

Final Project Recommendations for:

Ventnor City, Atlantic County

Prepared by Thomas Flynn, Coastal Resilience Coordinator

The Nature Conservancy in New Jersey

Thomas.Flynn@tnc.org

March, 2016

This project report is a summary of the information provided by utilizing the Restoration Explorer and is a complimentary planning component during the initial steps of developing a living shoreline project with coastal communities in NJ. The Restoration Explorer is a first-level screening tool. Therefore, the report is intended to help municipal decision-makers lay the groundwork toward planning a successful project by providing key information necessary to move forward with living shoreline projects. Once a project has been identified, the information in this report can be used in consultation with engineers and ecologists during the initial planning stages of implementing the project.

Please be aware that living shoreline techniques suggested by the Restoration Explorer will require Federal, State, and local regulatory approvals. The Nature Conservancy and its partners make no representation that potential projects will gain all required Federal, State or local approvals. Before engaging in design work, please contact Steve Jacobus at New Jersey's [Coastal Land Use Office](#) and local building officials for more specific information and guidance about the permits or other approvals which may be needed.

For additional information on key next steps for implementing living shorelines projects, please refer to [NOAA's: "Guidance for Considering Living Shorelines 2015"](#) which describes 12 guiding questions and answers for communities that can be used to determine the best approach to stabilize the shoreline and sustain coastal connections between land and water. In addition, for more information on the design process and engineering requirements for living shorelines, refer to [Stevens Institute of Technology \(SIT\): Guidelines to Living Shorelines](#).

Municipal Shoreline Summary

The coast of Ventnor City, NJ is heavily populated by marsh shoreline. Nearly 66% of the 15.4 miles of coastline is marsh habitat. The remaining shoreline is beach, upland or bulkheads. Across the township, approximately 23% of the coastline has been experiencing moderate to high rates of erosion. More information on the miles of shoreline that are suitable for different living shoreline techniques can be found within the Restoration Explorer. It can also be found via the Municipal Summary provided by the Restoration Explorer, and attached to this report.

Project Location – Ventnor West

The entire project area encompasses approximately 800 - 900 feet of coast. It will be oriented along the marsh shoreline between Ventnor West and Shelter Island (Figures 1, 2, & 3).

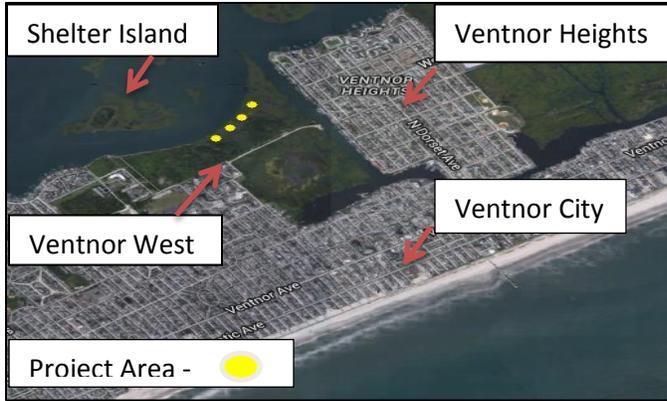


Figure 1. Citywide view of project location.

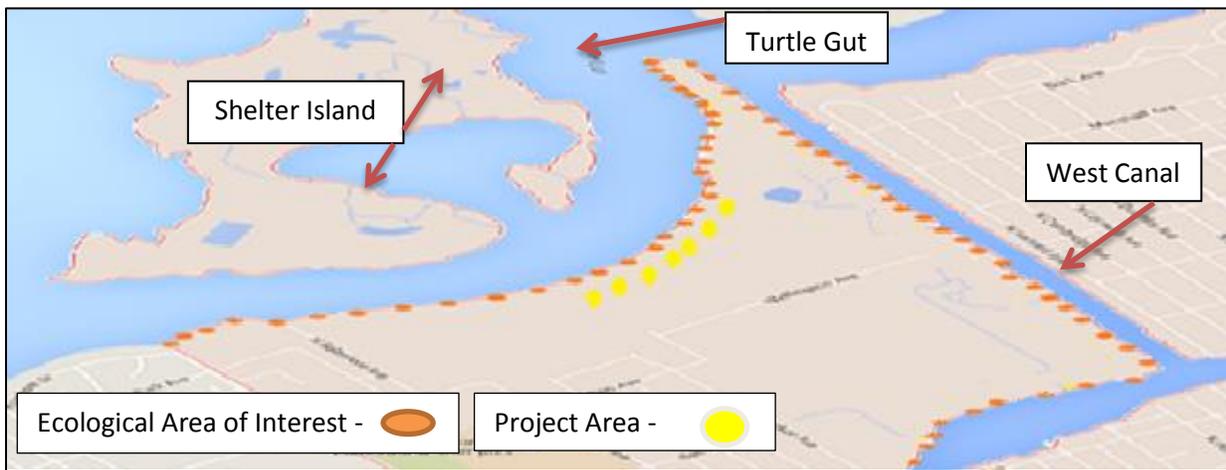


Figure 2. [Street Map](#)

