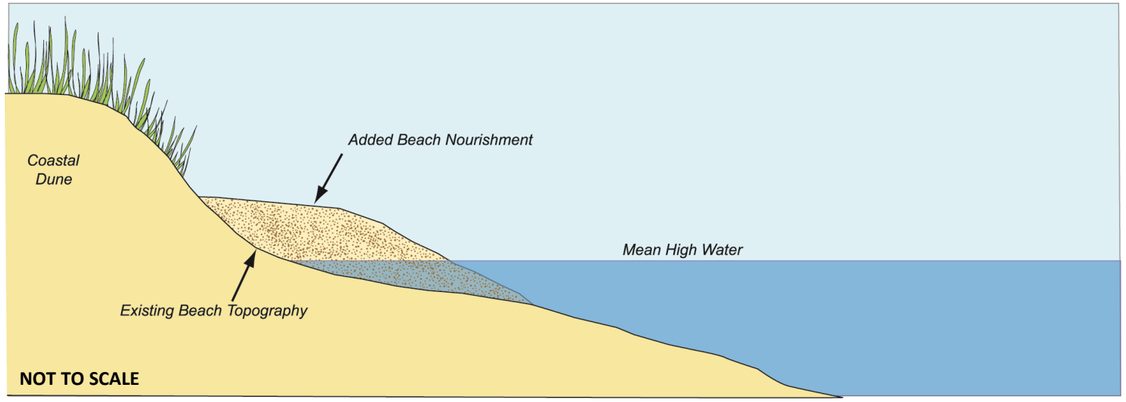
Beach Nourishment

Beach nourishment is the placement of sediment along the shoreline of an eroding beach from outside source. It widens and/or elevates the beach and usually moves the shoreline seaward, increasing the natural protection that a beach can provide against wave energy and storms. This may be a component of a dune restoration/creation effort or a stand alone project.

Objectives: erosion control; shoreline protection; enhance recreation; increased access; dissipate wave energy; enhanced wildlife and shorebird habitat.

Design Schematics



Case Study

Winthrop, MA Beach Nourishment

Applied Coastal Research & Engineering, Inc. designed the Winthrop Beach Nourishment Program to provide storm protection to an upland urban area fronted by a seawall originally constructed in 1899. The project utilized 460,000 cy of compatible sediment to nourish approximately 4,200 linear feet and to create the equilibrated designed berm width of 100 feet. Once the beach nourishment was completed in late 2014, the high tide shoreline was pushed more than 150 feet from the seawall, with a gradual slope extending approximately 350 feet offshore.

Winthrop Shores, Winthrop, MA
Photo courtesy of Applied Coastal Research & Engineering

Project Proponent	Massachusetts Division of Conservation and Recreation (DCR)
Status	Phase 1: 2013; Phase 2: 2014
Permitting Insights	Offshore sediment source was denied by Army Corps after a 12-year permitting process. Conservation Permit required from NHESP to address potential impacts to Piping Plovers.
Construction Notes	Upland derived mix of sand, gravel and cobble to match the existing beach sediments was required, where the nourishment was provided from two sources: sand borrow (80%) and naturally rounded cobble & gravel (20%).
Maintenance Issues	Cobble berms have begun forming along the beach, which conflicts with community recreation goals, requiring additional sand for aestheitcs.
Final Cost	Permitting: $2,000,000 (including attempt to permit offshore borrow site. Construction: $22,000,000 (included work on coastal engineering structures).
Challenges	Trucking through the community: urban community with two roads in and out, as well as roadway damage and air quality impacts associated with 16,000+ truck trips. Public perception of compatible sediment.

