

## Appendix M

### 30% Remedial Design Opinion of Probable Cost

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Attachment M-1	Detailed Cost Estimate Workbook
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## ABBREVIATIONS

BODR	Basis of Design Report
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
MLLW	mean lower low water
RAA	Remedial Action Area
RD	Remedial Design
RDWP	Remedial Design Work Plan
RM	river mile
RMC	residuals management cover
ROD	Record of Decision
ZVI	zero valent iron

# 1 Introduction

This appendix presents the Preliminary (30%) Remedial Design (RD) Opinion of Probable Cost and associated cost assumptions for the sediment remedy for the upper reach (river mile [RM] 3.0 to RM 5.0) of the Lower Duwamish Waterway (LDW) Superfund Site in King County, Washington. The design process is presented in the Remedial Design Work Plan (RDWP) (Anchor QEA and Windward 2019) for the remedy selected in U.S. Environmental Protection Agency's (EPA's) November 2014 Record of Decision (ROD) (EPA 2014). This Preliminary (30%) RD Opinion of Probable Cost was prepared in support of the Basis of Design Report (BODR), which corresponds to the Preliminary (30%) RD, based on the design information provided in the Preliminary Drawings (Appendix D to the BODR).

This Preliminary (30%) RD Opinion of Probable Cost evaluation was prepared on behalf of the City of Seattle, King County, the Port of Seattle, and The Boeing Company, collectively referred to as the Lower Duwamish Waterway Group (LDWG).

Based on the BODR's design criteria and other key elements for implementing the sediment remedy, this appendix outlines the basis and rationale for the Preliminary (30%) RD Opinion of Probable Cost and includes the following supporting information:

- **Section 2.** Sources of Cost Information and Costing Approach
- **Section 3.** Direct and Indirect Construction Tasks
- **Section 4.** Costing Assumptions Used for Preliminary (30%) Remedial Design
- **Section 5.** Dredge and Material Placement Quantities Summary
- **Section 6.** Costs Summary

Attachment M-1 contains the detailed cost estimate workbook for the Preliminary (30%) RD Opinion of Probable Cost, organized as follows:

- Table M-1.1: Summary 30% RD Opinion of Probable Cost
- Table M-1.2: Detailed 30% RD Opinion of Probable Cost
- Table M-1.3: Detailed Notes
- Table M-1.4: Detailed Quantities
- Table M-1.5: Production Rates and Durations
- Table M-1.6: Detailed Structural Work Costs

## 2 Sources of Cost Information and Costing Approach

The development of the Preliminary (30%) RD Opinion of Probable Cost was based on a multiple-step process to derive site-specific unit costs and lump sum prices for the upper reach sediment remedy; this process consisted of using both parametric and bottom-up costing approaches.

Parametric costing uses historical cost data to assign a dollar value to certain project costs.

Parametric costing applied to this Opinion of Probable Cost consisted of reviewing historical unit costs for similar sediment remediation and/or dredging projects completed locally and regionally, based on their relevance and applicability to the upper reach (i.e., similar quantities and/or remediation conditions).

In bottom-up costing, the large project is broken down into a number of smaller components, and costs are specifically derived for each of these smaller work components. Bottom-up costing applied to this Opinion of Probable Cost was developed by estimating labor, equipment, and other ancillary add-ons for each construction activity based on engineering cost guidance (e.g., RS Means) and past project experience. By comparing bottom-up costs with parametric cost information, along with engineering best professional judgment, “probable” unit costs and “probable” lump sums were then derived.

In addition, a three-point estimating approach was applied to provide a costing range around the “probable” (or “most likely”) cost scenario. In three-point estimating, three separate cost scenarios for the costs associated with the project were generated. While the first point represents an “optimistic” or “lower” cost scenario (assumed to have a 10% decrease in unit costs relative to the “probable” unit costs), the second point represents a “conservative” or “upper” cost scenario (assumed to have a 20% increase in unit costs relative to the “probable” unit costs). The “probable” (or “most likely”) cost scenario represents the third point, which typically falls somewhere in the middle of the first and second cost scenarios.

To support the Preliminary (30%) RD Opinion of Probable Cost, several sources of information were reviewed, including the following:

- Contractors’ bid costs and engineers’ construction cost estimates for similar sediment remediation and/or dredging projects completed locally (in the Seattle area) and regionally (in the Pacific Northwest), as well as knowledge of construction activities and challenges identified during construction oversight. The following project costs were reviewed:
  - Glacier Northwest, Inc., Terminal Maintenance Dredging (Seattle, Washington)
  - Terminal 18 Maintenance Dredging (Seattle, Washington)
  - J.A. Jack & Sons, Inc. and Lehigh Hanson Berths Maintenance Dredging (Seattle, Washington)
  - Denny Way CSO Nearshore Interim Sediment Cleanup (Seattle, Washington)

- Terminal 117 Phase 1 Sediment and Upland Cleanup (Seattle, Washington)
- Jorgenson Forge Sediment Remediation – LDW Early Action Area (Seattle, Washington)
- Slip 4 Sediment Remediation – LDW Early Action Area (Seattle, Washington)
- Port Gamble Bay Sediment Cleanup Project (Port Gamble, Washington)
- Whatcom Waterway Phase 1 Sediment Cleanup (Bellingham, Washington)
- Port of Olympia Marine Berths 2 & 3 Interim Action Dredging (Olympia, Washington)
- Anchor QEA’s engineering best professional judgment based on past experience with similar remedial actions and associated pricing, as well as project-specific considerations that influence key cost factors (e.g., production rates)
- Engineering cost guidance (RS Means)

Some of the above-referenced projects were recently constructed, while others were completed more than 10 years ago. The age of the reference project bid cost data was considered when reviewing historical sediment remediation costs (i.e., unit costs were adjusted for standard inflation to present-day U.S. dollars [2022] for comparison to current costing of the upper reach sediment remedy).

### 3 Direct, Indirect Construction, and Additional Construction Oversight Tasks

This section describes the activities used to develop costs for direct construction (Section 3.1), indirect construction (Section 3.2), and additional construction oversight (Section 3.3) tasks. Additional detailed descriptions of these tasks are provided in Attachment M-1 (see Table M-1.3).

#### 3.1 Direct Construction Tasks

Direct construction tasks include all construction activities anticipated to be conducted by the contractor. The following direct construction tasks are included in this Preliminary (30%) RD Opinion of Probable Cost:

- **Mobilization and demobilization** include the costs associated with mobilizing and demobilizing personnel and marine/land equipment, procedures, contractor work plan development and other submittals, and the contractor site office and administration. Special bonding and insurance are assumed to be included under this task.
- **Site preparation** includes the costs associated preparing the work site—clearing and grubbing upland areas prior to excavation—and preparation, setup, and maintenance of the upland staging area<sup>1</sup>.
- **Surveys** include the costs for contractor pre- and post-construction bathymetric and topographic surveys, including progress, post-dredge, post-placement bathymetric/topographic, and as-built surveys.
- **Structural work** includes the costs for temporary dismantle, relocation, and reinstallation of floats; removal and replacement of timber bulkheads; and removal, replacement, offloading, upland transportation, and disposal of timber/steel pile and dolphins. Costs for outfall abandonment, temporary support, and apron installation are included under the structural work task.
- **Dredging and excavation** activities include costs for dredging, contingency re-dredging, excavation, in-water barge transportation, and debris removal/disposal.
- **Transloading, upland transportation, and disposal** activities include costs for transloading dredged sediment and debris at the transload facility.

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<sup>1</sup> As described in Section 10.2.5 of the BODR, it is assumed that the LDW upper reach project will rely on established commercial transload facilities in close proximity (Duwamish Reload Facility, operated by WM [formerly Waste Management], and 5400 W. Marginal Way facility, operated by Lafarge North America) that could readily be used for offloading from barges and onloading to trucks or rail cars for transportation to a disposal facility. Therefore, no costs have been included in this cost estimate for developing a project-specific transload facility.

- **Material placement** activities include costs for material procurement, material transport to the site, and placement of backfill, engineered cap, residuals management cover (RMC), and enhanced natural recovery (ENR) materials.
- **Environmental controls** include costs for environmental protection during construction by providing an allowance for controls and best management practices.

Additional contractor health and safety, quality control, and project management costs were not separately estimated, as they are assumed to be included under the lump sum for mobilization/demobilization costs.

### 3.2 Indirect Construction Tasks

Indirect construction tasks include additional activities to provide quality assurance that are necessary to the project but are performed by parties other than the contractor. The following indirect construction tasks have been included in this Preliminary (30%) RD Opinion of Probable Cost:

- **Construction management (CM) and engineering support service** costs involve providing oversight of the contractor's implementation of the sediment remedy. CM typically refers to in-field work to oversee the contractor's work and includes construction inspection, progress tracking and reporting, reviewing progress payment requests, reviewing contractor submittals and work plans, addressing contractor Requests For Information and change order requests, leading adaptive design changes, and communicating with the Implementing Entity and EPA. Engineering support services are typically provided from the office and include design interpretation, contingency action decision coordination, change order negotiation support, and closeout report preparation.
- **Confirmational sediment sampling and contingency action determination** costs include collecting post-dredge confirmatory sediment samples and determining the need for contingency actions.
- **Environmental monitoring** costs include water quality monitoring activities during construction.
- **Site access agreements and temporary leases** include costs for leases, if needed, and coordination costs associated with site access (e.g., directed barge or vessel temporary relocations, Tribal Usual and Accustomed Fishing agreements).

### 3.3 Additional Construction Oversight Tasks

Additional construction oversight tasks include supplemental activities conducted by the Implementing Entity and EPA to provide quality assurance during construction.



## 4 Costing Assumptions Used for Preliminary (30%) Remedial Design

The Preliminary (30%) RD criteria form the basis for development of the upper reach Opinion of Probable Cost. General and specific RD costing assumptions are summarized in this section. Further details are contained in the Preliminary Drawings (Appendix D to the BODR) and in the cost estimate workbook (Attachment M-1).

### 4.1 General Costing Assumptions

The following are general assumptions used in the cost estimate:

- **Construction seasons:** In-water construction activities for the LDW upper reach will occur during fish windows designated for the LDW (generally from October 1 through February 15, equivalent to 138 calendar days). Therefore, remedial construction for the LDW upper reach is assumed to span over two construction seasons based on the Preliminary (30%) RD production rates for dredging, material placement, and structural activities (see Sections 10.2.4 and 10.5.6 of the BODR), and as governed by the fish windows.<sup>2</sup>
- **Daily work schedule:** It is assumed that work will be performed in 1 10-hr shift per day, 6 days a week, during the following work hours: 7:00 am to 7:00 pm (on weekdays) and 9:00 am to 7:00 pm (on Saturdays). Note that this assumption is for cost purposes only; actual work hour limits, to the extent they will be specified, will be included in the project technical specifications.
- **Sales tax:** Sales tax is included at 10.25% to account for Washington State (6.5%) and the City of Seattle (3.75%) taxes. Although the upper reach RAAs fall into both the Cities of Seattle and Tukwila jurisdictions, for the purposes of this opinion of probable cost, sales tax for the City of Seattle is included as a conservative assumption for Preliminary (30%) RD; sales tax for the City of Tukwila tax rate is 10.1%.
- **Contingency:** A 30% contingency is applied to total direct construction, indirect construction, and additional construction oversight costs, based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgement. Due to the nature of the project (i.e., environmental sediment remediation), additional factors that cannot be forecasted at this time—such as scope unknowns (i.e., significant changes in site conditions or quantities), price uncertainty (i.e., varying market conditions, increasing inflation, fuel and labor changes), or any other unforeseen circumstances (i.e., additional design requirements)—may influence

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<sup>2</sup> A third construction season may be required depending on the sequencing of work elements and overall production rates. Production rates and the anticipated construction schedule will be refined in the Intermediate (60%) RD.

contractor bidding prices and impact the final project costs outside, in excess, or below this contingency.

All costs in this Preliminary (30%) RD Opinion of Probable Cost are presented in present-day U.S. dollars (i.e., 2022).