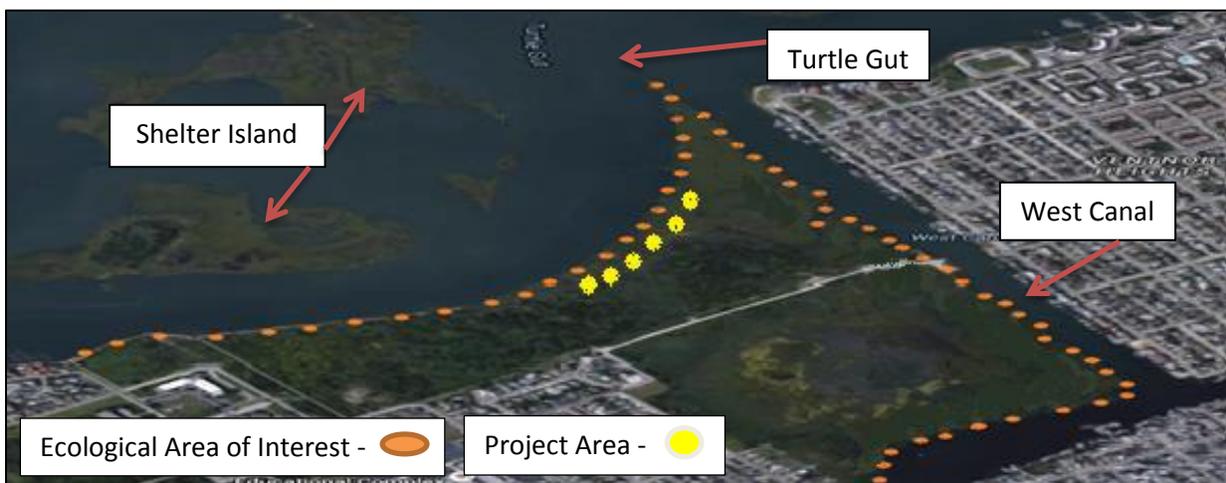


Figure 3. [3-D Aerial View](#)

Project Goals:

- Absorb wave energy and reduce shoreline erosion
- Enhance tidal marsh vegetative regrowth
- Increase aquatic and upland habitat benefits
- Encourage ecotourism and recreational opportunities

Project Summary

The project seeks to use a living shoreline in order to stabilize the community's coastline and maintain upland and aquatic habitat benefits along Ventnor West. In addition, the larger proposed ecological area of interest will provide open space enjoyment for residents and promote eco-tourism. A living shoreline project that would seek to address erosion of the coastline at Ventnor West would need to consider the overall ecological plan for protecting and preserving the area. The ecological area of interest (see Figures 1, 2, & 3) is being considered for open space preservation and protected as a wildlife sanctuary. Wildlife lookouts and established boardwalk platforms have been discussed as potential ways for local residents and tourists to enjoy birding, fishing, kayaking, and nature-walks. These circumstances lend to the consideration of implementing a living shoreline technique that incorporates natural native vegetation, such as Smooth Cordgrass (*Spartina alterniflora*) and biodegradable organic materials (Coir Fiber Logs) in order to create pleasing aesthetics and enhanced habitat view-sheds through resiliency tactics. The recommendation presented below highlights a manner by which the shoreline can be stabilized using a restoration technique primarily focused on the use of nature-based living shorelines.

Shoreline Condition

Along the shoreline of the proposed project area the Restoration Explorer shows that erosion rates are between 1ft.-3ft./year (Figure 4). Due to the average rate at which the shoreline is eroding, and the intent to utilize the ecological area of interest as a wildlife sanctuary, biodegradable components such as coir material and natural vegetation are included as recommended bank stabilization techniques for this proposed living shoreline project.

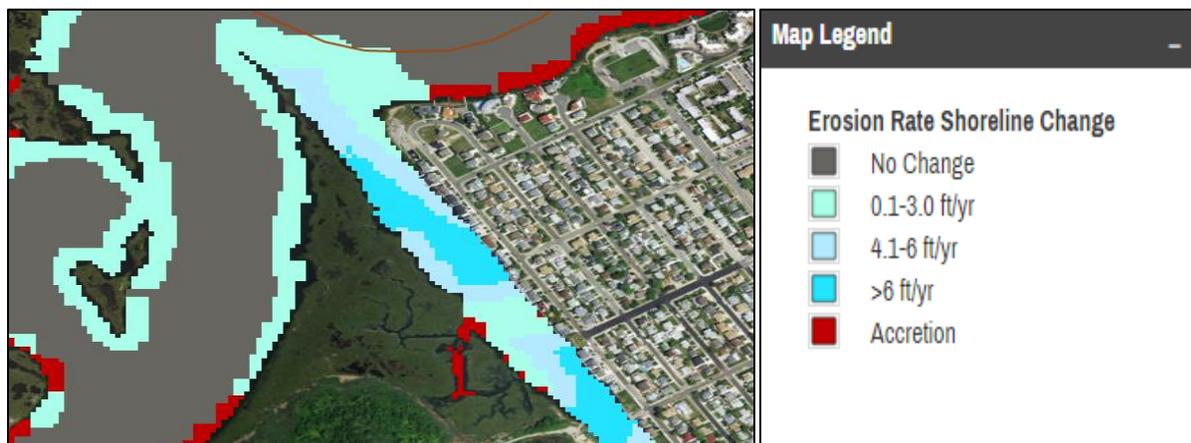


Figure 4. Average erosion rate of project sites (from 1977-2012).

