Novel Shoreline Cap for Controlling Sheen and Dissolved-phase Constituent Discharge

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Agenda

1. Project Details and Tasks
2. Oleophilic Bio Barrier
3. NAPL Site Conceptual Model
4. Design Details
5. Phase 1 Construction - 2017
6. Phase 2 Construction - 2018

Project Tasks

- FFS/Remedy selection with both ODEQ and EPA
- Permitting through USACE, ODSL, ODEQ, NMFS, ODFW, SHPO, City of Portland
- Design: civil, geotechnical, flood rise hydraulic engineers, surveyors
- Procurement/Contracting
- Construction Management

Linnton Bulk Fuel Terminal

- Intermittent sheens since 2004 due to upland fuel release
- 2011 – 216-foot-long, 30-foot-deep FRP sheetpile wall installed at top of bank
- Sheens greatly reduced, but persisted intermittently

Project within Portland Harbor Superfund Site

Image from EPA ROD, Figure 1, January 2018

- Located in Portland, Oregon, USA
- Approximately 9 miles of the Willamette River (RM 2 to 11)
- Kinder Morgan Linnton Bulk Terminal Facility at ~RM 4
- Record of Decision issued in January 2017
- Over 10,000 feet of river bank to be addressed within ROD

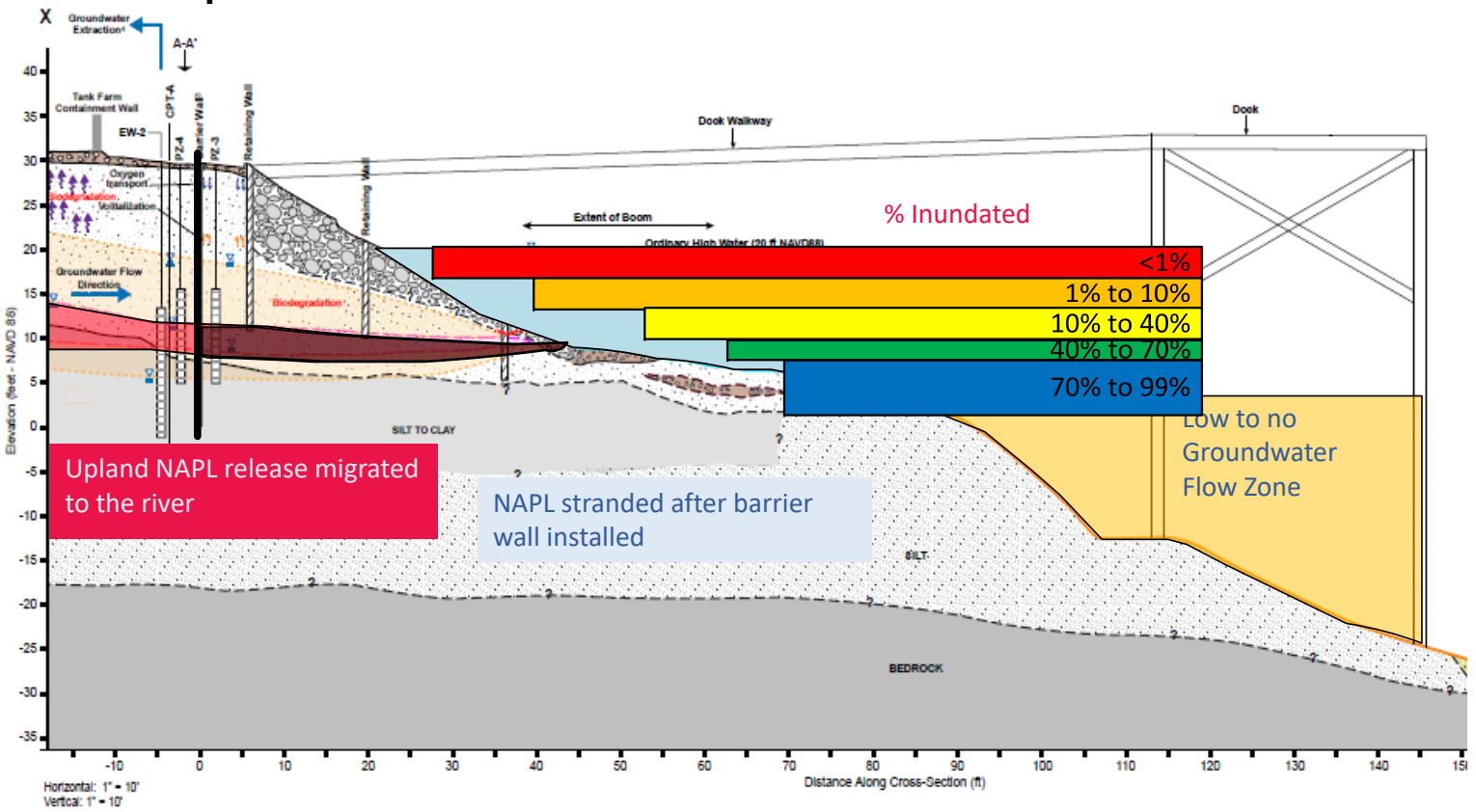
Bank pictures in sheen area prior to capping

