Boeing Plant 2 Sediment Remediation:

Remedial Dredging Methods to Manage the Risks of Residuals, Resuspension and Release: The Benefits and Costs

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WEDA SUMMIT & EXPO
JUNE 2017
VANCOUVER, BC
Boeing Plant 2 Project

- Duwamish Waterway Superfund Site - Early Action Area
- 3 dredging seasons (2013-2015)
- 125,000 M³ (163,000 CY) of sediment removed
- 150,000 tonne (265,000 Tons) Backfill
- No Measurable Post Dredging Residuals
- WODCON 2016 Environmental Excellence Award
Compliance - Cost Drivers

- **Risk**
  - Protect downstream from resuspension/release
  - Residuals
- **RCRA Site**
  - Permits required
  - State Implemented CWA 401
- **Multiple Seasons**
  - In Water Work Windows
  - Other Projects in Area
- **Tribal Fishing**
- **Backfill to Pre-Project Grade**
EPA: Just Build a **WALL** Around It...

- Scour, Flooding, Navigation Impacts
- Extend duration

**Alternate Approach**
- Remediation Dredging Methods (RDMs)

Sheetpile Wall envisioned by EPA & Local Stakeholders
Mechanical Dredging RDM’s

- Accurate delineation of elevation of contamination (EOC)
- Precision dredge plan
- Dredge with excavator
- RTK-GPS based bucket positioning
- Stair-step cuts on slopes

- Enclosed Environmental bucket
- No overfilled buckets
- Remove water from sediment barges and process – No Barge Overflow
- Place initial backfill
- Understanding by project staff
- Performance consistent with project objectives
Benefit of Improved Accuracy of Excavator

- DSOA Dredging Area: 16.3 Acres
- Overdepth reduced by 1/3 to 1/2 ft.
- Volume reduction: 9,000 to 13,000 CY
- Dredge/Landfill Savings: $2M to $3M
- Eliminate sheet pile walls and silt curtains
- Greatly reduced residuals / release / resuspension
Active Oversight and Monitoring
Dredge Engineer in Cab with Dredge Operator

**Dredge Engineer**
- Sequencing of Removal
- Consistent Application of RDMs
- Unanticipated Conditions
- Adaptive Management

**Dredge Operator**
- Precision Bucket Placement
- Productivity

**Engineer-Operator Team**
- Improved Environmental Outcomes
- Higher Production & Efficiency
- Reduced Overall Costs

Improved Accuracy of Excavator also Paid for Construction Oversight
Water Management - Remove Water from Barge, No Overflow

Remove *dredge water* from dredged material barges during dredging for processing and management as dredge return water.

Previous experience – Sediment volume = 10 cm (4”) over dredge area
Original Plan - Add Flocculent, Pump to Geotubes
Actual Dredge Water System

RCRA Project
• State Issued Water Quality Certificate
• No chemical flocculants – Electro coagulation used
• Short term Water Quality Variances not allowed
• Regulated as NPDES Outfall
  • Marine Chronic Criteria at point of discharge

~$7M Cost Increase
Backfilling to Original Grade

- Restore subtidal elevations for habitat concerns
- 265,000 Tons Backfill Material
- Washed Backfill Material
- 5 NTU Over background
- $13 M
Water Quality Criteria
5 NTU Above Background

- No exceedances during dredging
- Some exceedances during backfilling
- Washed backfill material
- **Slow placement rate to meet WQ criteria**
In-Water Work Seasons & Active Tribal Fishery

- Endangered Species Protection
- In water window typically September 1 – February 15 (5.5 months)
- Tribal Fishing Rights
  - Cannot impact fishers or nets
  - Can Reduce In-Water Season
- Actual Dredging Days
  - CS1 45 days
  - CS2 36 days
  - CS3 94 days

Sediment Remediation is Seasonal Activity
Increases Project Durations and Costs
Dredging Over Multiple Seasons Increases Costs

Added MOB/DEMOB/Standby (between seasons) & Tribal Payments $7M
Other Construction – Bridge
Other Construction

Other Projects can Increase Costs
Other Factors

Planned and Actual Sediment Offloaded to TTD
(1/2/14 - 3/13/14)