Recommended Technique -- Nature-Based Living Shoreline (Figure 5). This technique is best in low-energy areas. “Biological enhancements” like biodegradable fiber logs (which also provide habitat for ribbed mussels) are placed along the tidal marsh edge to provide a contained area for sediment to accumulate and marsh vegetation to grow. A nature-based living shoreline is the most ‘natural’ solution recommended by the Restoration Explorer, and will provide communities with benefits associated with healthy coastal habitats, including wave attenuation, improved water quality, and increased habitat.

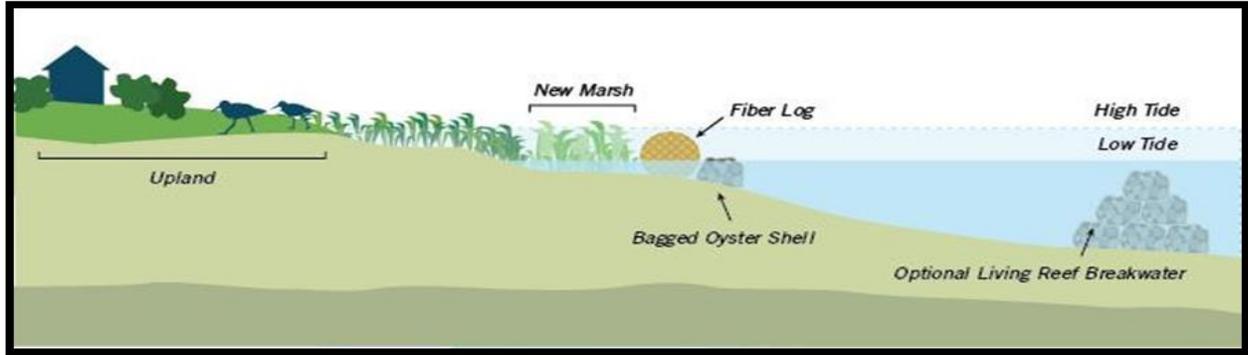


Figure 5. Graphic depiction of a nature-based living shoreline technique.

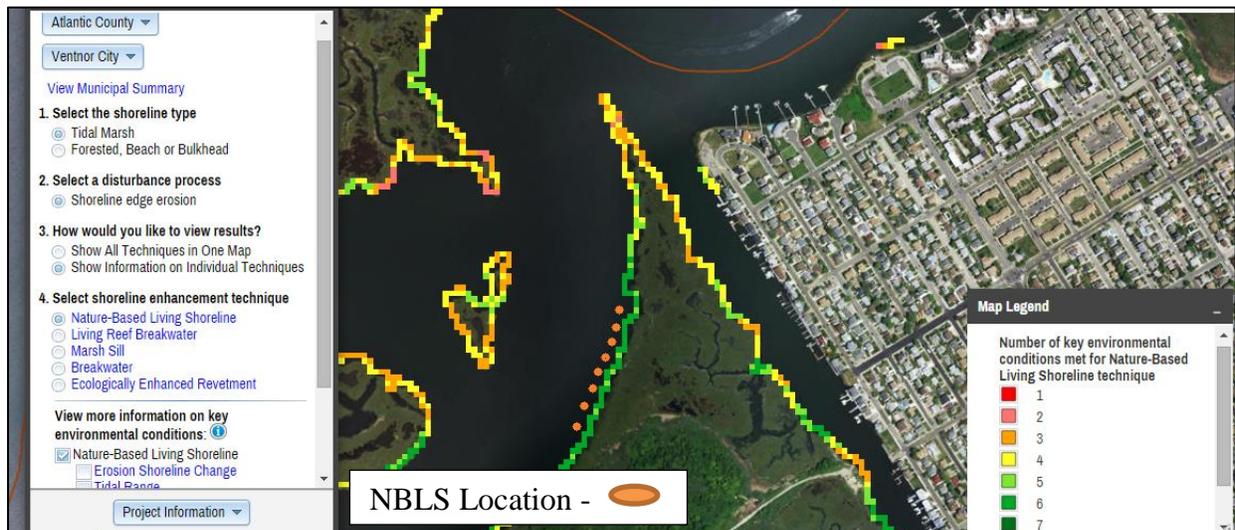


Figure 6. Restoration Explorer information on applicability of a nature-based living shoreline at proposed project location.

Nature-Based Living Shoreline Environmental Conditions

The implementation of a nature-based living shoreline along the selected project area meets key environmental conditions as outlined by the Restoration Explorer. A table describing the ways in which these considerations are met is included below.