Low River Stage

High River Stage

15-foot seasonal river elevation changes

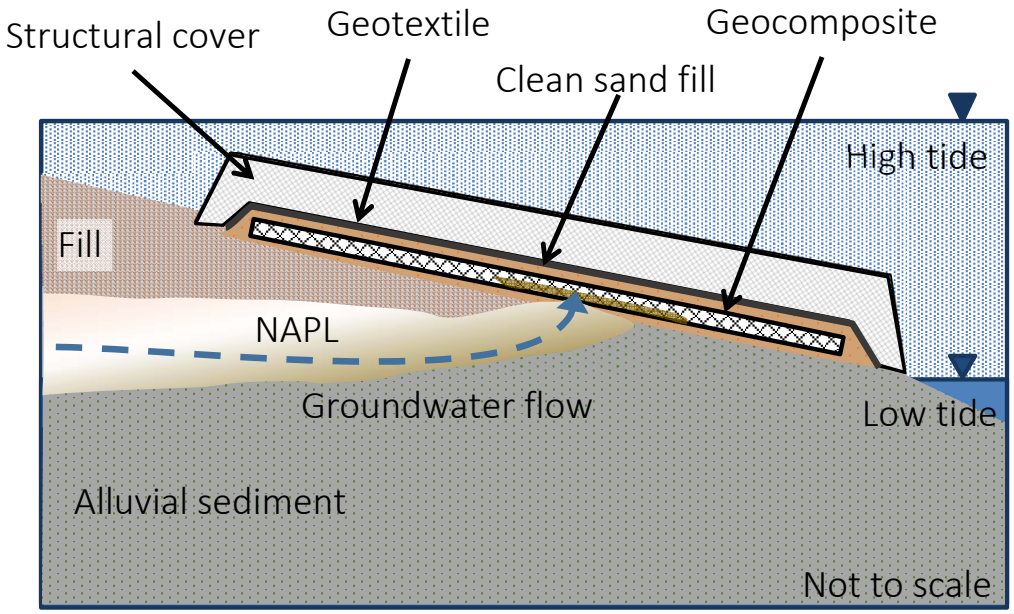
Conceptual Site Model - NAPL

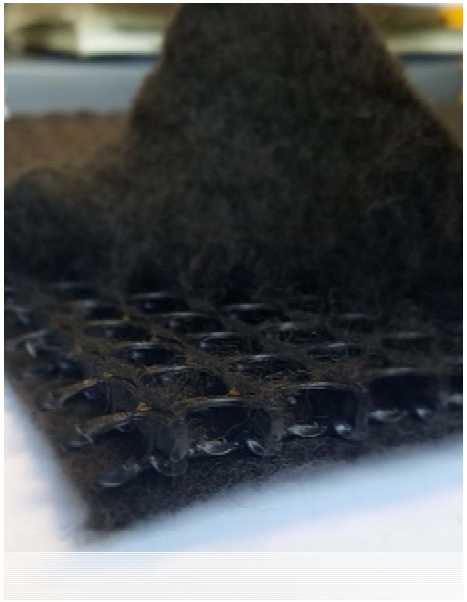


Challenges with Sheens

- Sheens form at Groundwater/Surface water Interfaces (GSIs) due to seeps, ebullition, and erosion/scour
- Challenges include permitting and access
- Current remedies have limitations
- Oleophilic bio barrier (OBB) designed to be a low-cost, sustainable sheen solution
- OBB is a reactive material where NAPL is trapped and allowed to biodegrade