Seahawks Games Cause Delays, Increase Costs
## Dredging/Landfilling Cost

<table>
<thead>
<tr>
<th>Activity</th>
<th>Units</th>
<th>Quantity</th>
<th>Cost</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOB/DEMOB (Start/End)</td>
<td></td>
<td></td>
<td>$3.7 M</td>
<td></td>
</tr>
<tr>
<td>Additional MOB, Between Season Charges</td>
<td></td>
<td></td>
<td>$5.1 M</td>
<td></td>
</tr>
<tr>
<td><strong>DREDGING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Water</td>
<td>CY</td>
<td>163,000</td>
<td>$6.1 M</td>
<td>$38 per CY</td>
</tr>
<tr>
<td>Under Bridge</td>
<td>CY</td>
<td>1000</td>
<td>$1.0 M</td>
<td>$1000 per CY</td>
</tr>
<tr>
<td>TSCA</td>
<td>CY</td>
<td>500</td>
<td>$0.5 M</td>
<td>$1000 per CY</td>
</tr>
<tr>
<td>Survey/Controls</td>
<td></td>
<td></td>
<td>$2.0 M</td>
<td>$12 per CY</td>
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<tr>
<td><strong>Dredging Total</strong></td>
<td></td>
<td></td>
<td>$9.6 M</td>
<td>$59 per CY</td>
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<tr>
<td><strong>LANDFILLING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER TREATMENT, SEDIMENT OFFLOAD, STABILIZATION, TRANSPORT &amp; DISPOSAL</td>
<td></td>
<td></td>
<td>$29.7M</td>
<td>$182 per CY</td>
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<tr>
<td><strong>SUBTOTAL MOB, DREDGING AND LANDFILLING</strong></td>
<td></td>
<td></td>
<td>$48.1 M</td>
<td>$295 per CY</td>
</tr>
</tbody>
</table>

Landfilling costs ~ 2-3x Dredging Costs  
Water Treatment ~$7M increased costs – State CWA 401
## Other Costs

<table>
<thead>
<tr>
<th>Activity</th>
<th>Units</th>
<th>Quantity</th>
<th>Cost</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACKFILL</strong></td>
<td>Tons</td>
<td>265,000</td>
<td>$6.1 M</td>
<td></td>
</tr>
<tr>
<td>Purchase &amp; Deliver</td>
<td>Tons</td>
<td></td>
<td>$6.1 M</td>
<td></td>
</tr>
<tr>
<td>Place w/ Derrick</td>
<td>CY</td>
<td></td>
<td>$7.0 M</td>
<td></td>
</tr>
<tr>
<td><strong>Backfill Total</strong></td>
<td></td>
<td></td>
<td>$13.1 M</td>
<td>$80 per CY</td>
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<tr>
<td><strong>DERRICK- SUPPORT ACTIVITIES, OUTFALLS, ETC</strong></td>
<td></td>
<td></td>
<td>$4.8 M</td>
<td></td>
</tr>
<tr>
<td><strong>CONSTRUCTION: MOB/DREDGE/ BACKFILL</strong></td>
<td></td>
<td></td>
<td>$66.0 M</td>
<td></td>
</tr>
<tr>
<td><strong>CM/OVERSIGHT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling &amp; Monitoring</td>
<td></td>
<td></td>
<td>$2.9 M</td>
<td></td>
</tr>
<tr>
<td>Construction Oversight</td>
<td></td>
<td></td>
<td>$1.9 M</td>
<td></td>
</tr>
<tr>
<td>Construction Management</td>
<td></td>
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<td>$2.5 M</td>
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<tr>
<td><strong>CM/Oversight Total</strong></td>
<td></td>
<td></td>
<td><strong>$7.3 M</strong></td>
<td>11% Const. Cost</td>
</tr>
</tbody>
</table>

$73.3 M TOTAL Construction and CM/Oversight
Summary

- Many Compliance Related Factors Drive Costs
- Factors Increasing Costs Often Not Readily Apparent
  - Seasonal Restrictions
  - Working Hours per Day
  - Backfill
  - Water Quality
  - Transload Capacity
- Improving Return on Investment
Questions?

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