Design Overview

Materials	Sediment is brought in from an offsite source, such as a sand and gravel pit or coastal dredging project.[1]
Habitat Components	Beaches nourished with compatible sediments can provide significant wildlife habitat.[5,6]
Durability and Maintenance	A coarser sand may erode more slowly than a finer sand.[6] To maintain an effective beach berm, sediment may need to be added regularly maintain the desired beach profile.[6,11] The need to replenish the beach depends upon the rate of erosion at the particular site, but is typically once every 1-5 years.[6]
Design Life	To increase erosion and flooding protection, nourished beaches are frequently built higher and wider than would occur naturally.[11] Grain size (e.g. sand, gravel, cobble) drives appropriate design slopes; gentler slopes generally perform better than steep areas. However, coarser grain sizes allow for steeper project slopes.
Ecological Services Provided	A nourishment beach can provide additional beach habitat area. Added sediment used for the nourishment can also provide a sand source for surrounding areas. The increased width and height of the beach berm can help attenuate wave energy.[10]
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	Beach nourishment sites subject to ice impacts are generally most successfully stabilized with gentler slopes (e.g., 6:1-10:1).[13] Presence of sensitive species may require design (e.g. slope, plant density) and timing adjustments.

Revere Beach, MA
Photo courtesy of MA CZM

Long Beach, Barnstable, MA
Photo courtesy of MA CZM

Beach Nourishment

Beach nourishment projects are appropriate for almost any tide range or grain size, and can be done independently, or in conjunction with a dune restoration project.

Misquamicut Beach, RI
Photo courtesy of Janet Freedman

Western Scarborough Beach, ME
Photo courtesy of Peter Slovinsky

Regulatory and Review Agencies

Maine	Municipal Shoreland Zoning, Municipal Floodplain, ME Dept. of Environmental Protection, ME Land Use Planning Commission, ME Coastal Program, ME Department of Marine Resources, ME Department of Inland Fisheries and Wildlife, ME Geological Survey, and ME Submerged Lands Program.
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 Dept. of Environmental Protection (Waterways and Water Quality), 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, and RI Dept. of Environmental Management.
Connecticut	Local Planning and Zoning Commission, and CT Department of Energy and Environmental Protection.
Federal (for all states)	U.S. Army Corps of Engineers, National Marine Fisheries Service, 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 high
EE Existing Environmental Resources	Coastal beach; subtidal
SR Nearby Sensitive Resources	Endangered and threatened species; shellfish. The added sand may result in shoaling of adjacent areas and increase turbidity during the placement of the sand, which can cause temporary adverse effects.[6] Nourishment can also bury native vegetation. Nourished sediment may also adversely affect nesting and foraging of shorebirds and other coastal animals, but can be avoided through a time of year restriction.[11]
TR Tidal Range	Low to high
EL Elevation	Above MHW to Below MLW. When designing beach berm elevations, consider increasing elevation above existing berm elevation.
IS Intertidal Slope	Flat to steep. Beach nourishment is most effective where a gently sloping shoreline is present, but it can also be appropriate for use on other slopes.
BS Bathymetric Slope	Flat to steep. However, areas with steep bathymetric slope may result in offshore transport carrying sediment past depth of closure. A steep bathymetric slope will also produce larger waves.
ER Erosion	Low to high. The erosion rate at the site is one of the most important elements when designing a beach nourishment project; if the rate is high then beach nourishment may not be appropriate.[6]
Other Characteristics	**Detail**
Grain Size	It is important to utilize sediment with a grain size, shape and color compatible to the site.[5] The percentage of sand-, gravel-, and cobble-sized sediment should match, or be slightly coarser than, the existing sediments.[1] The shape of the material is also important, especially for larger sediment, and should be rounded rather than angular.[1]
Impairment Level	Consideration should be given to invasive species, level of existing armoring, and extent of public use. Beach nourishment projects are more successful is they are located where there are already existing beaches. The longer and more contiguous the project is, the more resilient the project will be.
Surrounding Land Use	Beach nourishment is best suited where natural beaches have existed at a site and where there is a natural source of sand to help sustain the beach.[6] Beach nourishment is also suitable to help restore sediment supply to a sediment-starved system. Not generally well-suited for application to most major urban centers or areas with large port and harbor facilities because of the space requirements and the level of risk reduction desired. [10] Existing structures on site, like seawalls, may force beach nourishment projects to have a steeper slope than desirable. Steeper slopes leave little opportunity for wave energy dissipation.[13]