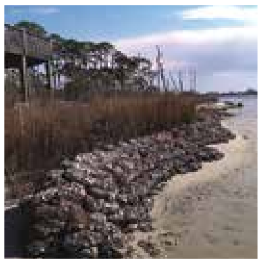



LIVING SHORELINES

A Guide for Alabama Property Owners

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A Guide for Alabama Property Owners

Alabama Department of Natural Resources and Mobile Bay National Estuary Program, 2014

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This Living Shorelines Guide is for informational and educational purposes only. Please be advised that the techniques and methods described herein may not be appropriate for all locations and/or situations. Additionally, rules, regulations and permitting requirements may have changed since the drafting of this document. Please consult with the appropriate regulatory and natural resource agencies to ensure that you obtain proper permits for any projects.

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The National Oceanic and Atmospheric Administration has defined a Living Shoreline as:

A shoreline management practice that provides erosion control benefits; protects, restores, or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g. biologs, oyster reefs, etc.).

1.0 Why a Living Shoreline?

Coastal erosion is the wearing away of land and the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. Day-to-day wave action, boat wakes, storm events, and even stormwater runoff all cause erosion that threatens the shorelines of waterfront properties. Traditionally, property owners have turned to hardened structures – bulkheads, revetments, rubble, and concrete seawalls – to stop erosion. Yet ***armoring*** disrupts the ability of a shoreline to carry out natural processes, eliminates habitat opportunities for the critters we value (like oysters, crabs, shrimp, and finfish), and often *increases* the rate of shoreline erosion.

Alabama's 607 miles of tidal shoreline provide important services to coastal residents. They buffer our properties from storms and tropical weather events while offering foraging, breeding, and sheltering opportunities for the fish and shellfish we like to catch and eat. ***Living shorelines*** offer a way to keep shorelines in place while maintaining the vital connection between land and water ecosystems that sustains the fish and shellfish we value.


A successful living shorelines project along a Pensacola waterfront.

1.1 Problems with Shoreline Armoring

Vertical structures like seawalls and bulkheads have been the most common measure used to protect waterfront properties from erosion. In high-energy areas with lots of wave action and high erosion rates, their use might be unavoidable. But there are significant "downsides" to vertical shoreline armoring that include:

- The expense of construction or installation and maintenance.
- An average lifespan of only 15-20 years.
- Creation of a barrier and loss of a connecting edge between land and water ecosystems.
- Elimination of any seaward beach or intertidal habitat, since reflected waves scour and deepen the water bottom at the base of the structure.
- Interruption of sand and sediment movement to more downstream shorelines.
- Intensified erosion to adjacent, unarmored properties.


Bulkhead


Revetment

1.2 What is the alternative to armoring?

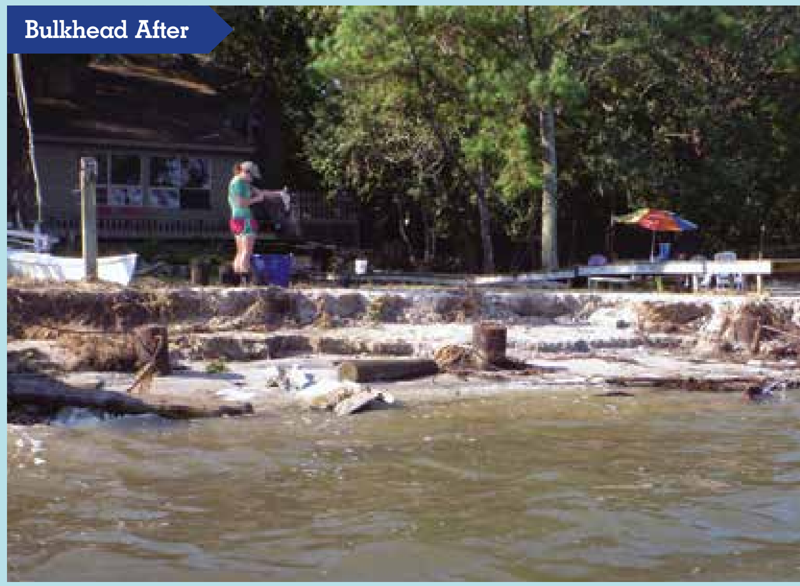
Living shorelines provide a more natural approach to protecting shorelines while restoring, creating, or preserving valuable intertidal habitat for birds, wildlife, fish, and shellfish. While not completely stopping erosion, they reduce it in lower-energy situations and restore or enhance natural habitats without cutting connections between upland and aquatic areas.

