed over the closed seal.
- The sealed bags will be labeled with the sample ID. Intact sediment core 1-foot segments will be collected and shipped to the EGL.

Upon receipt at the EGL, the core segments will be unwrapped (under a nitrogen atmosphere in the glove bag) to verify that they were packaged in accordance with the QAPP requirements (e.g., placed with oxygen absorbers in mylar bags and sealed with tape). Prior to screening and subsampling, the cores segments will be opened (under a nitrogen atmosphere) and laboratory personnel will visually inspect and photograph the cores and document any evidence of oxidation (e.g., color changes resulting from exposure to oxygen). Subsamples will be collected from the central portion of the core, furthest from the outer edge.

At the EGL, material will be screened using the SciAps X-550 X-ray fluorescence (XRF; SOP E35; Appendix C) for the presence of arsenic and other constituents that may affect arsenic speciation (i.e., iron, manganese). Subsamples will be collected and submitted to ARL for metals (including total arsenic, iron, manganese by EPA Method 6020B), sulfide (by Standard Method [SM]-4500-S2) and total organic carbon (by EPA 9060A) analysis.[13] SSE of arsenic will be conducted at the EGL in accordance with SOP E36 (Appendix C). The resulting extracts will be submitted to ARL for analysis

[13] Analytical methods and sample handling requirements for sediment are included in Table 4-6 of the QAPP.

(by EPA Method 6020B). EGL duplicates will be analyzed 1 per 20 samples and one blank will be analyzed. Reproducibility will be assessed by comparing duplicates.

5.7.4.2 Porewater Sampling and Analysis

Porewater samples from RAAs 9A through 9D will be collected via one of the three methods, depending on field conditions. Options A and B (micro push point sampler and direct push drill rig respectively) are detailed in SOP E37 (Appendix C). Option C (centrifuged to extract porewater) is detailed in SOP E42.

If sufficient volume can be collected in the field using Option A (micro push point sampler) or Option B (direct push drill rig), porewater samples will be sent directly to the analytical laboratories for analysis. Sample bottles will be labeled and placed in mylar bags with oxygen absorbers. Each bag will be partially sealed, leaving a small hole for air to escape, and the top will be rolled down, slowly pushing as much air out of the bag as possible prior to sealing the bag. Tape will be placed over the closed seal.

If sufficient volume cannot be collected in the field, a sediment core will be collected and sent to the EGL (Option C). If a sediment core is collected, it will be collected using the procedure described in Section 5.7.4.1 and transported directly to the EGL. Upon receipt at the EGL it will be documented using the procedures described in Section 5.7.4.1.

Porewater will be extracted as described in SOP E42: Porewater Extraction by Centrifuge (Appendix C) and samples will be sent to the analytical laboratories for analyses. Porewater samples will be analyzed for arsenic speciation (BAL 4100), dissolved arsenic, iron, manganese (EPA 6020B), sulfide (EPA Method SM 4500S2D), conductivity (EPA 120.1/SM 2510), and pH (EPA 150.1/SM 4500-H)[14]. SOPs are included in Appendix C.

5.7.4.3 Metals Treatability Testing

If partial dredging and capping is the selected remedy at RAAs 9A through 9D, the results of the initial testing described in Sections 5.7.4.1 and 5.7.4.2 will be used to identify one or more suitable, iron-based cap amendments (e.g., zero-valent iron). Metals treatability testing will be conducted to evaluate one or more amendments (e.g., uptake capacity for arsenic) to inform the dose of the selected amendment during cap design. A plan for the treatability study including discussion of selection of amendments and potential impacts (if any) to sediment biogeochemistry will be submitted to EPA in a supplemental memorandum. The draft memorandum will be submitted to EPA 60 days after receipt of related preliminary Phase III results (i.e., the results of testing described in Sections 5.7.1 through 5.7.3, 5.7.4.1, and 5.7.4.2).

[14] Analytical methods and sample handling requirements for porewater are provided in SOP E37 Porewater Sample Collection.

5.7.5 Treatability (Isotherm) Studies (RAAs 8B and 26)

During Phase III, sediment cores will be collected at RAA 8B to determine the vertical extent of the RAL exceedances. If a cap is required, treatability testing will be required to complete the cap isolation layer design. Specifically, isotherm testing will be conducted to evaluate the adsorptive capacity of a carbon amendment (i.e., CT2050C Virgin Granular Activated Carbon) for dichlorobenzene under location-specific conditions at RAA 8B.