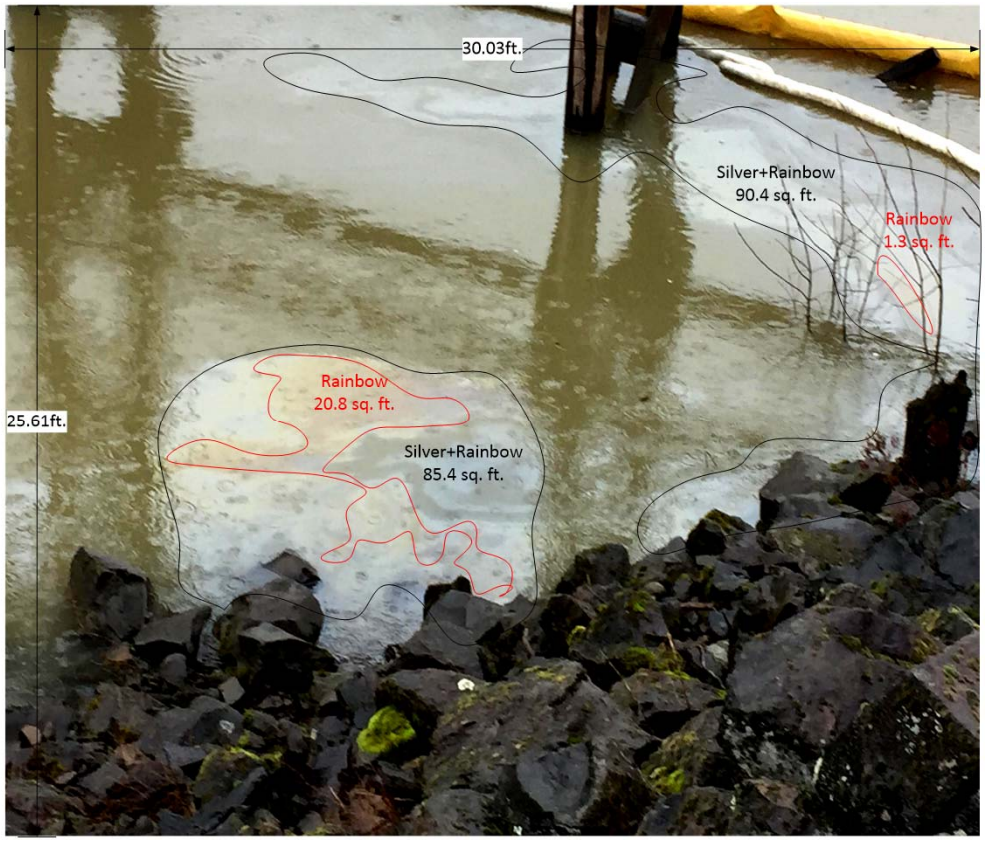
OBB Utilizes Multiple Layers



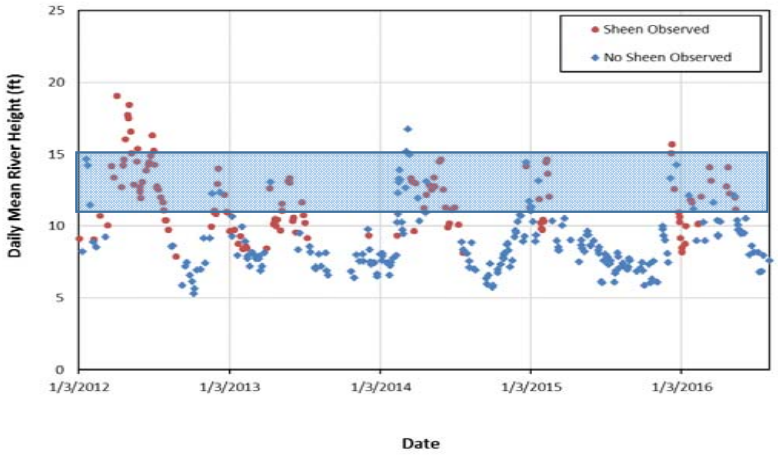


- Colorado State University Research Foundation and others have a patent on the biobarrier technology
- Jacobs has an agreement with CSU to implement the OBB technology
- A royalty fee of $5,000 is required under Jacobs' agreement for each full-scale project