## 4.2 Specific Remedial Design Costing Assumptions

The following specific RD assumptions are incorporated into the Preliminary (30%) RD Opinion of Probable Cost:

- **Required Dredging:**
  - Required cut thicknesses or elevations for the Remedial Action Areas (RAAs) and associated side-slopes, as shown in the Preliminary Drawings (Appendix D to the BODR)
  - Overdredge allowance of 1 ft in excess of the required cut thickness or elevation within the dredge footprint and associated side-slopes
  - Dredging around existing structures considers horizontal offset requirements based on adjacent required sediment removal elevations/thickness cuts and associated short- and long-term structure stability (see Section 9 of the BODR).
- **Contingency Re-Dredging:** Conducted over a portion of the total dredge area, related assumptions are as follows:
  - 15% of the total dredge area to be re-dredged to a total 1-ft thickness (including a 6-in overdredge allowance) to address generated residuals that have concentrations elevated above RMC placement criteria
  - An additional 20% of the total dredge area to be re-dredged to a total 2.5-ft thickness (including a 6-in overdredge allowance) to remove missed inventory
- **Debris:** An estimated 650 tons of larger debris are assumed for this cost estimate for discrete and separate removal and disposal, based on visual aerial observations, shoreline photograph inventory, and measurements derived from ArcGIS LDW webmap imagery of the LDW upper reach shorelines/banks; debris includes those items generally larger than 12 in. in size. For this Opinion of Probable Cost, buried and smaller debris is considered to be incidental debris, and its removal, transportation, and disposal are accounted for in the total dredge volume.
- **Structural work:** This item includes the costs for temporary dismantling, relocation, and reinstallation of the South Park Marina floats; removal of 88 piles from the Boeing Thompson stub pile timber bulkhead and associated replacement; and removal, replacement, offloading, upland transportation, and disposal of 93 timber/steel pile and dolphins from Container Properties and Boeing Developmental Center. Costs for outfall abandonment, temporary support, and apron installation are included under the structural work task.

- **Disposal of dredge/excavated sediment, at permitted off-site Subtitle D and C disposal facilities:** For costing purposes, and although no Subtitle C-level materials have been identified in the design dataset, an allowance of 2% of the total dredge volume is included for disposal at a Subtitle C landfill and the remaining percentage at a Subtitle D landfill.
- **Stand-by Time:** Assumed for costing purposes to be 15 days total over the two construction seasons. This is the time for work stoppage related to relocation of contractor construction equipment to accommodate emergencies, downtime due to inclement weather, and/or directed but unexpected operational needs (i.e., unforeseen or unplanned vessel access or passage through the upper reach).
- **Placement of backfill:**
  - Backfill is intended to restore, for habitat purposes, the sediment bed to pre-construction elevations and to flatten temporary steeper dredge cuts (e.g. along the Boeing Plant 2 EAA).
  - For Preliminary (30%) RD, all dredge areas located outside of the Federal Navigation Channel (FNC) and above elevation -10 ft mean lower low water [MLLW]), are assumed to be backfilled and integrated with habitat material placement in intertidal areas as appropriate, as shown in the Preliminary Drawings (Appendix D) to the BODR; see also Section 10.2.9 of the BODR. As described in Section 14.1 of the BODR, the backfill design will be developed during Intermediate (60%) RD, as backfill volumes are dependent on the final dredge cut surface and may not exactly match the pre-dredge elevations due to equipment placement accuracy, and geotechnical properties of the placement materials.
  - For costing purposes, backfill material is assumed to conform to a granular gravelly sand material.
- **Placement of RMC:**
  - RMC placement will be directed based on post-dredge confirmation sample analytical results. The dredge residuals management approach (including sampling, reporting, decision logic, and communication) will be detailed in the CQAP in the Intermediate (60%) RD (see Section 10.2.8 of the BODR).
  - For costing purposes, RMC is assumed to be placed over 100% of the dredge area that does not receive backfill or a cap. RMC placement footprint includes side slopes areas and an additional 10% footprint [approximately equivalent to a 10-ft buffer surrounding the dredge area] in specific RAAs (as shown in the Preliminary Drawings [Appendix D to the BODR])
  - For costing purposes, RMC is assumed to be applied at a minimum 6-in. thickness, with a 3-in. maximum overplacement allowance.
  - For costing purposes, RMC is assumed to conform to a medium-to-coarse grained sand.

- **Placement of ENR:**
  - ENR will be placed in specific RAAs (as shown in the Preliminary Drawings [Appendix D to the BODR]). The ENR quantity assumes a placement footprint that includes a 10-ft buffer around the planned ENR placement area.
  - For costing purposes, ENR is assumed to be applied at a minimum 6-in. thickness, with a 6-in. maximum overplacement allowance.
  - For costing purposes, ENR is assumed to conform to a medium-to-coarse grained sand.
- **Placement of engineered cap:**
  - As described in Section 10.3.2 of the BODR, two options are available for management of the contaminated sediments of RAA 18. For this Preliminary (30%) RD and consistent with the Preliminary Drawings (Appendix D) to the BODR, the RAA 18 interim cap design assumptions (Option 2) are used for costing purposes, assuming that the engineered cap is limited to portions of RAA 18 (50% of the RAA 18 footprint) and outside of the FNC.
  - The engineered cap is assumed to consist of two layers, one for chemical isolation and one for erosion protection:
    - For costing purposes, the chemical isolation layer is assumed to be 1.5 ft thick with a 6-in. maximum overplacement allowance. It is also assumed to conform to medium-to-coarse sand amended with zero valent iron (ZVI) (for costing purposes and only to address arsenic exceedances in RAA 18, ZVI dose assumed to be 10% by weight, as described in Section 10.3.3 of the BODR and Appendix G).
    - For costing purposes, the erosion protection/filter layer is assumed to be 6 in. thick with a 6-in. maximum overplacement allowance; it is also assumed to conform to mixed cobble-sized aggregate and gravel.
  - For costing purposes, the engineered cap also assumes a 1.5-ft-thick surficial layer for clam habitat substrate to be placed above the engineered cap, intended to restore similar habitat substrate materials to the sediment bed; the habitat materials are assumed to conform to a granular gravelly sand.
- **Construction management and engineering support:** This cost is assumed on a monthly basis for the total construction duration.
- **Confirmational sediment sampling:** This includes costs for equipment, labor, analytical, and data validation. Sediment sampling of surface grabs and cores is assumed to occur throughout the total dredge area post-dredging to evaluate the potential need for contingency re-dredging.
- **Environmental monitoring (water quality):** This includes costs for equipment, labor, and field measurements of water samples collected during dredging and placement activities.

Costs for environmental monitoring of water quality are assumed on a monthly basis for the total dredging and placement duration.

- **Site access agreements and temporary leases:** This is assumed to include allowances for Tribal Usual and Accustomed fishing agreements and directed barge or vessel temporary relocations. It is not anticipated that special leases will be required.
- **Implementing Entity construction oversight:** This cost is assumed on a monthly basis for the total construction duration.
- **EPA construction oversight:** This cost is assumed on a monthly basis for the total construction duration.

## 5 Dredge and Material Placement Quantities Summary

Preliminary (30%) RD dredging and material placement quantities for the LDW upper reach are summarized in Tables M-1 and M-2, respectively.

**Table M-1**  
**Summary of Preliminary (30%) RD Dredging Quantities**

Required Dredge Volume (CY)	Overdredge Allowance Volume (CY)	Contingency Re-Dredging Volume (CY)	Total Payable Dredge Volume <sup>1</sup> (CY)
84,900	22,600	10,200	117,700

Note:

1. Volumes are rounded to the nearest hundred. See Attachment M-1 (Table M-1.4) for detailed dredging quantities. Total payable dredge volume includes: 1) required dredge volume, including associated external side-slope and transition (between RAAs) volumes, as shown on the Preliminary Drawings (Appendix D); 2) 1-ft overdredge allowance on the entire dredge footprint; and 3) contingency re-dredging volume. Includes required dredge and excavation volumes.

CY: cubic yards

**Table M-2**  
**Summary of Preliminary (30%) RD Material Placement Quantities**

Backfill Placement Volume (CY)	RMC Placement Volume (CY)	ENR Placement Volume (CY)	Engineered Cap (RAA 18) Volume (CY)	Total Placement Volume (CY)
56,400	8,300	1,000	2,100	67,800

Note:

1. Volumes are rounded to the nearest hundred. See Attachment M-1 (Table M-1.4) for detailed material placement quantities.

CY: cubic yards

ENR: enhanced natural recovery

RAA: remedial action area

RD: remedial design

RMC: Residuals Management Cover

## 6 Costs Summary

The Opinion of Probable Cost for Preliminary (30%) RD for the upper reach is summarized in Table M-3.

As described in Section 4.1, a contingency of 30% was applied at the Preliminary (30%) RD level to the total direct construction, total indirect construction, and total additional construction oversight costs. This contingency is based on potential cost uncertainty associated with the level of information currently available and best professional judgement. It also accounts for scope unknowns, price uncertainty, and any other unforeseen circumstances that may impact the final project costs.

In addition, specific construction tasks are included in this Preliminary (30%) RD Opinion of Probable Cost but considered as allowances to cover potential costs incurred due to uncertainty in the associated scope. These construction elements will be refined as more information becomes available in the next RD phase (Intermediate [60%] RD). Two types of allowances are included: 1) allowances for construction tasks considered reasonably likely to occur and their scope, which is pending further design (e.g., contingency re-dredging, debris quantity, stand-by time, and potential need for capping amendment in RAA 18); and 2) allowances for construction tasks considered highly unlikely to occur but are still presented pending further design (e.g., presence of hazardous waste, environmental controls).

**Table M-3**  
**Total Project Cost for LDW Upper Reach Implementation**

Task ID	Task Description	Lower Probable Total Cost (\$)	Probable Total Cost (\$)	Upper Probable Total Cost (\$)
<b>Direct Construction Costs</b>				
1	Mobilization/Demobilization	\$2,142,000	\$2,380,000	\$2,856,000
2	Site Preparation	\$245,000	\$278,000	\$338,000
3	Surveys	\$675,793	\$920,385	\$1,218,878
4	Structural Work	\$2,192,951	\$2,436,612	\$2,923,934
5	Dredging, Excavation, Transloading, Upland Transportation, and Disposal	\$19,220,322	\$21,356,080	\$25,627,596
6	Material Placement	\$3,997,163	\$4,380,235	\$5,145,925
7	Environmental Controls	\$90,000	\$100,000	\$120,000
<b>Direct Construction Costs Subtotal</b>		<b>\$28,563,229</b>	<b>\$31,851,312</b>	<b>\$38,230,334</b>
8	Direct Construction Contingency (30.0 %)	\$8,568,969	\$9,555,394	\$11,469,100
<b>Direct Construction Costs Subtotal with Contingency</b>		<b>\$37,132,198</b>	<b>\$41,406,706</b>	<b>\$49,699,434</b>
9	Sales Tax (10.25%)	\$3,806,050	\$4,244,187	\$5,094,192
<b>Total Direct Construction Costs (with Contingency and Sales Tax) – Rounded</b>		<b>\$40,939,000</b>	<b>\$45,651,000</b>	<b>\$54,794,000</b>
<b>Indirect Construction Costs</b>				
10	Other Indirect Construction Costs	\$3,020,400	\$3,356,000	\$4,027,200
<b>Indirect Construction Costs Subtotal</b>		<b>\$3,020,400</b>	<b>\$3,356,000</b>	<b>\$4,027,200</b>
11	Indirect Construction Contingency (30.0 %)	\$906,120	\$1,006,800	\$1,208,160
<b>Total Indirect Construction Costs (with Contingency) – Rounded</b>		<b>\$3,927,000</b>	<b>\$4,363,000</b>	<b>\$5,236,000</b>
<b>Additional Construction Oversight Costs</b>				
12	Additional Construction Oversight Costs	\$826,200	\$918,000	\$1,101,600
<b>Additional Construction Oversight Costs Subtotal</b>		<b>\$826,200</b>	<b>\$918,000</b>	<b>\$1,101,600</b>
13	Additional Construction Oversight Contingency (30.0 %)	\$247,860	\$275,400	\$330,480
<b>Total Additional Construction Oversight Costs (with Contingency) - Rounded</b>		<b>\$1,075,000</b>	<b>\$1,194,000</b>	<b>\$1,433,000</b>
14	<b>Total Project Costs</b>	<b>\$45,941,000</b>	<b>\$51,208,000</b>	<b>\$61,463,000</b>

Notes:

1. Costs are presented in present-day US dollars (i.e., 2022).
2. Sales tax is included at 10.25% to account for Washington State (6.5%) and the City of Seattle (3.75%) taxes.
3. Attachment M-1 contains the detailed cost estimate workbook for the Preliminary (30%) RD Opinion of Probable Cost.
4. Long-term monitoring costs are not included in this opinion of probable cost as assumptions for these activities will be developed consistent with the Long-Term Maintenance and Monitoring Plan in subsequent RD phases.



