

**Tenth International Conference
on the
Remediation and Management of Contaminated Sediments**

**Spirit Lake:
Designing a Sediment Remedy that
Embraces Habitat Restoration**

February 13, 2019



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Project Team

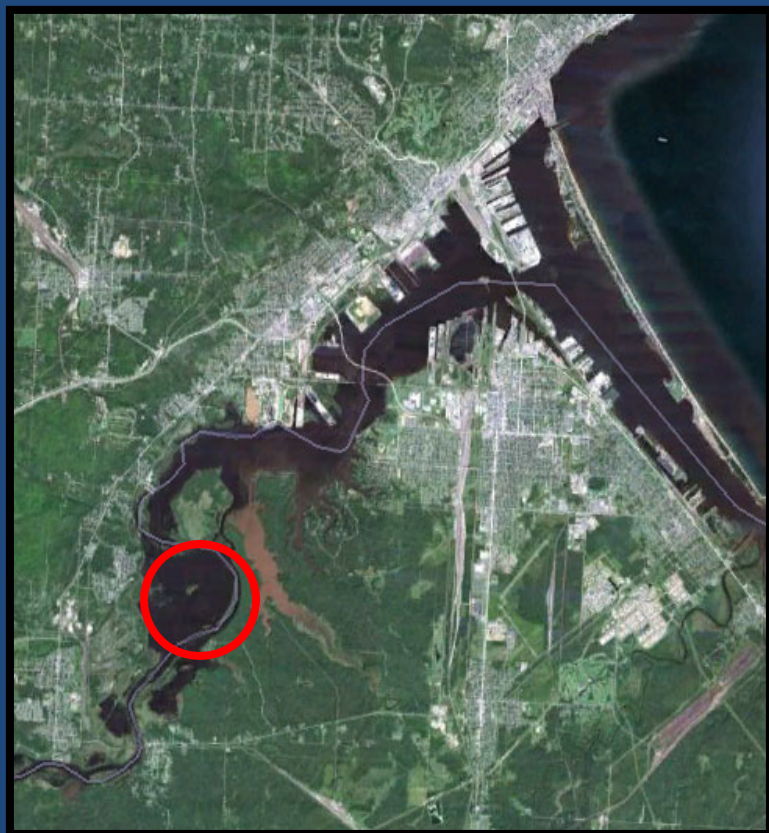
- **U.S. EPA Great Lakes National Program Office**
 - EA Engineering, Science, and Technology, Inc., PBC
- **U. S. Steel Corporation**
 - Barr Engineering
 - AECOM
- **Minnesota Pollution Control Agency**

Other Stakeholders

- Fond du Lac Band of Lake Superior Chippewa + 1854 Treaty Authority
- Minnesota Department of Natural Resources
- U.S. Fish and Wildlife Service
- Minnesota Land Trust
- City of Duluth
- St. Louis River Alliance
- NOAA



Western Lake Superior and Lower St. Louis River



Project Summary

- **Great Lakes Legacy Act Project - 2011**
- **Western Duluth neighborhood of Morgan Park**
- **Former U. S. Steel Duluth Works Site (1915-1979)**
- **Wetlands and estuary sediment contaminated with PAHs + Pb (and other RCRA metals)**
- **~3,000,000 CY of sediment exceed remedial goals**
- **Selected Remedy Includes:**
 - Dredging ~700K CY
 - Capping ~107 acres
 - Construction of two (2) onsite CDFs
 - **HABITAT RESTORATION**
- **Final RD expected Spring 2019**
- **Permits - Summer 2019**
- **Site Prep - Fall 2019**
- **Dredging / Capping – 2020-2021**
- **Habitat Restoration – 2020-2021**