Oleophilic Bio Barrier Design



- Sheen area and intensity monitored weekly for years
- Sheen volume estimated at 1 to 15 mL each event
  - ✓ Capacity >5,000 sheen events without exceeding capacity
- Sheen discharge primarily occurs between an elevation of 10 to 13 feet
  - ✓ Overlaps in OBB panels designed to allow multiple layers between 10 to 13 feet



Summary of ROD Cap Design Requirements

- NAPL
  - Use oleophilic clay or other reactive materials
- Groundwater Discharge
  - Meet pore water CULs
  - Use carbon or other adsorbents
- Armor
  - Use habitat friendly beach mix…but only if it will not erode
- Habitat
  - Compensatory mitigation required for beach habitat loss
- Slope
  - 5:1 slope preferred but not constructible at this site
- Flood Rise
  - No net fill
  - No net rise

Cap Design – Groundwater Discharge

<u>Cap design will require the use of activated carbon, other reactive material, and/or low permeability materials, as necessary</u>

- Cleanup levels are presented in the ROD
- Groundwater discharge flux and pore water concentration data were available for site COCs (PAHs, BTEX, C10-C12 hydrocarbon range)
- Conservative assumptions to design the active cap layer using CapSim
- A 6-inch layer of a carbon/gravel mixture with 20% activated carbon can treat discharge for 100 years

Cap Design – Armor

Caps will be constructed with sufficient armor to prevent erosion. Engineered beach mix layer consisting of rounded gravel typically 2.5 inches or less to be applied to the uppermost layer of all caps.

- ROD prefers “habitat friendly” cap surfaces; however, these surfaces can be erodible
- Reduction in habitat from addition of riprap requires mitigation
- Marine Mattresses deployed in areas of existing beach to prevent habitat degradation, reduce total fill, and allow for beach mix cover

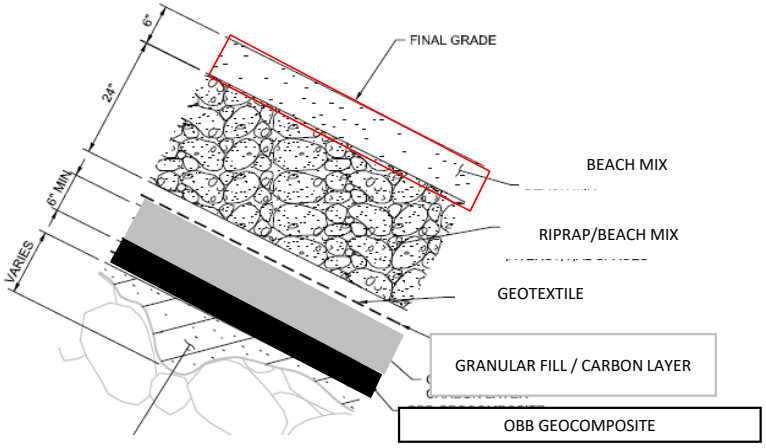
Cap Design – Flood Rise and Navigation

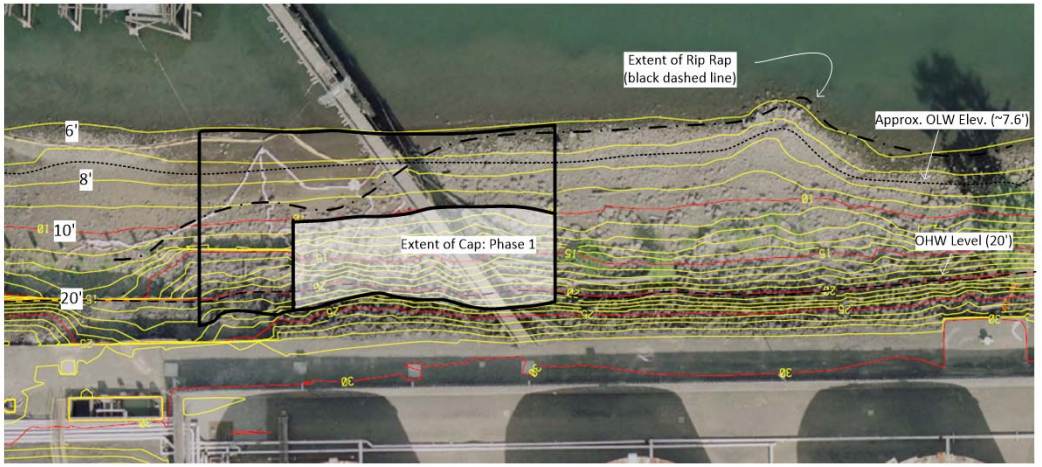
Caps will be designed to avoid adverse impacts to the floodway