Environmental Condition	Environmental Conditions met	Applicable Range for NBLs	Project location information
Erosion Shoreline Change	Yes	0ft. – 4ft./yr.	1ft. - 3ft./yr.
Tidal Range	No	0ft. – 4ft.	4.5ft.
Salinity	Yes	3 ppt. – 30 ppt.	29.5 ppt.
Wave Height	Depends on selected 10x10 meter square	<1ft.	0.8ft. - 1ft.
Ice Cover	Yes	Low - Moderate	None - Low
Shoreline Slope	Depends on selected 10x10 meter square	0 - 10%	2% - 20%
Nearshore Slope	Yes	0 - 10%	0 - 10%

Rationale for a Nature-Based Living Shoreline

This habitat enhancement technique will seek to improve bank stabilization and increase sediment accretion helping to reduce erosion. Moreover, this technique will help to enhance marsh shoreline habitat and upland revegetation by providing a sheltered environment for regrowth. Additionally, organic material and bivalves can accrue along the shell bags or stone containment used for coir log stabilization. As a result native fish populations use these areas as nursery environments, and native birds can be found utilizing the restoration area as a resource. Thus, reestablishing a stronger more resilient coastline along the project area will help to support habitat persevere through coastal hazards and sea level rise while providing enhanced viewsapes.

Various small segmented areas (10x10 meter areas) of the approximately 800 - 900 ft. of coast that are most suitable for a nature-based living shoreline have a shoreline slope, tidal range, and /or wave height that fall outside the most applicable range for the implementation of this technique. However, exceeding these thresholds does not negate the applicability or effectiveness of this restoration technique throughout most of the area, but addressing these concerns with an engineer is highly recommended in order for the project to function effectively. It's also important to consider that because this technique is constructed near the shoreline, and visible at low tide, it should not impede upon the navigable waterways between Ventnor West and Shelter Island.

Municipal Planning

Incorporating living shoreline projects into municipal plans can help to facilitate project implementation by opening up funding opportunities and/or providing a community with the ability to budget for a future project. Updates and revisions to municipal coastal resilience measures, such as shoreline restoration and enhancement strategies, are becoming more easily adapted into local planning efforts. For example, the New Jersey Municipal Land Use Law (MLUL) requires each municipality in the State to review and update its local master plan regularly. This affords an opportunity to include shoreline restoration and enhancement strategies not only in Ventnor's master plan but also in municipal floodplain management and hazard mitigation plans. Inclusion of living shoreline strategies into different municipal plans can also

benefit Ventnor’s ability to budget and apply for State and Federal funding opportunities including, but not limited to, opportunities from the Federal Emergency Management Agency’s (FEMA) Hazard Mitigation Assistance, Pre-Disaster Mitigation, and Flood Mitigation Assistance programs. Communities that participate in FEMA’s National Flood Insurance Program’s Community Rating System can also receive discounted flood insurance premium rates to reward community actions.

Recommendations for additional data collection

Additional data should always be collected to ensure that the Restoration Explorer’s results are accurate. As part of the design process, engineers and ecologists will verify the conditions at the project site and provide site-specific design recommendations. Given the results of the Restoration Explorer, project engineers and ecologists should verify the tidal range, slope of the shoreline and wave energy at the site, among other key design criteria.

Initial Costs & Considerations

The data included in the table below is based on relative costs associated with only the raw cost of materials of living shorelines (adapted from [Seachange Consulting, \(2011\)](#) and [Rella, A., & Miller, Ph.D., J. \(2012\)](#)). The following factors should be additionally analyzed based on accessibility to materials and local cost rates including: labor, shipping, size of the project, vegetation for replanting, accessibility to bagged shell, stone/concrete work and procurement. Annual or bi-annual maintenance might include (but is not limited to) the removal of debris and possible repositioning of structural project components. Please consult engineering and design firms for more accurate estimates.

Total ESTIMATED Cost	Estimated Cost of structural material	Benefits Of Technique	Additional factors to consider
<i>Nature-Based Living Shoreline</i>	Biolog - Coir Log (coconut fiber) 12” X 10’ - \$100-\$150 per log	<ul style="list-style-type: none"> *Attenuate wave energy and reduce shoreline edge erosion. *Enhances Water Quality *Marsh Protection-Carbon Storage *Promotes Biodiversity *Ecotourism *Promote shellfish ecology 	This is the most natural shoreline restoration option but it is only applicable in low energy areas. Factors to consider include labor, shipping, size of the project, accessibility to bagged shell, and the procurement of a biolog. In addition, the state of New Jersey does not currently allow oysters to be “planted” in waters closed to shellfish harvest. However, the project design can include ribbed mussels to help stabilize the new marsh edge.

<p><u>Bulkhead Non-nature based</u></p>	<p>Ranging between Approx. \$80- \$1,200 per/ft. Average - \$640.00 per/ft.</p>	<p>*Provides protection from high energy waves.</p>	<p>Bulkheads are the traditional, “hard armoring” approach. Wave energy is reflected not absorbed; this has the possibility of resulting in bottom scour and loss of vegetation. Natural shoreline is eliminated resulting in a loss of upland and shallow water habitat.</p>
--	---	---	---

Potential Funding Sources

Although project funding can't be guaranteed, resources are available for communities to explore. An initial list of potential grant opportunities is provided below. Additional information can be found by following the hyperlink for each program.

