Design and Construction of Engineered Sediment Caps Using Activated Carbon Amendments for the Y Jetty/Lang Cove Remediation Project

Presented by

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WEDA Pacific Chapter – October 28, 2021

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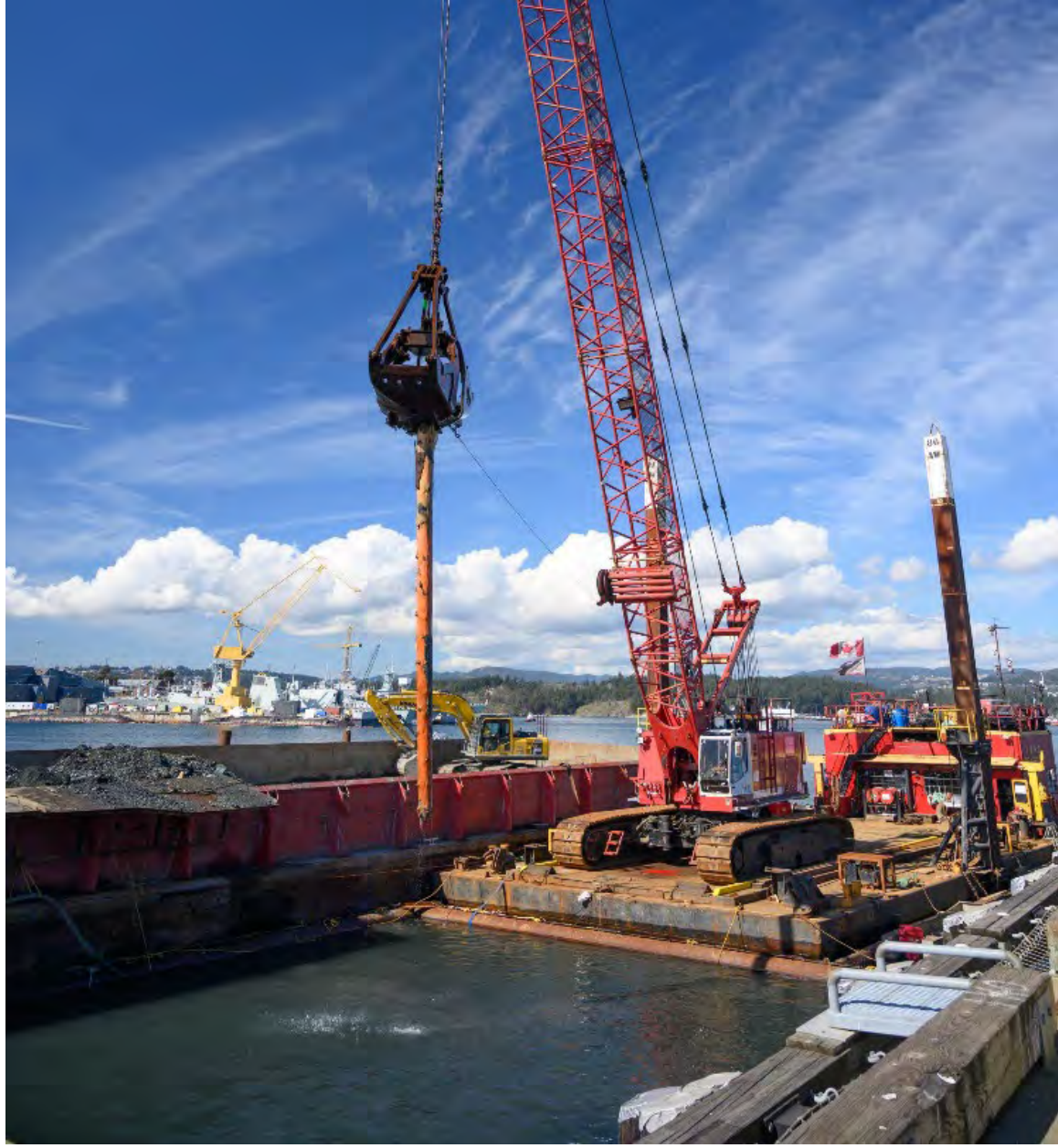
Presentation Overview

- Y Jetty/Lang Cove site description and background
- Granular activated carbon (GAC) amendments and mechanisms
- Engineered cap design criteria
- Construction challenges
- Cap monitoring sampling data