- City of Portland administers FEMA regulations:
  - No net fill
  - No net rise of flood waters (<0.004 ft)
- Surplus fill mitigated by removal of material downstream of cap area
- No rise analysis performed that showed no net rise

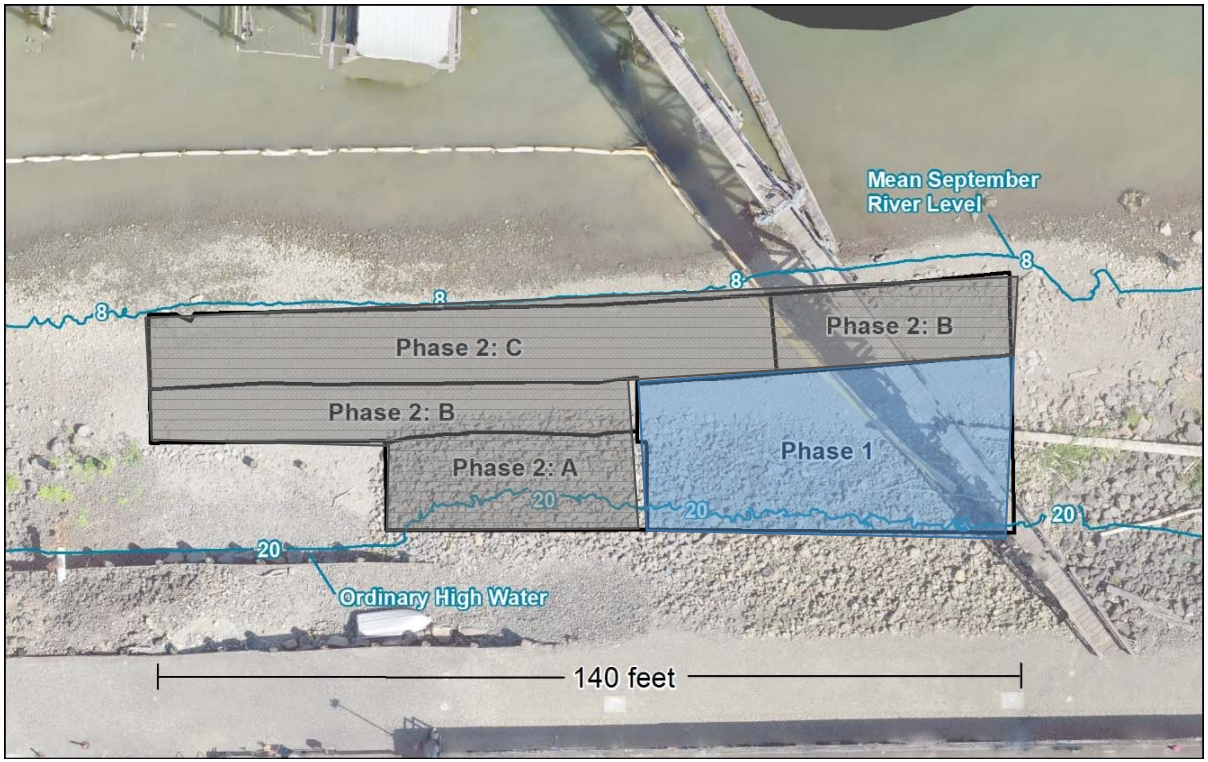
Cap Design Summary

- The significantly augmented cap contains the following layers:
  - Leveling layer
  - Geogrid (Phase 1 only)
  - Oleophilic bio barrier layer
  - Granular activated carbon gravel mix
  - Geotextile separation layer
  - Armor layer
- Overall thickness, 3-foot allowance