- [NOAA Regional Coastal Resilience Grants Program](#) - The NOAA Regional Coastal Resilience Grants Program is centered on helping communities increase preparedness and improve coastal resiliency measures. This program is applicable to nonprofit organizations, institutions of higher education, regional organizations, private (for profit) entities, and local, State, and tribal governments organizations that work toward resiliency strategies for land and ocean use, disaster preparedness, environmental restoration, and hazard mitigation projects benefiting coastal communities in one or more of the 35 U.S. coastal States or territories. In addition, awards range from \$500,000 to \$1 million for projects lasting up to 36 months.
- [The Department of the Interior Fish and Wildlife Service, Coastal Program](#) – The Department of the Interior Fish and Wildlife Service, Coastal Program utilizes the tax revenue from hunting, boating, and fishing in order to reinvest in conservation and coastal wetland ecosystems. A primary goal of the program is centered on seeking to help mitigate flooding and increase water quality. Most recently this program has helped to provide \$21 million dollars in grant funding in order to help improve more than 11,000 acres.
- [U.S. Environmental Protection Agency \(EPA\) Urban Waters Small Grants Program](#) – The U.S. EPA funding opportunity addresses urban runoff pollution to best serve community health benefits, with emphasis on underserved communities with award amounts of up to \$60,000. The proposed project must take place entirely within one of the [Eligible Geographic Areas](#). This program helps to influence how healthy and accessible urban waters can help to grow local businesses and enhance educational, recreational, and social and employment opportunities.
- [New Jersey State Department of Environmental Protection \(NJDEP\) - Shore Protection Grants and Loans program](#) - In an effort to protect existing development from sea-level rise, this NJDEP funding opportunity offers a cost share program whereby 25% of the cost is municipally funded & 75% of the cost is State funded. Loans are available from the

State for the 25% of the cost owed by the municipality. For additional questions regarding qualification for this program contact the [NJDEP-Office of Engineering and Construction](#),

- [The New Jersey Corporate Wetlands Restoration Project](#) -The New Jersey Corporate Wetlands Restoration Project is a public-private partnership that works to help fund a multitude of restoration work including living shorelines. The project must be located in New Jersey, have a Federal partner, and meet a request for funding generally below \$25,000.00. Each project will need to include the submittal of the NJCWRP Project Executive Summary Sheet and include a project location map. For examples and templates of submittal forms [click here](#).
- [Environmental Solutions for Communities Initiative](#) - Wells Fargo and NFWF are providing grants ranging from \$25,000 to \$100,000 to localities for sustainability projects. Wells Fargo and NFWF are supporting engagement with at least 4-8 neighborhoods with the goal of helping these communities become more sustainable through conserving critical land and water resources, improving local water quality, and restoring and managing natural habitat, species, and ecosystems.

Project Permitting

All living shoreline projects in New Jersey are subject to state and federal permitting requirements. It's recommended to consult with relevant permitting agencies early in your planning process (prior to the completion of formal designs) to ensure that the potential project can be permitted. Should there be any issues with conceptual designs, representatives from the state and federal agencies can provide recommended changes to the project design to help ensure a smooth permitting process.

State Permitting Requirements: [N.J.A.C. 7:7 Coastal Zone Management Rules](#). This regulation enables living shoreline projects to be implemented under the State of New Jersey Department of Environmental Protection Division of Land Use Regulation. Lawfully this provision is recognized as Coastal General Permit 24 (N.J.A.C. 7:7-6.24.) With questions or concerns regarding regulations and permitting contact the NJDEP [Coastal Land Use Office](#).

Federal Army Corps of Engineers (USACE) Permit: Depending on the goals and design of a living shoreline project, it will need either a "nationwide" or "individual" permit before construction can begin. [Nationwide Permit 13 \(NWP-13\)](#) is centered on shoreline bank stabilization. A Pre-Application Meeting Request Form is required to be completed *before* the NWP-13 application. In addition, the Individual Permit Application Submittal Form is a complementary procedure and only should be completed if Nationwide Permit is not applicable for a specific project. For more information on the different permits and necessary forms, visit the [USACE webpage](#).

NJ Bureau of Tidelands Licensing Requirements: The State of New Jersey has ownership of Tidelands public lands. Tidelands are considered to be land currently and previously flowed by the mean high tide of a natural waterway. Written permission from the State and a fee are required in order to use these lands. A [Tidelands license or lease](#) is required for submerged structures that are constructed off shore, and are situated

anywhere from the tidelines line landward (i.e. Breakwaters, Living Reef Breakwaters).

Additional Considerations

- Additional factors are discussed in the [Stevens Institute of Technology \(SIT\): Guidelines to Living Shorelines](#).
- Consider the feasibility of public access in relation to developing a project with a goal of enhancing economic development.
- Impacts to adjacent properties should be considered when identifying living shoreline project areas. Shifts in wave energy and bottom scour can result in negative unforeseen consequences to neighboring locations if not examined properly.
- Careful attention should be placed on the nature and quality of fill during project construction in order to ensure that restoration occurs utilizing the most ecologically conducive material.
- Project planners should engage State officials early in preparatory project stages when considering to plant and/or seed commercial shellfish species.
- All living shoreline projects also require a letter of approval from the land owner or land manager. Make sure to discuss property boundaries and relevant local concerns with local municipal officials.

Next Steps

Local conservation organizations can be helpful advisors to municipalities that are interested in pursuing a living shoreline project. It's most useful to consult with local conservation groups and State permitting officials early in the planning process for a living shoreline project to ensure the highest likelihood of success: The Restoration Explorer provides information that informs the planning process. An effective planning process should include the steps below. These are not necessarily in order, but each is important to address at some point in your planning process.

