

Appendix O

Cost Estimates

Appendix O – Cost Estimates

O.1 Introduction

The cost estimates presented in this appendix and associated cost analysis information are provided for use in evaluating the Removal Action alternatives set forth in the EE/CA. The estimated costs reflect a conceptual stage of development of each alternative, generally on the order of 10% or 15% design level. The cost estimates were prepared in general accordance with regulatory guidance for cost estimating (USEPA, 2000; USEPA, 1993). In accordance with USEPA guidance, estimates are intended to provide values within +50% to -30% of actual short-term and lifecycle costs for each alternative.

The estimated Removal Action costs for Alternatives A through D, including present value adjustments on OMM and other periodic costs, are as follows:

- Alternative A – MNR Emphasis: \$23,303,000
- Alternative B – Capping Emphasis: \$24,627,000
- Alternative C – Dredging Emphasis with CDF Disposal: \$30,555,000
 - Alternative C – including excess capacity value: \$20,555,000
- Alternative D – Dredging Emphasis with Landfill Disposal: \$26,431,000

For Alternative C, the benefit associated with the CDF excess capacity for contaminated sediments is estimated to be on the order of \$10,000,000 (refer to Section O.3.5 for more detail).

Table O-1 presents the preliminary cost analysis for Alternative A. Table O-2 presents the preliminary cost analysis for Alternative B. Table O-3 presents the preliminary cost analysis for Alternative C. Table O-4 presents the preliminary cost analysis for Alternative D. Assumptions made in the cost estimates are discussed below.

O.2 General Assumptions

- **Dredge Volumes – Bottom of Slips.** Dredge volumes for bottom of slip were estimated using a preliminary dredge layout of rectangular areas having depths based on removal to threshold effects concentration (TEC) exceedance criteria. TEC exceedance criteria are not, however, intended as cleanup goals.
- **Dredge Volumes – Slope Areas.** Dredge volumes for sloping areas were estimated assuming that the average dredge depth along slopes would be on the order of 2 feet.
- **Capping Volumes.** Capping volumes were based on a uniform thickness of 3 feet.
- **Volumetric Contingencies.** No volumetric contingency on dredging or capping was included at this stage (i.e., overdredging or overcapping).
- **Quantity Assumptions.** Dredging and capping volumes/areas are provided in the EE/CA report, Section 7.

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- **Present Value Calculations.** A discount rate of 7% is suggested for present value calculations per USEPA guidance (USEPA, 2000). However, a discount rate of 5% was used for discounting OMM/periodic costs based on the anticipation that interest rates will remain relatively low and to account for inflation. The cost for those CDF construction components that would be implemented in a shorter term (i.e., CDF cap and pavement constructed eight years after start of Terminal 4 Early Action construction) were also discounted at the 5% rate.
 - **Construction Contingencies.** Contingencies are not applied to capital and OMM/periodic costs. For most of the cost items, cost ranges were established. Based on the unit cost ranges and detailed analysis of the cost items, interpreted most likely unit costs were selected for individual cost items. As a result, the total cost for each Removal Action alternative reflects the most likely cost and is generally anticipated to be within the expected accuracy for cost estimates for remedy selection outlined in USEPA (2000), which is -30% to +50% of the final Removal Action cost. The intent of the cost estimates is to compare costs for the purpose of alternative selection, which is accomplished in this document by comparison of most likely Removal Action costs; additional contingencies are not considered necessary for comparative analysis.

O.3 Capital Cost Assumptions

O.3.1 Mobilization/Demobilization

- **Mobilization/Demobilization.** A value of \$1,000,000 was used for all alternatives based on recent bidding experience on the McCormick and Baxter capping project in Portland Harbor. This value is on the order of 4% to 5% of capital costs of the alternatives. The McCormick and Baxter bids for this item ranged from about \$780,000 to \$1,390,000. Mobilization/demobilization was not varied among alternatives to avoid biasing the cost comparison, as this is typically a high-cost parameter and has a high degree of uncertainty. Mobilization/demobilization includes the contractor's cost to transport equipment to the site, provide temporary facilities, prepare staging areas, etc.
- **Contractor Work Plans.** A value of \$250,000 was assumed for the cost for the preparation of miscellaneous work plans. This value is based on experience on the Thea Foss and Hylebos projects located in Tacoma, Washington, as well as on bid information for the McCormick and Baxter capping project (cost ranged from about \$60,000 to \$300,000). The value of \$250,000 for Terminal 4 was selected based on judgment related to the project type and size relative to the projects referenced above. The contractor will have to prepare a dredge/cap, sediment management/disposal plan, construction quality control plan, environmental protection plan, and a health and safety plan.

O.3.2 Site Preparation

- **Timber Framework Demolition/Disposal.** A cost of \$6 per square foot was used for pier timber framework demolition based on experience on similar Port of Portland projects at Terminal 1 and Terminal 4/Slip 1 in 2000, in combination with engineering judgment. The cost assumes non-contaminated disposal and maximizing recycle of applicable materials. The total costs are based on the following areas:

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- Berth 405 Pier: 72,000 ft²
 - Berth 408 Pier: 105,000 ft²
 - **Timber Pile Removal and Disposal – Slip 1.** Site preparation for the CDF will include timber pile removal and disposal. A cost of \$200 per pile is assumed for removal and disposal of creosote-treated timber piles. This cost is based on bid information for the McCormick and Baxter capping project in Portland Harbor (bid items ranged from approximately \$150 per pile to \$270 per pile) and information provided by ACC Hurlen for the Pacific Sound Resources (PSR) project in Seattle (approximately \$200 per pile). An estimated 3,700 pilings is assumed for removal and disposal within Slip 1 based on an assumed pile spacing of 7 feet and an estimated total pier area of 177,000 square feet (72,000 square feet for Berth 405 and 105,000 square feet for Berth 408).
 - **Sediment Transload Facility.** The more costly of two estimated alternatives, one for Slip 1 and Slip 3, was assumed. The cost was estimated to be \$920,000, which includes lining/berming the staging area, preparing and operating the decontamination facility, providing stormwater management and treatment, use of equipment for sediment handling and transfer from barges, use of stabilizing agent (e.g., fly ash) to reduce the amount of free water, and water sampling. At this time, barge-to-rail transloading is assumed to be performed using the rail spurs at Berths 410/411 (i.e., Kinder Morgan facility). The active rail spurs are assumed to be in adequate condition and are currently used by Kinder Morgan. Kinder Morgan's operations would be shut down during dredging in Slip 3. An additional transload facility could be established at the head of Slip 1 for barge-to-truck transloading, but is not considered to be necessary to meet production rates at this point.