1.3 What factors should be considered in selecting shoreline management strategies?

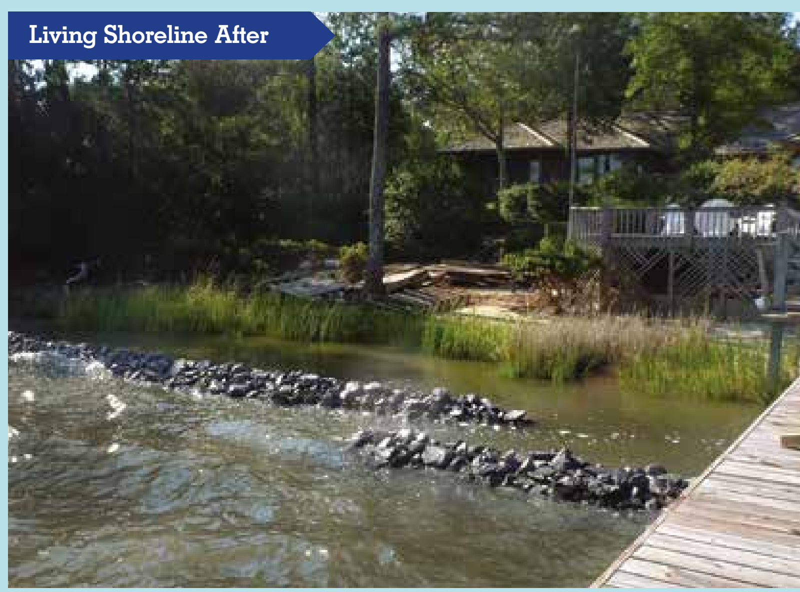
- **Type of shoreline** – Is the shoreline a marsh or a beach, is it sand or fragmented shells, or is it already armored?
- **Slope** – Is the slope along the shoreline pretty flat, gradual, or steep?
- **Fetch** – This is the term used for distance across the water to the nearest opposite shore, providing wind the opportunity to create waves. The greater the fetch, the greater the wave energy.
- **Rate of erosion** – Has erosion occurred gradually, or is it rapid and measurable in inches or feet per year?
- **Erosional forces** – What forces cause erosion on this shoreline? High to moderate wave action? Ship or recreational boat wakes? Occasional storm events?
- **Wave energy** – The intensity of the wave energy affecting the shoreline will be most important to developing a strategy to slow erosion.
- **Water depth** – Knowing whether the depth profile is gradual or steep is also important.
- **Offshore bottom character** – Whether the bottom is sand, silt, clay, or gravel and how much weight it can bear are important if placement of rocks is necessary.
- **Salinity** – Salt, brackish, or fresh? Salinities determine which plants are appropriate.

1.4 Will a living shoreline protect a waterfront property from a hurricane or tropical storm? Will it survive a tropical weather event?

There is no guarantee that a living shoreline will protect a property from a major storm. It will dissipate the energy that causes erosion, but it cannot offer protection from flooding. Properly-designed living shorelines have demonstrated greater resiliency to storm events (that include surge) than bulkheads and seawalls. When waters recede, vertically-armored properties often require expensive backfilling and bulkhead repair. A well-designed living shoreline will remain in place, installed structures will continue to perform as they did pre-storm, and planted marsh vegetation will rebound quickly.



These pictures were taken of two properties approximately 100 meters apart in Pine Knoll Shores, NC along Bogue Sound. Photos on the left were taken in May, 2011. Photos on the right were taken in September, 2011, three days after Hurricane Irene made landfall. The bulkhead required replacement and backfill of approximately 22 truck loads (or 330 cubic yards) of sand. The living shoreline's stone sill was left intact, and required no repair, although the property owner decided to plant additional marsh vegetation the following spring to enhance the shoreline.



2.0 Living Shorelines Strategies

Choosing the right measure to reduce shoreline erosion depends upon a combination of several factors. In very low-energy situations, simply planting appropriate native plants along the water's edge may be enough to hold the ground in place while providing habitat for critters. When wave energy exceeds what new marsh plants can tolerate, you will have to take some action to knock that energy down.

2.1 Plantings

Lining a shoreline with a network of tidal marsh plants, riparian (along the water's edge) buffer plants, and upland bank plants is the first measure to protect a **low-energy shoreline** along a creek or cove if:

1. The water depth is less than one foot,
2. The fetch is short (less than a mile) and boat wakes are not excessive, and
3. The erosion rate is not too great.