- 1. Set project goals.** Goal setting should take priority in the planning process. Determine what the project seeks to achieve and note the existing environmental conditions (e.g., eroding shoreline, etc.) If shoreline stabilization is a goal of the project then design and monitoring should be centered on meeting that goal.
- 2. Determine a timeline.** Understanding time constraints for permitting and construction will heavily determine the factors for timing. Be sure to note all fixed dates for funding applications and consult with conservation groups about the best time of year to start a project to avoid disrupting migratory birds and fish.
- 3. Identify project partners.** Project partners can assist with design, implementation and maintenance of the site. This can include conservation groups as well as community organizations.
- 4. Determine permitting requirements.** Consult with municipal and State officials in order to best assess how project recommendations can be implemented and permitting requirements fulfilled. It is highly recommended to work with the NJDEP [Coastal Land Use Office](#) and the [U.S. Army Corps of Engineers](#) during the early planning stages of the project, while applying for permits, and through the on-the-ground implementation stages of the of the project.

- 5. Develop your project budget and potential funding sources.** Establishing a project budget will determine the size of your project. Contact funding sources and determine the most applicable possibilities, as well as timelines for proposal submission, etc.
- 6. Determine site conditions and develop project design.** Work with engineers and marine contractors to develop specific project designs. The RE data should only be used as a screening tool. Collecting site specific information is critical to engineering and design.
- 7. Develop a monitoring plan.** Conduct baseline monitoring to document the current conditions of the proposed project site. More information on project monitoring can be found (starting in March 2016) on the Conservancy's [Coastal Resilience website](#).
- 8. Plans for project construction.** Contact marine contractors to determine a construction schedule, access to materials, and pricing. Also, conduct site visits during preparation stages to monitor conditions and establish an on-the-ground layout of the project using GPS coordinates and visual markers. In preparation for the installation of the project, work with local conservation organizations to best coordinate volunteers, the construction schedule, preliminary site work, tools, access to the site, and to galvanize media attention.

Living Shoreline Snapshot

Ventnor City, Atlantic County

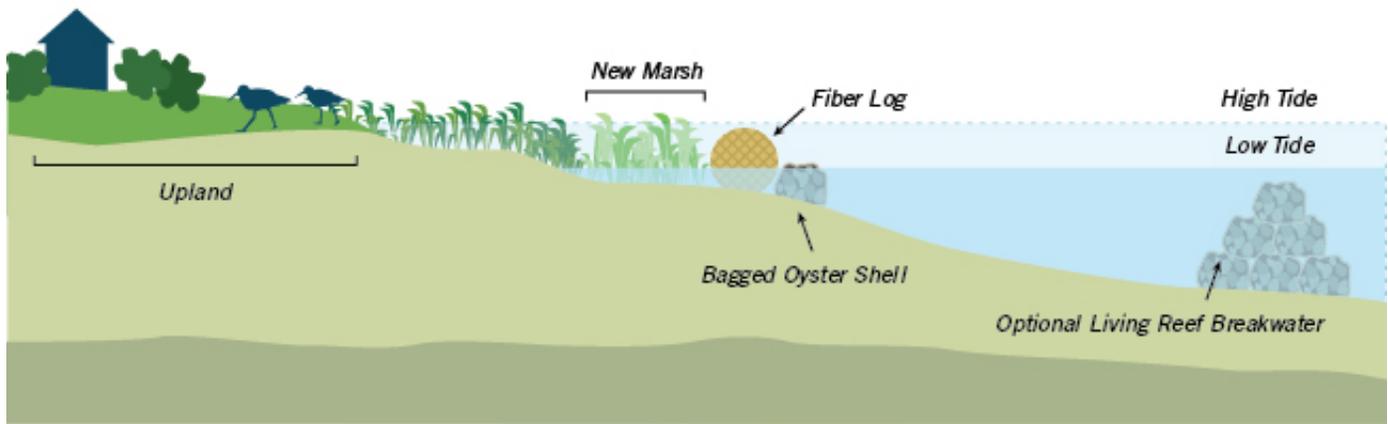
What is a living shoreline?

A living shoreline is a nature-based alternative to bulkheads to address coastal erosion by providing for the protection, restoration or enhancement of these habitats. As indicated by NJDEP, this is accomplished through the strategic placement of plants, stone, sand, or other structural and organic materials. **Natural living shorelines** include natural vegetation, submerged aquatic vegetation, fill, and biodegradable organic materials (see graphic below). **Hybrid living shorelines** incorporate natural vegetation, submerged aquatic vegetation, fill, biodegradable organic materials, and low-profile rock structures such as segmented sills, stone containment, and living breakwaters seeded with native shellfish. **Structural living shorelines** include, but are not limited to, revetments, breakwaters, and groins. Additional information on different types of living shorelines can be found on the NJDEP [webpage \(PDF\)](http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf). (<http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf>)

DISCLAIMER: Living shoreline projects have a variety of ecological and engineering requirements and can often be mixed and match to tailor projects designs to local conditions. It is important to consult with ecologists and engineers to determine the specific design requirements for any proposed project. It is also important to consult with federal, state and local officials regarding permitting requirements. Resources are listed below.