Sediment samples will be collected from the locations shown on Map 5-4b. Subsurface sediment collection for isotherm testing will follow the same procedures described in QAPP SOP E16. Cores will be processed into 1-foot segments prior to transport to the EGL.

The procedure for conducting isotherm testing is described in SOP E34 (Appendix C). In summary, porewater for isotherm testing will be created using the procedure described in SOP E34 and spiked with 1,4-dichlorobenzene. Specified amounts of activated carbon will be added to jars containing the porewater. After the required reaction time, water samples will be collected from each jar and sent to ALS-Kelso for analysis via EPA Method 8260B to determine the remaining aqueous 1,4-dichlorobenzene concentrations in each jar. These data will be used to establish a site-specific adsorption coefficient (i.e., Freundlich Isotherm). The results of the isotherm testing will provide RAA-specific adsorption coefficients that can be input to the cap design model to allow for a refinement of amendment dosages for the final design. The proposed site-specific adsorption coefficient will be presented in a technical memorandum to be submitted to EPA 30 days after receipt of related preliminary Phase III results (i.e., the results of testing described in Sections 5.7.5).

During Phase III, 0- to 45-cm sediment cores will be collected at RAA 26 to determine the vertical extent of contamination and will be compared to the 0- to 10-cm surface RAL to aid cap design. If a cap is required at RAA 26, a treatability study will be needed to complete cap design. The specifics of a treatability study will depend on the COCs that exceed surface RAL in sediments present below the dredge cut and would be summarized in a supplemental memorandum. The draft memorandum will be submitted to EPA 60 days after receipt of related preliminary Phase III results (i.e., the results of testing described in Sections 5.7.1 through 5.7.3).

5.8 Data for Water Quality Evaluations

As described in Appendix J for preliminary 30% RD (Anchor QEA and Windward 2025b), additional data are needed for water quality evaluations at RAAs 31 (Duwamish Marine Center, RM 1.9 East), and 24B, 24C, and 24D (Inlet at RM 2.2 West). Testing for each area is described in the following subsections.

5.8.1 RAA 31

Elutriate tests are designed to measure and predict the release of COCs to the water column. Dredging elutriate test results will be used as a line of evidence to assess the need for additional best management practices at RAA 31. Testing will be conducted using sediment from archived samples with the greatest PCB concentrations within the proposed dredge area. Site water samples will be collected from the middle of the water column in each area. Water samples will be collected in a manner that minimizes incidental turbidity (e.g., prior to the collection of any sediment samples). As required by the method, site sediment and water samples will be mixed, aerated, and allowed to settle. Elutriate will be analyzed for total suspended solids and total and dissolved COC concentrations.

5.8.2 Inlet at RM 2.2W

The remedial technology for RAAs 24B, 24C, and 24D (RM 2.2 West) includes construction of a temporary cofferdam to isolate the area from the main waterway and facilitate sediment removal "in the dry" (see Section 8.4 of preliminary 30% RD [Anchor QEA and Windward 2025b]). The contractor is responsible for the final design of the cofferdam and water control system that will be required to maintain relatively dry conditions and facilitate sediment removal. It is anticipated that the contractor will design a system to treat the water prior to its disposal at the publicly owned King County Industrial Waste facility. There are several groundwater wells surrounding RAAs 24B through 24D that provide information regarding the quality of groundwater. Additional liquid might drain from the sediment and contribute to the water that must be managed (i.e., collected, stored, treated, and tested). To support the development of contractor specifications for the intermediate design, archived sediment from the Phase II PDI containing the greatest COC concentrations will be tested via the synthetic precipitation leaching procedure (SW-846 Test Method 1312). This procedure is designed to predict the mobility of COCs in solids, liquids, and wastes. The synthetic precipitation leaching procedure test parameters were selected in consultation with King County Industrial Waste.

5.9 Sheen Testing

Sheen testing will be conducted to determine if potential sheen-producing material is present. For RAAs where dredging is planned, sheen testing will be conducted on one representative sample for each RAA (or group of RAAs), using either Phase III samples (where available) or archived Phase II PDI samples. The following describes the process for identifying samples for sheen testing that will be used to evaluate the potential to generate sheen during dredging:

- **RAAs where Phase III samples will be collected** – If the collection of samples considered representative of the planned dredge area are planned as part of the Phase III PDI, sheen testing will be conducted for a minimum of one sample per RAA.