Attachment M-1

Detailed Cost Estimate Workbook

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**Table M-1.1 Summary 30% Remedial Design Opinion of Probable Cost**

Task ID	Task Description	Lower Probable Total Cost (\$)	Probable Total Cost (\$)	Upper Probable Total Cost (\$)
<b>DIRECT CONSTRUCTION COSTS</b>				
1	Mobilization/Demobilization	\$ 2,142,000.00	\$ 2,380,000.00	\$ 2,856,000.00
2	Site Preparation	\$ 245,000.00	\$ 278,000.00	\$ 338,000.00
3	Surveys	\$ 675,793.00	\$ 920,385.00	\$ 1,218,878.00
4	Structural Work	\$ 2,192,951.00	\$ 2,436,612.00	\$ 2,923,934.00
5	Dredging, Excavation, Transloading, Upland Transportation, and Disposal	\$ 19,220,322.00	\$ 21,356,080.00	\$ 25,627,596.00
6	Material Placement	\$ 3,997,163.00	\$ 4,380,235.00	\$ 5,145,925.00
7	Environmental Controls	\$ 90,000.00	\$ 100,000.00	\$ 120,000.00
<b>Direct Construction Costs Subtotal</b>		<b>\$ 28,563,229.00</b>	<b>\$ 31,851,312.00</b>	<b>\$ 38,230,334.00</b>
8	Direct Construction Contingency (30.0%)	\$ 8,568,969.00	\$ 9,555,394.00	\$ 11,469,100.00
<b>Direct Construction Cost Subtotal with Contingency</b>		<b>\$ 37,132,198.00</b>	<b>\$ 41,406,706.00</b>	<b>\$ 49,699,434.00</b>
9	Sales Tax (10.25%)	\$ 3,806,050.00	\$ 4,244,187.00	\$ 5,094,192.00
<b>Total Direct Construction Costs (with Contingency and Sales Tax) - Rounded</b>		<b>\$ 40,939,000.00</b>	<b>\$ 45,651,000.00</b>	<b>\$ 54,794,000.00</b>
<b>INDIRECT CONSTRUCTION COSTS</b>				
10	Indirect Construction Costs	\$ 3,020,400.00	\$ 3,356,000.00	\$ 4,027,200.00
<b>Indirect Construction Costs Subtotal</b>		<b>\$ 3,020,400.00</b>	<b>\$ 3,356,000.00</b>	<b>\$ 4,027,200.00</b>
11	Indirect Construction Contingency (30.0%)	\$ 906,120.00	\$ 1,006,800.00	\$ 1,208,160.00
<b>Indirect Construction Costs Subtotal with Contingency</b>		<b>\$ 3,926,520.00</b>	<b>\$ 4,362,800.00</b>	<b>\$ 5,235,360.00</b>
<b>Total Indirect Construction Costs (with Contingency) - Rounded</b>		<b>\$ 3,927,000.00</b>	<b>\$ 4,363,000.00</b>	<b>\$ 5,236,000.00</b>
<b>ADDITIONAL CONSTRUCTION OVERSIGHT COSTS</b>				
12	Additional Construction Oversight Costs	\$ 826,200.00	\$ 918,000.00	\$ 1,101,600.00
<b>Additional Construction Oversight Costs Subtotal</b>		<b>\$ 826,200.00</b>	<b>\$ 918,000.00</b>	<b>\$ 1,101,600.00</b>
13	Additional Construction Oversight Contingency (30.0%)	\$ 247,860.00	\$ 275,400.00	\$ 330,480.00
<b>Additional Construction Oversight Costs Subtotal with Contingency</b>		<b>\$ 1,074,060.00</b>	<b>\$ 1,193,400.00</b>	<b>\$ 1,432,080.00</b>
<b>Total Additional Construction Oversight Costs (with Contingency) - Rounded</b>		<b>\$ 1,075,000.00</b>	<b>\$ 1,194,000.00</b>	<b>\$ 1,433,000.00</b>
14	<b>TOTAL PROJECT COSTS</b>	<b>\$ 45,941,000.00</b>	<b>\$ 51,208,000.00</b>	<b>\$ 61,463,000.00</b>

Notes:

1. In providing this Opinion of Probable Cost, the Client understands that the Consultant (Anchor QEA, LLC) has no control over the cost or availability of labor, equipment, or materials, or over market condition or the Contractor's method of pricing, and the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the work will not vary from the Consultant's opinion of probable construction cost.
2. Costs are presented in present-day US dollars (i.e., 2022).
3. Although the upper reach RAAs fall into both the Cities of Seattle and Tukwila jurisdictions, for the purposes of this opinion of probable cost, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Preliminary (30%) RD; City of Tukwila tax rate is 10.1%.
4. A 30% contingency is applied to both total direct construction, total indirect construction costs and total additional construction oversight costs, based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgement. Due to the nature of the project (i.e., environmental sediment remediation), additional factors that cannot be forecasted at this time—such as scope unknowns (i.e., significant changes in site conditions or quantities), price uncertainty (i.e., varying market conditions, increasing inflation, fuel and labor changes), or any other unforeseen circumstances (i.e., additional design requirements)—may influence contractor bidding prices and impact the final project costs outside, in excess, or below this contingency.
5. Long-term monitoring costs are not included in this opinion of probable cost as assumptions for these activities will be developed consistent with the Long-Term Maintenance and Monitoring Plan in subsequent RD phases.

Table M-1.2 Detailed 30% Remedial Design Opinion of Probable Cost

Task ID	Task Description	Quantity	Unit	Unit Costs			Total Costs		
				Lower Probable Unit Cost (\$)	Probable Unit Cost (\$)	Upper Probable Unit Cost (\$)	Lower Probable Total Cost (\$)	Probable Total Cost (\$)	Upper Probable Total Cost (\$)
<b>DIRECT CONSTRUCTION COSTS</b>									
<b>1</b>	<b>Mobilization/Demobilization</b>								
1 a	Mobilization/Demobilization for All Equipment (In-Water, Specialized, Upland)	2	LS	\$ 990,000.00	\$ 1,100,000.00	\$ 1,320,000.00	\$ 1,980,000.00	\$ 2,200,000.00	\$ 2,640,000.00
1 b	Procedural Costs and Contractor Workplan Submittals	2	LS	\$ 81,000.00	\$ 90,000.00	\$ 108,000.00	\$ 162,000.00	\$ 180,000.00	\$ 216,000.00
<b>2</b>	<b>Site Preparation</b>								
2 a	Shoreline/Upland Site Preparation (Removal, Handling, Disposal and/or Reuse)	2	AC	\$ 10,000.00	\$ 14,000.00	\$ 19,000.00	\$ 20,000.00	\$ 28,000.00	\$ 38,000.00
2 b	Upland Staging Area Setup and Site Decommissioning	1	LS	\$ 225,000.00	\$ 250,000.00	\$ 300,000.00	\$ 225,000.00	\$ 250,000.00	\$ 300,000.00
<b>3</b>	<b>Surveys</b>								
3 a	Contractor Progress Surveys	191	EA	\$ 1,000.00	\$ 2,000.00	\$ 3,000.00	\$ 190,692.51	\$ 381,385.01	\$ 572,077.52
3 b	Pre-Construction Surveys (Bathy and Topo)	2	LS	\$ 20,700.00	\$ 23,000.00	\$ 27,600.00	\$ 41,400.00	\$ 46,000.00	\$ 55,200.00
3 c	Post-Dredge Construction Survey (per RAA)	24	EA	\$ 7,200.00	\$ 8,000.00	\$ 9,600.00	\$ 172,800.00	\$ 192,000.00	\$ 230,400.00
3 d	Post-Placement Construction Survey (per RAA)	29	EA	\$ 7,200.00	\$ 8,000.00	\$ 9,600.00	\$ 208,800.00	\$ 232,000.00	\$ 278,400.00
3 e	Post-Construction Survey (Bathy and Topo)	2	LS	\$ 20,700.00	\$ 23,000.00	\$ 27,600.00	\$ 41,400.00	\$ 46,000.00	\$ 55,200.00
3 f	As-Built Surveys	1	LS	\$ 20,700.00	\$ 23,000.00	\$ 27,600.00	\$ 20,700.00	\$ 23,000.00	\$ 27,600.00
<b>4</b>	<b>Structural Work</b>								
4 a	Remove and Replace Timber Piles Including Dolphins and Groins	1	LS	\$ 1,413,592.20	\$ 1,570,658.00	\$ 1,884,789.60	\$ 1,413,592.20	\$ 1,570,658.00	\$ 1,884,789.60
4 b	Remove and Replace Steel Pipe Piles	1	LS	\$ 28,501.20	\$ 31,668.00	\$ 38,001.60	\$ 28,501.20	\$ 31,668.00	\$ 38,001.60
4 c	Remove and Replace Timber Bulkheads (Stub Piles)	1	LS	\$ 287,040.60	\$ 318,934.00	\$ 382,720.80	\$ 287,040.60	\$ 318,934.00	\$ 382,720.80
4 d	Temporary Relocation of Floats	1	LS	\$ 77,625.00	\$ 86,250.00	\$ 103,500.00	\$ 77,625.00	\$ 86,250.00	\$ 103,500.00
4 e	Plug and Abandon, Temporary Diversion	1	LS	\$ 5,175.00	\$ 5,750.00	\$ 6,900.00	\$ 5,175.00	\$ 5,750.00	\$ 6,900.00
4 f	Pipe Extension and Support, Including Apron	1	LS	\$ 15,525.00	\$ 17,250.00	\$ 20,700.00	\$ 15,525.00	\$ 17,250.00	\$ 20,700.00
4 g	Structural-Specific Contingency	20.00%	PERCENT	-	-	-	\$ 365,491.80	\$ 406,102.00	\$ 487,322.40
<b>5</b>	<b>Dredging, Excavation, Transloading, Upland Transportation, and Disposal</b>								
5 a	Required Dredging and In-Water Transportation (Open-Water)	70,058	CY	\$ 21.90	\$ 24.33	\$ 29.20	\$ 1,534,300.34	\$ 1,704,778.16	\$ 2,045,733.79
5 b	Required Dredging and In-Water Transportation (Nearshore)	16,821	CY	\$ 35.16	\$ 39.07	\$ 46.88	\$ 591,446.14	\$ 657,162.38	\$ 788,594.86
5 c	Required Dredging and In-Water Transportation (Restricted Access)	1,442	CY	\$ 49.69	\$ 55.21	\$ 66.25	\$ 71,653.43	\$ 79,614.92	\$ 95,537.90
5 d	Contingency Re-Dredging - Allowance	10,233	CY	\$ 28.28	\$ 31.43	\$ 37.71	\$ 289,429.13	\$ 321,587.92	\$ 385,905.50
5 e	Shoreline/Bank Excavation	19,200	CY	\$ 30.14	\$ 33.49	\$ 40.18	\$ 578,669.05	\$ 642,965.61	\$ 771,558.74
5 f	Dredged/Excavated Material Transloading	179,282	TON	\$ 4.50	\$ 5.00	\$ 6.00	\$ 806,769.65	\$ 896,410.72	\$ 1,075,692.87
5 g	Dredged/Excavated Material Upland Transportation and Disposal (Subtitle D)	175,060	TON	\$ 81.00	\$ 90.00	\$ 108.00	\$ 14,179,827.60	\$ 15,755,364.00	\$ 18,906,436.79
5 h	Dredged/Excavated Material Upland Transportation and Disposal (Subtitle C) - Allowance	3,573	TON	\$ 207.00	\$ 230.00	\$ 276.00	\$ 739,537.49	\$ 821,708.33	\$ 986,049.99
5 i	Debris Removal - Allowance	5	DAY	\$ 18,000.00	\$ 20,000.00	\$ 24,000.00	\$ 90,000.00	\$ 100,000.00	\$ 120,000.00
5 j	Debris Upland Transportation and Disposal - Allowance	650	TON	\$ 108.00	\$ 120.00	\$ 144.00	\$ 70,189.20	\$ 77,988.00	\$ 93,585.60
5 k	Standby Time - Allowance	15	DAY	\$ 17,900.00	\$ 19,900.00	\$ 23,900.00	\$ 268,500.00	\$ 298,500.00	\$ 358,500.00