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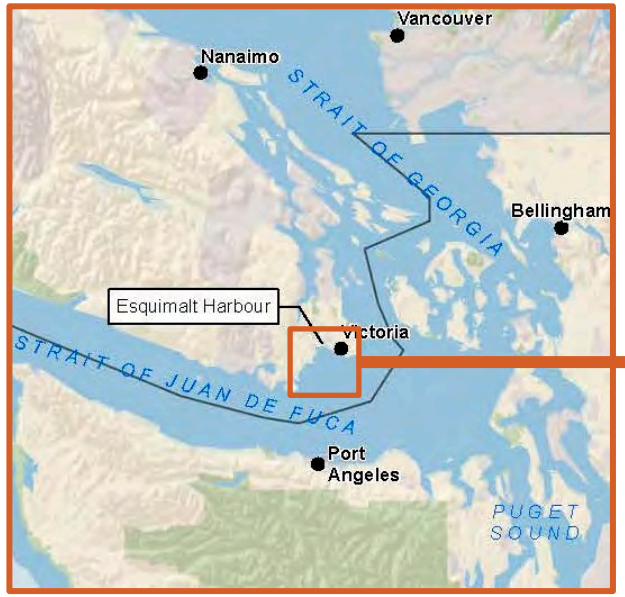
Esquimalt Harbour

- Vancouver Island, British Columbia
- Pacific homeport of the Royal Canadian Navy (RCN)
- Crown-owned harbour, including seabed



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Yarrows Shipyard/Y Jetty
Lang Cove Then and Today

- RCN established residence in Esquimalt Harbour in the 1840s
- Esquimalt Marine Railway built in 1890s in Lang Cove
- Esquimalt Marine Railway purchased by the Yarrows Shipyard in 1914
- Department of National Defence (DND) purchased Yarrows Lands in 1995

Then

Today

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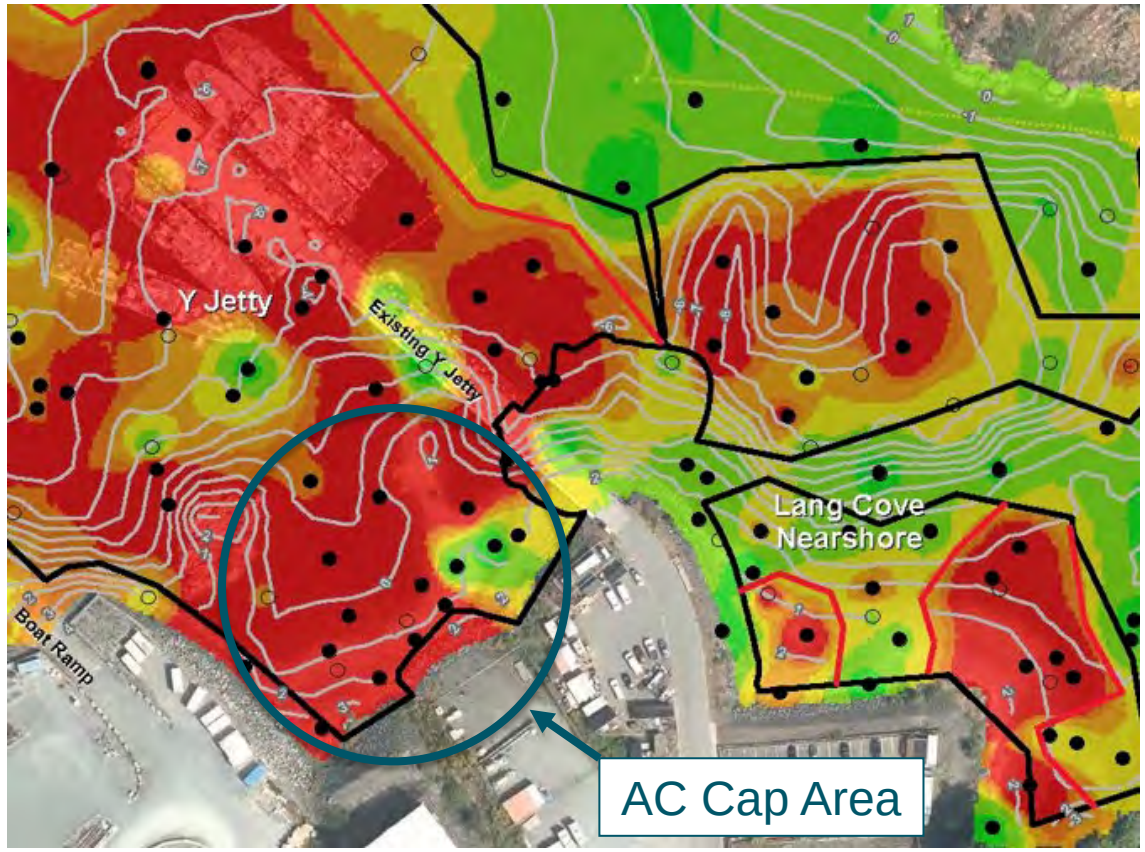
Yarrows Shipyard/Y Jetty Project Components