Whether the shoreline is marshy or sandy, salt-tolerant native plants in the intertidal and riparian zones and upland will help keep a low-energy shoreline in place. Pruning overhanging tree branches can increase the amount of sunlight necessary for shoreline plants to grow. *Different types of plants appropriate for our climate and local conditions will be recommended in Section 6.*

Native wetlands plants should be purchased from local vendors to ensure "survivability" in local conditions, either as two-inch plugs or in one-quart pots. Since marsh plants like smooth cord grass, black needle rush, or bulrush tend to grow well in good conditions, two-inch plugs, which are easy to plant, are recommended. If planted 18-inches apart, they are said to be planted on "18-inch centers," which is a good strategy for establishing most wetland plants *and* dune plants like sea oats or panic grasses.

Plantings on Dog River Park on 12" to 18" centers.

Pickerelweed in two-inch plugs.

Marsh plantings in front of this bulkheaded property on Dog River reduce wave energy and provide fisheries habitat.

Marsh creation or enhancement is a "win/win" proposition. The dense stems, roots, and rhizomes of marsh plants buffer the shoreline by reducing both wave energy and current velocity and by trapping sediments. Besides keeping a shoreline in place, a marsh:

- Provides habitat and refuge for small fish and shellfish.
- Improves water quality by trapping sediments and pollutants, increasing oxygen levels, and reducing nutrient levels from the water and runoff.
- Dampens the energy of driving rain and runoff.
- Attracts birds, wildlife, and fish, including most of the commercially- and recreationally-important fish and shellfish that use tidal wetlands for spawning or nurseries.

In higher-energy areas, where wave energy can be reduced through addition of some structural materials, marsh and riparian plantings may improve the overall performance of structural shoreline protection strategies. The type of species to plant depends upon the character of the shoreline and salinity of the water. If a shoreline is sandy with no marshes or wetlands nearby, planting dune vegetation upland will increase habitat complexity, recruit more sand deposition, and keep existing sand in place.

Not all shorelines are appropriate for marsh planting. When there is no historical record of marshes in a project area, then marsh creation as a part of the strategy should be carefully considered, and some guidance from an engineer or expert would be wise.

Coir logs in a Mississippi shoreline stabilization project.

2.2 Coir Logs, Timber Breakwaters, or Marsh Sills

On shorelines where there is too much wave energy for a simple marsh planting, installation of a small wave barrier may be required to protect the shoreline and the fringe marsh. ***Coir*** or ***Bio logs***, manufactured from the fiber of coconut husks and with diameters of one foot or larger, can be staked in place parallel to the shoreline and then backfilled with sand to create a higher marsh platform. The logs degrade over time but will incorporate the roots of growing marsh plants to form a semi-permanent marsh edge. They will protect a new marsh as vegetation gains a toehold and over time leave the shoreline completely restored to its original state.

Pile-supported timber breakwater and black needle rush along the Dog River shoreline.

Small, ***pile-supported timber breakwaters*** or rock ***marsh sills*** at the offshore edge of an existing or created marsh reduce the wave energy from boat wakes or smaller wind waves. Placement of geotextile or geogrid beneath *any* piled rock or stone is recommended to prevent settlement into soft substrate. Placing sand or sediment behind an installed coir log, timber breakwater, or rock sill provides nice substrate to support and promote growth of new marsh plants to keep the shoreline in place and support natural resources.

Rock marsh sill protecting perched-terrace at Satsuma's Steele Creek Lodge.


Exposed tree roots on eroded shore indicate need for sand fill.

2.3 Grading and Sand Fill

Grading a bank reduces the steepness of its slope and decreases erosion caused by waves striking its toe. More gradual slopes allow waves to "run up," dissipating their energy, promoting sediment deposition, and providing a better foundation for plant growth. Graded banks should be stabilized with native plants to keep soil in place, absorb wave energy, and intercept stormwater runoff.

Placement of clean ***sand fill*** on your shoreline at a gradual slope (at least 10:1, horizontal:vertical), is useful for raising its elevation and increasing its width. Relying upon accretion to supply sand for your shoreline is tricky business, and may get you into trouble with down-drift property owners. Alabama law prohibits projects that negatively impact adjacent properties (see Section 3.0), which is why placement of structures perpendicular to the shoreline is not allowed. By placing more fill than necessary, you can make sure you are not pulling material from the longshore sand transport system! If you are not sure, seek guidance from an engineer or expert.

Workers place sand fill behind rock headland breakwaters on Mon Louis Island.

If a shoreline has been so badly eroded that tree roots are exposed, or if you are concerned that structures you install might block sand from moving along the longshore transport system, placement and grading of fill material at a gradual slope should be a part of your project. When sand fill is used in shoreline stabilization projects, it often requires other measures such as marsh planting or installation of rock to reduce wave energy that will just remove and deliver your newly-placed sand down drift.