Table M-1.2 Detailed 30% Remedial Design Opinion of Probable Cost

Task ID	Task Description	Quantity	Unit	Unit Costs			Total Costs		
				Lower Probable Unit Cost (\$)	Probable Unit Cost (\$)	Upper Probable Unit Cost (\$)	Lower Probable Total Cost (\$)	Probable Total Cost (\$)	Upper Probable Total Cost (\$)
<b>6</b>	<b>Material Placement</b>								
6 a	Procure/Deliver Sand for RMC, ENR and Cap Chemical Isolation Layer	13,709	TON	\$ 24.00	\$ 26.00	\$ 30.00	\$ 329,006.31	\$ 356,423.51	\$ 411,257.89
6 b	Procure/Deliver Gravelly Sand for Backfill and Cap Habitat Layer	92,468	TON	\$ 23.00	\$ 25.00	\$ 29.00	\$ 2,126,752.63	\$ 2,311,687.65	\$ 2,681,557.67
6 c	Procure/ Deliver Gravel Material for Cap Erosion Protection/Filter Layer	370	TON	\$ 25.00	\$ 28.00	\$ 32.00	\$ 9,258.40	\$ 10,369.41	\$ 11,850.75
6 d	Procure/Deliver Cobble for Cap Erosion Protection/ Filter Layer	343	TON	\$ 31.00	\$ 34.00	\$ 41.00	\$ 10,632.22	\$ 11,661.15	\$ 14,061.97
6 e	Procure/Deliver Amendment ZVI Material - Allowance	137	TON	\$ 1,258.00	\$ 1,398.00	\$ 1,677.60	\$ 172,569.64	\$ 191,774.53	\$ 230,129.44
6 f	Place Sand for RMC and ENR (Open-Water)	7,708	CY	\$ 16.58	\$ 18.43	\$ 22.11	\$ 127,819.28	\$ 142,021.42	\$ 170,425.71
6 g	Place Sand for RMC and ENR (Nearshore)	405	CY	\$ 19.74	\$ 21.93	\$ 26.32	\$ 7,989.15	\$ 8,876.83	\$ 10,652.20
6 h	Place Sand for RMC and ENR (Restricted Access)	698	CY	\$ 30.05	\$ 33.39	\$ 40.06	\$ 20,984.73	\$ 23,316.36	\$ 27,979.63
6 i	Place Sand for RMC and ENR (Land-Based Equipment)	530	CY	\$ 22.11	\$ 24.57	\$ 29.48	\$ 11,707.67	\$ 13,008.52	\$ 15,610.23
6 j	Place Gravelly Sand for Backfill (Open-Water)	27,046	CY	\$ 16.58	\$ 18.43	\$ 22.11	\$ 448,493.42	\$ 498,326.02	\$ 597,991.23
6 k	Place Gravelly Sand for Backfill (Nearshore)	10,163	CY	\$ 19.74	\$ 21.93	\$ 26.32	\$ 200,632.60	\$ 222,925.11	\$ 267,510.13
6 l	Place Gravelly Sand for Backfill (Restricted Access)	18	CY	\$ 30.05	\$ 33.39	\$ 40.06	\$ 544.90	\$ 605.45	\$ 726.54
6 m	Place Gravelly Sand for Backfill (Land-Based Equipment)	19,172	CY	\$ 24.97	\$ 27.74	\$ 33.29	\$ 478,726.93	\$ 531,918.81	\$ 638,302.57
6 n	Place Sand/ZVI Mix for Cap Chemical Isolation Layer - Allowance	915	CY	\$ 26.51	\$ 28.91	\$ 33.69	\$ 24,248.21	\$ 26,434.39	\$ 30,806.75
6 o	Place Combined Cobble/Gravel for Cap Erosion Protection/Filter Layer	457	CY	\$ 28.52	\$ 31.69	\$ 38.02	\$ 13,040.24	\$ 14,489.15	\$ 17,386.98
6 p	Place Gravelly Sand for Cap Habitat Layer	686	CY	\$ 21.51	\$ 23.91	\$ 28.69	\$ 14,756.71	\$ 16,396.35	\$ 19,675.62
<b>7</b>	<b>Environmental Controls</b>								
7 a	Environmental Controls - Allowance	2	LS	\$ 45,000.00	\$ 50,000.00	\$ 60,000.00	\$ 90,000.00	\$ 100,000.00	\$ 120,000.00
	<b>Direct Construction Costs Subtotal</b>						<b>\$ 28,563,229.00</b>	<b>\$ 31,851,312.00</b>	<b>\$ 38,230,334.00</b>
<b>8</b>	<b>Direct Construction Contingency</b>	30.00%	PERCENT				\$ 8,568,969.00	\$ 9,555,394.00	\$ 11,469,100.00
	<b>Direct Construction Cost Subtotal with Contingency</b>						<b>\$ 37,132,198.00</b>	<b>\$ 41,406,706.00</b>	<b>\$ 49,699,434.00</b>
<b>9</b>	<b>Sales Tax</b>	10.25%	PERCENT				\$ 3,806,050.00	\$ 4,244,187.00	\$ 5,094,192.00
	<b>Total Direct Construction Costs (with Contingency and Sales Tax) - Rounded</b>						<b>\$ 40,939,000.00</b>	<b>\$ 45,651,000.00</b>	<b>\$ 54,794,000.00</b>
<b>INDIRECT CONSTRUCTION COSTS</b>									
<b>10</b>	<b>Indirect Construction Costs</b>								
10 a	Construction Management (Inspection and Oversight) and Engineering Support	9.0	MO	\$67,500.00	\$75,000.00	\$90,000.00	\$ 607,500.00	\$ 675,000.00	\$ 810,000.00
10 b	Confirmational Sediment Sampling	1	LS	\$666,000.00	\$740,000.00	\$888,000.00	\$ 666,000.00	\$ 740,000.00	\$ 888,000.00
10 c	Environmental Monitoring (Water Quality)	9.0	MO	\$179,100.00	\$199,000.00	\$238,800.00	\$ 1,611,900.00	\$ 1,791,000.00	\$ 2,149,200.00
10 d	Site Access Agreements and Temporary Leases	1	LS	\$135,000.00	\$150,000.00	\$180,000.00	\$ 135,000.00	\$ 150,000.00	\$ 180,000.00
	<b>Indirect Construction Costs Subtotal</b>						<b>\$ 3,020,400.00</b>	<b>\$ 3,356,000.00</b>	<b>\$ 4,027,200.00</b>
<b>11</b>	<b>Indirect Construction Contingency</b>	30.00%	PERCENT				\$ 906,120.00	\$ 1,006,800.00	\$ 1,208,160.00
	<b>Indirect Construction Costs Subtotal with Contingency</b>						<b>\$ 3,926,520.00</b>	<b>\$ 4,362,800.00</b>	<b>\$ 5,235,360.00</b>
	<b>Total Indirect Construction Costs (with Contingency) - Rounded</b>						<b>\$ 3,927,000.00</b>	<b>\$ 4,363,000.00</b>	<b>\$ 5,236,000.00</b>

Table M-1.2 Detailed 30% Remedial Design Opinion of Probable Cost

Task ID	Task Description	Quantity	Unit	Unit Costs			Total Costs		
				Lower Probable Unit Cost (\$)	Probable Unit Cost (\$)	Upper Probable Unit Cost (\$)	Lower Probable Total Cost (\$)	Probable Total Cost (\$)	Upper Probable Total Cost (\$)
<b>ADDITIONAL CONSTRUCTION OVERSIGHT COSTS</b>									
<b>12</b>	<b>Additional Construction Oversight Costs</b>								
12 a	Implementing Entity Oversight	9.0	MO	\$36,000.00	\$40,000.00	\$48,000.00	\$ 324,000.00	\$ 360,000.00	\$ 432,000.00
12 b	EPA Oversight	9.0	MO	\$55,800.00	\$62,000.00	\$74,400.00	\$ 502,200.00	\$ 558,000.00	\$ 669,600.00
	<b>Additional Construction Oversight Costs Subtotal</b>						<b>\$ 826,200.00</b>	<b>\$ 918,000.00</b>	<b>\$ 1,101,600.00</b>
<b>13</b>	<b>Additional Construction Oversight Contingency</b>	30.00%	PERCENT				\$ 247,860.00	\$ 275,400.00	\$ 330,480.00
	<b>Additional Construction Oversight Costs Subtotal with Contingency</b>						<b>\$ 1,074,060.00</b>	<b>\$ 1,193,400.00</b>	<b>\$ 1,432,080.00</b>
	<b>Total Additional Construction Oversight Costs (with Contingency) - Rounded</b>						<b>\$ 1,075,000.00</b>	<b>\$ 1,194,000.00</b>	<b>\$ 1,433,000.00</b>
<b>14</b>	<b>TOTAL PROJECT COSTS</b>						<b>\$45,941,000.00</b>	<b>\$51,208,000.00</b>	<b>\$61,463,000.00</b>

Notes:

- In providing this Opinion of Probable Cost, the Client understands that the Consultant (Anchor QEA, LLC) has no control over the cost or availability of labor, equipment, or materials, or over market condition or the Contractor's method of pricing, and the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the work will not vary from the Consultant's opinion of probable construction cost.
- Costs are presented in present-day US dollars (i.e., 2022).
- Although the upper reach RAAs fall into both the Cities of Seattle and Tukwila jurisdictions, for the purposes of this opinion of probable cost, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Preliminary (30%) RD; City of Tukwila tax rate is 10.1%.
- A 30% contingency is applied to both total direct construction, total indirect construction costs and total additional construction oversight costs, based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgement. Due to the nature of the project (i.e., environmental sediment remediation), additional factors that cannot be forecasted at this time—such as scope unknowns (i.e., significant changes in site conditions or quantities), price uncertainty (i.e., varying market conditions, increasing inflation, fuel and labor changes), or any other unforeseen circumstances (i.e., additional design requirements)—may influence contractor bidding prices and impact the final project costs outside, in excess, or below this contingency.
- Long-term monitoring costs are not included in this opinion of probable cost as assumptions for these activities will be developed consistent with the Long-Term Maintenance and Monitoring Plan in subsequent RD phases.

AC: acre  
 CY: cubic yard  
 EA: each  
 LS: lump sum  
 MO: month  
 RAA: remedial action area  
 RD: remedial design  
 SF: square foot  
 TON: US ton

General Notes:	
1	The approach for developing the LDW upper reach Opinion of Probable Cost Estimate was based on several sources of information, including the following: <ul style="list-style-type: none"> <li>Anchor QEA's best professional judgment and past experience with similar remedial actions and associated pricing</li> <li>Review of contractor's bid costs and engineer's construction cost estimates for similar remediation projects completed (locally) in Seattle, Washington and (regionally) in the Pacific Northwest, as well as knowledge of construction activities and challenges identified during construction oversight.</li> <li>Engineering cost guidance (RS Means).</li> </ul> Anchor QEA performed a detailed internal review of the cost assumptions and unit prices to determine their relevance, anticipated accuracy, and cost variability. In addition, engineering best professional judgment was used to evaluate different prices obtained from various sources of information to select the lower, probable, and upper unit costs or lump sum prices (three-point estimating).
2	Assumed CY to TON conversions: 1) sediment: 1.5 TON/CY (in situ); 2) sand/gravel mix: 1.6 TON/CY; 3) sand: 1.4 TON/CY; 4) for cobble: 1.5 TON/CY.
3	Although the upper reach RAAs fall into both the Cities of Seattle and Tukwila jurisdictions, for the purposes of this opinion of probable cost, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Preliminary (30%) RD; City of Tukwila tax rate is 10.1%.
4	Estimated costs assume that construction could occur without interruptions from ongoing site operational uses, except as noted by stand-by time.
Specific Notes by Task ID:	
DIRECT CONSTRUCTION COSTS	
1	<b>Mobilization/Demobilization</b>
1 a	Mobilization/Demobilization cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumes two mobilization/demobilization events, which includes: 150-ton derrick/spud rig, 6- to 8-cy buckets, 2 tugs, up to 4 x 1,700-ton scows, work boat, front-end loader, and specialized equipment (i.e., various bucket sizes) for working in shallow-water environments. Costs also includes costs for bond and insurance premiums (estimated to be 2% of the total direct construction costs). Includes two mobilization/demobilization events for two construction seasons (in-water work window is defined as October 1 through February 15).
1 b	Includes labor for procedural costs and contractor's development of required workplans and submittals. Costs estimated from Anchor QEA past project experience. Includes two project workplan and submittals for two construction seasons.
2	<b>Site Preparation</b>
2 a	Includes shoreline preparation and remediation, estimated on a acre-basis, from Anchor QEA past project experience for similar projects of similar size.
2 b	Includes preparation of an upland area at a designated location (TBD) for contractor use for on site trailer office and other temporary facilities, as well as staging of equipment. Also, site decommissioning costs are included. Estimated from Anchor QEA past project experience for similar projects of similar size.
3	<b>Surveys</b>
3 a	Contractor progress bathymetric survey cost assumes multi-beam hydrographic survey equipment using: Real-Time Kinematic (RTK) GPS Positioning, Motion Platform, Multibeam Sonar, SV Profiler, eqQPS QINSy Software, mobilization/demobilization of survey vessel and survey equipment, data processing and product generation, one boat operator, and one licensed surveyor. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Contractor progress bathymetric survey costs assumed for the dredging and placement durations.
3 b	Includes costs for payment bathymetric and topographic surveys to be conducted prior to construction for the whole LDW upper reach site. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Includes two sets of pre-construction bathy/topo surveys for two construction seasons.
3 c	Includes costs for payment bathymetric survey to be conducted post-dredging for each RAA that requires dredging. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects.
3 d	Includes costs for payment bathymetric survey to be conducted post-backfill/RMC/ENR/cap placement for each RAA that requires material placement. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects.
3 e	Includes costs for payment bathymetric and topographic surveys to be conducted post-construction for the whole LDW upper reach site. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Includes two sets of post-construction bathy/topo surveys for two construction seasons.
3 f	Includes costs for final as-built surveys to be conducted post-construction for the whole LDW upper reach site. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Includes one set of as-built surveys for two construction seasons.