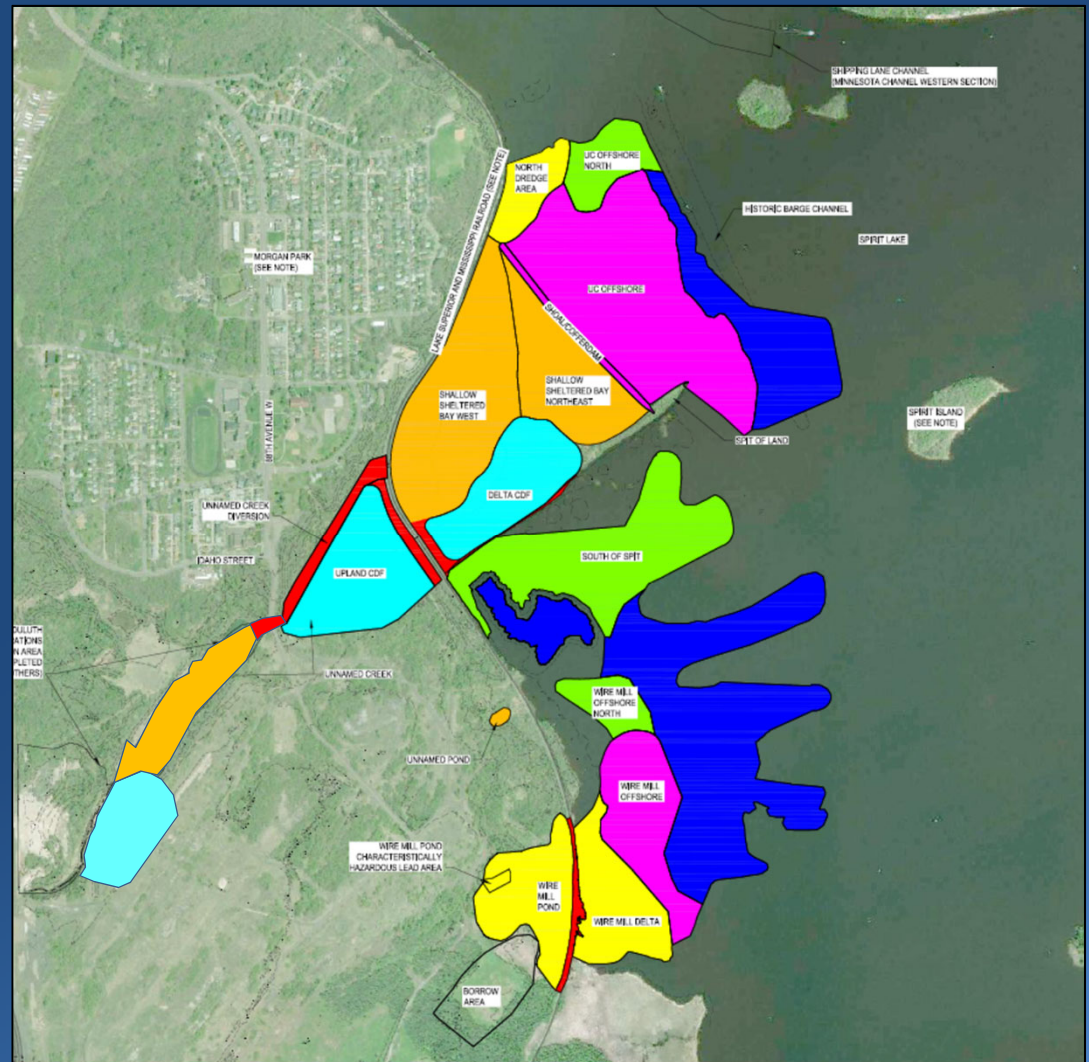
Restoration Goals

- **Help achieve the overarching goal of addressing beneficial use impairments and the eventual delisting of the St. Louis River Area of Concern**
- **Design habitat restoration components that supplement and enhance the remedy and fit within the overall budget for the project as a voluntary action**



Remedial Design Overview

- **Confined Disposal Facilities (CDFs)**
- **Dredge and Cap**
- **Sediment Cap**
- **Upland Cap / Stream Diversions**
- **Monitored Natural Recovery (MNR)**
- **Enhanced Monitored Natural Recovery (EMNR)**
- **Dredge + Residuals Cover**



Development of Habitat Restoration Plan

- **Conceptual habitat restoration plan developed by stakeholders include the following features:**
 - Limit hydraulic power *and* optimize hydrologic exchange across majority of the site
 - Increase area and density of aquatic vegetation
 - Increase deep water area
 - Improve habitat for:
 - Sturgeon foraging
 - Overwintering of fish
 - Fish nursery
 - Waterfowl foraging
 - Songbird nesting
 - Maintain recreational use
 - Protection of cultural heritage



Stakeholder Plan and Design Criteria

- **Elements of stakeholder plan incorporated into design**
- **Habitat types based on AOC standard definitions (based on depth regime)**
- **Key features incorporated:**
 - Substrate suitable to support ecological goals
 - Limit hydraulic power through creation of the shallow sheltered bay
 - Improve hydrologic exchange at Wire Mill Pond
 - Increase area and density of wetland, submerged, and emergent vegetation
 - Create mosaic of submerged and emergent vegetation
 - Improve habitat for aquatic life and terrestrial species
- **Design Criteria Includes:**
 - Planting zones based on water depth
 - Designed to average water levels based on OHWL and OLWL (with objective to have resilience through this range)
 - 7 planting zones
 - 4 substrates
 - Erosion protection