- Mechanical dredging
- Dredge material processing
- Demolition
- Y Jetty dock structural modifications to protect active DND utilities
- Shoreline excavation, capping, and backfilling across project site

Site Contaminants

- Elevated PAH and PCBs (hydrophobic organic compounds [HOCs]) >12ft bml
- Dredging and capping in nearshore areas
- Capping with GAC
  - Meet permissible exposure limit (PEL) values
  - Surface water quality criteria
  - Reduce overall cap thickness



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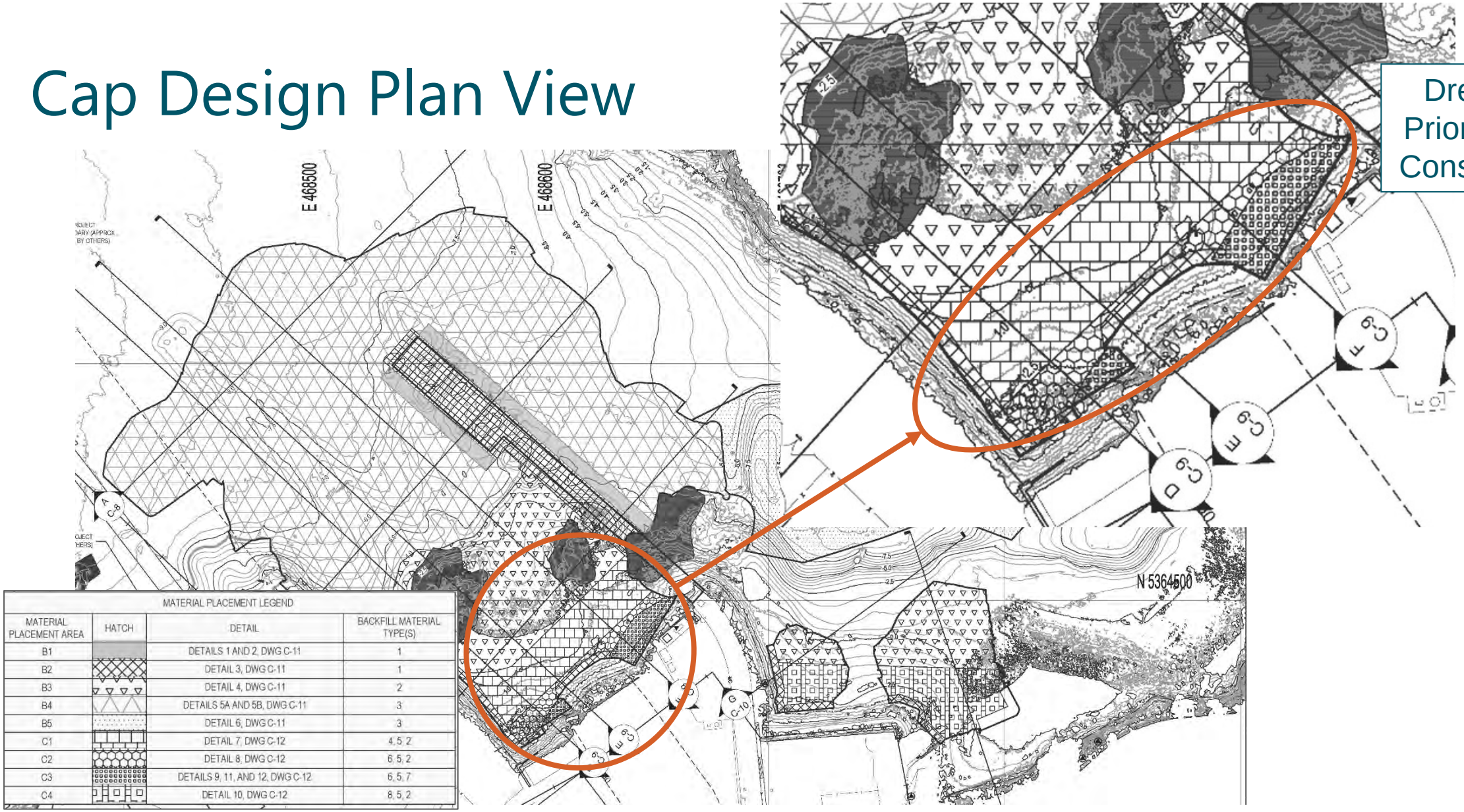
Cap Design Plan View