Table M-1.3 Detailed Notes

<b>4</b>	<b>Structural Work</b>
<b>4 a</b>	Cost provided by Bright Engineering Inc. on July, 2022. See table M-1.6 for detailed assumptions for costing.
<b>4 b</b>	Cost provided by Bright Engineering Inc. on July, 2022. See table M-1.6 for detailed assumptions for costing.
<b>4 c</b>	Cost provided by Bright Engineering Inc. on July, 2022. See table M-1.6 for detailed assumptions for costing.
<b>4 d</b>	Cost provided by Bright Engineering Inc. on July, 2022. See table M-1.6 for detailed assumptions for costing.
<b>4 e</b>	Cost provided by Bright Engineering Inc. on July, 2022. See table M-1.6 for detailed assumptions for costing.
<b>4 f</b>	Cost provided by Bright Engineering Inc. on July, 2022. See table M-1.6 for detailed assumptions for costing.
<b>4 g</b>	Structural-specific contingency of 20% is applied to direct construction of structural work elements only, as provided by Bright Engineering Inc. on July,2022. See table M-1.6 for detailed assumptions for costing. This structural-specific contingency is based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgement.
<b>5</b>	<b>Dredging, Excavation, Transloading, Upland Transportation, and Disposal</b>
<b>5 a</b>	Open-water dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required dredge volume and daylight dredge volume for open-water dredging. Probable open-water dredge production rate estimated to be approximately 1,200 CY/10-hour shift.
<b>5 b</b>	Nearshore dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required dredge volume and daylight dredge volume for dredging conducted in nearshore shallow areas, slopes, and any slow dredging. Probable nearshore dredge production rate estimated to be approximately 700 CY/10-hour shift.
<b>5 c</b>	Restricted access dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required dredge volume and daylight dredge volume for dredging conducted under bridge, near structures or bulkhead. Probable restricted access dredge production rate estimated to be approximately 500 CY/10-hour shift.
<b>5 d</b>	Contingency re-dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Contingency re-dredging conducted over an assumed 35% of the total dredge area, applied to a 1-ft thickness to address generated residuals (15% of area) and 2.5-ft thickness to remove missed inventory (20% of area). Contingency re-dredging production rate estimated to be 900 CY/10-hour shift. These costs are considered an 'allowance' for the upper probable cost in this Preliminary (30%) RD cost estimate.
<b>5 e</b>	Excavation unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required excavated volume and daylight excavated volume in shorelines and riverbanks. Probable excavation production rate estimated to be approximately 800 CY/10-hour shift.
<b>5 f</b>	Transloading unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. contractor's tonnage for transloading calculated from the contractor's dredge/excavated and incidental debris volume (converted with a 1.5 TON/CY factor) and anticipated debris tonnage.
<b>5 g</b>	Transportation and disposal unit cost in a Subtitle D landfill facility based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Tonnage for transportation and disposal calculated from the contractor's dredge/excavated and incidental debris volume (converted with a 1.5 TON/CY factor) for material designated as "Subtitle D Landfill Waste". Assume 98% of the contractor's dredge/excavated and incidental debris tonnage is material designated as "Subtitle D Landfill Waste".
<b>5 h</b>	Transportation and disposal unit cost in a Subtitle C landfill facility based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Tonnage for transportation and disposal calculated from the contractor's dredge/excavated and incidental debris volume (converted with a 1.5 TON/CY factor) for material designated as "Subtitle C Hazardous Landfill Waste". Although no Subtitle C level materials have been identified in the design data set, 2% of the contractor's dredge/excavated and incidental debris tonnage are assumed to be material designated as "Subtitle C Landfill Hazardous Waste". These costs are considered an 'allowance' for this Preliminary (30%) RD cost estimate.
<b>5 i</b>	Debris removal unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Debris removal includes visible and potentially buried debris associated with concrete blocks, timber piling, steel I beams, rubble, cables, and other items. Debris dimensions/quantities estimated based on visual aerial observations, shoreline photograph inventory, and measurements derived ArcGIS LDW webmap imagery, of the LDW upper reach shorelines/riverbanks for debris items generally larger than 12 inches in size. Buried and smaller debris is considered incidental dredge debris and its removal, transportation, and disposal are already accounted for in the contractor's dredge volume. These costs are considered an 'allowance' for the upper probable cost in this Preliminary (30%) RD cost estimate.

Table M-1.3 Detailed Notes

5	j	Debris transportation and disposal unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Debris removal includes visible and potentially buried debris associated with concrete blocks, timber piling, steel I beams, rubble, cables, and other items. Debris dimensions/quantities estimated based on visual aerial observations, shoreline photograph inventory, and measurements derived ArcGIS LDW webmap imagery, of the LDW upper reach shorelines/riverbanks for debris items generally larger than 12 inches in size. Buried and smaller debris is considered incidental dredge debris and its removal, transportation, and disposal are already accounted for in the contractor's dredge volume. These costs are considered an 'allowance' for the upper probable cost in this Preliminary (30%) RD cost estimate.
5	k	In-water standby time is estimated to be 15 days of contractor's time, over two construction seasons. Unit cost assumed to include equipment and labor costs at 70% of the daily dredging/placement costs; unit costs based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Work stoppage during dredging and/or placement activities is assumed to relate to relocation of contractor construction equipment to accommodate emergencies, downtime due to inclement weather, and/or directed but unexpected operational needs (i.e., unforeseen or unplanned vessel access or passage through the upper reach, inclement weather). These costs are considered an 'allowance' for the upper probable cost in this Preliminary (30%) RD cost estimate.
6	<b>Material Placement</b>	
6	a	Unit cost for medium-to-coarse sand material based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed sand unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for. Clean sand is assumed to be used for placement of RMC at 6-in (plus 3-in maximum overplacement allowance), ENR at 6-in (plus 6-in maximum overplacement allowance), and RAA 18-cap chemical isolation layer at 1.5-ft (plus 6-in maximum overplacement allowance). The RMC quantity includes side slopes and an additional 10% of footprint (approximately equivalent to a 10-ft buffer surrounding the dredge area); the ENR quantity assumes a placement footprint that includes a 10-ft buffer around the planned ENR placement area.
6	b	Unit cost for granular gravelly sand based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed gravelly sand unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for. Gravelly sand is assumed to be used for placement of backfill (to pre-construction elevations and to flatten temporary steeper dredge cuts (in all dredge areas located outside of the FNC above -10-ft mean lower low water) and of RAA 18-cap habitat layer at 1.5-ft thickness.
6	c	Unit cost for gravel based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed gravel unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for. Gravel material is assumed to be used mixed in with cobble for placement (at an assumed 50% volume ratio) of the RAA 18-cap filter layer. Total RAA 18-cap filter placement thickness is assumed to be 6-in (plus 6-in maximum overplacement allowance).
6	d	Unit cost for cobble based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed cobble unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for. Cobble is assumed to be used mixed in with gravel for placement (at an assumed 50% volume ratio) of the RAA 18-cap filter layer. Total RAA 18-cap filter layer placement thickness is assumed to be 6-in (plus 6 inches maximum overplacement allowance).
6	e	Unit cost for Zero Valent Iron (ZVI) material based on discussions with material supplier (Connelly-GPM, Inc.). Assumed ZVI unit cost includes delivery by truck to LDW upper reach site. ZVI amendment material is assumed to be placed at 10% by weight for the RAA 18-chemical isolation layer, mixed in with sand. Total RAA-18-chemical isolation layer placement thickness is assumed to be 1.5-ft (plus 6 inches maximum overplacement allowance). These costs are considered an 'allowance' for the upper probable cost in this Preliminary (30%) RD cost estimate.
6	f	Clean sand open-water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Clean sand open-water placement rate for RMC/ENR is estimated to be 1,200 CY/10-hour shift.
6	g	Clean sand nearshore placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Clean sand nearshore placement rate for RMC/ENR is estimated to be 1,000 CY/10-hour shift.
6	h	Clean sand restricted access placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Clean sand restricted access placement rate for RMC/ENR is estimated to be 700 CY/10-hour shift.
6	i	Clean sand land-based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Clean sand land-based equipment placement rate for RMC/ENR is estimated to be 900 CY/10-hour shift.
6	j	Gravelly sand open-water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Gravelly sand open-water placement rate for backfill and is estimated to be 1,200 CY/10-hour shift.



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6	k	Gravelly sand nearshore placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Gravelly sand nearshore placement rate for backfill and is estimated to be 1,000 CY/10-hour shift.
6	l	Gravelly sand restricted access placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Gravelly sand restricted access placement rate for backfill and is estimated to be 700 CY/10-hour shift.
6	m	Gravelly sand land-based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Gravelly sand land-based equipment placement rate for backfill and is estimated to be 900 CY/10-hour shift.
6	n	Sand/ZVI amendment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Sand/ZVI amendment mix placement rate for RAA 18- cap chemical isolation layer is estimated to be 900 CY/10-hour shift. These costs are considered an 'allowance' for the upper probable cost in this Preliminary (30%) RD cost estimate.
6	o	Cobble/gravel placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Cobble/gravel placement rate for RAA 18-cap filter layer and is estimated to be 700 CY/10-hour shift.
6	p	Gravelly sand placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Gravelly sand placement rate for RAA 18-cap habitat layer and is estimated to be 900 CY/10-hour shift.
7	<b>Environmental Controls</b>	
7	a	Costs assume general environmental controls during construction. These costs are considered an 'allowance' for this Preliminary (30%) RD cost estimate.
<b>Direct construction costs subtotal is the sum of costs from all direct construction tasks.</b>		
8	Direct construction contingency of 30% is applied to the direct construction costs subtotal.	
<b>Direct construction costs subtotal with contingency is the sum of direct construction cost subtotal and contingency costs.</b>		
9	Although the upper reach RAAs fall into both the Cities of Seattle and Tukwila jurisdictions, for the purposes of this opinion of probable cost, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Preliminary (30%) RD; City of Tukwila tax rate is 10.1%.	
<b>Total direct construction costs is the sum of direct construction cost subtotal, contingency costs, and sales tax.</b>		
<b>INDIRECT CONSTRUCTION COSTS</b>		
10	<b>Indirect Construction Costs</b>	
10	a	Construction management (including inspection and oversight) and engineering support costs include providing oversight of the contractor's implementation of the sediment remedy. Construction management costs typically refers to in-field work to oversee the contractor's work and includes construction inspection, progress tracking and reporting, reviewing progress payment requests, reviewing contractor submittals and work plans, addressing contractor Requests for Information and change order requests, leading adaptive design changes, and communicating with the Implementing Entity and EPA. Engineering support services are typically provided from the office and include design interpretation, contingency action decision coordination, change order negotiation support, and closeout report preparation. Construction management and engineering support effort is assumed on a monthly basis for the total construction duration.
10	b	Confirmational sediment sampling activities include collecting post-dredge confirmatory sediment samples throughout the total dredge area post-dredging to evaluate the potential need for contingency actions. Confirmational sediment sampling include costs for equipment, labor, analytical, and data validation.
10	c	Environmental monitoring (water quality sampling) costs include water quality monitoring activities during construction. Environmental monitoring includes costs for equipment, labor, and field measurements of water samples collected during dredging and placement activities. Costs for environmental monitoring for water quality are assumed on a monthly basis for the total dredging and placement duration.
10	d	Site access agreements and temporary leases include costs for leases, if needed, and coordination costs associated with site access (e.g., directed barge or vessel temporary relocations, Tribal Usual and Accustomed Fishing agreements. It is not anticipated that special leases will be required.
<b>Indirect construction costs subtotal is the sum of costs from all indirect construction tasks.</b>		
11	Indirect construction contingency of 30% is applied to the indirect construction cost subtotal.	
<b>Indirect construction costs subtotal with contingency is the sum of indirect construction cost subtotal and contingency costs.</b>		
<b>Total indirect construction costs is the sum of indirect construction cost subtotal and contingency costs.</b>		