O.3.3 Dredging

- **Dredging.** A dredging cost of \$8 per cubic yard was assumed based on experience on the Thea Foss Waterway project (bid item ranged from approximately \$5 to \$8 per cubic yard) and experience with sediment dredging at Port terminals (three maintenance dredging projects in 2000, 2001, and 2002 had dredging unit costs of \$6.30, \$8.20, and \$11.50 respectively).
- **Dredging Production Rates.** Dredging production rates for dredging in Slip 3 affect tenant disruption costs (refer to Section O.3.7). A dredge production rate of 2,400 cubic yards a day was assumed for Alternatives A, B, and D based on an estimated production rate of 150 cubic yards per hour and assuming that dredging would occur during two shifts (i.e., 16 hours of dredging per day). An example estimate of the hourly production rate is provided in Appendix J along with more detailed information regarding the feasibility of dredging. The production rate for Alternative C was assumed to be 4,800 cubic yards per day based on the use of a relatively large hydraulic cutterhead dredge and the close proximity of the final disposal location. The rationale and basis for the assumed production rates is discussed in detail in Appendix J – Dredging Feasibility.
- **Water Quality Control Measures.** A lump sum of \$250,000 was assumed based on discussions with silt curtain vendors and in combination with engineering judgment. The specific needs for the project would be determined during design.

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- **Backfill Berth 411.** Explorations detected contamination below the design dredge depth for the new sheet pile bulkhead at Berths 410/411. Therefore, some of the contaminated material that will be removed during dredging will have to be backfilled with clean, granular maintenance dredge material to provide sufficient support to the new sheet pile wall. A unit cost of \$5 per cubic yard was assumed for transport and placement of clean dredged sand from the Columbia River based on experience on recent Columbia River maintenance dredge projects. A required volume of 10,000 cubic yards of fill material was assumed based on the approximate area of detected contamination in front of Berth 411.
 - **Scour Protection.** For the purpose of the EE/CA, scour protection consisting of quarry spalls or riprap material of about 3 feet in thickness is assumed to be required for an area in front of Berth 411 that experiences frequent scouring by large vessels. The size of the area is approximately 150 feet by 650 feet. This is a stated requirement of the sheet pile wall design for the area in front of Berth 411 currently being constructed. Additionally, scour protection of the capping areas in Slip 1 consisting of 2 feet thickness of 3-inch minus material is assumed to be required for approximately 50% of the capping area. A propeller wash analysis is required to define the necessary extent and type of scour protection in Slip 1 and Slip 3 and will be conducted as part of design. Vessel traffic in Slip 1 is assumed to consist of tug boats and barges. Large vessels exporting soda ash and tugs will frequently berth and operate in Slip 3. A unit cost of \$25 per ton was assumed for scour protection material such as quarry spalls. A conversion factor of 1.8 tons per cubic yard was used for estimating the weight of the protective material.
 - **Modify Outfalls.** All outfalls were assumed to be potentially influenced by dredging in Slip 1 (Alternative D), requiring slight repairs of piping and placement of a scour pad. A cost of \$5,000 per outfall was assumed, which includes costs for two days of labor (two workers), an excavator, miscellaneous materials and equipment, quarry spalls/riprap (approximately 2 cubic yards), and an allowance for difficult access conditions.
 - **Dredging Verification.** Dredging verification includes post-dredge core sampling and chemical analyses as well as pre-dredge and post-dredge verification multi-beam bathymetric surveys. Based on recent experience on the Pacific Sound Resources project in Seattle, a cost of \$16,000 per acre was used for core sampling and chemical analyses. Additionally, recent information from vendors suggests the cost of multi-beam bathymetric surveys could vary between \$20,000 to above \$40,000 per deployment depending on specific site characteristics, size, and mobilization distance. Based on this information, a cost per acre of \$4,000 was estimated using the vendor information and an average area of 10 acres. The total unit cost of \$24,000 per acre selected for dredging verification represents the sum of the cost for sampling/chemical analyses and two bathymetric surveys.

O.3.4 Landfill Disposal

- **Landfill Disposal.** This cost includes the cost for transport and the disposal fee. A most likely cost of \$30 per ton was selected based on experience on past Port of Portland projects. The Port paid \$28.85 per ton in 2003 and \$30.87 per ton in 2004 for transport and disposal. A conversion of 1.6 tons per cubic yard is assumed for sediment.

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- **Metro Disposal Fee and DEQ Disposal Fee.** Based on the 2004 fee schedules, a Metro disposal fee of \$3.50 per ton and a DEQ disposal fee of \$1.24 per ton were assumed.

O.3.5 CDF Disposal

- **CDF Berm.** The indicated cost is assumed to represent well-graded sand and gravel import granular aggregate and riprap training terraces. A conversion factor of 1.55 tons per cubic yard is assumed. The unit cost of \$17 per ton is based on experience on the Thea Foss Waterway project in Tacoma, Washington in combination with engineering judgment.
- **CDF Pavement Cap.** The pavement is assumed to consist of 4 inches of asphalt (1 inch of asphalt wearing course and 3 inches of asphalt binder course) over an 8- to 10-inch-thick granular base. Unit costs were obtained from RSMMeans and are as follows:
 - Asphalt wearing course: \$2.48/SY;
 - asphalt binder course: \$6.25/SY;
 - granular base course: \$25.00/CY.

