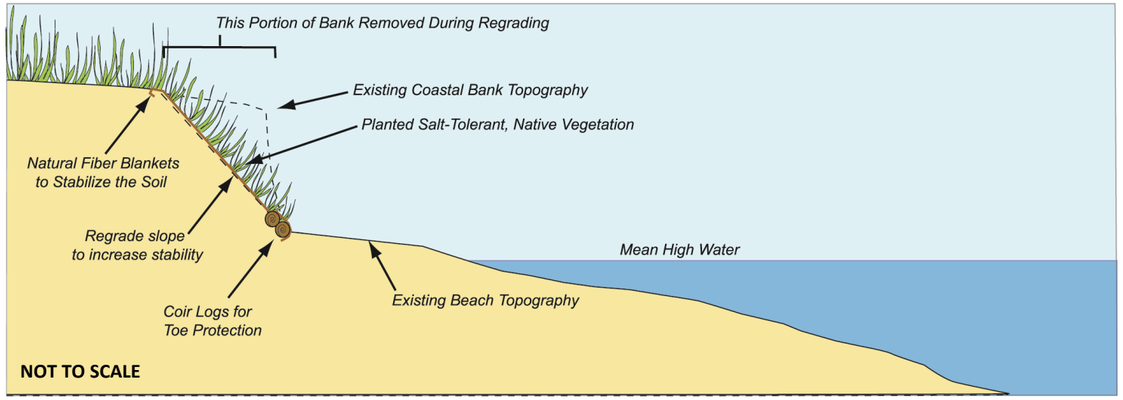
Coastal Bank - Natural

Coastal bank protection, including slope grading, and toe protection and planting of natural vegetation will reduce the steepness and protect the toe of the bank from further erosion. Coir logs, root wads protect bank toes from erosion, while planted vegetation develops strong root systems.

Objectives: erosion control; shoreline protection; dissipate wave energy; enhanced wildlife habitat.

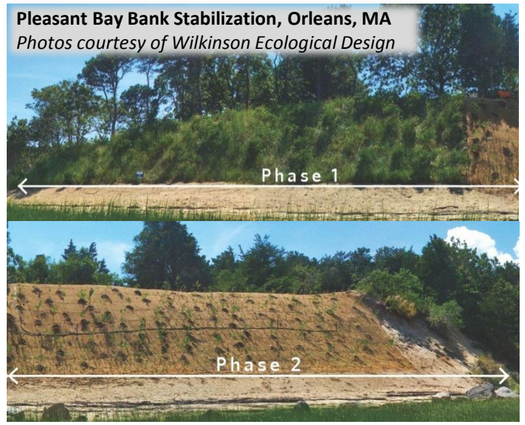
Design Schematics



Case Study

Coastal Bank Stabilization, Orleans, MA

Wilkinson Ecological Design developed a plant-focused coastal bioengineering project, determined not to be a coastal engineering structure by the local municipality and MA DEP. The project included a robustly anchored fiber roll array at the bottom of the bank and intensive planting and stabilization through the remainder of their coastal bank, which falls within a mapped FEMA Velocity Zone.



Pleasant Bay Bank Stabilization, Orleans, MA
Photos courtesy of Wilkinson Ecological Design

Project Proponent	Private property owners. The project spans three properties with multiple owners.
Status	Phase 1 constructed in 2010, Phase 2 constructed in 2013 and Phase 3 constructed in 2015.
Permitting Insights	The project involved one permit under the MA Wetlands Protection Act for each phase, three wetland permits in total.
Construction Notes	Regraded the over steepened bank, installed six rows of coir rolls at the toe of bank, installed natural fiber blankets on the bank face above the coir rolls, planted the bank face with native, salt-tolerant grasses and shrubs, and covered fiber rolls with sand.
Maintenance Issues	Monitor vegetation monthly throughout the growing season to ensure plant success; temporary irrigation for first three years; monitor coir rolls twice annually and after storms. Replant and retighten fiber roll anchoring system as needed.
Final Cost	Permitting: $10,000 Construction: $1,000/ linear foot Maintenance : $8,000/yr
Challenges	No substantial challenges in the permitting, construction or maintenance phases of work and has performed well through storms.