Habitat Restoration Zones

Zone	Vegetation Regime	Depth	Substrate
Zone 1	Deep	>6 ft	Hard or soft
Zone 2	Submerged Aquatic Vegetation	4.0 to 6.0 ft	Hard or soft
Zone 3	Mixed Vegetation	2.0 to 4.0 ft	Hard or Soft
Zone 4	Emergent Marsh Vegetation	0.0 to 2.0 ft	Hard or Soft; Loam Soil (areas 0 to 0.5 ft)
Zone 5	Upland Planting - CDF	NA	Topsoil
Zone 6	Upland Planting	NA	Topsoil
Zone 7	Riparian Zone	Temporarily Flooded	Topsoil/Bio-retention Mix



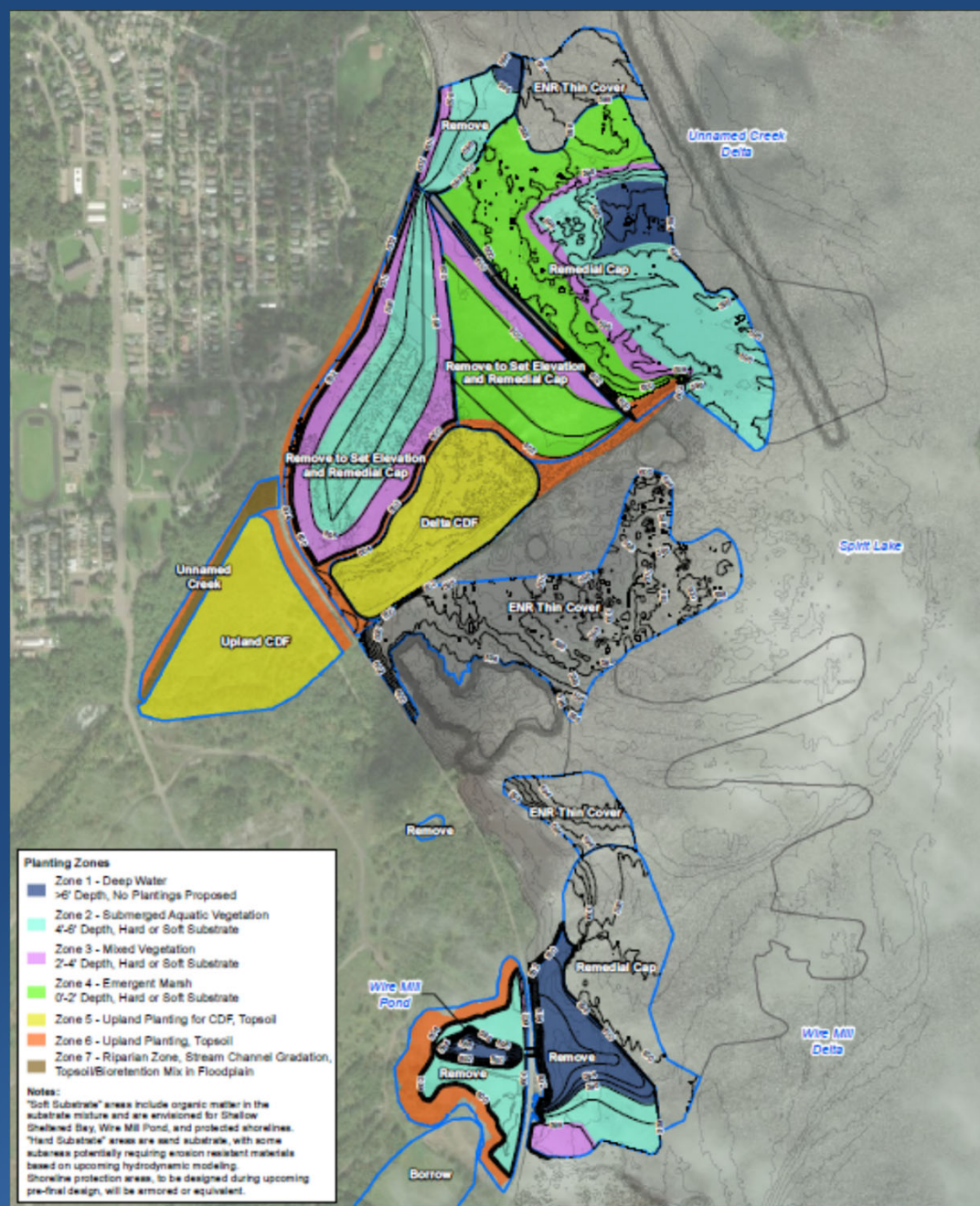
Planting Zones

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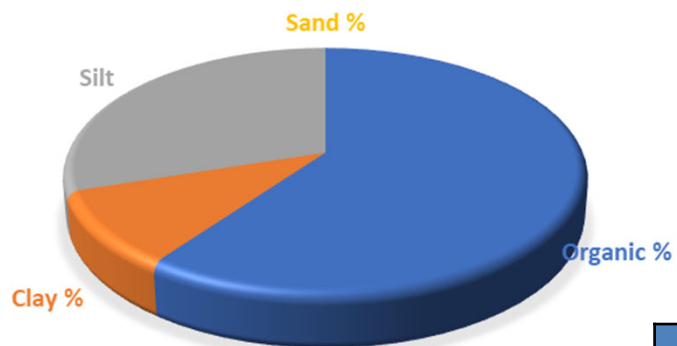
- Zone 1 - Deep Water
>6' Depth, No Plantings Proposed
- Zone 2 - Submerged Aquatic Vegetation
4'-6' Depth, Hard or Soft Substrate
- Zone 3 - Mixed Vegetation
2'-4' Depth, Hard or Soft Substrate
- Zone 4 - Emergent Marsh
0'-2' Depth, Hard or Soft Substrate
- Zone 5 - Upland Planting for CDF, Topsoil
- Zone 6 - Upland Planting, Topsoil
- Zone 7 - Riparian Zone, Stream Channel Gradation,
Topsoil/Bioretenation Mix in Floodplain

Notes:

"Soft Substrate" areas include organic matter in the substrate mixture and are envisioned for Shallow Sheltered Bay, Wire Mill Pond, and protected shorelines. "Hard Substrate" areas are sand substrate, with some subareas potentially requiring erosion resistant materials based on upcoming hydrodynamic modeling. Shoreline protection areas, to be designed during upcoming pre-final design, will be armored or equivalent.

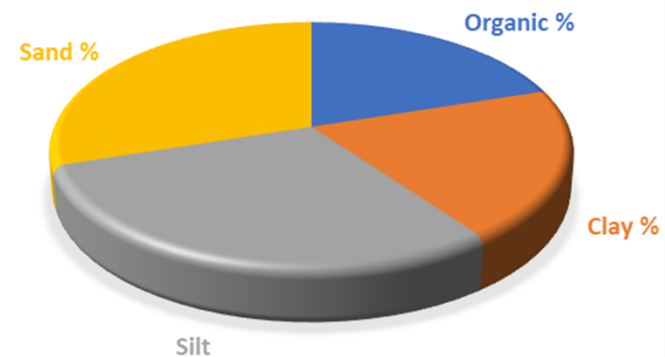
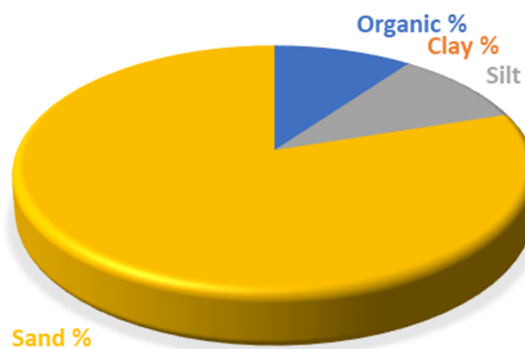
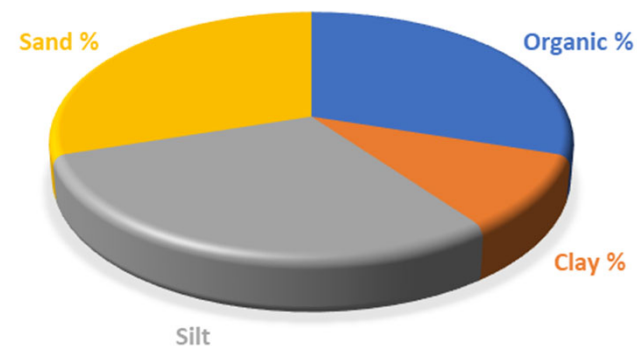


Substrate Types



TARGET COMPOSITION

Type	Org. %	Clay %	Silt %	Sand %
Soft	60	10	30	0
Hard	10	0	10	80
Loam	20	20	30	30
Top soil	30	10	30	30



Additional Design Considerations

- Focus on species that can be readily established as native habitat
- Need for current project to stabilize site remediation features
- Potential for re-use of materials from other regional projects
- Small scale variability in bathymetry for resilience to lake level change
- Potential for re-use of clean on-site sand borrow
- Potential for localized deepening in eastern Spirit Lake or other nearby areas



A light blue map of the Great Lakes region is centered on a dark blue background. The map shows the outlines of the five Great Lakes and the surrounding landmasses.

Thank You!

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