The estimated lump sum cost of \$1,250,000 is based on an estimated area of 16.9 acres and was rounded up slightly.

- **CDF Upper Sand Cap.** The use of relatively low-cost maintenance dredge sediment is assumed. A cost range of \$8 to \$12 per cubic yard was estimated based on experience on Columbia River maintenance dredging projects and includes compaction of the material. A most likely unit price of \$10 per cubic yard was selected for material, placement, and compaction of the upper cap material (i.e., top 5 feet of cap below the pavement). A conversion of 1.55 tons per cubic yard is assumed.
- **CDF Lower Sand Cap.** The same material is assumed to be used as for the upper cap. However, the lower cap material will not be compacted. A cost range of \$4 to \$6 per cubic yard was estimated based on experience on Columbia River maintenance dredging projects. A most likely unit price of \$5 per cubic yard was selected for material and placement.
- **Placement of Fill.** Placement of fill between the top of the dredged sediment and the bottom of the lower cap is assumed to incur no cost to the Terminal 4 Removal Action. The cost of placement of acceptable fill is assumed to be covered by the corresponding project that generates the fill.
- **Placement of Intermediate Sand Cap.** Suitable material will be used as temporary capping material following placement of the Terminal 4 dredged sediments, if contaminated dredged sediments from other sources are not immediately available for disposal in the CDF. It is assumed that material will be available similar to the material used for the “lower sand cap” (see above). A unit price of \$5 per cubic yard was assumed.
- **CDF Disposal, Place Dredged Sediment.** A conservative per cubic yard cost is assumed in the unlikely event double-handling of the sediment into the CDF is required by the contractor. The cost for rehandling/placement of soils typically ranges from \$2 to \$4 per cubic yard. A most likely cost of \$3 per cubic yard was selected.

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- **Relocate City/Port Storm Utilities and Relocate Outfalls.** It was assumed that a City of Portland sewer line will have to be relocated and that a new Port of Portland main sewer line would have to be provided, including reconfiguration/branching of piping serving five Port outfalls to be displaced. The relocation distance was estimated to be approximately 1,600 lineal feet for both the City of Portland sewer line and the new Port of Portland sewer main. A unit price of \$150 per lineal foot was selected based on experience on other Superfund sites in Region 10. The lump sum cost was rounded up to a total of \$500,000.
 - **Estimated Value of CDF Excess Capacity.** A value was estimated for the excess capacity provided by construction of a full-size, at-grade CDF in Slip 1. The CDF has an estimated total capacity for dredged sediments of about 695,000 cubic yards. The volume to be dredged at the Terminal 4 site was estimated to be 115,000 cubic yards (plus 20,000 cy of interim capping material for a total of 135,000 cy), leaving an estimated excess capacity for contaminated sediments from other Portland Harbor cleanup projects of 560,000 cubic yards. The value of the excess capacity is timing- and market-driven and would likely be on the order of the cost for disposal of dredged sediments from Terminal 4. The high-end unit cost for disposal was estimated to be \$30 per ton (compare with landfill disposal in Section O.3.4). Using a conversion factor of 1.6 tons per cubic yard, this comes to a unit cost of \$48 per cubic yard. The low end of the disposal cost was selected to be \$24 per cubic yard, or half of the high-end cost of \$48 per cubic yard. The most likely unit cost was selected to be \$30 per cubic yard (or roughly \$19 per ton) for the purpose of the EE/CA. The resulting total benefit of the CDF excess capacity would be on the order of \$16,800,000. Because of the uncertainties associated with timing and the market-driven nature of the benefit, the total value was discounted by 40%, resulting in a dollar value of approximately \$10,000,000.

O.3.6 Capping

- **Non-Under-Pier Capping.** The unit cost for non-under-pier capping was based on publicly available bid information for the Thea Foss Project in Tacoma, Washington. The bid for similar capping ranged from \$17 per ton to \$29 per ton. A most likely unit cost of \$25 per ton was selected for the Terminal 4 project.
- **Under-pier Capping.** An incrementally higher cost than standard capping (i.e., non-under-pier capping) is assumed to account for increased difficulty associated with capping under pier structures, likely requiring a conveyor or equivalent for placement of material.
- **Under-Pier Capping Production Rate.** Under-pier capping in Slip 3 (Berth 411) affects tenant disruption (refer to Section O.3.7). Based on experience on similar Superfund projects and engineering judgment, a production rate of 750 cubic yard per day is assumed.
- **Modify/Extend Outfalls.** All outfalls were assumed to be potentially influenced by capping, requiring extending the outfalls. The cost assumptions are generally similar to “Modify Outfalls” in Section O.3.3). However, since additional work is required for outfalls affected by capping, the unit price was doubled to account for extending the outfalls including additional labor, equipment, and materials. A unit cost of \$10,000 per outfall was selected.
- **Capping Verification.** The capping verification cost is based on the same rationale as “Dredging Verification” (refer to Section O.3.3). The cost includes core sampling, chemical analyses, and

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bathymetric surveys. A unit cost of \$24,000 per acre was assumed (the same as for dredging verification).

- **DSL Submerged Land Purchase for Capping Areas.** For cost estimating purposes, it is assumed that the Port would purchase the current State of Oregon owned submerged land located within the footprint of the capped areas. The cost is estimated based on a recent contaminated sediment site negotiation between Rhodia and DSL for purchase of submerged land to be capped. The price per acre for that project is \$8,500. It is acknowledged that the actual sale price will be negotiated directly with DSL through the land board process.