Clean sand is commercially available from local fill suppliers, quarries, or dirt pits that will provide price quotes for delivered material based upon location and access to the project site. Ensuring that the quality of purchased sand matches that of native sand is very important. Sand should have grain size that closely matches that of the project area and be nearly free of clay or fine-grained sediments (tell the supplier than less than 10% should pass through a 100-micron sieve).

If material is needed for marsh creation, using best management practices like silt curtains to contain fine sediments and protect water quality becomes critical.

The U. S. Army Corps of Engineers has been a source of free material for larger projects through their Beneficial Use of Dredged Material Program, but they cannot bear any expense to transport it from disposal sites to project areas.

2.4 Rock Headland Breakwaters

Along sandy shores with no marshes, strategic placement of ***rock headland breakwaters*** at intervals along the shoreline near the low tide line will diffract (or bend) waves and produce stable "pocket beaches" within gaps. Rocks should be sufficiently large to remain in place during extreme weather events. Generally, rocks should be at least class #3 riprap* for a Bay shoreline and even larger for offshore breakwaters, and smaller rock may work along a river shore. Rocks should be stacked with a trapezoidal cross-section, usually with a flat crest and 2:1 side slopes (although nearshore slopes can be steeper). Clean sand fill should be placed behind the rock breakwaters at a very gradual slope down to a line parallel with the offshore toe of the breakwater structures. As waves form crescent-shaped pocket beaches, some sand will be lost to longshore currents and carried to downdrift properties, benefiting your neighbors and ensuring no negative impacts. Well-designed and constructed headland breakwaters pin a beach in place and provide better habitat opportunities for intertidal organisms, especially those that burrow.

** Class 3 rocks range from 25 to 500 lbs, with no more than 10% of rocks greater than 500 lbs, over 50% of rocks greater than 200 lbs, and no more than 15% of rocks under 25 lbs.*

Aerial photo of rock headland breakwaters on Mon Louis Island.

2.5 Segmented Offshore Breakwaters

Along ***higher-energy shorelines***, breakwaters placed offshore and parallel to the shoreline reduce wave energy to create a quieter, nearshore "shadow zone" where sediments accumulate. They also provide places for oysters to attach and habitat for fish and other shellfish. Like headland breakwaters, construction materials should be heavy enough to stay in place and stacked with a trapezoidal cross-section. Depending upon the length and spacing of breakwater segments, sediments will either fill in and connect the shore to the structure (a formation called a "tombolo") or remain unconnected with only a shallow sand deposit (called a "salient,") along the shoreline. Offshore breakwaters are generally designed to form one of these two types: **shore-connected** or **detached**.

A **shore-connected breakwater** has segments that are long enough and/or close enough to shore for a tombolo to form or remain. **Detached breakwaters** have segments that are shorter or farther from shore, leaving the shadow zone too rough for tombolo formation, but quiet enough to allow some sediment to accumulate.

Detached breakwaters are usually preferred, since the beaches they protect are more suitable for bathing and water sports. They also have **less impact on downdrift shorelines**, since they do not completely block longshore sand transport. Segmented breakwaters trap sand from the longshore transport system to increase beach area in their shadow, so they potentially "steal" sand from downdrift shorelines. This is an important consideration in such a design!


Oyster bag breakwaters


Reef balls at Helen Wood Park


ReefBLK™ breakwater


Segmented oyster breakwaters at Coffee Island

WAD® segmented offshore breakwaters forming tombolos.

In Alabama, segmented breakwaters have been commonly used and constructed of bagged oyster shell, riprap, or manufactured structural components like ReefBLK™, gabion baskets, or pre-cast Wave Attenuation Devices® (WADs) or Reef Balls.

Any structure that might present a hazard to navigation is subject to Alabama Marine Police and U. S. Coast Guard guidance and regulations, as described later in Section 5.

WAD® breakwater with oyster growth at Alonzo Landing on Dauphin Island

3.0 The Regulatory Framework...Laws

The following will guide a property owner through the legalities of shoreline protection. If you want to read the regulations that address state-owned submerged lands (and that includes ***all of the water bottoms waterward of the "average" high tide line (called "mean high tide" or MHT),*** do a web search of **"SLR 220-4-.09"** (Placement and Configuration of Piers and Other Improvements on State Submerged Lands).

This regulation dictates what you can and cannot do waterward of your property line. Your property line – like most waterfront properties located on tidal waters – is probably "ambulatory," or "not fixed." The deeds of many waterfront parcels place a waterward property boundary at the MHT line, and MHT is something that naturally changes.

