Esquimalt Graving Dock Waterlot Remediation Mega-Site (Phase 1B): Design, Contracting, and Construction Challenges

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Presentation Overview

- Esquimalt Graving Dock (EGD) site description and background
- Phase 1B description and objectives
- Challenges
  - Remedial design
  - Construction tendering
  - Construction implementation
- Project performance
Site Description and Background

DND - Department of National Defense
EGD - Esquimalt Graving Dock
Site Description and Background (cont.)
Site Description and Background (cont.)
Active Shipyard/Graving Dock Facility

- More than 50 vessel calls per year
Phase 1A – Under-pier Erosion Protection System

• Sheetpile wall prevents resuspension and transport of contaminated under-jetty sediment into Phase 1B area

• Constructed November 2012 to April 2013
Phase 1A – Under-pier Erosion Protection System (cont.)
Phase 1B – Open-water Dredging

- Dredging and disposal
  - 145,600 m³
- In-water slope armouring
  - 22,800 m³
- Residuals management cover placement
  - 45,000 m³
- Structure demolition and temporary relocations
- Construction June 2013 to March 2014
Phase 1B – Open-water Dredging (cont.)
Phases 1C and 2

• Phase 1C – Habitat compensation
  - Offsets impacts of alteration and isolation of under-pier habitat
  - Construction of new intertidal marsh fish habitat

• Phase 2 – Under-pier remediation
  - 40,000 m³ of contaminated sediment removal
  - To be conducted within 10 years in coordination with jetty redevelopment projects
Key Phase 1B Objectives

- Remove maximum contamination practicable
  - Reduce Government of Canada financial liability
  - Establish baseline conditions for future operations
  - Meet federal and provincial standards
  - Reduce risks to human health and the environment
  - Achieve FCSAP objectives
Key Phase 1B Objectives (cont.)

• Schedule
  - Minimize disturbance to operations
  - Complete by March 2014

• Ensure high level of certainty in project outcome
  - Conservative, practical, and constructible design
  - Proven technologies
  - Qualified contractors
Design Challenges

- Development of remedial dredge prism
- Dredge residuals management
- Construction sequencing and operations needs
- Water quality criteria and best management practices (BMPs)
- Geotechnical and structural restrictions
- Balancing use of performance vs. prescriptive specifications
- Risk-based contingency
Development of Remedial Dredge Prism

- Dredge design considerations

Legacy contaminants (metals, tributyl tin [TBT], polycyclic aromatic hydrocarbons [PAHs], and polychlorinated biphenyls [PCBs])
**Development of Remedial Dredge Prism (cont.)**

- **Dredge design considerations**

<table>
<thead>
<tr>
<th>Removal Scenario</th>
<th>Removal Volume, m$^3$</th>
<th>Confidence Level</th>
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</thead>
<tbody>
<tr>
<td>Contaminated Neatline (no OD)</td>
<td>71,250</td>
<td>50%</td>
</tr>
<tr>
<td>Contaminated Neatline + 0.3 m OD</td>
<td>98,444</td>
<td>70%</td>
</tr>
<tr>
<td>Contaminated Neatline + 0.5 m OD</td>
<td>116,573</td>
<td>85%</td>
</tr>
<tr>
<td>Dredge Prism Design (no OD)</td>
<td>117,336</td>
<td>90%</td>
</tr>
<tr>
<td><strong>Dredge Prism Design + 0.3 m OD</strong></td>
<td><strong>149,630</strong></td>
<td><strong>94%</strong></td>
</tr>
<tr>
<td>Dredge Prism Design + 0.5 m OD</td>
<td>162,658</td>
<td>99%</td>
</tr>
</tbody>
</table>

* Selected design criteria
Residuals Management at EGD

- Confirmation testing for contingency redredging
- Placement of residuals management cover material

Residuals Management Flowchart

1. Remove dredged material to depth specified in remedial plan.
2. Collect confirmatory samples (50 cm composite core and 10 cm surficial grab)
   - Is missed inventory detected based on 50 cm composite samples?
     - NO
     - Do concentrations in the surface and mixing zone meet the remedial goals?
       - NO
       - Contingent cleanup pass
       - YES
       - Sand Placement
         - YES
         - Residuals Successfully Managed
         - Refine data
         - CONTINUE DREDGING IN SPECIFIC AREA

YES
Residuals Management at EGD (cont.)

