Shoreline Remediation of Petroleum Hydrocarbons Using Oleophilic Biobarrier for Sheen Control on the Portland Harbor Superfund Site

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Abstract

Migration of light non-aqueous phase liquid (LNAPL) resulted in occasional petroleum sheening on the Willamette River at the Linnton Terminal within the Portland Harbor Superfund Site

- Sheening initially addressed by an impermeable barrier wall and hydraulic control and LNAPL recovery system
- An oleophilic biobarrier (OBB) was designed and installed to address sheens due to residual LNAPL downgradient of the barrier wall
- No sheens have been observed since the installation of the Phase 1 OBB Cap (November 2017)
- Phase 2 installed in-water in Fall 2018

Background/Objectives

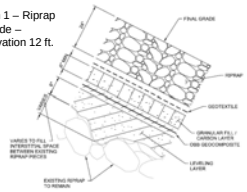
The site is an approximately 100-year-old fuel terminal on the bank of the Willamette River

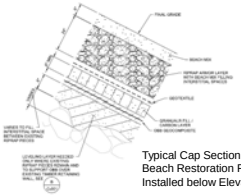
- Occasional sheening due to historic releases
- A 216-foot fiberglass sheetpile wall with Viton seals and hydraulic control and LNAPL recovery system was installed in 2011 to address LNAPL flow to river
- Sheen frequency and volumes decreased post-wall, but trace sheens still occurred during certain river stages
- Cap designed to mitigate residual sheening and dissolved phase transport
- Site riverbank listed as remediation area under Environmental Protection Agency (EPA) Portland Harbor Superfund Site Record of Decision (ROD)
- ROD required river bank remediation to be consistent with the in-water remedy

Map: EPA Portland Harbor Superfund Site ROD Fact Sheet (Jan. 2017)

Approach

Typical Cap Section 1 – Riprap Armor Finished Grade – Installed above Elevation 12 ft.





Typical Cap Section 2 – Fish Habitat Beach Restoration Finished Grade – Installed below Elevation 12 ft.

Portland Harbor Superfund ROD Requirements

- "Cap design will include organoclay, other reactive material, and/or low permeability material, as necessary…"

OBB was approved as an other reactive material

- Oleophilic (oil-loving) plastic geocomposite absorbs sheens as river stage changes
- Transmissive OBB layer delivers oxygen and nutrients via river fluctuations to microbes to degrade captured LNAPL

OBB Design

- LNAPL discharge volume estimated from sheen intensity and colors (NOAA 2012)
- OBB capacity of >5,000 sheen events without degradation, greater lifetime due to biodegradation

Additional Cap Layers:

- Activated carbon for dissolved phase
- Macafferi Marine Mattresses for armoring, provided thinner profile to reduce fill amounts within 100 year floodplain
- "Fish friendly" beach habitat mix required as top cover (2.5-inch minus rounded gravel)

Permitting – Local, State, Federal permits needed

- 401/404 Permits; Endangered Species Consultation, Biological Opinion
- City of Portland/FEMA No-rise No-fill requirements within 100 year floodplain; required mitigation for surplus fill.

Results

- No sheens observed since installation of Phase 1 cap in November 2017
- Phase 2 construction completed November 2018
- Hybrid approach of the OBB and carbon layer address both LNAPL and dissolved phase contamination
- Organoclay alone not likely successful at the air-water interface, due to extended dry periods. River elevations fluctuate 15 feet seasonally
- OBB was most geotechnically stable option
- Long-term monitoring required to confirm success of cap

Acknowledgements

Kinder Morgan, Inc.
Colorado State University