Spirit Lake: Designing a Sediment Remedy that Embraces Habitat Restoration

William Murray (U.S. EPA Great Lakes National Program Office)
Michael Ciarlo, Jamie Beaver, and Kaitlin McCormick (EA, Engineering, Science, and Technology, Inc. PBC)

Background/Objectives. Spirit Lake occupies approximately 900 acres along the St. Louis River near Duluth, Minnesota. A history of industrial activity has led to the presence of elevated concentrations of metals and PAHs in sediments within the western half of the lake. Through the Great Lakes Legacy Act, the U.S. Environmental Protection Agency Great Lakes National Program Office (U.S. EPA GLNPO) along with their non-federal sponsor (NFS), have been working in partnership to develop a comprehensive plan to clean up approximately 700,000 cubic yards of impacted sediment. The plan involves a combination of dredging, capping, and enhanced monitored natural recovery to address sediments and includes the construction of confined disposal facilities on site for placement of dredged materials. While the key driver during design is remediation, a significant effort has been made to incorporate habitat restoration components, identified as critical by natural resource managers, into the remedy.

Approach/Activities. Early in the process of remedy selection U.S. EPA and their NFS coordinated closely with Minnesota Pollution Control Agency (MPCA) and approached regional natural resources managers, tribes, and other stakeholders to solicit their input on long-term restoration goals for Spirit Lake. Through a series of meetings and discussions, this produced a habitat restoration plan developed by the resource managers and tribes that identified restoration goals for the Lake and served as a general guide for habitat restoration objectives available for the remediation project to address. Resource managers identified desired aquatic habitat types associated with specific water depths and vegetative communities. These habitats were considered in remedy selection, which incorporated the concept of dredging and capping to achieve shallow sheltered bay habitat as a resource for fish. They were further carried into remedial design, where areas subject to remediation were targeted for habitat restoration. The expected post-remediation water depths were mapped to identify ideal conditions for each habitat feature, i.e. emergent wetlands, emergent aquatic vegetation, submerged aquatic vegetation, a shallow sheltered bay, and deep water. The design was then modified to specify substrate types, planting regimes, and engineered features to provide stability under lake wave conditions and contributing conditions from the adjacent St. Louis River hydrodynamic regime.

Results/Lessons Learned. Design of combined remediation and restoration at Spirit Lake produced a number of lessons learned. Coordination with natural resources managers was key to understanding how restoration could be planned to match larger efforts within the St. Louis River Area of Concern. While their initial restoration plan extended beyond the limits of the project, their priorities and habitat type definitions proved invaluable for designing restoration that conformed to regional efforts. Also, specific habitat types (i.e., shallow sheltered bay) were identified early as both desirable and compatible with dredging plans. Another lesson learned is that designing aquatic habitats in conjunction with a remedy requires a careful consideration of trade-offs. Trade-offs were identified between water depths, dredge volumes, and cap thickness. Optimizing one of these factors required concessions on the other two. Cost-benefit analysis and iterative modeling were required to achieve a balanced design. The final lesson learned was advanced communication about habitat goals helped identify opportunities within the project design early on, which ultimately will lead to a more efficient and effective remedy and restoration.