Nature-Based Living Shoreline

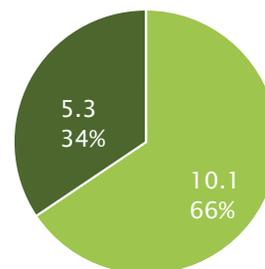
Nature-based living shorelines are best in low-energy areas. "Biological enhancements," like biodegradable fiber logs (which also provide habitat for ribbed mussels) or Christmas trees, are placed along the tidal marsh edge to provide a contained area for sediment to accumulate and marsh vegetation to grow. In more moderate energy areas, it might be possible to use a hybrid approach that pairs nature-based living shorelines with living reef breakwaters.



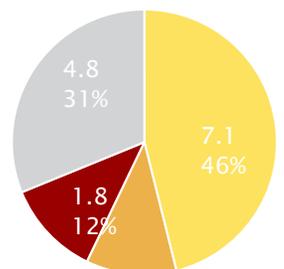
Coastal Shoreline Condition

Identifying how the shoreline is changing and how fast provides important background for a living shoreline project and can help to ensure a living shoreline project's success. Understanding existing shoreline environmental parameters helps to better conceptualize enhancement techniques that can be applied.

Shoreline Length (Miles)
Total: 15.4



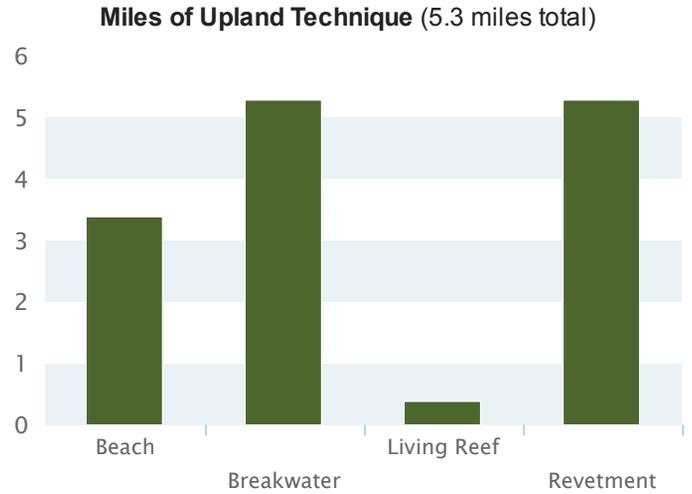
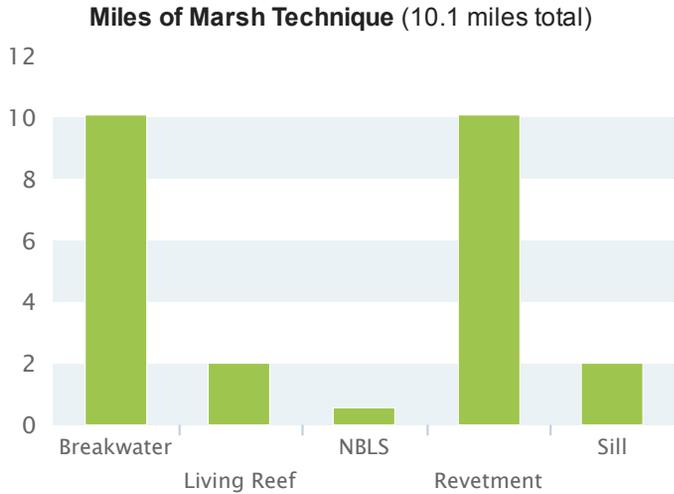
Erosion Rates (Miles)



■ Marsh ■ Upland ■ Low ■ Moderate
■ High ■ None/Accretion

Promoting The Most 'Natural' Solution

Determining which living shoreline techniques are applicable for a given area is based on ecological and engineering requirements. Each technique varies in both design and implementation. The graphs below highlight the applicability of each shoreline enhancement technique per the available miles of coastline. When suitable, the more 'natural' solutions will provide communities with the multiple benefits associated with healthy coastal habitats, including wave attenuation, improved water quality and increased habitat for important fish species. For instance, when applicable, the greatest environmental benefit is achieved through the implementation of a Nature-Based Living Shoreline instead of an Ecologically Enhanced Revetment. Click [here \(http://coastalresilience.org/\)](http://coastalresilience.org/) to learn more.

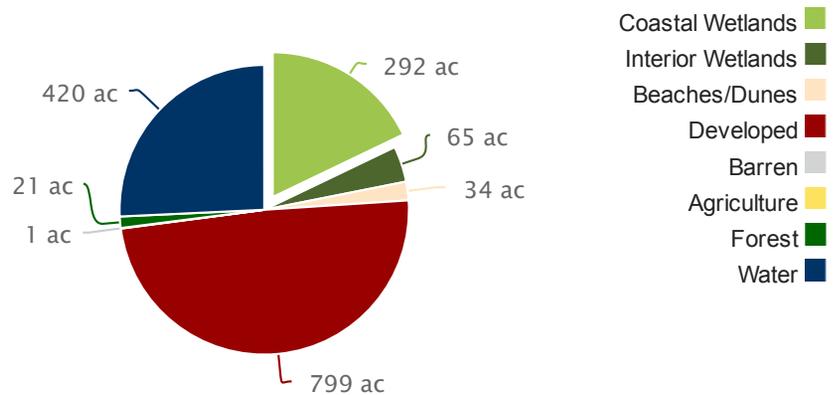


What Habitat Exists?

