Sediment Cap Design, Modeling, and Construction

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Background/Objectives. Sediment remediation at a former manufactured gas plant (MGP) site in Flint, Michigan was completed during the 2017 construction season that included dredging sediment and placing a multi-layer sediment cap within the Flint River. The cap layers consisted of a sand foundation, Blended Barrier™ (a patented mixture of AquaBlok® and gravel), cover sand, gravel, and gravel in-filled rip rap. The objectives of the cap were to: 1) create a barrier between remaining impacted sediments below the cap and the river, 2) provide stable riverbanks and riverbed, and 3) incorporate bedform diversity elements for improved aquatic habitat. Meeting these objectives required an evaluation of alternatives for the cap and included incorporation and analysis of materials, constructability, cap design, geotechnical modeling, performance-based construction quality standards and quality control (QC) requirements, and multi-stakeholder engagement. Successful implementation of the selected remedy relied upon the placement of the cap materials within the construction QC requirements. An integrated project team was necessary to deliver the project to the stated objectives.

Approach/Activities. Options for establishing a barrier along 1,700 feet of the riverbed were evaluated during the feasibility phase and included Blended Barrier, geo-composite mats, and geosynthetic fabrics and membranes. Blended Barrier was selected as the preferred option for in-water cap applications and geomembrane was selected for above water capping. Early engagement between the manufacturer and engineer identified critical design parameters for Blended Barrier performance. Bench/lab scale testing (swell and strength) were performed on the material under simulated field conditions. The data was used to demonstrate capability to meet barrier objectives, provide inputs for geotechnical modeling, gather data for use in designing supplemental cap layers, and aid in establishing construction requirements. A filter layer evaluation was performed to develop material specifications needed to effectively grade from the bentonite-coated particles to a final layer of coarse rip rap. The rip rap was evaluated by performing a hydrodynamic analysis. Global slope stability and veneer cover stability modeling were completed iteratively within the cap design process.

Effective implementation of the cap strategy required establishment of pragmatic construction specifications that included a wide range of core elements: on-site Blended Barrier preparation (mixing) and storage/handling management, appropriate barge spudding, equipment setbacks from bank crests to maintain slope stability, and placement of cap materials to within the allowable tolerances and within suitable timeframes. Maintaining conformance to the specifications during construction required additional planning, adaptive management, modifications to construction methods as conditions changed, heightened coordination between the contractor and engineer, and expedited review of survey data.

Results/Lessons Learned. The project outcome is a physically stable and functional multi-layer cap installed to meet the design intent. Results that will be discussed include requirements that were modified based on construction limitations, field observations, construction QC data collected and used during implementation, and other constructability and design lessons learned.