O.3.7 Miscellaneous Construction-Related Direct Costs

- **Short-Term Water Quality Monitoring.** A unit cost of \$12,000 per acre was assumed based on experience on the recent Pacific Sound Resources project in Seattle. The cost includes labor, materials, and equipment costs. Since monitoring will be required for both capping and dredging, the total cost is based on the combined acreages for capping and dredging.
- **Habitat and Other Mitigation.** Mitigation cost estimates are subject to uncertainty and depend on factors such as type and quality of habitat and the size of the affected area. Ultimate mitigation will be determined during the design phase of the project after collaboration with the agencies. For purposes of the EE/CA, mitigation costs were estimated as follows:
 - Alternatives A, B, and D — Mitigation may be required for areas where capping will occur (approximately 20, 24, and 9 acres, respectively). The cost estimate is based on capping performed at the McCormick and Baxter Superfund site, where 25 acres were capped and the mitigation for those activities was estimated at approximately \$380,000, giving a cost per acre of approximately \$15,000. The mitigation measures at McCormick and Baxter included removal of pilings; removal of a barge, concrete foundation, and concrete debris; waste handling, transportation, and disposal (of said debris); and sand armoring overlay for habitat recolonization. A net loss of habitat is not expected for Alternatives A, B, and D. However, if habitat is lost, compensatory mitigation may be required and the cost would be equivalent to that described below for Alternative C. Using this information, the cost included for purposes of the EE/CA for Alternatives A, B, and D is \$300,000, \$360,000, and \$135,000 respectively.
 - Alternative C — Mitigation may be required for the aquatic area that will be filled as part of the CDF construction. Habitat of varying quality in Slip 1 will be lost due to construction of the CDF and will require compensatory mitigation. Approximately 3.1 acres of shallow (<20 feet), nearshore beach and vegetated shallows, and 15.3 acres of deep-water habitat in the center of the slip would be lost. The cost for potential mitigation was estimated assuming different costs for shallow, nearshore areas and the deep-water habitat in the maintained channel in Slip 1. Compensatory mitigation for lost shallow habitat is likely to be conducted on Port property, and the Port would be required to forgo future revenue from sale or lease of the land. A land value of \$5 per square foot was assumed based on a regional estimate of commercial land value and the area of shallow-water habitat that would be lost from Slip 1 (3.1 acres), for a total of \$675,180. The cost of shallow-water habitat construction is based on \$50,000 per acre, which is an estimate used in the Portland area by Oregon

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DSL (published on their website) for development and construction of wetland and shallow-water habitat, for a construction cost of \$155,000. The cost for deeper areas was estimated for 15.3 acres assuming \$15,000 per acre based on average cost per acre associated with the McCormick and Baxter Superfund site cap, for a total of \$229,500. The cost of mitigation for capping (8.7 acres) is based on the same assumptions used for Alternatives A, B, and D (see above). The total estimated cost, including a 15% contingency, included for potential Alternative C mitigation is \$1,370,000.

- **Tenant Disruption Cost.** The tenant disruption cost is the estimated financial impact to the Port for disruption to tenant operations when Slip 3 is not accessible. The cost is based on reimbursement to the tenant pursuant to lease terms for each tenant, based on the assumption that the tenant will need to temporarily relocate to a port facility elsewhere. A cost of \$28,600 per day was established. Disruption durations were estimated using dredge and capping volumes (refer to Section 7 of the EE/CA report) and dredge and under-pier capping production rates (refer to Sections O.3.3 and O.3.6). The Port intends to minimize disruption to tenant operations.
- **State of Oregon Property Cost for Applicable CDF Area.** For cost estimating purposes, it is assumed that the Port would purchase the current State of Oregon owned submerged land located within the footprint of the CDF. The cost is estimated based on a recent contaminated sediment site negotiation between Rhodia and DSL for purchase of submerged land to be capped. The price per acre for that project is \$8,500. The land that would be purchased from DSL for purposes of the CDF covers approximately 6.5 acres, bringing the total estimated cost to \$52,250. It is acknowledged that the actual sale price will be negotiated directly with DSL through the land board process.
- **Relocation of Barge Leg.** The cost for the relocation of the barge leg in Slip 1 is provided as a lump sum cost that is based on a preliminary feasibility-level cost estimate that includes installation of new barge dolphins, barge leg support structure, walkway to barge leg, conveyors, grain elevators, transfer shoots and surge bins, electrical and mechanical upgrades to existing leg, relocation of barge leg, and miscellaneous other items. This item represents the cost to relocate grain-loading infrastructure to maintain this bulk cargo transfer operation.
- **Other Necessary Improvements.** For Alternative C, this item includes relocation of IRM piping to maintain this operation for liquid bulk cargo transfer. For Alternatives A, B, and D, the lump sum cost includes installation of a new docking facility for IRM after removal of the old pier structure at Berth 408. The costs for other necessary improvements are based on preliminary feasibility-level estimates. A cost of \$1,000,000 was included for Alternative C. The cost for Alternatives A, B, and D was estimated to be on the order of \$500,000.

O.3.8 Project Development Cost

- Project development costs consisting of “Removal Action Design”, “Port Advertise, Bid, Contract Procurement Costs”, “Construction Management and Daily Oversight”, “Engineering Support During Construction”, and “Special Insurance, Bonding, Permitting” are estimated based on assumed level of effort from experience on similar Superfund projects. Planned activities include the necessary coordination and consultation with agencies to comply with ARARs. The cost for “Engineering Support” does not include the cost for “Short-Term Water Quality Monitoring,” which is a separate cost item.

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O.3.9 OM&M and Other Periodic Costs

For the purpose of the EE/CA cost estimate, monitoring schedules for MNR, capping, and CDF monitoring were assumed as outlined below. More detailed monitoring plans will be prepared during later stages of design.

