



# LIVING SHORELINES

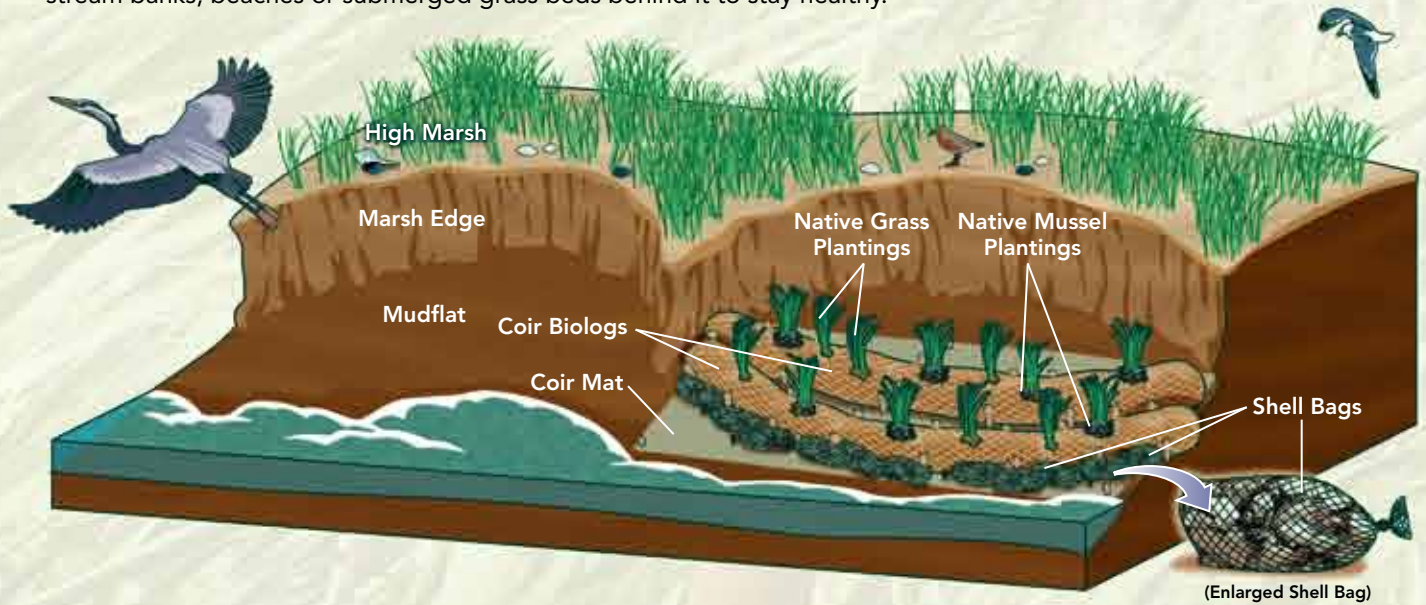
HEALTHY SHORES, HEALTHY COMMUNITIES



# WHAT IS A LIVING SHORELINE?

A “Living Shoreline” is a method of shoreline stabilization that protects the coast from erosion while also preserving or enhancing environmental conditions. For example, one method consists of planting native wetland plants with shellfish along the tidal water line. Shellfish, like mussels and oysters, help to clean up our water by filtering it as they feed. They also form dense stable reefs that dampen wave action and prevent erosion. Plantings are often paired with bioengineering materials, such as manmade coconut fiber logs, oyster shell, or other natural materials.

A diverse array of Living Shoreline tactics now exists, including combinations of these tactics that provide shoreline armoring in areas eroding quickly. There are other, fixed structures that can be used to stop erosion — like bulkheads or other retaining walls. However, these can further degrade habitat in the areas they are supposed to protect, and can even increase flooding downstream. A Living Shoreline encourages the natural shape of the coastline, and can help marshland, stream banks, beaches or submerged grass beds behind it to stay healthy.



# WHAT ARE THE BENEFITS OF LIVING SHORELINES?

Living Shorelines are a type of ‘soft’ infrastructure. ‘Soft’ refers to the idea that something can adapt to a changing environment, and does not mean that they are weak. Normally, soft infrastructure is made from natural materials, like plants or biodegradable elements. ‘Hard’ refers to something that is fixed, and does not move, bend, or change depending on the season, weather, or other conditions. Both ‘hard’ and ‘soft’ infrastructure have proven track records of reducing wave energy and protecting the coast. However, ‘hard’ infrastructure, like bulkheads and revetments, abruptly severs the ecological connection between the coast and the water. On the other hand, ‘soft’ infrastructure, like Living Shorelines can:

- Promote a higher abundance and diversity of organisms,
- Keep pace with sea level rise,
- Filter pollutants from the water,
- Maintain critical spawning and foraging areas for fish and wildlife,
- Allow for natural sand and soil movement,
- Reduce the potential for downstream erosion issues.

