Monitoring Effectiveness of Pilot-Scale Sediment Caps in a Dynamic Sand Riverbed

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Background/Objectives. Columbia Gas of Massachusetts (a NiSource Company) is successor to the Springfield Gas Light Company, which operated a manufactured gas plant (MGP) in Springfield, Massachusetts for over a century. The MGP released coal tar to the Connecticut River, affecting a narrow swath of sandy sediments nearly two miles long. The riverbed is characterized by sand waves and ripples, indicating a bedload river constantly in motion. Columbia proposed to isolate surficial expressions of tar-infused sediment from aquatic receptors by capping with armor stone. The Massachusetts Department of Environmental Protection required pilot-scale testing of the proposed cap before approving the full-scale remedy. Different pilot cap configurations were designed to assess resistance to major storm events, upward migration of tar into the cap, and scour along the cap margins.

Approach/Activities. Eight, low-profile pilot caps were installed to a thickness of 1 to 2 feet, using: (1) coarse gravel only; (2) coarse gravel underlain by a fine gravel filter layer; and (3) cobbles underlain by fine gravel (for high-energy environments near bridge piers). Each full-thickness cap covered an area of 1,600 feet^2, and tapered down to the sediment surface along the margins. A fourth cap configuration included the deposition of gravel in concentric arcs, using approximately one-half the material over the 1,600 feet^2. The goal for this “cellular” design was to assess trapping and retention of the bedload of natural sand being transported by the river. Open test cells were installed in the caps to evaluate sediment deposition, whereas closed cells containing cap material were installed to assess tar intrusion. Settlement plates with survey rods were installed in the full-thickness and cellular caps to monitor vertical changes in cap thickness and any horizontal movement for those caps installed on the sloping riverbed margins. Monitoring includes SCUBA dives to measure test cells and survey plates, and bathymetric surveys to assess elevation changes on and around the caps between monitoring events.

Results/Lessons Learned. Since construction in late 2016, five monitoring events have been completed. Interstitial spaces in the gravel and cobbles have filled with sand, and all cap configurations have remained in place even after a 2-year flood event (i.e., >100,000 cubic feet per second). The cellular caps have accumulated and retained the bedload sand in the uncapped spaces between the gravel arcs. The open test cells have also filled with sand, except for those caps constructed on the sloping river margin where less sand is being transported. No tar has intruded into the closed cells filled with cap material. As evidenced by the rod measurements, sand accumulates and erodes from the cap surface, although sufficient sand exists to support revegetation and mussel habitat. Sand has also been observed to accumulate behind the pilot caps. Margin scour is minimal, and changes around the pilot caps appear to be attributable to the passing of naturally-occurring sand waves. Monitoring will continue until a larger storm event has occurred.