- **MNR Year 1 Monitoring.** The MNR monitoring costs reflect the cost, on a per-acre basis, to prepare necessary plans and implement a program of surface sampling and chemical analysis and report the results of such a program. These costs are based on experience on the Pacific Sound Resources project. A cost of \$16,000 per acre is included for one sample core per acre, mobilization/demobilization, core sample analysis, one week of project chemist time, and approximately one week for a chemical quality control officer. Additionally, a cost of \$3,000 per acre was included to account for preparation of a sampling and analysis plan, a quality assurance project plan, and final chemical data report. The unit total cost for this item was estimated to be \$19,000 per acre.
- **MNR Subsequent Monitoring.** The annual MNR monitoring costs reflect the cost of each year of monitoring and reporting as part of the program established in the first year. For the purpose of the EE/CA, monitoring was assumed to occur for four events (years 2, 3, 4, and 5) following completion of construction. The cost for each event was estimated to be 50% of the year-1 monitoring cost estimate (i.e., \$9,500 per acre and event).
- **Capping Year 1 Monitoring.** The year-1 capping monitoring would consist of surface sediment sampling, bathymetric surveys, and diver surveys to ensure integrity of the capped areas and is assumed to be performed at \$19,000 per acre.
- **Capping Subsequent Monitoring.** The capping monitoring costs reflect the cost of each year of monitoring and reporting for bathymetric and diver surveys. A total of eight events (years 2, 5, 7, 10, 15, 20, 25, and 30) following completion of construction was assumed for capping. The cost for each event was estimated to be 50% of the year-1 monitoring cost estimate (i.e., \$9,500 per acre and event).
- **Cap Maintenance Cost.** A feasibility-level cost assumption of \$250,000 is applied to a 30-year period and discounted as a periodic cost.
- **CDF Year 1 Monitoring.** The cost for the year-1 CDF monitoring includes the following estimated lump sum costs: Prepare a sampling and analysis plan and quality assurance project plan (\$60,000), install two new wells (\$20,000), perform quarterly monitoring of eight wells (\$80,000), and prepare the final report (\$70,000). The total lump sum cost was estimated to be \$230,000.
- **CDF Subsequent Monitoring.** The annual cost to perform monitoring and reporting as part of the program established in the first year is assumed to be \$75,000 and is based on monitoring of eight wells and reporting of the results. For the purpose of the EE/CA, we have assumed monitoring will occur for eight events (years 2, 5, 7, 10, 15, 20, 25, and 30) following completion of construction.
- **CDF Maintenance Cost.** A feasibility-level cost assumption of \$500,000 is applied to a 30-year period and discounted as a periodic cost.

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O.4 References

U.S. Environmental Protection Agency (USEPA), 1993. Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., EPA/540-R-93-057, Publication 9360.0-32, PB93-963402, August 1993.

U.S. Environmental Protection Agency (USEPA), 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study; Prepared by EPA and USACE, EPA 540-R-00-002, OSWER 9355.0-75.

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Table O-1. Cost Analysis Spreadsheet for Alternative A.

Alternative A -- Monitored Natural Recovery Emphasis				
<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT COST</u>	<u>EXTENDED COST</u>
CAPITAL COSTS:				
Direct Construction Costs				
Mobilization/Demobilization	1	LS	\$ 1,000,000.00	\$ 1,000,000
Contractor Work Plans	1	LS	\$ 250,000.00	\$ 250,000
			Subtotal =	\$ 1,250,000
Site Preparation	---	---	---	---
Timber Framework Demolition/Disposal	177,000	SF	\$ 6.00	\$ 1,062,000
Timber Pile Removal and Disposal - Slip 1	0	EA	\$ 200.00	\$ -
Sediment Transload Facility	1	LS	\$ 920,000.00	\$ 920,000
			Subtotal =	\$ 1,982,000
Dredging and Sediment Disposal	---	---	---	---
Dredging	105,000	CY	\$ 8.00	\$ 840,000
Water Quality Control Measures	1	LS	\$ 250,000.00	\$ 250,000
Backfill Berth 411	10,000	CY	\$ 5.00	\$ 50,000
Scour Protection	58,000	TON	\$ 25.00	\$ 1,450,000
Modify Outfalls	0	EA	\$ 5,000.00	\$ -
Landfill Disposal	168,000	TON	\$ 30.00	\$ 5,040,000
Metro Disposal Fee	168,000	TON	\$ 3.50	\$ 588,000
DEQ Disposal Fee	168,000	TON	\$ 1.24	\$ 208,400
Dredging Verification	9.2	AC	\$ 24,000.00	\$ 220,800
			Subtotal =	\$ 8,647,200
Capping	---	---	---	---
Under-pier Capping	12,900	TON	\$ 35.00	\$ 451,500
Non-Under-pier Capping	136,800	TON	\$ 25.00	\$ 3,420,000
Modify/Extend Outfalls	11	EA	\$ 10,000.00	\$ 110,000
Capping Verification	20.0	AC	\$ 28,000.00	\$ 560,000
DSL Submerged Land Purchase for Capping Areas	7.0	AC	\$ 8,500.00	\$ 59,500
			Subtotal =	\$ 4,601,000
Miscellaneous Construction-Related Direct Costs	---	---	---	---
Short-Term Water Quality Monitoring	29.2	AC	\$ 12,000.00	\$ 350,400
Habitat and other Mitigation	1	LS	\$ 300,000.00	\$ 300,000
Tenant Disruption Cost	47	DAY	\$ 28,600.00	\$ 1,344,200
Other Necessary Improvements	1	LS	\$ 500,000.00	\$ 500,000
			Subtotal =	\$ 2,494,600
			TOTAL DIRECT CAPITAL COST =	\$ 18,974,800
Indirect Construction Costs				
Project Development Construction Costs	---	---	---	---
Removal Action Design	1	LS	\$ 600,000.00	\$ 600,000
Port Advertise, Bid, Contract Procurement Costs	1	LS	\$ 200,000.00	\$ 200,000
Construction Management and Daily Oversight	1	LS	\$ 650,000.00	\$ 650,000
Engineering Support During Construction	1	LS	\$ 250,000.00	\$ 250,000
Special Insurance, Bonding, Permitting	1	LS	\$ 225,000.00	\$ 225,000
			Subtotal =	\$ 1,925,000
			TOTAL INDIRECT CAPITAL COST =	\$ 1,925,000
			TOTAL CAPITAL COST =	\$ 20,899,800
OM&M AND OTHER PERIODIC COSTS:				
MNR Year 1 Monitoring	15.9	AC	\$ 19,000.00	\$ 302,100
MNR Subsequent Monitoring	4	EA	\$ 151,050.00	\$ 604,200
Capping Year 1 Monitoring	20.0	AC	\$ 19,000.00	\$ 380,000
Capping Subsequent Monitoring	8	EA	\$ 190,000.00	\$ 1,520,000
Cap Maintenance Cost	1	LS	\$ 250,000.00	\$ 250,000
			TOTAL PERIODIC COST =	\$ 3,056,300
			TOTAL REMOVAL ACTION COST =	\$ 23,957,000
NET PRESENT VALUE ADJUSTMENT:				
Discount Rate for Periodic Costs				5%
			TOTAL PERIODIC COST (with NPV Adjustment) =	\$ 2,402,539
			TOTAL REMOVAL ACTION COST =	\$ 23,303,000
NOTES:				
1. Refer to Appendix O for detailed assumptions.				
2. AC = acre, LS = Lump Sum, EA = each				
3. No contingencies are applied capital or periodic costs, though individual cost items contain a high degree of uncertainty. The removal action cost estimate without contingency factors is considered reasonably representative of the EPA guidance objective of attaining an estimate within a accuracy range of -30% to +50% of actual implementation costs.				