Table M-1.3 Detailed Notes

<b>ADDITIONAL CONSTRUCTION OVERSIGHT COSTS</b>	
<b>12</b>	<b>a</b> Implementing entity oversight costs include supervision activities during implementation of the sediment remedy. Implementing entity oversight costs are assumed on a monthly basis for the total construction duration.
<b>12</b>	<b>b</b> EPA oversight costs include supervision activities by EPA during implementation of the sediment remedy. EPA oversight costs are assumed on a monthly basis for the total construction duration.
<b>Additional construction oversight costs subtotal is the sum of costs from implementing oversight and EPA oversight tasks.</b>	
<b>13</b>	Additional construction oversight contingency of 30% is applied to the additional construction oversight cost subtotal.
<b>Additional construction oversight costs subtotal with contingency is the sum of additional construction oversight cost subtotal and contingency costs.</b>	
<b>Total additional construction oversight costs is the sum of additional construction oversight cost subtotal and contingency costs.</b>	
<b>14</b>	<b>Total project cost is the sum of total direct construction costs, indirect construction costs, and additional construction oversight costs.</b>

Notes:

- CY: cubic yard
- ENR: enhanced natural recovery
- EPA: Environmental Protection Agency
- LDW: Lower Duwamish Waterway
- LS: lump sum
- MO: month
- RAA: remedial action area
- RD: remedial design
- RMC: residuals management cover
- TBD: to be determined
- TON: US ton

Table M-1.4 Detailed Quantities

Remedial Action Area	Technology Assignment	Slope Assumptions Description	Quantities Throughout LDW Upper Reach							Quantities Inside FNC						Quantities Outside FNC					
			Required ENR Surface Area (SF)	Required Neatline Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side-Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)	Required Neatline Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side-Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)	Required Neatline Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side-Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)
AREA 01/02/3	Dredge and Partial Backfill/Partial RMC	2:1 Outside FNC, 3:1 Inside FNC (7/18/22)		70,704	34,704	17,677	2,619	1,285	21,581	61,223	16,143	11,676	2,267	598	14,541	9,481	18,561	6,001	352	687	7,040
AREA 04/5	Dredge and Partial Backfill/Partial RMC	2:1 outside FNC, 3:1 Inside (7/22/22)		130,641	52,210	25,717	4,839	1,934	32,490	118,533	34,883	20,344	4,390	1,292	26,026	12,108	17,326	5,373	449	642	6,464
AREA 04/5	ENR		5,681																		
AREA 06	Dredge and Backfill	3:1 Slopes All Around (3/17/22)		869	541	84	32	20	136							869	541	84	32	20	136
AREA 07	ENR		1,201																		
AREA 08	Dredge and Backfill	2:1 Slopes All Around (6/21/22)		900	256	38	33	9	80							900	256	38	33	9	80
AREA 09 (Not included)																					
AREA 10	ENR		1,558																		
AREA 11	Dredge and Partial Backfill/Partial RMC	3:1 Slopes All Around (6/3/22)		915	4,155	746	34	154	934	312	432	56	22	16	94	603	3,723	690	12	138	840
AREA 12	Dredge and RMC	3:1 Slopes All Around (6/20/22)		900	570	43	33	21	97	900	570	43	33	21	97						
AREA 13	Dredge and Backfill	2:1 from the Toe of Armored Slope into the Dredge Area (4/13/22)		725	2,184	329	27	81	437							725	2,184	329	27	81	437
AREA 13	ENR		2,300																		
AREA 14	Dredge and Partial Backfill/Partial RMC	3:1 Slopes All Around (7/20/22)		11,785	13,425	5,329	436	497	6,262	11,785	11,407	5,146	436	422	6,004		2,018	183		75	258
AREA 15/16	Dredge and Partial Backfill/Partial RMC	2:1 Shoreline Slope, 3:1 for the Rest (6/3/22)		13,547	12,568	5,797	502	465	6,764	2,968	5,680	1,676	110	210	1,996	10,580	6,888	4,121	392	255	4,768
AREA 17	Dredge and Partial Backfill/Partial RMC	3:1 Slopes All Around (6/3/22)		3,658	1,204	155	135	45	335	3,658	514	145	135	19	299		691	10		26	36
AREA 18	Partial Dredge and Cap (18A-18B) and Dredge and Partial Backfill/Partial RMC	2:1 Shoreline Slope, 3:1 for the Rest (7/21/22)		41,640	22,487	12,069	1,542	833	14,444		3,325	438		123	561	41,640	19,162	11,631	1,542	710	13,883
AREA 18	ENR		4,498																		
AREA 19/20	Dredge and Backfill	2:1 Slopes All Around (6/7/22)		4,828	2,073	537	179	77	793							4,828	2,073	537	179	77	793
AREA 21	Dredge and Backfill	2:1 Slopes All Around (4/15/22)		2,223	975	200	82	36	318							2,223	975	200	82	36	318
AREA 22	Dredge and Partial Backfill/Partial RMC	3:1 Slopes toward the FNC, 2:1 for the rest (6/8/22)		20,967	4,248	1,705	777	157	2,639		771	28		29	57	20,967	3,478	1,677	777	129	2,583
AREA 23	ENR		2,739																		
AREA 24	Dredge and Partial Backfill/Partial RMC	2:1 Slopes All Around (4/22/22)		4,198	2,115	677	155	78	910							4,198	2,115	677	155	78	910
AREA 24	ENR		1,838																		
AREA 25	ENR		2,338																		
AREA 26	Dredge and Backfill	2:1 Slopes All Around (6/8/22)		5,391	882	216	200	33	449							5,391	882	216	200	33	449
AREA 26	ENR		2,604																		
AREA 27	Dredge and Backfill	2:1 Slopes All Around (6/21/22)		81,247	22,341	11,872	3,009	827	15,708							81,247	22,341	11,872	3,009	827	15,708
AREA 28	Dredge and Backfill	3:1 Slopes All Around (6/7/22)		7,038	2,440	610	261	90	961							7,038	2,440	610	261	90	961
AREA 29	Dredge and Backfill	2:1 Slopes All Around (8/11/22)		5,388	1,093	329	240	40	609							5,388	1,093	329	240	40	609
AREA 30	Dredge and Backfill	2:1 Slopes All Around (4/7/22)		1,304	426	84	48	16	148							1,304	426	84	48	16	148
AREA 31	Dredge and Backfill	2:1 Slopes All Around (4/7/22)		1,489	716	136	55	27	218							1,489	716	136	55	27	218
AREA 32	Dredge and Backfill	2:1 All Around, Ex Shoreline Toe of Slope (6/6/22)		2,578	621	107	95	23	225							2,578	621	107	95	23	225
AREA 33	ENR		2,131																		
AREA 34	Dredge and Backfill	2:1 Slopes All-Around, Ex Shoreline Toe of Slope (6/10/22)		1,698	481	71	63	18	152							1,698	481	71	63	18	152
AREA 35	Dredge and Backfill	2:1 Slopes All Around Ex Shoreline Toe of Slope (6/3/22)		10,439	1,028	405	387	38	830							10,439	1,028	405	387	38	830

Total Quantities Throughout Site						
Required ENR Surface Area (SF)	Required Neatline Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side-Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)
26,888	425,071	183,743	84,933	15,783	6,805	107,521

Total Quantities Inside FNC					
Required Neatline Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side-Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)
199,379	73,724	39,552	7,393	2,731	49,676

Total Quantities Outside FNC					
Required Neatline Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side-Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)
225,693	110,018	45,381	8,390	4,075	57,846

Table M-1.4 Detailed Quantities

% Volume Assumptions for Production Rates				Dredge/Excavation Volume Distribution (CY)				Material Placement Volume Distribution (CY)													
Open Water (%)	Nearshore/ Slope/ Slow (%)	Restricted Access (%)	Excavation (Shoreline/ Bank) (%)	Open Water Dredging (CY)	Nearshore / Slope/ Slow Dredging (CY)	Restricted Access Dredging (CY)	Excavation (Shoreline/ Bank) (CY)	Sand Material				Gravelly Sand Material				Capping Materials					
								RMC/ ENR (Open Water) (CY)	RMC/ ENR (Nearshore) (CY)	RMC/ ENR (Restricted Access) (CY)	RMC/ ENR (Land-Based Equipment) (CY)	Backfill (Open Water) (CY)	Backfill (Nearshore) (CY)	Backfill (Restricted Access) (CY)	Backfill (Land-Based Equipment) (CY)	Sand/ZVI for Cap Chemical Isolation Layer (CY)	Cobble/Gravel For Cap Erosion Protection/Filter Layer (CY)	Gravelly Sand for Habitat Layer (CY)			
100%				21,581				2,364				7,040									
94%		6%		31,048		1,442		4,257		430		6,447		18							
		100%								210											
100%				136								136									
	100%							44													
			100%				80							80							
		100%								58											
100%				934				23				840									
100%				97				45													
	100%				437								437								
			100%							85											
100%				6,262				709				258									
50%	50%			3,382	3,382			132	132			2,384	2,384								
100%				335				127				36									
25%	50%		25%	5,964	7,048		1,432	51	51			9,588	1,416		1,432	915	457	686			
			100%							167											
100%			100%	318			793					318			793						
	50%		50%		1,320		1,320		12	12			1,291		1,291						
			100%							101											
			100%				910								910						
			100%							68											
	100%							87													
	50%		50%		224		224					224		224							
			100%							96											
	10%		90%		1,633		14,076					1,633		14,076							
	100%				961							961									
	100%				609							609									
			100%				148								148						
			100%				218								218						
	100%				225								225								
			100%					79													
	100%				152								152								
	100%				830								830								

Open Water Dredging (CY)	Nearshore / Slope/ Slow Dredging (CY)	Restricted Access Dredging (CY)	Excavation (Shoreline/ Bank) (CY)	RMC/ ENR (Open Water) (CY)	RMC/ ENR (Nearshore) (CY)	RMC/ ENR (Restricted Access) (CY)	RMC/ ENR (Land-Based Equipment) (CY)	Backfill (Open Water) (CY)	Backfill (Nearshore) (CY)	Backfill (Restricted Access) (CY)	Backfill (Land-Based Equipment) (CY)	Sand/ZVI for Cap Chemical Isolation Layer (CY)	Cobble/Gravel For Cap Erosion Protection/Filter Layer (CY)	Gravelly Sand for Habitat Layer (CY)
70,058	16,821	1,442	19,200	7,708	195	430	12	27,046	10,163	18	19,172	915	457	686
--				--	210	268	518							

## Table M-1.4 Detailed Quantities

### Notes:

1. ENR material assumed to be a medium-grained sand, applied at a minimum 6-in thickness, with a 6-in maximum overplacement allowance intended in specific RAAs (as shown in the Preliminary Drawings [Appendix D]). ENR quantity assumes a placement footprint that includes a 10-foot buffer around the planned ENR placement area.
2. Total payable dredge volume includes: 1) required dredge volume (neatline), including associated external side-slope and transition (between RAAs) volumes, as shown on the Preliminary Drawings (Appendix D); and 2) 1-ft overdredge allowance on the entire dredge footprint. Includes required dredge and excavation volumes.
3. Backfill material assumed to be a gravelly sand material, intended to restore for habitat purposes sediment bed to pre-dredge elevations in specific RAAs, for areas above -10-ft MLLW (as shown in the Preliminary Drawings [Appendix D]). For 30% RD, the backfill volumes were assumed to be equal to the dredge volumes in the habitat areas and may be overestimated. The backfill design will be developed during Intermediate (60%) RD, as backfill volumes are dependent on the final dredge cut surface and may not exactly match the pre-dredge elevations due to equipment placement accuracy, and geotechnical properties of the placement
4. RMC material assumed to be a medium-grained sand, applied at a minimum 6-in thickness, with a 3-in maximum overplacement allowance, over 100% of the dredge area that does not receive backfill or a cap (including side slopes and a 10-ft buffer surrounding the dredge footprint) in specific RAAs (as shown in the Preliminary Drawings [Appendix D]).
5. Engineered capping is limited to portions of RAA 18 (as shown in the Preliminary Drawings [Appendix D]), outside of the FNC. Engineered cap is assumed to consist of two layers: chemical isolation layer (assumed to be a sand/ZVI mix; 1.5-ft thick with a 6-in maximum overplacement allowance) and erosion protection/filter layer (mixed cobble and gravel; 6-in thick with a 6-in maximum overplacement allowance). A surficial 1.5-ft layer for clam habitat substrate (gravelly sand) is assumed to be placed above the engineered cap.
6. RAA 9 is not included in the Preliminary (30%) RD.