  - *Selection of representative sampling location* – For RAAs where Phase III sampling is planned, one Phase III location has been selected for sheen testing. In most cases, this location represents a vertical extent core. However, in some cases where a Phase III vertical extent core is not planned in an RAA, a Phase III non-vertical sample (i.e., surface [0- to 10-cm] or subsurface [0- to 45-cm or 0- to 60-cm]) has been selected for sheen testing, provided the sample is representative of the dredge depth or elevation within the RAA.
  - *Selection of interval for vertical cores* – For vertical extent cores identified for sheen testing, testing will be conducted for at least one interval during core processing. The interval identified for sheen testing will be within the dredge elevation or dredge thickness from 30% RD (Anchor QEA and Windward 2025b), and will be determined by the field crew based on the following considerations:
    - Visual examination of the core for the presence of sheen or non-aqueous-phase liquid
    - Photoionization detector readings (taken at 1-foot intervals during core processing)
    - Presence of petroleum odor during processing
  - *Additional testing* – If any Phase III vertical cores not identified for sheen testing meet the above criteria, indicating the potential for sheen-producing material, sheen testing will also be conducted on those cores (one interval per core).
- **RAAs where no Phase III samples are planned** – If no sampling is planned as part of the Phase III PDI in RAAs where dredging is planned, sheen testing will be conducted on frozen, archived samples from the Phase II PDI (a minimum of one sample per RAA [or group of RAAs] will be tested). The selection of specific samples for sheen testing was based on a review of field logs (e.g., for notes regarding sheen or odor) and information regarding historical land use. The frozen sample will be thawed prior to conducting the shake test. Because the shake test will concentrate any sheen-producing material within each sample, the freezing and thawing of the archived samples is not expected to affect the results of the shake test.

The Phase III sampling locations and archived Phase II samples where sheen testing will be conducted are identified in Table B-4 of Appendix B and are shown on Map 5-5. The procedures for conducting a shake test (which will utilize sediment-water shake kits) are described in SOP E31 in Appendix C.

5.10 Characterization of Precipitate Layer in the Inlet at RM 2.2W

As described in the draft remedial investigation (RI) report for the Industrial Container Services Site (DOF 2024), a hard layer of material (referred to as a precipitate layer) is present along the northern portion of the inlet at RM 2.2W (RAAs 24C and 24D). The RI states the following with regard to this material: "Near the mouth, it appears that waste concrete was deposited from the upland (Douglas Property) shoreline. Within the central and upper portions of the embayment the relatively harder surface appears to be a precipitate that has cemented sand and other particulates. Exploration in a number of locations indicated the deposit to be 8 to 10 inches in thickness." The RI further suggests that the source of this material was likely waste concrete from the former Seattle Ready Mix plant that operated on the southern portion of the Douglas Property in the 1970s.

5.10.1 Phase III Investigation Approach

Attempts to collect sediment samples in this area using a vibracorer were not successful during Phase II. To help inform the design in this area, Phase III data gaps related to the area with this precipitate layer include the following:

- Delineation of the horizontal extent and thickness of the precipitate layer (DQO 14) (primary objective)
- Characterization of sediment concentrations under the precipitate layer, if sampling below the layer is feasible (DQO 12) (secondary objective)

The methods for determining extent and thickness of precipitate, as well as those for how to characterize sediment concentrations under the precipitate layer, are described in SOP E29 (Appendix C). A diver will use an underwater-capable core drill with a diamond core bit (or other similar equipment) to core through the precipitate layer. Once through, the precipitate layer, or "plug," can be withdrawn from the corer or pried from the mudline and retained for thickness measurements, field observations, and possible geotechnical analysis. After visual inspection, if an intact length of the precipitate layer is obtained, the precipitate layer material will be submitted for an unconfined compression (ASTM International D2166) analysis. This analysis will inform the feasibility of removing and technologies used to remove the precipitate layer. After the hole is opened, sediment sampling can take place. A diver will guide the sediment sampling equipment to ensure reoccupation of the drilled hole.

Precipitate coring will take place at eight locations (i.e., approximately every 50 feet) to delineate the thickness of the precipitate layer (Map 4-1l and Map 5-2c). A composite sample of the precipitate layer material will be collected from the recovered material at the eight locations, excluding any intact length submitted for unconfined compression analysis, for waste profiling. Waste profiling is detailed in Section 5.6 and will be consistent with the information provided for RAAs 24C and 24D. If

possible, sediment sampling will take place at up to three of the precipitate coring locations. Based on depth of contamination observed in Phase II data, sediment cores will be advanced to a target elevation of -5 feet MLLW, or as deep as possible depending on field conditions. Specific sampling locations will be determined in the field. In conjunction with drilling, sediment probing will take place, as described in Section 5.2, to determine the horizontal extent of the precipitate layer. Health and safety procedures specific to the Inlet at RM 2.2W will be followed, as described in QAPP Addendum No. 2 for the middle reach (Anchor QEA and Windward 2024c). In addition, this work will be conducted in accordance with the updated, site-specific Dive Safety and Work Plan (Appendix E).