Protecting our coasts from erosion is progressively more important with sea level rise and more severe storminess. Losing coastal land means that homes and businesses are more exposed to flooding. It also means that we are losing wetlands. Wetlands are crucial to the health of the bay and all of the people and wildlife that depend on it. Wetlands filter pollutants, provide habitat for fish and wildlife, and help to absorb flood waters and storm surges, which prevents flooding in homes and businesses.

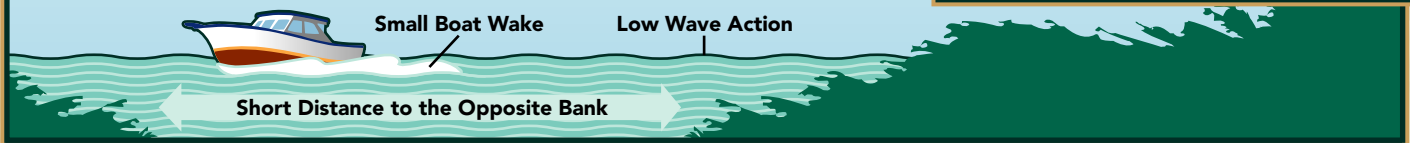
Unfortunately, we are losing coastal wetlands at a rapid pace. Wetlands can grow in height, and can survive a certain amount of sea level rise; however, if the water rises too quickly, wetlands drown. Living Shorelines help wetlands to keep pace with sea level rise while buffering them from waves from storms and boat wakes.

# EXAMPLES OF LIVING SHORELINES

Different types of Living Shorelines are appropriate for locations with different amounts of wave energy. A site's wave energy is determined by things like boat wakes, currents, distance to the opposite bank and typical wind speed at a location. Local plants and animals as well as the presence of fresh or salt water need to be taken into consideration when selecting the type or combination of Living Shoreline types for each site. Other local factors such as piers, pollution and need for access can also guide Living Shoreline design.

## LOW-ENERGY SITE:

**Shellfish and Plant Tactics.** Fiber logs (also known as coir logs or biologs) can trap mud and reduce wave action. They are useful to quickly stabilize an eroding bank while creating a thriving marsh plant community. Additionally, fiber logs and oyster shell bags can attract shellfish such as oysters and mussels. Logs can be planted with shellfish and native marsh grasses during installation, or attract native populations on their own. Establishing shellfish on the fiber logs will help bind plants and fiber logs together tightly, thereby quickly stabilizing trapped muds. These shellfish also form healthy habitat of their own, which benefit fish, wildlife and water quality. This type of enhancement has some of the best ecological outcomes, since healthy marsh edges are thriving areas for wildlife.

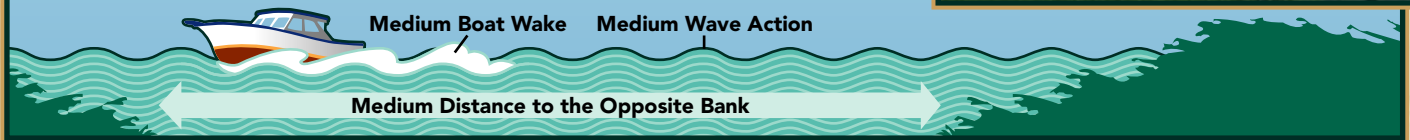


## MEDIUM-ENERGY SITE:

**Marsh Sills.** Marsh sills are mounds of rock or oyster shell slightly offshore (running in a line parallel to the coast) that shield coast lines from wave action. Sills can be segmented, adjusted in height, or adjusted to be different distances from the shore. Various designs can be used to protect fish and wildlife while shielding the shore from erosion. Near shore sills are also often paired with mussel and plant tactics mentioned above to create a hybrid Living Shoreline.