CY: cubic yard

ENR: enhanced natural recovery

FNC: Federal Navigation Channel

MLLW: mean lower low water

RAA: remedial action area

RD: remedial design

RMC: residuals management cover

SF: square foot

ZVI: zero valent iron

**Table M-1.5 Production Rates and Durations**

**Summary Table**

Item Description	Unit	Dredging/Excavation					Material Placement										
		Dredging (Open Water)	Dredging (Nearshore / Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-dredging	Excavation (Shoreline/ Bank)	Sand for RMC/ ENR (Open Water)	Sand for RMC/ ENR (Nearshore)	Sand for RMC/ ENR (Restricted Access)	Sand for RMC/ ENR (Land-Based Equipment)	Gravelly Sand for Backfill (Open Water)	Gravelly Sand for Backfill (Nearshore)	Gravelly Sand for Backfill (Restricted Access)	Gravelly Sand for Backfill (Land-Based Equipment )	Sand/ZVI Amendment Mix for Cap Chemical Isolation Layer	Cobble/ Gravel for Cap Erosion Protection/ Filter Layer	Gravelly Sand for Cap Habitat Layer
Dredge Volume/Placement Volume	CY	70,058	16,821	1,442	10,233	19,200	7,708	405	698	530	27,046	10,163	18	19,172	915	457	686
Cycle Time	min	1.87	1.93	2.50	2.07	2.10	2.10	2.50	2.65	2.10	2.10	2.50	2.65	2.10	2.53	3.13	2.53
Daily Production Rate	CY/day	1,168	727	515	904	780	1,200	1,008	662	900	1,200	1,008	662	900	925	698	925
	CY/day (rounded)	1,200	700	500	900	800	1,200	1,000	700	900	1,200	1,000	700	900	900	700	900
Daily Cost per Unit Volume	\$/CY-day	\$24.33	\$39.07	\$55.21	\$31.43	\$33.49	\$18.43	\$21.93	\$33.39	\$24.57	\$18.43	\$21.93	\$33.39	\$27.74	\$23.91	\$31.69	\$23.91
No. Dredge/Placement Work Days	Days	60	24	3	11	25	6	1	2	1	23	10	1	21	1	1	1
No. Dredge/Placement Calendar Days	Days	70	28	3	13	29	7	1	2	1	26	12	1	25	1	1	1

**Cycle Time**

Item Description	Unit	Dredging/Excavation					Material Placement										
		Dredging (Open Water)	Dredging (Nearshore / Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-dredging	Excavation (Shoreline/ Bank)	Sand for RMC/ ENR (Open Water)	Sand for RMC/ ENR (Nearshore)	Sand for RMC/ ENR (Restricted Access)	Sand for RMC/ ENR (Land-Based Equipment)	Gravelly Sand for Backfill (Open Water)	Gravelly Sand for Backfill (Nearshore)	Gravelly Sand for Backfill (Restricted Access)	Gravelly Sand for Backfill (Land-Based Equipment )	Sand/ZVI Amendment Mix for Cap Chemical Isolation Layer	Cobble/ Gravel for Cap Erosion Protection/ Filter Layer	Gravelly Sand for Cap Habitat Layer
Load Bucket	sec	20	16	30	22	20	20	26	28	20	20	26	28	20	28	32	28
Lift Load	sec	18	20	22	20	18	18	24	22	18	18	24	22	18	24	28	24
Swing Load	sec	16	16	20	16	16	16	16	20	16	16	16	20	16	16	20	16
Lower Load	sec	16	18	18	18	18	16	18	20	18	16	18	20	18	18	24	18
Dump/Place Load	sec	10	10	10	10	10	20	22	25	10	20	22	25	10	22	30	22
Return Swing	sec	10	10	16	10	10	10	12	12	10	10	12	12	10	12	14	12
Lower Bucket	sec	14	16	18	16	18	16	18	18	18	16	18	18	18	22	18	18
Lost Time (accelerating, positioning, stepping ahead, weather, hydraulics, bucket change, shifting anchors/silt curtains)	sec	8	10	16	12	16	10	14	14	16	10	14	14	16	14	18	14
<b>Total Cycle Time</b>	<b>sec</b>	<b>112</b>	<b>116</b>	<b>150</b>	<b>124</b>	<b>126</b>	<b>126</b>	<b>150</b>	<b>159</b>	<b>126</b>	<b>126</b>	<b>150</b>	<b>159</b>	<b>126</b>	<b>152</b>	<b>188</b>	<b>152</b>
	<b>min</b>	<b>1.87</b>	<b>1.93</b>	<b>2.50</b>	<b>2.07</b>	<b>2.10</b>	<b>2.10</b>	<b>2.50</b>	<b>2.65</b>	<b>2.10</b>	<b>2.10</b>	<b>2.50</b>	<b>2.65</b>	<b>2.10</b>	<b>2.53</b>	<b>3.13</b>	<b>2.53</b>

**Daily Production Rate**

Item Description	Unit	Dredging/Excavation					Material Placement										
		Dredging (Open Water)	Dredging (Nearshore / Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-dredging	Excavation (Shoreline/ Bank)	Sand for RMC/ ENR (Open Water)	Sand for RMC/ ENR (Nearshore)	Sand for RMC/ ENR (Restricted Access)	Sand for RMC/ ENR (Land-Based Equipment)	Gravelly Sand for Backfill (Open Water)	Gravelly Sand for Backfill (Nearshore)	Gravelly Sand for Backfill (Restricted Access)	Gravelly Sand for Backfill (Land-Based Equipment )	Sand/ZVI Amendment Mix for Cap Chemical Isolation Layer	Cobble/ Gravel for Cap Erosion Protection/ Filter Layer	Gravelly Sand for Cap Habitat Layer
Cycle Time	min	1.87	1.93	2.50	2.07	2.10	2.10	2.50	2.65	2.10	2.10	2.50	2.65	2.10	2.53	3.13	2.53
Bucket Capacity	CY	8	6	6	8	6	8	8	6	6	8	8	6	6	8	8	8
Effective Bucket Capacity	%	70%	65%	65%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	70%	75%	75%
	CY	5.6	3.9	3.9	5.2	4.2	6	6	4.5	4.5	6	6	4.5	4.5	6	5.6	6
Shift Duration	hrs/day	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
No. of Shifts	No.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Work Days/Week	No.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Running Time Efficiency	%	65%	60%	55%	60%	65%	70%	70%	65%	70%	70%	70%	65%	70%	65%	65%	65%
<b>Daily Production Rate (per Shift)</b>	<b>cy/day</b>	<b>1,168</b>	<b>727</b>	<b>515</b>	<b>904</b>	<b>780</b>	<b>1,200</b>	<b>1,008</b>	<b>662</b>	<b>900</b>	<b>1,200</b>	<b>1,008</b>	<b>662</b>	<b>900</b>	<b>925</b>	<b>698</b>	<b>925</b>

Table M-1.5 Production Rates and Durations

Durations

Item Description	Unit	Dredging/Excavation					Material Placement										
		Dredging (Open Water)	Dredging (Nearshore / Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-dredging	Excavation (Shoreline/ Bank)	Sand for RMC/ ENR (Open Water)	Sand for RMC/ ENR (Nearshore)	Sand for RMC/ ENR (Restricted Access)	Sand for RMC/ ENR (Land-Based Equipment)	Gravelly Sand for Backfill (Open Water)	Gravelly Sand for Backfill (Nearshore)	Gravelly Sand for Backfill (Restricted Access)	Gravelly Sand for Backfill (Land-Based Equipment)	Sand/ZVI Amendment Mix for Cap Chemical Isolation Layer	Cobble/ Gravel for Cap Erosion Protection/ Filter Layer	Gravelly Sand for Cap Habitat Layer
Total Dredge Volume/Placement Volume	CY	70,058	16,821	1,442	10,233	19,200	7,708	405	698	530	27,046	10,163	18	19,172	915	457	686
No. Dredge/Placement Work Days	Days	60	24	3	11	25	6	1	2	1	23	10	1	21	1	1	1
No. Dredge/Placement Work Hours	hrs	600	240	28	113	250	64	10	20	6	225	101	10	213	10	7	10
<b>Total Dredge/Placement Duration (Work Days)</b>	<b>Days</b>	<b>123</b>					<b>68</b>										
No. Dredge/Placement Calendar Days	Days	70	28	3	13	29	7	1	2	1	26	12	1	25	1	1	1
<b>Total Dredge/Placement Duration (Calendar Days)</b>	<b>Days</b>	<b>144</b>					<b>79</b>										

Daily Unit Costs

Item Description	Unit	Dredging/Excavation					Material Placement										
		Dredging (Open Water)	Dredging (Nearshore / Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-dredging	Excavation (Shoreline/ Bank)	Sand for RMC/ ENR (Open Water)	Sand for RMC/ ENR (Nearshore)	Sand for RMC/ ENR (Restricted Access)	Sand for RMC/ ENR (Land-Based Equipment)	Gravelly Sand for Backfill (Open Water)	Gravelly Sand for Backfill (Nearshore)	Gravelly Sand for Backfill (Restricted Access)	Gravelly Sand for Backfill (Land-Based Equipment)	Sand/ZVI Amendment Mix for Cap Chemical Isolation Layer	Cobble/ Gravel for Cap Erosion Protection/ Filter Layer	Gravelly Sand for Cap Habitat Layer
Dredge/Excavator	\$/day	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 5,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000	\$ 7,000
Tug (2 for dredging and 1 for material placement)	\$/day	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000
Barge (2 for dredging and 1 for material placement)	\$/day	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000
Work Boat	\$/day	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600	\$ 600
Front-end loader	\$/day	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500	\$ 500
<b>Daily Subtotal Cost for Equipment</b>	<b>\$/day</b>	\$ 15,100	\$ 15,100	\$ 15,100	\$ 15,100	\$ 13,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100	\$ 12,100
FOG (15%)	\$/day	\$ 2,265	\$ 2,265	\$ 2,265	\$ 2,265	\$ 1,965	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815	\$ 1,815
<b>Daily Total Cost for Equipment</b>	<b>\$/day</b>	\$ 17,365	\$ 17,365	\$ 17,365	\$ 17,365	\$ 15,065	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915	\$ 13,915
	<b>\$/cy</b>	\$ 15	\$ 24	\$ 34	\$ 19	\$ 19	\$ 12	\$ 14	\$ 21	\$ 15	\$ 12	\$ 14	\$ 21	\$ 15	\$ 15	\$ 20	\$ 15
Superintendent	\$/day	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800
Operator Foreman	\$/day	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650
Dredge/Excavator Operator	\$/day	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650
Deck Hands for Dredge (assumed 3)	\$/day	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950	\$ 1,950
Tug Operator (2 for dredging and 1 for material placement)	\$/day	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 1,300	\$ 650	\$ 650
Deck Hands for Tug (assumed 2)	\$/day	\$ 2,600	\$ 2,600	\$ 2,600	\$ 2,600	\$ 2,600	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 650	\$ 2,600	\$ 650	\$ 650
Front-loader Operator	\$/day	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300	\$ 1,300
Health and Safety and Quality Assurance	\$/day	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800	\$ 800
<b>Daily Subtotal Cost for Labor</b>	<b>\$/day</b>	\$ 10,050	\$ 10,050	\$ 10,050	\$ 10,050	\$ 10,050	\$ 7,450	\$ 7,450	\$ 7,450	\$ 7,450	\$ 7,450	\$ 7,450	\$ 7,450	\$ 10,050	\$ 7,450	\$ 7,450	\$ 7,450
Travel / Per Diem Allowance (10%)	\$/day	\$ 1,005	\$ 1,005	\$ 1,005	\$ 1,005	\$ 1,005	\$ 745	\$ 745	\$ 745	\$ 745	\$ 745	\$ 745	\$ 745	\$ 1,005	\$ 745	\$ 745	\$ 745
<b>Daily Total Cost for Labor</b>	<b>\$/day</b>	\$ 11,055	\$ 11,055	\$ 11,055	\$ 11,055	\$ 11,055	\$ 8,195	\$ 8,195	\$ 8,195	\$ 8,195	\$ 8,195	\$ 8,195	\$ 8,195	\$ 11,055	\$ 8,195	\$ 8,195	\$ 8,195
	<b>\$/cy</b>	\$ 9	\$ 15	\$ 21	\$ 12	\$ 14	\$ 7	\$ 8	\$ 12	\$ 9	\$ 7	\$ 8	\$ 12	\$ 12	\$ 9	\$ 12	\$ 9
<b>Daily Total Cost for Equipment and Labor</b>	<b>\$/day</b>	\$ 28,420	\$ 28,420	\$ 28,420	\$ 28,420	\$ 26,120	\$ 22,110	\$ 22,110	\$ 22,110	\$ 22,110	\$ 22,110	\$ 22,110	\$ 22,110	\$ 24,970	\$ 22,110	\$ 22,110	\$ 22,110
	<b>\$/cy</b>	\$ 24	\$ 39	\$ 55	\$ 31	\$ 33	\$ 18	\$ 22	\$ 33	\$ 25	\$ 18	\$ 22	\$ 33	\$ 28	\$ 24	\$ 32	\$ 24