Table O-2. Cost Analysis Spreadsheet for Alternative B.

Alternative B -- Capping Emphasis				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	EXTENDED COST
CAPITAL COSTS:				
Direct Construction Costs				
Mobilization/Demobilization	1	LS	\$ 1,000,000.00	\$ 1,000,000
Contractor Work Plans	1	LS	\$ 250,000.00	\$ 250,000
			Subtotal =	\$ 1,250,000
Site Preparation	---	---	---	---
Timber Framework Demolition/Disposal	177,000	SF	\$ 6.00	\$ 1,062,000
Timber Pile Removal and Disposal - Slip 1	0	EA	\$ 200.00	\$ -
Sediment Transload Facility	1	LS	\$ 920,000.00	\$ 920,000
			Subtotal =	\$ 1,982,000
Dredging and Sediment Disposal	---	---	---	---
Dredging	105,000	CY	\$ 8.00	\$ 840,000
Water Quality Control Measures	1	LS	\$ 250,000.00	\$ 250,000
Backfill Berth 411	10,000	CY	\$ 5.00	\$ 50,000
Scour Protection	70,000	TON	\$ 25.00	\$ 1,750,000
Modify Outfalls	0	EA	\$ 5,000.00	\$ -
Landfill Disposal	168,000	TON	\$ 30.00	\$ 5,040,000
Metro Disposal Fee	168,000	TON	\$ 3.50	\$ 588,000
DEQ Disposal Fee	168,000	TON	\$ 1.24	\$ 208,400
Dredging Verification	9.2	AC	\$ 24,000.00	\$ 220,800
			Subtotal =	\$ 8,947,200
Capping	---	---	---	---
Under-pier Capping	12,900	TON	\$ 35.00	\$ 451,500
Non-Under-pier Capping	168,500	TON	\$ 25.00	\$ 4,212,500
Modify/Extend Outfalls	11	EA	\$ 10,000.00	\$ 110,000
Capping Verification	24.2	AC	\$ 28,000.00	\$ 677,600
DSL Submerged Land Purchase for Capping Areas	11.5	AC	\$ 8,500.00	\$ 97,750
			Subtotal =	\$ 5,549,350
Miscellaneous Construction-Related Direct Costs	---	---	---	---
Short-Term Water Quality Monitoring	33.4	AC	\$ 12,000.00	\$ 400,800
Habitat and other Mitigation	1	LS	\$ 360,000.00	\$ 360,000
Tenant Disruption Cost	47	DAY	\$ 28,600.00	\$ 1,344,200
Other Necessary Improvements	1	LS	\$ 500,000.00	\$ 500,000
			Subtotal =	\$ 2,605,000
			TOTAL DIRECT CAPITAL COST =	\$ 20,333,550
Indirect Construction Costs				
Project Development Construction Costs	---	---	---	---
Removal Action Design	1	LS	\$ 600,000.00	\$ 600,000
Port Advertise, Bid, Contract Procurement Costs	1	LS	\$ 200,000.00	\$ 200,000
Construction Management and Daily Oversight	1	LS	\$ 650,000.00	\$ 650,000
Engineering Support During Construction	1	LS	\$ 250,000.00	\$ 250,000
Special Insurance, Bonding, Permitting	1	LS	\$ 225,000.00	\$ 225,000
			Subtotal =	\$ 1,925,000
			TOTAL INDIRECT CAPITAL COST =	\$ 1,925,000
			TOTAL CAPITAL COST =	\$ 22,258,550
OM&M AND OTHER PERIODIC COSTS:				
MNR Year 1 Monitoring	11.7	AC	\$ 19,000.00	\$ 222,300
MNR Subsequent Monitoring	4	EA	\$ 111,150.00	\$ 444,600
Capping Year 1 Monitoring	24.2	AC	\$ 19,000.00	\$ 459,800
Capping Subsequent Monitoring	8	EA	\$ 229,900.00	\$ 1,839,200
Cap Maintenance Cost	1	LS	\$ 250,000.00	\$ 250,000
			TOTAL PERIODIC COST =	\$ 3,215,900
			TOTAL REMOVAL ACTION COST =	\$ 25,475,000
NET PRESENT VALUE ADJUSTMENT:				
Discount Rate for Periodic Costs				5%
			TOTAL PERIODIC COST (with NPV Adjustment) =	\$ 2,368,072
			TOTAL REMOVAL ACTION COST =	\$24,627,000
NOTES:				
1. Refer to Appendix O for detailed assumptions.				
2. AC = acre, LS = Lump Sum, EA = each				
3. No contingencies are applied capital or periodic costs, though individual cost items contain a high degree of uncertainty. The removal action cost estimate without contingency factors is considered reasonably representative of the EPA guidance objective of attaining an estimate within a accuracy range of -30% to +50% of actual implementation costs.				