1. Dredged material

Design Depth

Pre-dredge Condition

Post-dredge Condition with Residual Layer

Condition After Sand Placement

Post Remediation Condition After Mixing

1. Dredged material

2. 10 cm grab

50 cm composite core

3. Clean Sand Layer (30 cm)

Propwash Mixing Zone (40 cm)

Surface After Sand Placement

Residual Layer

Surface After Sand Placement

Residual Layer
Confirmatory Sampling

• Residuals management strategy included in design
  - Contingency actions during construction
Construction Sequencing

- Construction sequencing to remove “hotter” contamination areas first
- Operational considerations
Water Quality Monitoring

- Intensive water quality monitoring as part of comprehensive environmental monitoring program
  - Field turbidity monitoring
  - Assess total suspended solids from dredging
  - Allow faster responsiveness in the field
  - Laboratory analysis to confirm field results
Silt Curtain
Integrating Geotechnical and Structural Restrictions

• Work adjacent to existing structures
  - Requirements for dredging setback and offsets
Integrating Geotechnical and Structural Restrictions (cont.)

- Graving dock sill
Integrating Geotechnical and Structural Restrictions (cont.)
Performance-Based vs. Prescriptive-Based Specifications

- Performance-based specifications
  - Achieving required dredge prism
  - Environmental compliance
    - Silt curtain usage
    - Water quality
  - Placement of in-water slope armour and backfill material
  - Transport and disposal
Performance-Based vs. Prescriptive-Based Specifications (cont.)

• Prescriptive-based specifications
  - Operational considerations
  - Construction sequencing
    • Fisheries and Oceans Canada (DFO) work windows
  - Work near structurally sensitive areas
  - Quality control
    • Surveying
    • Reporting
  - Transport and disposal
Risk Management Contingency Budget

- Identify key construction risks and potential consequences
- Identify controls and risk response strategy
- Calculate risk allowance
  - Based on likelihood, impact, and response
- Calculate Risk Management Contingency (Pre-Approved Amounts for Anticipated Amendments [PAAA])
- Update during course of project
Construction Tendering Challenges

• Limited pool of potentially qualified contractors
  - Develop Invitation To Tender (ITT) qualification criteria
    • Contaminated sediment dredging > 40,000 m$^3$
    • In-water slope armoring
    • Silt curtains and projects requiring EMPs
    • Active marine site
    • Land transport and landfill disposal > 20,000 m$^3$
  - Contracting strategy
    • Single Design-Bid-Build contract
    • Public tender
  - Balance cost competitiveness vs. risk
Key Pre-Construction Challenges

• Pre-construction submittal requirements
  - Landfill disposal and off-load facility permits
  - Construction work plan
  - Environmental protection plan
  - Quality control plan

• Public communication and outreach

• Design team responsibilities
  - Construction Quality Assurance Plan
  - Environmental Management Implementation Plan
  - Confirmatory Sediment Sampling Plan
Key Construction Challenges

- Construction impacts on EGD operations
  - Operations takes precedence over construction
  - Booking schedule changes
  - Limited on-site staging area
  - DND facility coordination
- Contractor schedule changes
- Residual Management Cover (RMC) placement after dredging is complete
Key Construction Challenges

• Contractor experience with large-scale sediment remediation
  - Achieve tight design tolerances
  - Off-load facility production rate
  - Diver-assisted hydraulic dredging
  - Dewatering
Key Construction Challenges

- Remove maximum contamination practicable
  - Unanticipated subsurface conditions

- Rock buttress material encountered above design dredge elevation
- Debris encountered in hydraulic dredge area
- Timber piles encountered in dredge prism
- Hard material (debris) and glacial till encountered above design dredge elevation
- Bedrock encountered above design dredge elevation
- Re-design of backfill pads
Key Construction Challenges

- Remove maximum contamination practicable
  - Missed inventory and residuals contingency dredging
Project Performance

- Work completed on schedule in March 2014
- Maximum contaminant removal - 145,600 m³
- Confirmatory results
Project Performance

• Predicted post-cover mixed concentration
Note: A total of 145,548 cubic metres of dredged material (payable and non-payable volume) has been removed from the EGD Work Site to date.
Lessons Learned

• Develop specifications to address risk and minimize claim potential
  - Allow contractor flexibility in means and methods
  - Be prescriptive where operational needs govern
• Plan for dredge residuals with sequencing, BMPs, and contingency actions
• Incorporate risk-based contingency into project cost estimate
• Select qualified contractor using criteria that balance cost-competitiveness and risk
Lessons Learned (cont.)

• On-site construction management staff reinforce objectives of the cleanup
  - Slower pace of work
  - Techniques to manage more precise dredge cuts
  - Maximize removal of contamination

• Minimize impact to operations
  - Regular communication with contractor is essential
  - Full-time construction inspection improves coordination
  - Adaptive management approach is critical
Questions?

Photos courtesy of Heath Moffatt