MATERIAL PLACEMENT LEGEND			
MATERIAL PLACEMENT AREA	HATCH	DETAIL	BACKFILL MATERIAL TYPE(S)
B1		DETAILS 1 AND 2, DWG C-11	1
B2		DETAIL 3, DWG C-11	1
B3		DETAIL 4, DWG C-11	2
B4		DETAILS 5A AND 5B, DWG C-11	3
B5		DETAIL 6, DWG C-11	3
C1		DETAIL 7, DWG C-12	4, 5, 2
C2		DETAIL 8, DWG C-12	6, 5, 2
C3		DETAILS 9, 11, AND 12, DWG C-12	6, 5, 7
C4		DETAIL 10, DWG C-12	8, 5, 2

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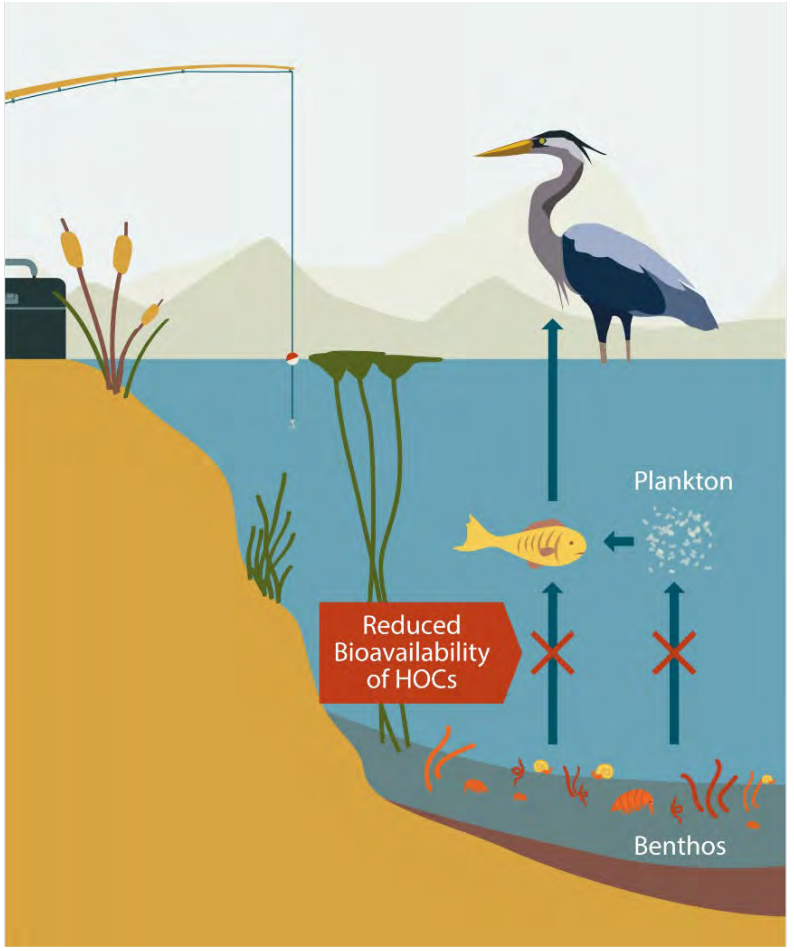
Bioavailability Reduction Using Carbon Amendments

- Reduced bioaccumulation of HOCs in benthic organisms
- Reduced flux of HOCs into water column and uptake in food web
- Reduce overall cap thickness



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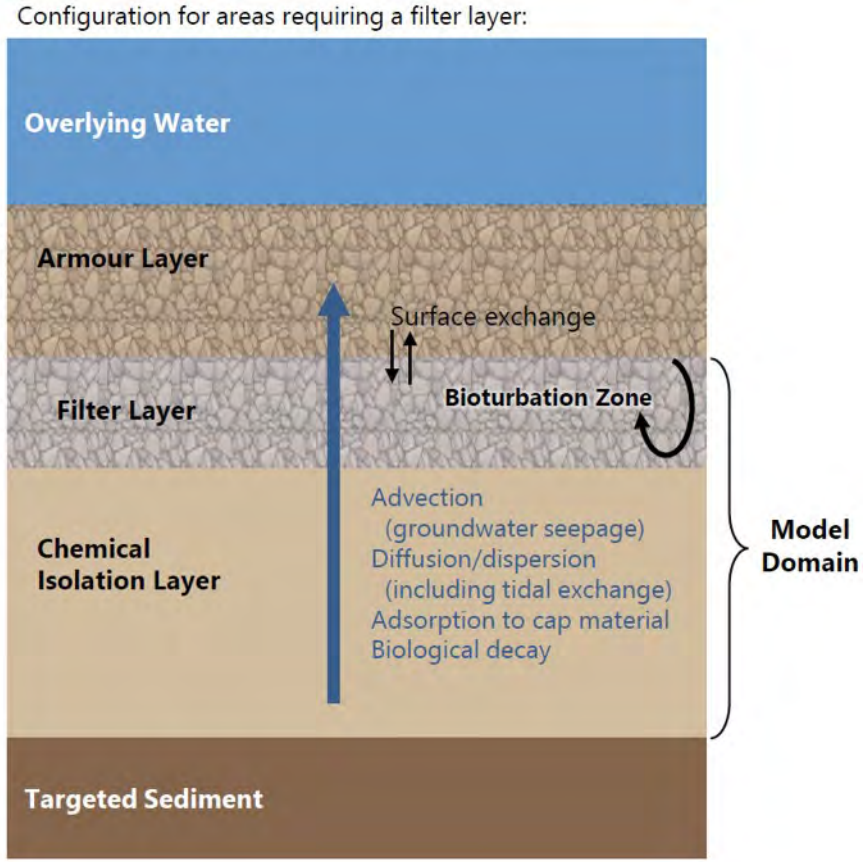
Cap Design with Sand/GAC Chemical Isolation Layer