Table O-3. Cost Analysis Spreadsheet for Alternative C.

Alternative C – Dredging Emphasis, At-Grade Full Size CDF				
<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT COST</u>	<u>EXTENDED COST</u>
CAPITAL COSTS:				
Direct Construction Costs				
Mobilization/Demobilization	1	LS	\$ 1,000,000.00	\$ 1,000,000
Contractor Work Plans	1	LS	\$ 250,000.00	\$ 250,000
			Subtotal =	\$ 1,250,000
Site Preparation	---	---	---	---
Timber Framework Demolition/Disposal	177,000	SF	\$ 6.00	\$ 1,062,000
Timber Pile Removal and Disposal - Slip 1	3700	EA	\$ 200.00	\$ 740,000
Sediment Transload Facility	0	LS	\$ 920,000.00	\$ -
			Subtotal =	\$ 1,802,000
Dredging and Sediment Disposal	---	---	---	---
Dredging	115,000	CY	\$ 8.00	\$ 920,000
Water Quality Control Measures	1	LS	\$ 250,000.00	\$ 250,000
Backfill Berth 411	10,000	CY	\$ 5.00	\$ 50,000
Scour Protection	25,000	TON	\$ 25.00	\$ 625,000
Modify Outfalls, Dredging-Related	0	EA	\$ 5,000.00	\$ -
CDF Berm	214,675	TON	\$ 17.00	\$ 3,649,475
CDF Pavement Cap	1	LS	\$ 1,250,000.00	\$ 1,250,000
CDF Upper Sand Cap	130,000	CY	\$ 10.00	\$ 1,300,000
CDF Lower Sand Cap	125,000	CY	\$ 5.00	\$ 625,000
Placement of Fill	560,000	CY	\$ -	\$ -
Placement of Intermediate Sand Cap	20,000	CY	\$ 5.00	\$ 100,000
CDF Disposal, Place Dredged Sediment	115,000	CY	\$ 3.00	\$ 345,000
Relocate City/Port Storm Utilities and Relocate Outfalls	1	LS	\$ 500,000.00	\$ 500,000
Dredging Verification	10.2	AC	\$ 24,000.00	\$ 244,800
			Subtotal =	\$ 9,859,275
Capping	---	---	---	---
Under-pier Capping	12,900	TON	\$ 35.00	\$ 451,500
Non-Under-pier Capping	52,300	TON	\$ 25.00	\$ 1,307,500
Modify/Extend Outfalls	5	EA	\$ 10,000.00	\$ 50,000
Capping Verification	8.7	AC	\$ 28,000.00	\$ 243,600
DSL Submerged Land Purchase for Capping Areas	5.0	AC	\$ 8,500.00	\$ 42,500
			Subtotal =	\$ 2,095,100
Miscellaneous Construction-Related Direct Costs	---	---	---	---
Short-Term Water Quality Monitoring	18.9	AC	\$ 12,000.00	\$ 226,800
Habitat and other Mitigation	1	LS	\$ 1,370,000.00	\$ 1,370,000
Tenant Disruption Cost	26	DAY	\$ 28,600.00	\$ 743,600
DSL Property Cost for Applicable CDF Area	6.5	AC	\$ 8,500.00	\$ 55,250
Relocation of Barge Leg	1	LS	\$ 7,900,000.00	\$ 7,900,000
Other Necessary Improvements	1	LS	\$ 1,000,000.00	\$ 1,000,000
			Subtotal =	\$ 11,295,650
			TOTAL DIRECT CAPITAL COST =	\$ 26,302,025
Indirect Construction Costs				
Project Development Construction Costs	---	---	---	---
Removal Action Design	1	LS	\$ 1,000,000.00	\$ 1,000,000
Port Advertise, Bid, Contract Procurement Costs	1	LS	\$ 400,000.00	\$ 400,000
Construction Management and Daily Oversight	1	LS	\$ 950,000.00	\$ 950,000
Engineering Support During Construction	1	LS	\$ 350,000.00	\$ 350,000
Special Insurance, Bonding, Permitting	1	LS	\$ 400,000.00	\$ 400,000
			Subtotal =	\$ 3,100,000
			TOTAL INDIRECT CAPITAL COST =	\$ 3,100,000
			TOTAL CAPITAL COST =	\$ 29,402,025
OM&M AND OTHER PERIODIC COSTS:				
MNR Year 1 Monitoring	10.9	AC	\$ 19,000.00	\$ 207,100
MNR Subsequent Monitoring	4	EA	\$ 103,550.00	\$ 414,200
Capping Year 1 Monitoring	8.7	AC	\$ 19,000.00	\$ 165,300
Capping Subsequent Monitoring	8	EA	\$ 82,650.00	\$ 661,200
Cap Maintenance Cost	1	LS	\$ 250,000.00	\$ 250,000
CDF Year 1 Monitoring	1	EA	\$ 230,000.00	\$ 230,000
CDF Subsequent Monitoring	8	EA	\$ 75,000.00	\$ 600,000
CDF Maintenance Cost	1	LS	\$ 500,000.00	\$ 500,000
			TOTAL PERIODIC COST =	\$ 3,027,800
			TOTAL REMOVAL ACTION COST =	\$ 32,430,000
NET PRESENT VALUE ADJUSTMENT:				
Discount Rate for CDF Cap Construction Costs				5%
			TOTAL DIRECT CONSTRUCTION COSTS (with NPV Adjustment for Cap Construction) =	\$ 25,275,990
Discount Rate for Periodic Costs				5%
			TOTAL PERIODIC COST (with NPV Adjustment) =	\$ 2,178,096
			TOTAL REMOVAL ACTION COST =	\$ 30,555,000
ESTIMATED VALUE OF CDF EXCESS CAPACITY				\$ 10,000,000
			Total Removal Action Cost including Value of CDF Excess Capacity =	\$ 20,555,000
NOTES:				
1. Refer to Appendix O for detailed assumptions.				
2. The "Estimated Value of CDF Excess Capacity" is considered a benefit of the CDF alternative. Refer to Section O.3.5 of Appendix O for an explanation.				
3. AC = acre, LS = Lump Sum, EA = each				
4. No contingencies are applied capital or periodic costs, though individual cost items contain a high degree of uncertainty. The removal action cost estimate with contingency factors is considered reasonably representative of the EPA guidance objective of attaining an estimate within a accuracy range of -30% to +50% of actual implementation costs.				

