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

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Background/Objectives. This project in Portland, Oregon, is for an approximately 100-year-old fuel terminal situated on the bank of the Willamette River within the Portland Harbor Superfund Site. Migration of petroleum light non-aqueous phase liquid (LNAPL) present at the site leads to occasional petroleum sheening on the Willamette River. LNAPL migration is currently partially controlled by a 200-foot impermeable barrier wall and a hydraulic control and LNAPL recovery system located parallel to the shoreline. The intensity of intermittent sheens on the Willamette River has decreased since the barrier was installed; however, occasional sheening is still observed. Work began in 2015 to address the portion of the bank beyond the barrier wall where the bank is steeply sloped and extends about 80 feet to the sandy beach of the river.

The U.S. Environmental Protection Agency (EPA) issued its record of decision (ROD) for the Portland Harbor Superfund site in January 2017, which identified the terminal as a river bank remediation area. The ROD requires that LNAPL in river banks be remediated or controlled with a "significantly augmented cap." The ROD also requires river bank remediation to be consistent with the selected in-water remedy, which specifies that significantly augmented cap design "will include organoclay, other reactive material, and/or low-permeability material, as necessary, to provide a sufficient chemical isolation layer to reliably contain underlying contamination." A Source Control Measure Focused Feasibility Study was submitted to the Oregon Department of Environmental Quality and United States Environmental Protection Agency in June 2017, documenting that an oleophilic biobarrier developed at Colorado State University (patent pending) was selected as the preferred technology for sheen control. On August 23, 2017, the Oregon Department of Environmental Quality in coordination with EPA approved the use of the oleophilic biobarrier as a source control for LNAPL indicating "DEQ believes the conditions at the site are favorable for this technology."

Approach/Activities. The conceptual site model was refined using LNAPL transmissivity and diagnostic gauge plots to better understand the sheening. LNAPL impacts were also evaluated in association with river levels. The ROD cap design approach was reviewed in conjunction with research on the performance of organoclay and oleophilic biobarriers at the air-water interface, to develop an appropriate cap design. Based on this review, an oleophilic biobarrier was determined to be superior to the prescriptive organoclay technology in the ROD.

Results/Lessons Learned. Transmissivity of LNAPL near the shoreline is too low for effective hydraulic recovery and to prevent sheening. Although the barrier wall has effectively mitigated LNAPL transport upgradient of the wall, a 2- to 4-foot-thick lens of LNAPL is present in the soil riverside of the wall at an elevation periodically inundated by the river. Sheening occurs when the river level intersects this LNAPL-contaminated soil layer.

The use of organoclay alone in the shoreline application was not recommended based on previous research that identified concerns regarding its efficacy at the air-water interface. A hybrid approach was developed that incorporates an oleophilic biobarrier and a carbon layer to address LNAPL and dissolved-phase-contaminant migration to the river. Construction of the cap is scheduled for fall 2017.