Cap Constructed in Two Phases



- Phase 1 constructed in Fall 2017
  - All work above fall river stage to 10 foot elevation
- Phase 2 constructed in Fall 2018
  - In-water work allowed by permit

Phase 1 Construction

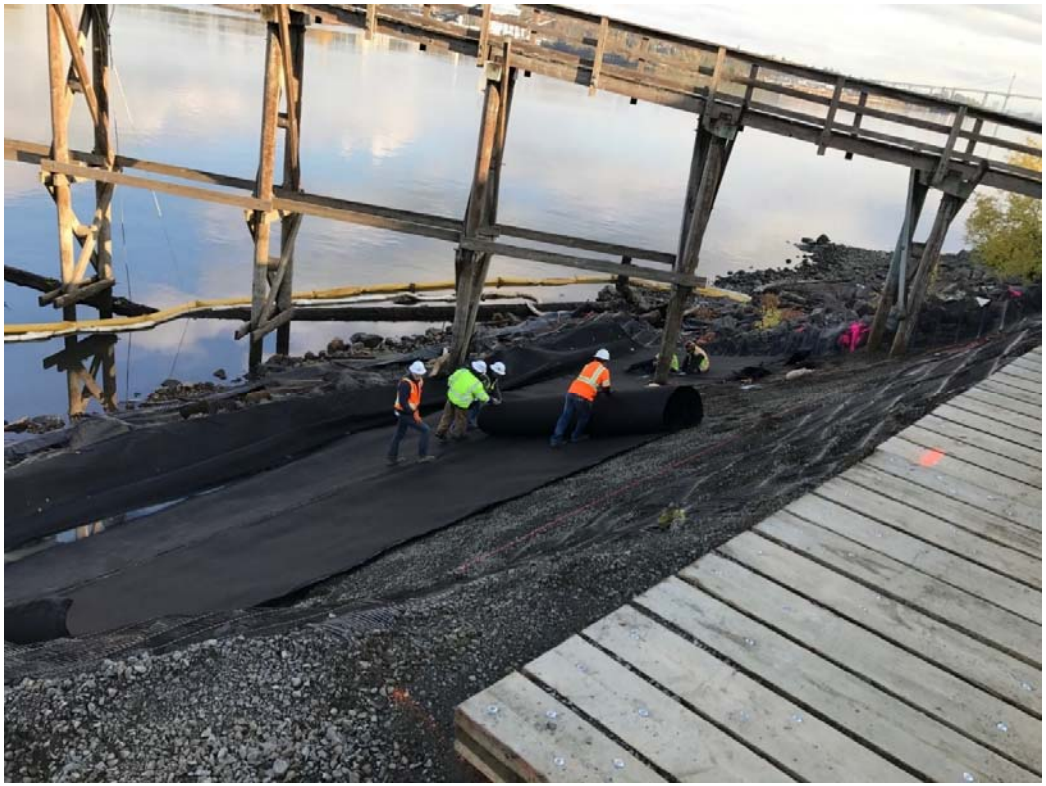
Removing existing riprap. Note very tight working area.

Phase 1 Construction – Geogrid

Install geogrid in anchor trench.

Phase 1 Construction – OBB Installation

Install Oleophilic Bio Barrier on top of levelling layer, with overlaps.



