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Designing Living Shorelines for New England Coasts

TRAINING TYPE

Peer-to-Peer Case Studies

CONTACT

Seth Wilkinson

SCALE

Three neighboring properties at site scale

LOCATION

Orleans, Massachusetts

We'd love to hear from you.

The Takeaway: Discover how a sturdier living shoreline is created when plans include rigorous site analysis, teamwork between ecologist and engineer, and winter storm-resistant materials and design.

Overview

New England conditions create special challenges for coastal property owners in the Cape Cod and islands region, with shorelines threatened by erosion, flooding, varying tidal ranges, winter ice, sea level rise, and storms. In Orleans, Massachusetts, one property owner asked a local ecologist to design a living shoreline sturdy enough to protect a steep bank and sand-cobble beach from these threats. A sturdier living shoreline was built with the aid of rigorous site analysis, an ecologist-engineer design team, winter-storm-resistant design, and effective communication with the regulatory board. As a result of this project, the property owner was able to slow the erosion of a 30-foot bank, protect property and coastal structures, and preserve the seasonally sandy beach.

“It is our business model to always involve an engineering firm on our team when designing a shoreline management project.”



**Seth
Wilkinson**

President and
Restoration
Ecologist

Wilkinson
Ecological
Design

Lessons Learned

- **For best results, use an ecologist-engineer team.** Ecologists should work with an engineering firm to develop a survey and site plan and collaborate on design details and the review process. The collaboration benefits projects confronting extreme New England conditions such as large tidal ranges, winter ice, fierce nor'easters, and wakes from seasonal boating, which all contribute to erosion.
- **Start with a rigorous site analysis.** The analysis should include assessing physical forces, slope, water levels, wave heights, and other site characteristics.
- **Seek out anecdotes to augment scientific information and data.** Don't just rely on historical storm elevations and “one percent” storm elevation from the Federal Emergency Management Agency. People who have watched the local shoreline for years or decades know its condition and challenges in a way that must be captured.
- **Figure in higher Mean High Water and an increased tidal range.** Accounting for these elements can increase the project's design life—particularly when working with salt marsh.
- **Before starting the permitting process, assess the regulatory board's knowledge of living shorelines.** Some boards have no experience in this area. Educate them on living shoreline benefits, success stories, techniques, and materials. Board members often show special interest in the wildlife habitat benefits—communicate those benefits, too.

- Seth Wilkinson, President and Restoration Ecologist, Wilkinson Ecological Design

The Process

New England's severe winter storms cause erosion that can devastate coastal properties. Winter storm Juno on January 28, 2015, was no different, battering the region with heavy snow, coastal flooding, and tropical-storm-force winds. For one property owner in Orleans, Massachusetts, Juno demolished an erosion-control structure of plantings and bank nourishment. Every cubic yard of sand previously brought in was washed away, and a steep bank was scoured out again and again by Juno and subsequent storms. It was time for a more robust shoreline management approach.

The property owner moved ahead with Massachusetts' strict regulations in mind. In decades past, engineered seawalls or revetments were used to protect eroding shorelines. Now, in most cases, the state requires softer erosion-management methods such as vegetation that buffers wave energy, maintains natural sediment movement, and is more attractive than engineered structures.

Noticing that some neighboring properties experienced no erosion from Juno, the owner learned that coconut fiber rolls and pillows (also known as coir products) had been used to control erosion. When properly selected and laid down, these materials dramatically slow water velocity at the base of slopes, shorelines, and stream banks. Seth Wilkinson, the project manager and president of Wilkinson Ecological Design, learned that this owner's property was a good candidate for the same method because of its stable base elevation, fringe marsh, and offshore sandbar.

Designing Living Shorelines for New England Conditions

In the past, shoreline management projects were either designed by ecologists without the aid of engineers, or by engineers who might bring ecologists in at the end to put some green in the project.