Photo courtesy of Carolyn A. Currin, NOAA

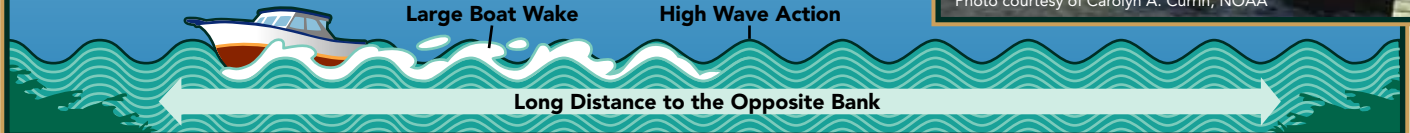


## HIGH-ENERGY SITE:

**Nearshore or Offshore Breakwaters.** A breakwater system is a series of freestanding structures positioned off the coast to absorb some of the wave energy that would normally pound the shore. When used by themselves, breakwaters are not typically considered to be Living Shorelines because they tend to be large, costly, and 'hard' structures. But there are ways to construct breakwaters to promote ecological benefits, as well as using them in tandem with near shore plant and mussel tactics to create hybrid Living Shorelines.



Photo courtesy of Carolyn A. Currin, NOAA



# WHICH, WHERE, AND HOW MUCH?

The type of Living Shoreline used must complement the conditions at the site. Several technical aspects like fetch, water depth, salinity, erosion rates, slope and tide ranges will have to be determined before beginning the process. It is important that you speak with an experienced environmental professional when considering a Living Shoreline. An experienced consultant will help determine the proper location and Living Shoreline type. They can also help with regulatory and permitting information.

Cost can be a prohibitive issue for any project. For general information regarding the costs and benefits of the various types of Living Shorelines, consult the chart below. For more specific information regarding the cost of different types of materials necessary for coastal stabilization techniques visit [www.delawareestuary.org/science\\_projects\\_living\\_shoreline\\_reports.asp](http://www.delawareestuary.org/science_projects_living_shoreline_reports.asp).

There is a limited lifespan and maintenance costs that need to be considered with Living Shorelines, just like with a roof or any other capital improvement project. Some Living Shoreline methods might need to be augmented periodically but they also have promise in keeping pace with rising seas. Remember to take into consideration the cost of replacing expensive infrastructure and coastal communities behind these eroding areas too. Protecting them could be much less expensive than replacing them!



LIVING SHORELINE TYPES	BENEFITS						COSTS PER LINEAR FOOT
	Reduce Erosion	Provide Habitat	Improve Water Quality	Filter Sediments	Improve Water Access	Slow Wave Energy	
Mussel and Plant Tactics	Yes	Yes	Yes	Yes	Yes	Yes	\$100 – \$225
Marsh Creation with Stone Sill	Yes	Yes, if gaps in sill	Yes	Yes	Yes	Yes	\$250 – \$700
Nearshore Oyster Reefs	Yes	Yes	Yes	Yes	No	Yes	\$100 – \$1000
Breakwaters	Yes	Minor	No	No	No	Yes	\$450 – \$1000

Information on chart partially provided by Environmental Concern Inc. [www.wetland.org](http://www.wetland.org)

Bulkhead	Yes, but may cause erosion downstream	No	No	No	No	Yes	\$500 – \$1500
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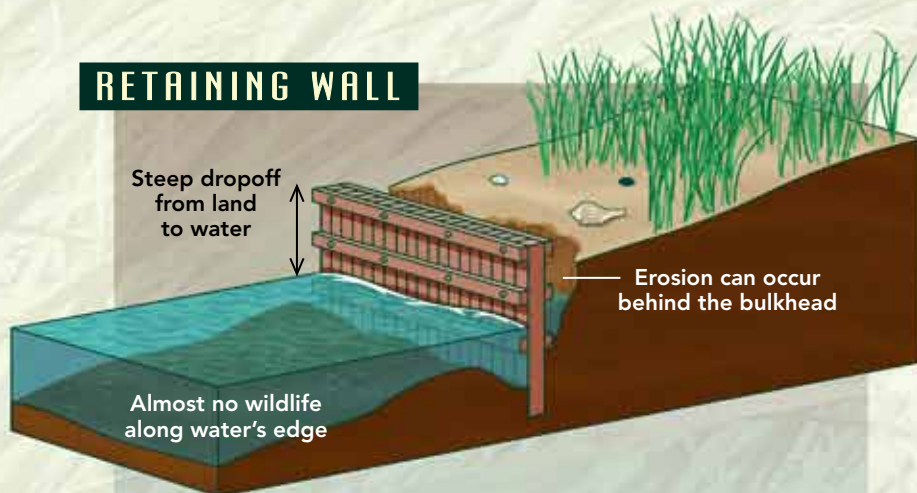
The costs per linear foot includes just the cost of materials and does not include any labor related expenses, survey costs, field studies, modeling, design, permitting or special equipment rental fees. Due to the wide variety of conditions that need to be taken into account, costs can vary significantly site to site.

