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Wagon Hill Farm

from **Engineering With Nature: An Atlas, Volume 3.**

by **US Army Engineer Research and Development Center**

Durham, New Hampshire, United States

Constructing New Hampshire's first living shoreline. The Wagon Hill living shoreline project addressed the loss of almost 30 centimeters per year of fringing salt marsh due to foot traffic from people and dogs, soil ice needles, wind-driven ice, tides, boat waves, and shade from nearby trees that prevented the growth of marsh vegetation. Decades of erosion had created a shoreline scarp approximately one meter high. Rather than fill in the mudflats with a long, gentle slope leading up to the remaining marsh, project designers opted to build out the marsh approximately nine meters into the mudflats and grow new salt marsh to replace what had been there 25 years earlier. The project has three planting zones: low marsh (mean tide to mean high water), high marsh (mean high tide to mean higher high water [MHHW]), and a tidal buffer zone above MHHW. Trees were removed so sunlight could reach the new marsh plants. A nearly vertical rock sill incorporating root wads in places was constructed as the new shoreline. Fencing above the tidal buffer and extending into the water protects the site, and a viewing deck and walkway connect the public to Great Bay and

the marsh. The project took almost three years of monthly meetings to plan and was completed in 2019.

Article Cover: Restored marsh. (Photo by Michael Lynch, Durham Public Works Department)

Producing Efficiencies

The retreat of the Wagon Hill shoreline and loss of salt marsh plants was remarkable. One fence was moved back at least eight meters in 25 years, and pins along the shoreline measured an annual average erosion rate of almost 30 centimeters. Game cameras recorded people and dogs walking on the marsh daily and small waves removing sediment from the shoreline. Light at the tree line was insufficient for marsh vegetation. Winter ice broke apart shoreline soil, promoting erosion when the banks thawed. Ice also shoved against the banks and undercut marsh blocks. Sea level rise outpacing marsh accretion exacerbated shoreline erosion.

Aerial view of the prerestoration shoreline and fence.
(Photo by Michael Lynch, Durham Public Works Department)

Prerestoration marsh erosion.

(Photo by Tom Ballestero, University of New Hampshire Coastal Habitat Research Team, [UNH CHaRT])

Using Natural Processes

A perimeter fence protects the restored salt marsh from people and dogs. Gentle marsh slopes limit outgoing tide velocities. Rocks provide perches for birds, break up blankets of ice, and prevent ice rafting of surface sediments and vegetation. Coir logs parallel to the shoreline permit marsh inspections without trampling plants and interrupt erosion rill formation until full salt marsh vegetation coverage occurs. The plants also dramatically reduce boat and wind waves. Root wads and the rock sill arrest marsh edge erosion; the sill withstands ice shoving and waves. A shoreward tidal buffer accommodates marsh migration as sea level rises. Tree removal improved light on the marsh.

Sill and marsh construction.
(Photo by Tom Ballestero, UNH CHaRT)

Broadening Benefits

A focal point of a very public setting, the restored salt marsh is often the site for weddings, graduations, announcements, and other photo opportunities. A boardwalk and viewing platform were also constructed to maintain the public's connection to the bay and the marsh environment. The marsh is again functioning as a fringing salt marsh with attendant flora and fauna. It has galvanized the community's dedication to restoring impaired aquatic systems in general— more specifically, restoring the additional 426 meters of shoreline at this property—erecting additional fencing, and relocating trails to protect them.

Sill and marsh construction with habitat boulders that provide perches for birds but, more important, break up large ice sheets and prevent ice rafting of marsh plants and sediments.

(Photo by Tom Ballestero, UNH CHaRT)

Promoting Collaboration

Three years of monthly meetings were held with the Durham Planning Department, Durham Conservation Commission, Durham Public Works Department, University of New Hampshire Coastal Habitat Research Team, Strafford Regional Planning Commission, New Hampshire Coastal Program, New Hampshire Department of Environmental Services, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency. The New Hampshire Port Authority, New Hampshire Fish and Game Department, and U.S. Coast Guard also provided input. These meetings dissected the field data and discussed the universe of available solutions to develop a final system that met all stakeholder and environmental needs.

Sill and root wads incorporated into the rock sill to provide microtopography that leads to local hydraulic and habitat diversity.

(Photo by Tom Ballestero, UNH CHaRT)

Colonization of the rock sill by algae.

(Photo by Tom Ballestero, UNH CHaRT)

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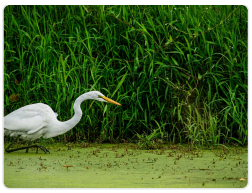

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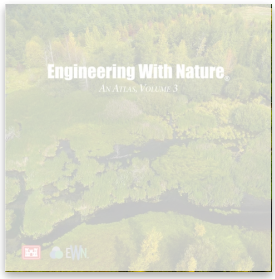

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