- Sand/GAC chemical isolation layer
  - Limits the vertical movement of dissolved contaminants
  - Reduces bioavailability of contaminants
- Erosion protection layer
  - Prevents the chemical isolation layer from being eroded (filter and armour)



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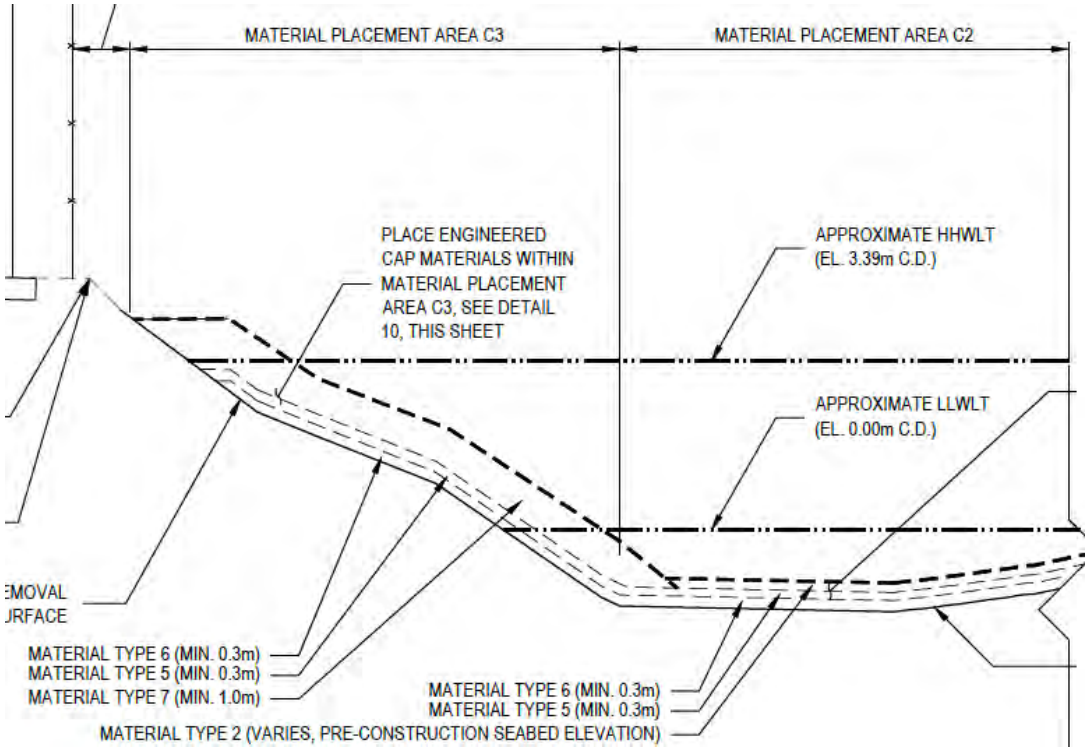
Contaminant Isolation Design Analyses

- Optimize dredge design and cap
- Reible model: predict future porewater concentrations; compare to PEL and surface water criteria
- Model output used to identify cap layer thicknesses and activated carbon (AC) amendment needed
- Erosion protection model (wind, wave, and propwash modeling)



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Cap Design Details

Layer	Material	Minimum Thickness (cm)	Overplacement Allowance (cm)	Maximum Total Layer Thickness (cm)
Contaminant Isolation	Fine gravel (BC MoT granular base) with GAC amendment	30	15	45
Filter	200-mm clear	30	15	45
Armor	0.3- to 0.6-m riprap (existing riprap armour)	100	50	150
	Total	**160**	**80**	**240**
			Optimized Dredge Thickness (cm)	**100**