# A LIVING SHORELINE IN ACTION

Using Living Shorelines, the Partnership for the Delaware Estuary seeks to stem erosion, help marshes keep pace with sea level rise, and enhance and restore shellfish reefs in the tidal Delaware River and Bay. The placement of shellfish can protect marshes from wave action and erosion, which gives marshes more time to grow in height or move inland. Mussels help stabilize eroding marsh edges by binding tightly to each other and to plants. Mussels also remove nutrient-rich particles from the water (that can pollute waterways), which are then transferred to plants, leading to even more plant growth and a healthy shore.

Living Shorelines are a practical way to protect coastal communities and the environment from shoreline erosion. In addition to the ones shown here, Living Shorelines come in many varieties to suit different sites.

## RETAINING WALL



'Hard' infrastructure like retaining walls abruptly severs the ecological connection between the coast and water.

## LIVING SHORELINE



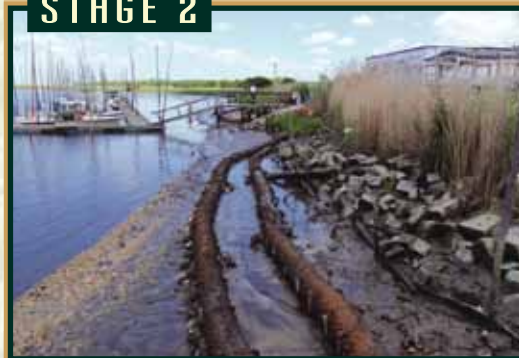
Not only do Living Shorelines defend land against destructive waves, but they also provide crucial habitat for fish and wildlife.

## STAGE 1



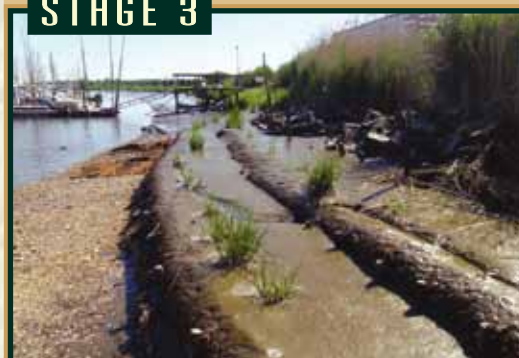
**April 2010** – Rip rap had been used in an unsuccessful attempt to control erosion in Heislerville Fish and Wildlife Management Area in New Jersey along Anchor Marina.

## STAGE 2



**May 2010** – Coconut-fiber (coir) logs and mats were put in place.

## STAGE 3



**June 2010** – A few native marsh grasses were planted behind the coir logs where sediment (mud) had started to collect.

## STAGE 4



**June 2011** – Just one year later, native marsh grass flourishes in the mud that had collected behind the new Living Shoreline.

# RESOURCES



- **Living Shorelines Inventory:** a summary of types of Living Shorelines, compiled by the Partnership for the Delaware Estuary. Can be found at [www.delawareestuary.org/science\\_projects\\_living\\_shoreline.asp](http://www.delawareestuary.org/science_projects_living_shoreline.asp).
- **Living Shorelines Practitioner Guide:** practical information on implementing a shellfish-based project. Includes information on permitting — including phone numbers to call, forms to fill out, and agencies to contact. Can be found at [www.delawareestuary.org/science\\_projects\\_living\\_shoreline.asp](http://www.delawareestuary.org/science_projects_living_shoreline.asp).
- **Climate Change and the Delaware Estuary — a Climate-Ready Estuary Report:** describes what can be done to monitor and maintain key resources in the Delaware Estuary watershed in the face of climate change. The report contains local climate predictions, information on projected wetland loss in the Delaware Estuary and an overview of Living Shorelines as a climate change adaptation. The report can be found at [www.delawareestuary.org/science\\_programs\\_climate\\_change.asp](http://www.delawareestuary.org/science_programs_climate_change.asp).
- **NOAA Habitat Conservation Restoration Center:** the National Ocean and Atmospheric Administration Living Shorelines information page can be found at [www.habitat.noaa.gov/restoration/techniques/livingshorelines.html](http://www.habitat.noaa.gov/restoration/techniques/livingshorelines.html).
- **American Littoral Society:** the ALS also has many useful resources on Living Shorelines. You can access information on their website, at [www.littoralsociety.org](http://www.littoralsociety.org).

For more information please contact [restoration@delawareestuary.org](mailto:restoration@delawareestuary.org), or at (800) 445-4935, ext. 107.



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Research Partner:



The Partnership for the Delaware Estuary leads collaborative and creative efforts to protect and enhance the Delaware Estuary and its tributaries for current and future generations.



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