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North Carolina Highway 24



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

by US Army Engineer Research and Development Center



Swansboro, North Carolina, United States

Reducing wave energy for salt marsh and highway infrastructure

protection. The North Carolina Highway 24 (NC 24) causeway island lies in the Town of Swansboro, North Carolina, within the White Oak River and the Bogue Sound and in eyesight of Bogue Inlet and the Atlantic Ocean. This location, between several waterways, places it in a vulnerable spot, subject to hydrodynamic forces and erosion. The causeway island has been susceptible to wave erosion from extreme storm events and has suffered damage on numerous occasions, most recently during Hurricane Florence in 2018. The NC 24 corridor is also a vital route for hurricane evacuation and acts as a connector between North Carolina's Crystal Coast communities and the local military installations at Camp Lejeune and Cherry Point. Instead of continuing to repair using traditional methods, like armoring the embankment with rock, the North Carolina Department of Transportation (NCDOT) looked to nature-based solutions. NCDOT constructed approximately 260 meters of living shoreline, consisting of granite rock and oyster reef structures and a 0.1-hectare salt marsh. The living shoreline reduces the wave energy impacting the causeway,

increasing resiliency while also providing environmental uplift through habitat creation and water-quality improvement. This living shoreline project is the first to be completed by NCDOT, serving as a model for future living shoreline projects along the highways of coastal North Carolina.

Article Cover: Aerial view of the living shoreline at the end of construction, looking toward the west into the Town of Swansboro, North Carolina.
(Photo by NCDOT)

Producing Efficiencies

The NC 24 causeway's location is faced with numerous hydrodynamic forces from riverine flows, tidal cycles, storm surge, and wind-blown waves. To make this project successful, all of these forces were considered. The project team collected topographic and bathymetric surveys and current flow data to complete surge and wave analysis, sediment transport, and hydraulic modeling. Although the overall cost for design and construction of this living shoreline is likely similar to a traditional seawall, due to the location and a number of other factors, the anticipated long-term maintenance costs will be much less.



Erosion around the bridge end bent and under the sidewalk from Hurricane Florence and other extreme storm events.

(Photo by SWCA Environmental Consultants)

Using Natural Processes

The rock sills and oyster structures offer a stable structural element to reduce wave energy. The oyster structures, made of jute cloth hardened with cement, provide a rough surface that quickly recruits oyster spat and supports oyster growth, creating a natural oyster reef. Theoretically, the growth of the oyster reef may be able to keep up with sea level rise over time, continuing to provide wave-reduction benefits. The smooth cordgrass (*Sporobolus alterniflorus*) marsh plantings further reduce the wave energy, allowing sediments to accrete and building the marsh up along with sea level rise as well.



Installation of Oyster Catcher tables, a jute fiber and cementitious material matrix that has high oyster spat recruitment, thereby allowing for the creation of a new oyster reef.

(Photo by SWCA Environmental Consultants)

Broadening Benefits

The Crystal Coast is a tourism hot spot, with the NC 24 causeway a gateway into the Town of Swansboro, which attracts fishers, boaters, kayakers, beachgoers, and other water-related recreational users. The living shoreline provides a more aesthetically pleasing, environmentally friendly area that blends into the natural beauty of the marshlands and sandbars within the river and sound and also an economic uplift for all of these groups. The combination of tidal salt marsh, deep and shallow water, rock, and oyster structure sills creates a habitat where small crustaceans can thrive and attract larger fish species. The oyster reef will also improve water quality in the area through the oyster's ability to naturally filter water.



Relocating shellfish, oysters, and clams from the project site to neighboring marsh prior to construction.

(Photo by North Carolina Coastal Federation)

Promoting Collaboration

Using National Fish and Wildlife Foundation grant funding, NCDOT partnered with the North Carolina Coastal Federation and multiple consultants, including SWCA Environmental Consultants, Moffatt & Nichol, and RK&K, for the design, data collection, modeling, and monitoring. The project team collaborated with the U.S. Army Corps of Engineers, the North Carolina Division of Coastal Management, and the Division of Marine Fisheries to produce a design that met the needs of NCDOT while providing environmental uplift with minimal impacts. The design was then constructed by the T. A. Loving Company, Native Shoreline, and Sandbar Oyster Company.



Wave energy being dissipated as the tide comes in and begins to inundate the newly planted marsh grasses.

(Photo by NCDOT)



The saved, existing salt marsh and new granite rock sill. They represent what the entire site will resemble once new marsh grasses mature.

(Photo by NCDOT)



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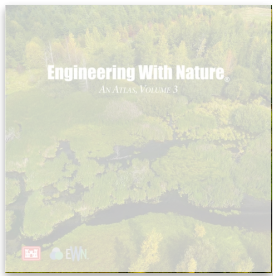


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