Phase 1 Construction

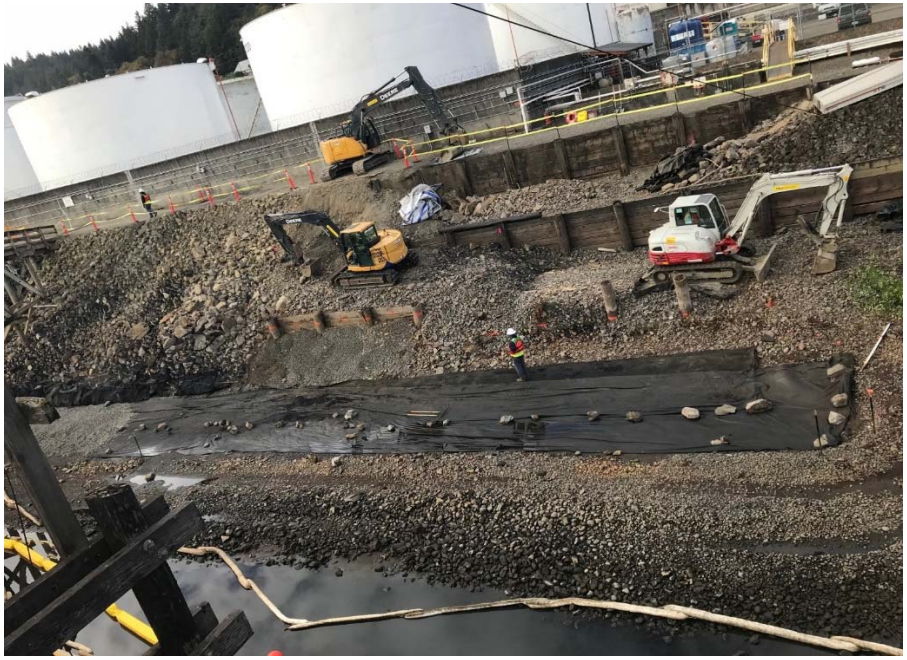
Cap sequence:

- Geogrid
- Leveling layer
- OBB
- Carbon/gravel mix
- Geotextile and armoring (not shown)

Construction - Phase 2

2-foot excavation along toe of slope – Needed for Cut/Fill Balance

Construction - Phase 2



OBB installed – Low and high tides on the same day

Construction - Phase 2

6-inch carbon layer on top of OBB, conveyor truck able to shoot granular materials from top of bank

Geotextile and 1-inch minus gravel on top of carbon/OBB

Construction - Phase 2

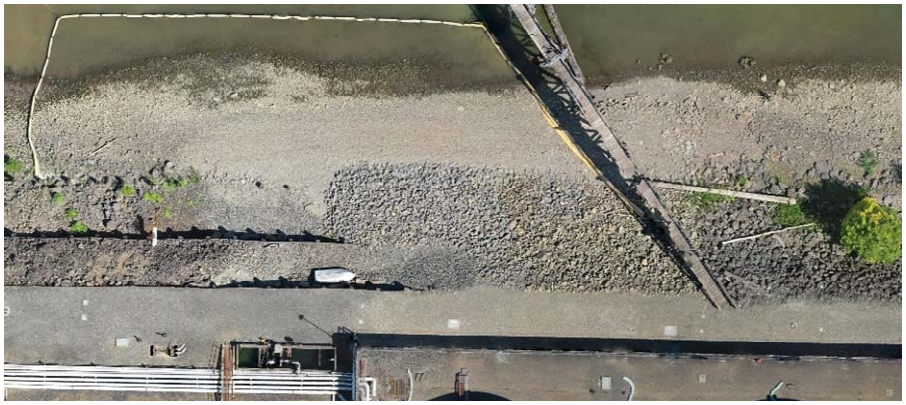
- Maccaferri Polymeric Marine Mattress armoring for lower bank
- Provided lower profile, less total fill; increased habitat footprint

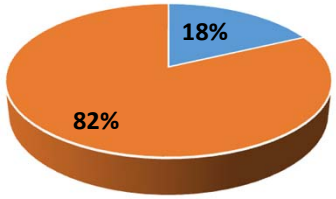
Completed Cap

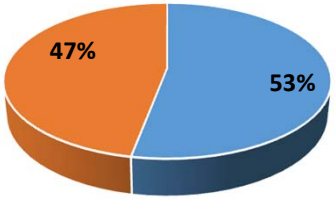
Completed cap

Fish-friendly beach mix: 2.5-inch minus rounded gravel, no fines

Habitat Before and After







2,100 square feet of new beach habitat was created

Summary and Observations

For the site:

- Oleophilic Bio Barrier has been effective for sheen control since November 2017
  - ✓ No sheen has been observed
- OBB was the most geotechnically stable design

For the technology:

- Preferred technology for sheen control on banks that are intermittently wetted?
  - ✓ More long-term performance data are needed

Thank you!