By contrast, Wilkinson works with an engineering firm to develop a survey and site plan and collaborate on design details and the review process. The collaboration benefits projects confronting extreme New England conditions such as large tidal ranges, winter ice, fierce nor'easters, and wakes from seasonal boating, which all contribute to erosion.

A related NOAA project that interviewed living shoreline practitioners in New England backs up this approach. "As projects are installed farther north, they become more difficult," says Andrew Rella of the Stevens Institute. "This is why we need both engineering and science: to create well-designed projects that perform functions."

For this project, a rigorous site analysis to assess physical forces, slope, water levels, wave heights, and other site characteristics was essential. As a lifetime resident of the Cape Cod region, Wilkinson also considers anecdotes an essential aspect of gathering information on both past and present conditions.

During the winter, tidal ice flows enter salt marsh and the ice often bonds to the marsh, picking up sediment and moving it while also pulling out the upper level of peat. This can cause severe damage to anchored plantings and coir products that control erosion. Small boulders and rocks can be placed in the area for protection, but that adds to the permitting hurdles.

For durability, Wilkinson incorporates a higher mean high water base elevation figure into this kind of project. Doing so increases sturdiness against both present and future conditions.

Wilkinson's design reinforced the toe of the steep slope with coconut fiber rolls and pre-vegetated coir pillows, which will help him gather data about which species are best and the feasibility of future fringing salt marsh options. Diverse planting will enhance the wildlife habitat function.

More robust alternatives are being used to secure bioengineering measures, given the increased frequency and intensity of coastal storms. "Some people say you cannot use fiber rolls in high-velocity zones, but I have

installed miles of successful fiber roll arrays in high-velocity zones. However, if you do not pay attention to details you will find out in the first storm that your rolls have failed,” says Wilkinson. “It is important to understand that not all coconut fiber rolls are created equal. Part of my job is to constantly educate people about this.”

Tools Used

Detailed design guidance is hard to come by. Wilkinson has developed his own detailed design criteria to help streamline the design process according to site conditions. The Federal Emergency Management Agency’s Federal Insurance Rate Maps are a resource for determining whether a site is in the velocity zone or would experience still water flooding. A property in the velocity zone signals the need for a more robust design.

Outcome

As a result of this project, property owners were able to slow the erosion of a 30-foot bank, protect property and coastal structures, and preserve their seasonally sandy beach. Plant coverage has increased by 80 percent, and the property owners value the added wildlife habitat the plants provide. This project is a model for another living shorelines installation in the same estuary. Beyond the site-specific outcomes, Wilkinson is contributing to the local knowledge of living shorelines in Cape Cod because his projects provide performance data for fiber rolls in various energy and sediment environments. His use of the marsh pillows provides a local understanding of current water levels and impacts of sea level rise.

Next Steps

Coastal property owners that invest in annual maintenance see less impact on their shoreline from major storm events. In Cape Cod from May to September, planting maintenance includes removing invasive species and ensuring native plants are thriving. Ongoing beach profile monitoring, including after substantial storms, assesses the performance of the design.

Contributing Partners

Wilkinson Ecological Design

More Details

Tools Used



- FEMA Federal Insurance Rate Maps (<https://msc.fema.gov/portal>)
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Funding



- The Northeast Regional Ocean Council (NROC) received funds through NOAA's Regional Coastal Resilience Grants Competition to facilitate the adoption of living shorelines policies across the region. The grant provides an opportunity to bring coastal ecologists and engineers together to consider best practices.
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To Learn More



- StormSmart Properties Fact Sheet #4: Bioengineering – Coir rolls on coastal banks (<https://www.mass.gov/service-details/stormsmart-properties-fact-sheet-4-bioengineering-coir-rolls-on-coastal-banks>)
- Wilkinson Ecological Design (<https://www.wilkinseecological.com>)
- Northeast Regional Ocean Council Living Shorelines Resources (<https://www.northeastoceancouncil.org/committees/coastal-hazards-resilience/resilient-shorelines/>)