Table O-4. Cost Analysis Spreadsheet for Alternative D.

Alternative D -- Dredging Emphasis				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	EXTENDED COST
CAPITAL COSTS:				
Direct Construction Costs				
Mobilization/Demobilization	1	LS	\$ 1,000,000.00	\$ 1,000,000
Contractor Work Plans	1	LS	\$ 250,000.00	\$ 250,000
			Subtotal =	\$ 1,250,000
Site Preparation	---	---	---	---
Timber Framework Demolition/Disposal	177,000	SF	\$ 6.00	\$ 1,062,000
Timber Pile Removal and Disposal - Slip 1	3700	EA	\$ 200.00	\$ 740,000
Sediment Transload Facility	1	LS	\$ 920,000.00	\$ 920,000
			Subtotal =	\$ 2,722,000
Dredging and Sediment Disposal	---	---	---	---
Dredging	204,000	CY	\$ 8.00	\$ 1,632,000
Water Quality Control Measures	1	LS	\$ 250,000.00	\$ 250,000
Backfill Berth 411	10,000	CY	\$ 5.00	\$ 50,000
Scour Protection	25,000	TON	\$ 25.00	\$ 625,000
Modify Outfalls	6	EA	\$ 5,000.00	\$ 30,000
Landfill Disposal	326,400	TON	\$ 30.00	\$ 9,792,000
Metro Disposal Fee	326,400	TON	\$ 3.50	\$ 1,142,400
DEQ Disposal Fee	326,400	TON	\$ 1.24	\$ 404,800
Dredging Verification	24.7	AC	\$ 24,000.00	\$ 592,800
			Subtotal =	\$ 14,519,000
Capping	---	---	---	---
Under-pier Capping	12,900	TON	\$ 35.00	\$ 451,500
Non-Under-pier Capping	52,300	TON	\$ 25.00	\$ 1,307,500
Modify/Extend Outfalls	5	EA	\$ 10,000.00	\$ 50,000
Capping Verification	8.7	AC	\$ 28,000.00	\$ 243,600
DSL Submerged Land Purchase for Capping Areas	5.0	AC	\$ 8,500.00	\$ 42,500
			Subtotal =	\$ 2,095,100
Miscellaneous Construction-Related Direct Costs	---	---	---	---
Short-Term Water Quality Monitoring	33.4	AC	\$ 12,000.00	\$ 400,800
Habitat and other Mitigation	1	LS	\$ 135,000.00	\$ 135,000
Tenant Disruption Cost	47	DAY	\$ 28,600.00	\$ 1,344,200
Other Necessary Improvements	1	LS	\$ 500,000.00	\$ 500,000
			Subtotal =	\$ 2,380,000
			TOTAL DIRECT CAPITAL COST =	\$ 22,966,100
Indirect Construction Costs				
Project Development Construction Costs	---	---	---	---
Removal Action Design	1	LS	\$ 700,000.00	\$ 700,000
Port Advertise, Bid, Contract Procurement Costs	1	LS	\$ 200,000.00	\$ 200,000
Construction Management and Daily Oversight	1	LS	\$ 650,000.00	\$ 650,000
Engineering Support During Construction	1	LS	\$ 250,000.00	\$ 250,000
Special Insurance, Bonding, Permitting	1	LS	\$ 225,000.00	\$ 225,000
			Subtotal =	\$ 2,025,000
			TOTAL INDIRECT CAPITAL COST =	\$ 2,025,000
			TOTAL CAPITAL COST =	\$ 24,991,100
OM&M AND OTHER PERIODIC COSTS:				
MNR Year 1 Monitoring	11.7	AC	\$ 19,000.00	\$ 222,300
MNR Subsequent Monitoring	4	EA	\$ 111,150.00	\$ 444,600
Capping Year 1 Monitoring	8.7	AC	\$ 19,000.00	\$ 165,300
Capping Subsequent Monitoring	8	EA	\$ 82,650.00	\$ 661,200
Cap Maintenance Cost	1	LS	\$ 250,000.00	\$ 250,000
			TOTAL PERIODIC COST =	\$ 1,743,400
			TOTAL REMOVAL ACTION COST =	\$ 26,735,000
NET PRESENT VALUE ADJUSTMENT:				
Discount Rate for Periodic Costs				5%
			TOTAL PERIODIC COST (with NPV Adjustment) =	\$ 1,439,734
			TOTAL REMOVAL ACTION COST =	\$26,431,000
NOTES:				
1. Refer to Appendix O for detailed assumptions.				
2. AC = acre, LS = Lump Sum, EA = each				
3. No contingencies are applied capital or periodic costs, though individual cost items contain a high degree of uncertainty. The removal action cost estimate without contingency factors is considered reasonably representative of the EPA guidance objective of attaining an estimate within a accuracy range of -30% to +50% of actual implementation costs.				