- Chemical isolation layer: 1 ft. sand/GAC layer cover with 6-inch overplacement
- Target ranges for cap areas: 1% to 3% or 3% to 5% GAC dry weight
- Filter and armour erosion protection layers
- Top layer of habitat substrate

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Cap Construction – Procurement and GAC Soaking

GAC supersacks were soaked in watertight containers on mixing barge and agitated to remove entrained air (24 hrs)

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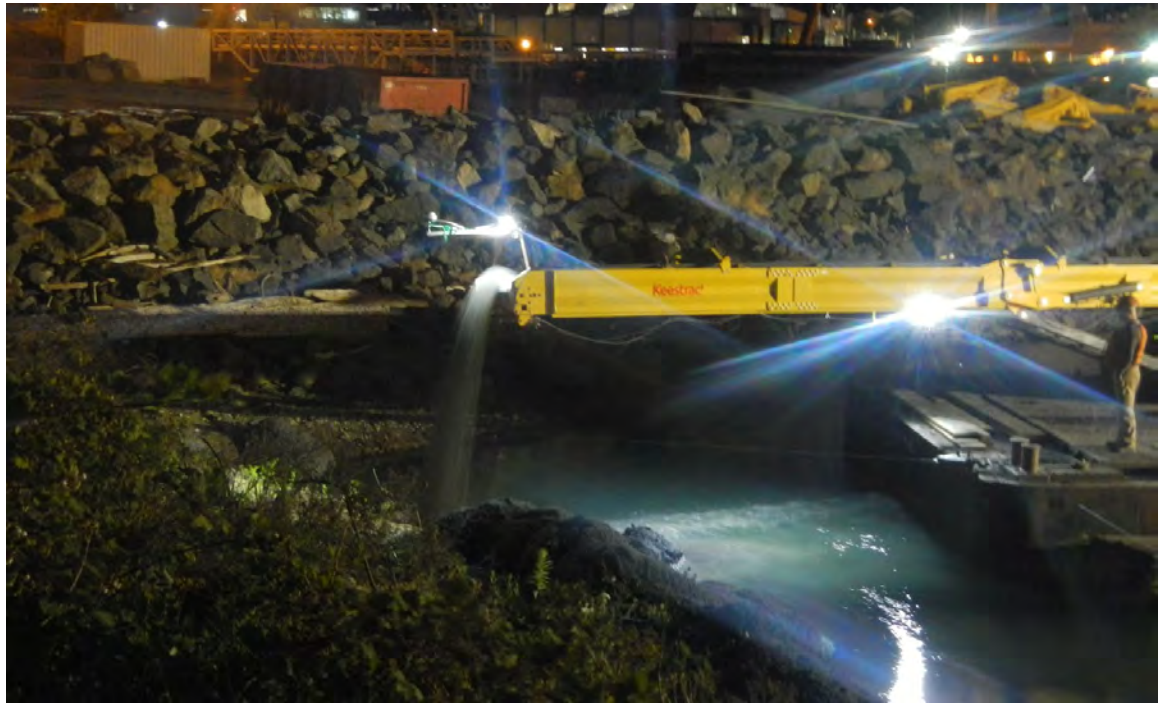
Cap Construction – GAC and Sand Material Blending