Coastal habitats provide important storm and flood buffering benefits as well as serve as critical wildlife habitat and public open space

While our tidal marshes have some protection from dredging, filling and development by New Jersey's pioneering Coastal Wetlands Protection law of 1970, some loss still occurs. Between 1986 and 2012, **37 acres** of tidal marsh have been lost in **Ventnor City** due to human development and/or natural processes.

Amount of Land Use/Land Cover (acres) Total: 1632 ac



Implementing Living Shoreline Projects

The Restoration Explorer is an on-line decision support tool designed to help community leaders during the initial steps of planning a living shoreline project. The Restoration Explorer helps users to identify nature-based coastal resilience techniques to stabilize New Jersey's shorelines. Community leaders can utilize the Restoration Explorer and other applications on the Coastal Resilience tool as a platform to discuss the ways in which local concerns can be addressed through the implementation of living shorelines.

However, please be aware that living shoreline techniques suggested by the Restoration Explorer may require Federal, State, and local regulatory approvals and The Nature Conservancy makes no representation that potential projects will gain all required Federal, State or local approvals. Before engaging in design work, please contact New Jersey's [Coastal Land Use Office \(http://www.nj.gov/dep/lum/lup.htm\)](http://www.nj.gov/dep/lum/lup.htm) and local building officials for more specific information and guidance about the permits or other approvals which may be needed.

Next Steps

Not all restoration techniques are applicable for every community. It is important to recognize that the success of a living shoreline project is contingent upon recognizing relevant ecological and engineering considerations, funding requirements, and municipal planning scenarios.

- 1. Contact local conservation groups and engage engineers.** Working closely with conservation organizations is a good way to ensure that all ecological considerations are well addressed. Conservation organizations can help to provide ecological expertise along with advice regarding permitting and construction ([Click here \(http://delawareestuary.org/living-shorelines\)](http://delawareestuary.org/living-shorelines) to view the Partnership for the Delaware Estuary's webpage about working with living shorelines). It is also important to consult with engineers to determine specific design requirements for living shoreline techniques recommended by the Restoration Explorer. [Click here \(PDF document\) \(http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf\)](http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf) to find out more about engineering requirements.
- 2. Identify potential funding sources.** State, Federal, or locally sourced funding depends upon the availability of grants and programs centered on coastal restoration and enhancement. Federal opportunities include: [NOAA Regional Coastal Resilience Grants Program \(http://coast.noaa.gov/resilience-grant/\)](http://coast.noaa.gov/resilience-grant/), and [Department of the Interior Fish and Wildlife Service - The Coastal Program \(http://www.fws.gov/coastal/CoastalGrants/\)](http://www.fws.gov/coastal/CoastalGrants/), opportunities from the State of New Jersey include: [Shore Protection Grants and Loans – State of N.J. Department of Environmental Protection \(http://www.nj.gov/dep/grantandloanprograms/nhr_spql.htm\)](http://www.nj.gov/dep/grantandloanprograms/nhr_spql.htm).
- 3. Identify how to incorporate projects into existing municipal plans.** The Restoration Explorer is meant to work with existing municipal plans, and function as a guideline for preparing your own unique project(s). Living shoreline projects can be integrated into existing community plans by noting their ability to enhance natural habitats and strengthen shorelines. Integrating living shorelines into municipal plans offers a governmental means by which projects can be organized and implemented through carefully thought out policies relevant to a localized community.

Additional Resources

- **The Nature Conservancy (TNC) – New Jersey Chapter** (<http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newjersey/>) TNC resources can help planners better understand coastal ecological benefits associated with living shoreline projects.
- **American Littoral Society (AmLS)** (<http://www.littoralsociety.org/>) AmLS provides resources for project planners about habitat restoration and overall environmental health.
- **Barnegat Bay Partnership (BBP)** (<http://bbp.ocean.edu/pages/1.asp>) BBP can help planners better understand the ways in which community outreach can help projects gain support.
- **Partnership for the Delaware Estuary (PDE)** (<http://www.delawareestuary.org/>) PDE provides resources for planners centered on project implementation and scientific research.
- **Stevens Institute of Technology (SIT): Guidelines to Living Shorelines (PDF document)** (<http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf>) SIT can help planners to better understand the engineering parameters of living shoreline implementation.
- **Rutgers University Center for Remote Sensing and Spatial Analysis (Rutgers)** (<http://crssa.rutgers.edu/>) Rutgers CRSSA can be a useful resource to learn about geospatial information sciences and how mapping can be an effective tool for planning a project.
- **NJ Department of Environmental Protection (NJDEP)** (<http://www.nj.gov/dep/landuse/activity/livingshore.html>) NJDEP can assist planners in better understanding State regulations concerning living shoreline management and permitting.
- **National Oceanic & Atmospheric Administration (NOAA)** (<http://www.noaa.gov/>) NOAA resources can help planners better understand habitat zones and living shorelines treatments.