Overview of Technique

Materials	Sediment, if fill is needed, to establish a stable slope. Coir rolls or root wads from fallen trees to minimize erosion. Coir rolls, typically rolls 12-20” in diameter and 10-20 feet long, packed with coir fibers and held together by mesh.[1] (Coir rolls can be pre-vegetated to head start the growing process.) A high-density roll may be necessary at the toe, while lower-density rolls could be used above.[5] Wooden stakes for blankets, earth anchors for rolls, or a combination of the two are necessary to anchor the system.[1] Other naturally occurring woody material or root wads may also be utilized to stabilize the toe of the coastal bank in some sites. Salt-tolerant vegetation with extensive root systems are often used in conjunction with fiber rolls to help stabilize the site.[1] Natural fiber blankets can be used to stabilize the ground surface while plants become established.[1] (Blankets should be run up and down the slope rather than horizontally across it.)
Habitat Components	Because they are made with natural fibers and planted with vegetation, natural fiber blankets also help preserve the natural character and habitat value of the coastal environment.[1]
Durability and Maintenance	Installing coir rolls at the toe of a bank stabilization project can provide increased stability while the vegetation becomes established,[1] but bioengineering projects with coir rolls and vegetation require ongoing maintenance, such as resetting, anchoring, or replacement, to ensure their success.[1,6] Coir logs must be securely anchored to prevent wave and tidal current-induced movement.[11] Invasive species management should be incorporated into the project.[1] Runoff and groundwater management will also be crucial to project success.[6]
Design Life	As the coir rolls disintegrate, typically over 5-7 years, the plants take over the job of site stabilization.[1] The bank slope is extremely important. Often the existing condition of the slope is steep or undercut. Before installing coir logs or planting vegetation, the bank slope should be stabilized.[1] This is often done by regrading the bank slope by removal of sediment from the top of the bank rather than adding sediment to the toe of the slope.[1]
Ecological Services Provided	Upland plantings stabilize bluffs and reduce rainwater runoff.[11]
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	Shorter planting and construction window due to shorter growing season. Utilization of irrigation to establish plants quickly. Freeze and thaw processes can damage this design. Consideration should be given to the slope aspect and the implications on plant growth and microbiome from shading and sun exposure.

Coastal Bank - Natural

Natural coastal bank protection projects are appropriate for almost any tide range, topographic slope, or grain size, provided that the toe of the bank is situated above mean high water where it will not be regularly inundated.

Bustins Island, Freeport, ME
Photo courtesy of Troy Barry

Bank Stabilization in Chappaquiddick, MA
Photo courtesy of Woods Hole Group

Regulatory and Review Agencies

Maine	Municipal Shoreland Zoning, Municipal Floodplain, ME Dept. of Environmental Protection, ME Land Use Planning Commission, ME Coastal Program, ME Dept. of Marine Resources, ME Dept. of Inland Fisheries and Wildlife, and ME Geological Survey.
New Hampshire	Local Conservation Commission, NH Natural Heritage Bureau, NH Department of Environmental Services (Wetlands Bureau, Shoreland Program, and Coastal Program), and NH Fish & Game Department.
Massachusetts	Local Conservation Commission, MA Division of Fisheries and Wildlife (Natural Heritage and Endangered Species Program), MA Environmental Policy Act, and MA Office of Coastal Zone Management.
Rhode Island	Coastal Resources Management Program.
Connecticut	Local Planning and Zoning Commission, and CT Department of Energy and Environmental Protection.
Federal (in all states)	U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service.

Siting Characteristics and Design Considerations

Selection Characteristics	Detail
ES Energy State	Low to moderate. Coir rolls can be used on both sheltered sites and sites exposed to wave energy.[1] However, they are most effective in areas with higher beach elevations with some dry beach at high tide, where the rolls are not constantly subject to erosion from tides and waves.[1] Naturally occurring fringe protection (e.g. bedrock outcrop, salt marsh or higher beach elevations with some dry beach at high tide), will also help protect the project.
EE Existing Environmental Resources	Coastal bank; vegetated upland.
SR Nearby Sensitive Resources	All. If the project is proposed in or adjacent to habitat for protected wildlife species or horseshoe crab spawning areas, there may be limitations on the time of year that the project can be constructed.[1] Mudflats, clam flats and other adjacent habitat are dependent on eroded habitat; this loss in sediment source to adjacent habitat must be accounted for. If trees are removed during construction, replanting is required; the removed trees can also be used to stabilize the toe of the bank.
TR Tidal Range	Low to high. Natural coastal bank protection projects can be designed for all tidal ranges, provided the toe of bank is above the mean high water line and will not be regularly inundated.
EL Elevation	Above MHW
IS Intertidal Slope	Flat to steep. Although, flat to moderate slopes are preferred; steeper slopes may require armoring, which would result in a non-living shoreline.
BS Bathymetric Slope	Flat to steep
ER Erosion	Low to moderate
Other Characteristics	**Detail**
Impairment Level	Groundwater can be the cause of slope failure (particularly when clay is the base material), but wave exposure can be the dominant driver of loss.
Climate Vulnerability	Both horizontal and vertical loss to a coastal bank is permanent.
Surrounding Land Use	The ends of a coir roll project should be carefully designed to minimize any redirection of waves onto adjacent properties. Tapering the rolls down in number and height so that the project blends in to the adjacent bank helps address this problem. [1] If pavement or lawn extends all the way to the edge of the top of the bank, or if forests are cut to the edge of the top of the bank, coastal bank loss is more likely; maintenance or creation of a vegetated buffer will mitigate loss.