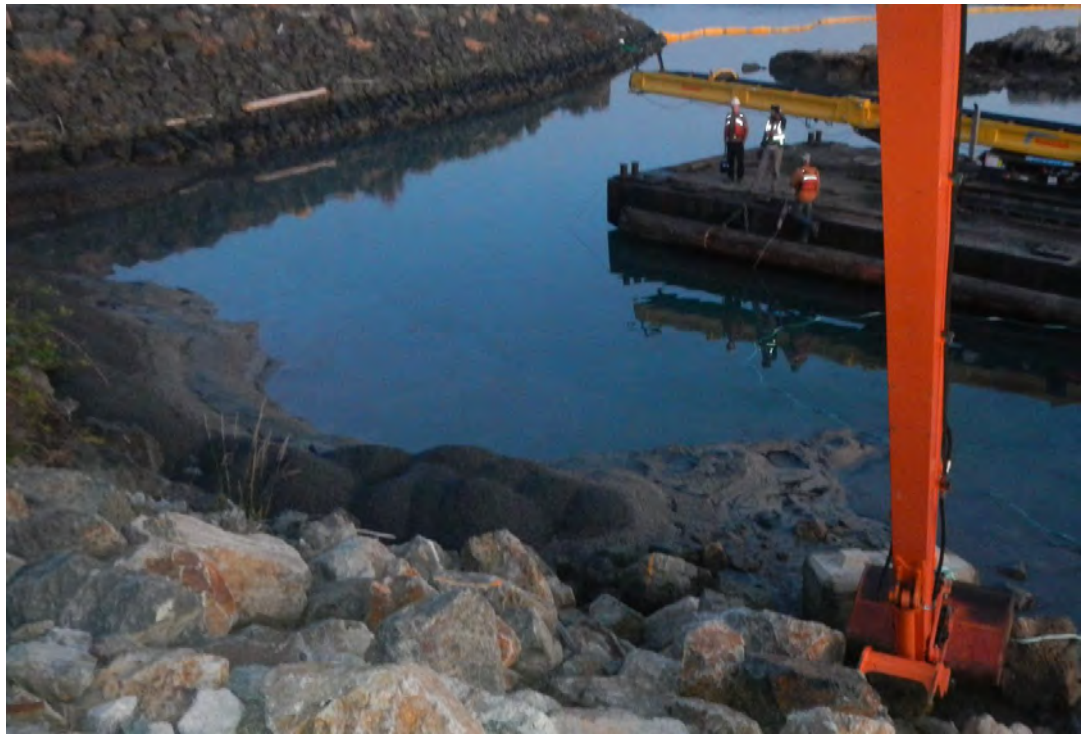
- Sand and GAC blended uniformly with excavator on mixing barge
- Blend ratio determined by dry weight calculation of sand and GAC
- Confirmed percent GAC by and analytical laboratory
- Blended sand/GAC placed within 8 hours

Cap Construction – Sand/GAC Material Placement by Conveyor

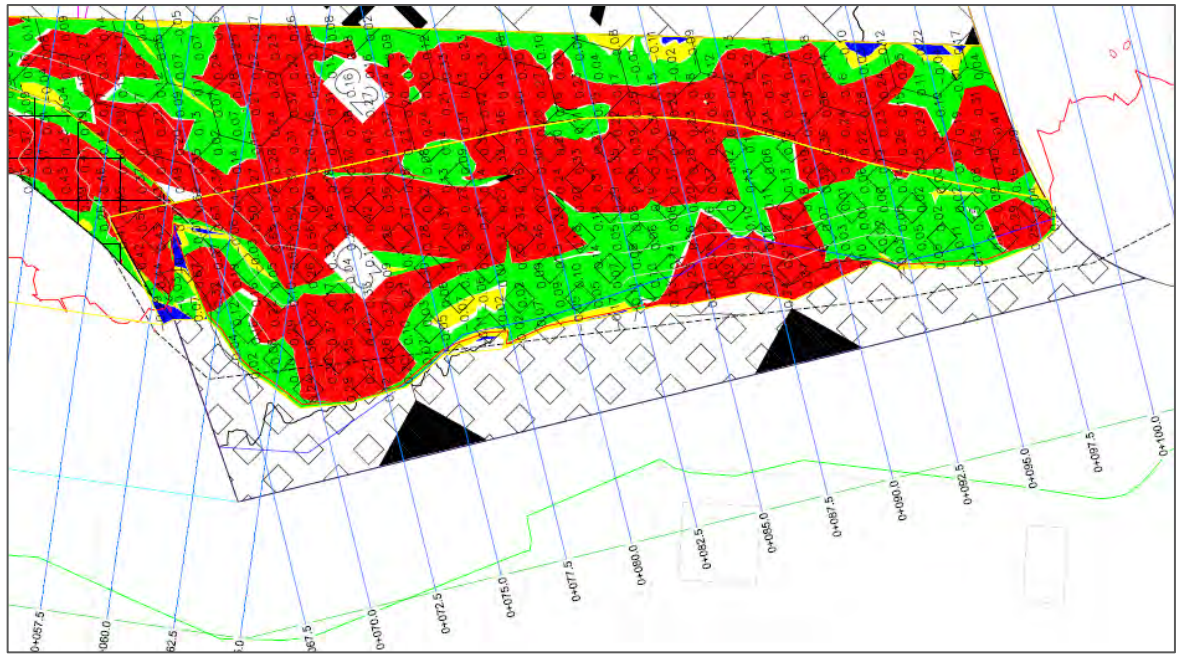


Conveyor mounted on low draft/maneuverable barge for restricted access placement due to shallow water and working tides

Cap Construction – Shoreline Slope



Cap Construction – Hydrographic and Topographic Surveying



Daily/nightly progress surveying and engineering review to confirm areas and minimum thicknesses of multiple cap layers

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Cap Construction – Shallow Subtidal (Crane/Clamshell)

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Cap Construction – Pre- and Post-Cap Completion