5.10.2 Management of Surface Water Sheens

There is potential for surface water sheens to develop during investigation of the precipitate layer. To ensure any sheen observed is managed appropriately, sheens resulting from the disturbance of sediment during the investigation will be handled using the following procedures:

- The field team will take photographs to document the sheen and record information regarding the sampling location(s) where sheen is observed. Sampling may be paused depending on the extent of the sheen if response actions are needed.
- Sorbent booms will be deployed to capture any significant sheen[15] observed on the water surface. The sorbent booms may be deployed and managed by a small support vessel to allow the sampling vessel to continue operating without interruption.
- Depending on the size and extent of the sheen observed, the National Response Center will be contacted to advise on additional mitigation measures and appropriate agency notifications, if necessary.

The EPA project manager will be notified during field work if surface water sheens requiring the deployment of sorbent booms and/or notification of the National Response Center are observed.

[15] Action will not be required for small sheens that dissipate rapidly. Significant sheens (i.e., those requiring action) will be those that extend more than 500 feet from the point of sampling.

6 Assessment and Oversight

Protocols outlined in Sections 7.1 and 7.2 of the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c) for compliance assessments and response actions and reports to management will be followed.

After the Phase III PDI sample collection and analysis efforts are complete, the middle reach design dataset will be supplemented with the Phase III data and used in RD. The Phase III data and an updated RAL exceedance area interpolation will be incorporated into 90% RD. Phase III data will be presented in an appendix to the 90% RD report. The appendix will contain the following:

- Summary of all field activities, including descriptions of any deviations from the approved QAPP Addendum for Phase III
- Sampling locations reported in latitude and longitude to the nearest one-tenth of a second and in northing and easting to the nearest foot
- Sample elevations (feet MLLW) and depths below mudline
- Summary of the chemical data QA/QC review
- Summary of field QC result evaluation
- Results from the analyses of sediment and an updated table with reoccupied results
- Results of data collection efforts related to other engineering data

In addition, a data package with Phase III sediment collection, analysis, and toxicity testing details will be posted to https://ldwg.org/. The package will include Phase III data and sampling locations, copies of field logs and representative photographs, chain of custody forms, and laboratory and data validation reports. The Phase III data package will be submitted to EPA 10 days after validated data are received.

Once the 100% RD has been approved by EPA, toxicity testing results and chemistry database exports will be created for Phase III from the project SQL Server database and submitted to Ecology (Environmental Information Management) and EPA (Scribe), as specified in the middle reach PDI QAPP (Windward and Anchor QEA 2022) and Phase II QAPP Addenda (Anchor QEA and Windward 2024b, c).

7 References

Anchor QEA, Windward. 2024a. Final (100%) remedial design basis of design report for Lower Duwamish Waterway upper reach. Submitted to EPA January 16, 2024. Anchor QEA and Windward Environmental LLC, Seattle, WA.

Anchor QEA, Windward. 2024b. Pre-Design Investigation Quality Assurance Project Plan Addendum No. 1 for the Lower Duwamish Waterway Middle Reach - Phase II Sampling. Final. Anchor QEA and Windward Environmental LLC, Seattle, WA.

Anchor QEA, Windward. 2024c. Quality assurance project plan addendum No. 2 for the Lower Duwamish Waterway middle reach - Phase II sampling for the Inlet at RM 2.2W. Draft. Submitted to the US Environmental Protection Agency April 19, 2024. Anchor QEA and Windward Environmental LLC, Seattle, WA.

Anchor QEA, Windward. 2025a. Pre-design investigation data evaluation report for the Lower Duwamish Waterway - middle reach. Final. Submitted to EPA September 30, 2025. Anchor QEA and Windward Environmental LLC, Seattle, WA.

Anchor QEA, Windward. 2025b. Preliminary (30%) remedial design basis of design report for the Lower Duwamish Waterway Middle Reach. Submitted to EPA October 27, 2025. Anchor QEA and Windward Environmental LLC, Seattle, WA.