**Table M-1.5 Production Rates and Durations**

<b>Durations</b>	
<b>Item Description</b>	<b>Totals</b>
Dredge Volume (CY)	88,321
Contingency Re-Dredging Volume (CY)	10,233
Excavation Volume (CY)	19,200
Material Placement Volume (CY)	67,798
Total Dredge Duration (Work Days)	123
Total Material Placement Duration (Work Days)	68
Total Mob/Demob + Dredge/Material Placement Durations + Structural Work (Work Days)	255
Total Duration (Work Months)	8.4
Total Duration (Work Months) - Rounded	9.0
Total Dredge Duration (Calendar Days)	144
Total Material Placement Duration (Calendar Days)	79
Total Mob/Demob + Dredge/Material Placement Durations + Structural Work (Calendar Days)	298
Total Duration (Calendar Months)	9.8
Total Duration (Calendar Months) - Rounded	10.0

Notes:  
 CY/day: cubic yard/day  
 CY: cubic yard  
 CY-day: cubic yard-day  
 ENR: enhanced natural recovery  
 hrs/day: hours/day  
 min: minute  
 RMC: residuals management cover  
 sec: second  
 SF: square foot  
 ZVI: zero valent iron



Table M-1.6 Detailed Structural Work Costs (Provided by Bright Engineering, July 21, 2022)

LDWG - Structures and Outfalls  
 Sediment Cleanup of Upper Reach of Lower Duwamish Waterway  
 Probable Construction Cost Estimate  
 30% Design - Phase 3, Revised July 21, 2022

Bid Item No.	Specs Section No.	Item	Quantity	Unit	Min Unit Cost	Max Unit Cost	Bracketed Avg Unit Cost <sup>1</sup>	Probable Unit Cost <sup>2</sup>	Min Total Cost	Max Total Cost	Bracketed Avg Total Cost	Probable Total Cost <sup>2</sup>	Duration (days)
<b>SCHEDULE A - Structures</b>													
<b>OVER AND IN-WATER STRUCTURES</b>													
<b>Remove and Replace Timber Piles, Incl Dolphins and Groins</b>													
		Remove Creosote Timber Piles (6 per day, 16 days total)	91	Ea	\$ 50.00	\$ 3,500.00	\$ 2,729.46	\$ 3,138.88	\$ 4,550	\$ 318,500	\$ 248,381	\$ 285,638	16
		Replace with Steel Pipe Piles - Material and Driving (4 per day, 22 days total)	91	Ea	\$ 5,500.00	\$ 13,712.67	\$ 11,062.56	\$ 12,721.94	\$ 500,500	\$ 1,247,853	\$ 1,006,693	\$ 1,157,696	22
		Remove Creosote Timber Dolphins (2 Days)	1	Ea	\$ 1,670.00	\$ 8,000.00	\$ 4,437.57	\$ 5,103.21	\$ 1,670	\$ 8,000	\$ 4,438	\$ 5,103	2
		Replace with Steel Pipe Pile Dolphins - Material and Driving (4 per day, 3 days total)	1	Ea	\$ 40,000.00	\$ 76,000.00	\$ 56,133.33	\$ 64,553.33	\$ 40,000	\$ 76,000	\$ 56,133	\$ 64,553	3
		New Dolphins Mooring Cleats (10 days)	1	LS	\$ 32,000.00	\$ 32,000.00	\$ 32,000.00	\$ 36,800.00	\$ 32,000	\$ 32,000	\$ 32,000	\$ 36,800	10
		Timber Pile Disposal (10" Dia Avg x 40ft @ 36pcf)	72.25	Ton	\$ 100.99	\$ 650.00	\$ 251.12	\$ 288.79	\$ 7,297	\$ 46,967	\$ 18,145	\$ 20,867	
		<b>Sub Total</b>							\$ 586,017	\$ 1,729,319	\$ 1,365,790	\$ 1,570,658	53
<b>Remove and Replace Steel Pipe Piles</b>													
		Remove Piles (2 per day, 1 day total)	2	Ea	\$ 1,670.00	\$ 3,017.86	\$ 2,343.93	\$ 2,695.52	\$ 3,340	\$ 6,036	\$ 4,688	\$ 5,391	1
		Replace Piles - Material and Driving (2 per day, 1 day total)	2	Ea	\$ 5,500.00	\$ 13,712.67	\$ 11,062.56	\$ 12,721.94	\$ 11,000	\$ 27,425	\$ 22,125	\$ 25,444	1
		Pile Disposal (14"Dia x 0.5" Wall x 50ft)	2.89	Ton	\$ 100.99	\$ 650.00	\$ 251.12	\$ 288.79	\$ 291	\$ 1,876	\$ 725	\$ 834	
		<b>Sub Total</b>							\$ 14,631	\$ 35,337	\$ 27,538	\$ 31,668	2
<b>Remove and Replace Timber Bulheads (Stub Piles)</b>													
		Remove Piles (6 per day, 15 days total)	88	Ea	\$ 50.00	\$ 3,500.00	\$ 2,729.46	\$ 3,138.88	\$ 4,400	\$ 308,000	\$ 240,193	\$ 276,222	15
		Replace Piles with Steel Sheet Piles - Material and Driving (4-18" Wide Sheets per day, 22 days total)	650	SF	\$ 42.00	\$ 52.50	\$ 47.13	\$ 54.20	\$ 27,300	\$ 34,125	\$ 30,632	\$ 35,227	22
		Timber Pile Disposal (10"Dia Avg x 15ft @ 36pcf)	25.92	Ton	\$ 100.99	\$ 650.00	\$ 251.12	\$ 288.79	\$ 2,617	\$ 16,847	\$ 6,509	\$ 7,485	
		<b>Sub Total</b>							\$ 34,317	\$ 358,972	\$ 277,334	\$ 318,934	37
<b>Temporary Relocation of Floats</b>													
		Removal, Storage, Reinstallation and Minor Repairs (4 days total)	1	LS	\$ 75,000.00	\$ 75,000.00	\$ 75,000.00	\$ 86,250.00	\$ 75,000	\$ 75,000	\$ 75,000	\$ 86,250	4
		<b>Sub Total</b>							\$ 75,000	\$ 75,000	\$ 75,000	\$ 86,250	4
		<b>Total</b>							\$ 709,966	\$ 2,198,628	\$ 1,745,662	\$ 2,007,511	96
<b>SCHEDULE B - Outfalls</b>													
<b>Plug and Abandon, Temporary Bypass, Temporary Support, Extension and Bank Protection</b>													
<b>Plug and Abandon, Temporary Diversion</b>													
		Plug and Abandon (4 days total)	1	LS	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,750.00	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,750	4
		<b>Sub Total</b>							\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,750	4
<b>Pipe Extension and Support, Incl Apron</b>													
		Pipe Support (2 days total)	1	LS	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,750.00	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,750	2
		Apron/Bank Protection (4 days total)	1	LS	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 11,500.00	\$ 10,000	\$ 10,000	\$ 10,000	\$ 11,500	4
		<b>Sub Total</b>							\$ 15,000	\$ 15,000	\$ 15,000	\$ 17,250	6
		<b>Total</b>							\$ 20,000	\$ 20,000	\$ 20,000	\$ 23,000	10

**TOTAL** \$ 2,030,511

<sup>1</sup> Bracketed Average is calculated average with outliers omitted.

<sup>2</sup> Probable Cost is Bracketed Average plus 15% bump.

Table M-1.6 Detailed Structural Work Costs (Provided by Bright Engineering, July 21, 2022)

Structures (ST) - Bulheads, Single Pile Fields, Guide Piles, Dolphins, Bridge Work Inventory																			
(See 30% Structural Drawings and Structural Decision Table in BODR for Quantities Indicated)																			
Structure ID	RAA	RM	River Bank Stationing				LF	Adjacent Property Owner	Description	# Piles			Creosote Dolphin Removal	Dolphin Replacement w/ Steel Piles	Cleat Replacement	Stub Pile Bulkhead Removal	Bulkhead Replacement w/ Steel Sheet Piles, SF (Exposed)	Bulkhead Shoring, Support (20%), SF (Exposed)	Comments
			Start STA	End STA	Creosote Single/Groin Piles Removal	Steel Piles Removal				Steel Pile Replacement									
ST02	8	3.3					South Park Bridge	Fenders											
	9	3.3						Bascule Pier											
	10	3.3						South Abutment											
ST03	18A, 18B, 18C	3.7	292	10	296	40	430	Boeing Plant 2 (Boeing Vacant Land)	Bulkhead										
	18 E	3.8	297	60	298	70	110	Jorgensen Forge (Boeing Thompson Site)	Bulkhead										
	22	3.8	301	00	302	30	130	Jorgensen Forge (Boeing Thompson Site)	Bulkhead				88.00	650				Assume stub piles @18" oc, 15ft long. 5ft exposed	
	24	3.9	304	30	305	00	70	Insurance Auto Auction	Bulkhead										
	26	3.9	306	50	306	90	40	Centerpoint Properties	Bulkhead										
																			Assumed per total LF, Piles @ ft oc @ 15ft tall walls
ST04	27A, 27B, 27C	4.0-4.1	309	60	315	80	620	Container Properties, LLC	Piles (Delapidated Dock)	4									
	27								Dolphins			1	1	1					
ST07	29	4.6	361	70	362	90	120	Boeing Developmental Center	Wharf										
ST07	32	4.8	371	20	371	40	20	Boeing Developmental Center	Groin	40		40							
ST07	33	4.8	371	60	372	00	40	Boeing Developmental Center	Groin?										
ST07	34	4.8	372	40	373	00	60	Boeing Developmental Center	Groin	40		40							
ST10	30	4.7	410	70	410	90	20	Port of Seattle	Piles	7									Demolished Piles not Replaced
ST20	13	3.5	492	20	492	60	40	South Park Marina	Guide Piles		2	2							
								Totals		91	2	82	1	1	1	88.00	650	0	

### Outfalls Work Inventory

(See 30% Structural Drawings and Structural Decision Table in BODR for Quantities Indicated)

Structure ID	RAA	RM	Riverbank Stationing		Adjacent Property Owner	Description	Plug and Abandon	Temporary Support	Temporary Diversion	Protect in Place <sup>1</sup>	Extension	Bank Protection	Comments
			STA										
2075	22	3.9	301	80	Jorgensen Forge (Boeing Thompson Site)	32" Dia Steel Riser				1			
2073	26	3.9	307	10	Centerpoint Properties	18" Dia Concrete				1			
2093	35	4.9	375	00	Boeing	24" Dia Concrete		1				1	
2094	35	4.9	375	10	Boeing	12" Dia Concrete	1						
<b>Totals</b>							<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>1</b>	

<sup>1</sup>Incidental to Dredging Activities