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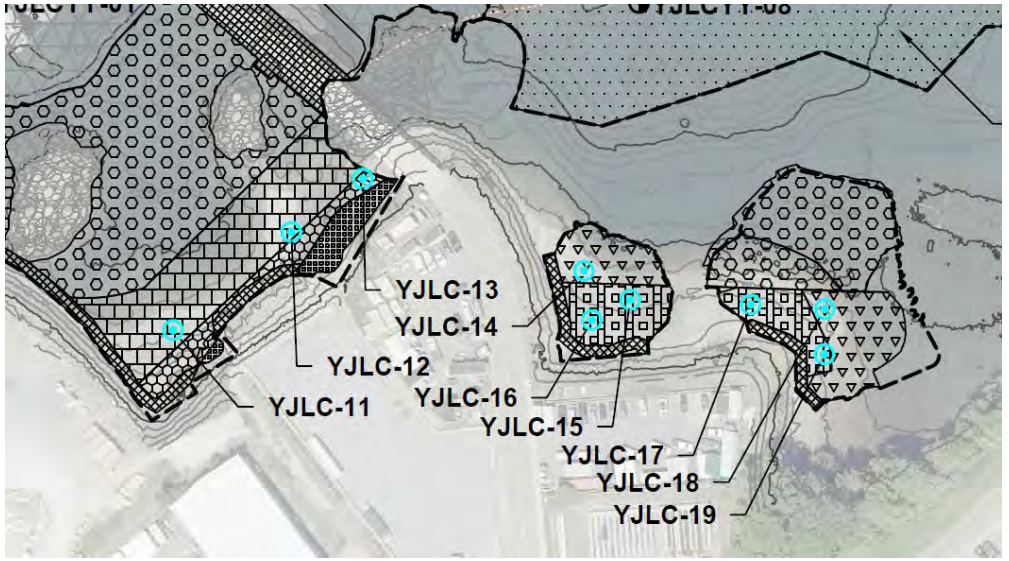
Key Implementation Challenges

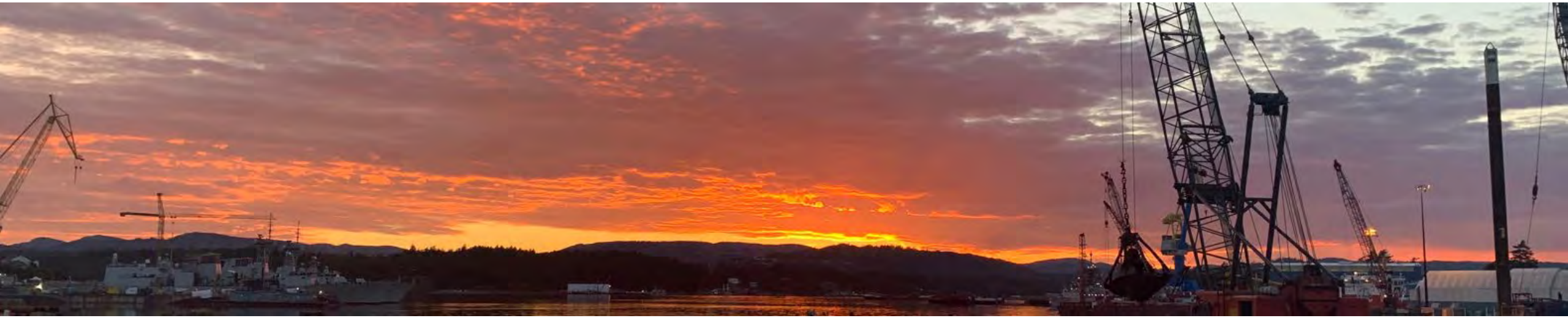
- QA/QC process during preparation and blending GAC/sand
- GAC soaking and blending operations on material barge
- Challenging nearshore equipment access (tides) and day/night work crews required
- Surveying and review coordination of multiple cap layers
- Debris and piling fields during nearshore dredging
- Adjacent harbour projects and ongoing DND operations

Year 1 Cap Monitoring Sampling

- Multimedia sampling to monitor cap performance
- Three sample locations in AC cap area
- PCBs and PAHs tested
  - Surface water results are nondetect or in line with background sample data
  - Solid phase (bulk cap material) results are nondetect
  - Very low-level detections in porewater



Conclusions



- In situ treatment using carbon amendments has progressed from an innovative sediment remediation approach to a proven, reliable technology
- Accurate placement of AC has been demonstrated using a range of conventional construction equipment

Questions?

Thanks to:

Department of National Defense
Mike Bodman

Public Services and Procurement Canada
Rae-Ann Sharp
Kristen Ritchot
Dave Osguthorpe

Anchor QEA, LLC
Matt Woltman
Tom Wang
Derek Ormerod
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