Cowardin LM, Carter V, Golet FC, LaRoe ET. 1979. Classification of wetlands and deepwater habitats of the United States. 1985 edition. Office of Biological Services, US Fish and Wildlife Service, Washington, DC.

City of Seattle, 2024. Seattle Department of Construction and Inspections, Directors's Rule 7-2024. Effective November 7, 2024. Available at: https://www.seattle.gov/dpd/codes/dr/DR%207-2024.pdf.

DOF. 2024. Remedial investigation report, Industrial Container Services, WA, LLC (former NW Cooperage Site). Prepared for Industrial Container Services, WA, LLC (ICS-WA). Dalton, Olmsted, and Fuglevand.

Ecology. 2021. Biological testing methods 80-12 for the designation of dangerous waste, static acute fish toxicity test. Hazardous Waste and Toxics Reduction Program, Washington State Department of Ecology, Olympia, WA.

Environmental Laboratory. 1987. Corps of Engineers wetland delineation manual. Wetlands Research Program technical report Y-87-1. US Army Corps of Engineers, Waterways Experiment Station.

EPA. 2006. Guidance on systematic planning using the data quality objectives process. EPA/240/B-06/001, EPA QA/G-4. Office of Environmental Information, US Environmental Protection Agency, Washington, DC.

EPA. 2014. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

EPA. 2021a. Fifth Amendment to the Administrative Order on Consent for remedial investigation/feasibility study (AOC) for the Lower Duwamish Waterway (LDW), CERCLA-10-2001-0055. US Environmental Protection Agency, Region 10, Olympia, WA.

EPA. 2021b. Proposed explanation of significant differences. September 2021. Lower Duwamish Waterway Superfund site. US Environmental Protection Agency Region 10, Seattle, WA.

FGDC. 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second edition. Wetlands Subcommittee, Federal Geographic Data Committee.

Hruby T, Yahnke A. 2023. Washington State wetland rating system for Western Washington 2014 update version 2.0. Publication 23-06-009. Shorelands and Environmental Assistance Program, Washington State Department of Ecology, Olympia, WA.

LDWG. 2025a. LDW middle reach - archive PDI sediment samples to be analyzed (tier 2c) and response to EPA comments on the August 2025 Tier 2b memorandum. Prepared by Anchor QEA and Windward Environmental LLC. Lower Duwamish Waterway Group, Seattle, WA.

LDWG. 2025b. LDW middle reach - archive PDI sediment samples to be analyzed. Prepared by Anchor QEA and Windward Environmental LLC. Lower Duwamish Waterway Group, Seattle, WA.

Munsell. 2012. Munsell Soil-Color Charts: with Genuine Munsell Color Chips. 2012 year revised. Munsell Color, Grand Rapids, MI.

USACE. 2010. Regional supplement to the Corps of Engineers wetland delineation manual: western mountains, valleys, and coast region (version 2.0). ERDC/EL TR-10-3. US Army Corps of Engineers Environmental Laboratory, Vicksburg, MS.

USACE. 2023. 2022 national wetland plant list, version 3.6. Western mountains, valleys, and coast region. US Army Corps of Engineers, US Army Engineer Research and Development Center, Vicksburg, MS.

USDA, NRCS. 2018. Field indicators of hydric soils in the United States. A guide for identifying and delineating hydric soils, Version 8.2, 2018. Edited by Vasilas, L M; Hurt, G W; and Berkowitz, J F. US Department of Agriculture and Natural Resources Conservation Service.

USFWS. 2026. National Wetlands Inventory [online]. US Fish and Wildlife Service, Arlington, VA. [Cited January 7, 2026.] Available from: http://www.nwi.fws.gov/.

Windward, Anchor QEA. 2022. Pre-design investigation quality assurance project plan for the Lower Duwamish Waterway - Middle Reach. Final. Submitted to EPA November 21, 2022. Windward Environmental LLC and Anchor QEA, Seattle, WA.

Windward, Anchor QEA. 2023. Pre-design investigation work plan for the Lower Duwamish Waterway - Middle Reach. Final. Submitted to EPA February 14, 2023. Windward Environmental LLC and Anchor QEA, Seattle, WA.

Appendix A
Updated Analytical Methods, DQIs, and Requirements

Appendix B
Phase III Sampling Location Details

Appendix C
Updated Standard Operating Procedures

Appendix D
Data Generation and Acquisition for SMA 10

Appendix E
Updated Site-Specific Dive Safety and Work Plan

Appendix F
Updated Field Forms

Appendix G
Tier 2b and Tier 2c Memoranda