As you develop a project concept, keep in mind that:

- Any installed structures must maintain at least a ***ten-foot (10') setback*** from adjacent properties,
- Any structures installed must be designed and placed ***in a manner that will not unreasonably restrict or infringe upon the riparian rights of adjacent upland riparian owners,*** and
- Structures oriented perpendicularly to the shoreline are seldom permitted by regulatory agencies, since they almost always disrupt sediment transport along the shore and impact downdrift shorelines negatively.

3.1 State-Owned Submerged Lands

- In Alabama, the MHT line is the boundary between state-owned submerged lands and upland private properties along tidal waters.
- "All the beds and bottoms of the rivers, bayous, lagoons, lakes, bays, sounds and inlets within the jurisdiction of the state of Alabama are the property of the State of Alabama to be held in trust for the people thereof." (Ala. Code § 9-12-22).

3.1.1 Riparian Rights

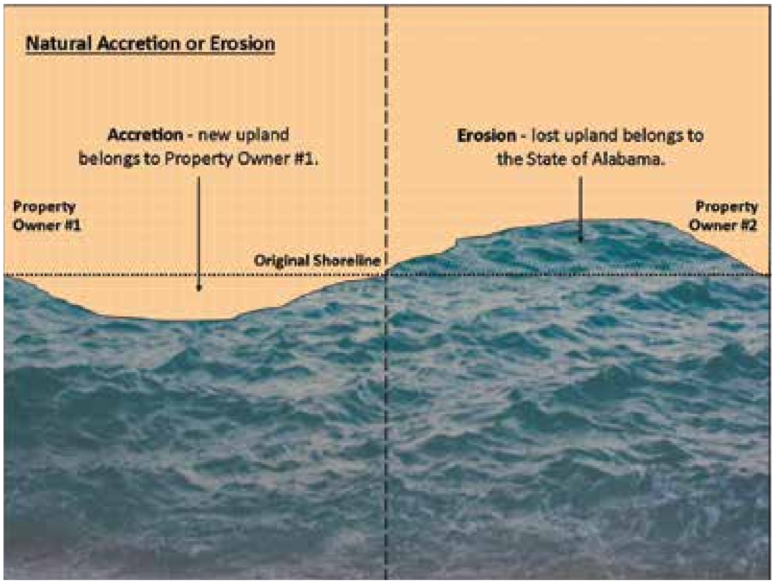
- Although waterfront property owners do not own the submerged lands waterward of their properties, they do retain special ***riparian rights*** to that tidal area.
- In Alabama, riparian rights include the right to build a pier or dock over state lands, harvest oysters, and access the water.

3.1.2 Ambulatory Property Lines

- The legal boundary between a privately-owned upland property and the state-owned submerged bottom generally ***shifts*** with natural changes in the shoreline, so they are called ***"ambulatory"*** boundaries.
- There are some technical words or terms which must be understood in order to discuss changes in shoreline property lines in more detail, including some instances in which property lines may become "fixed."

Erosion is the slow, day-to-day loss of upland area or shoreline that results from routine, "normal" factors, like wind, waves, and boat wakes.

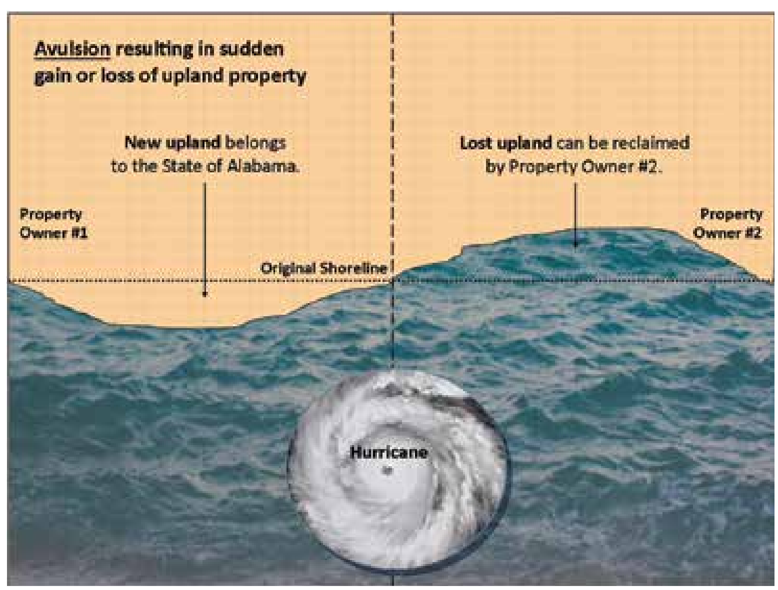
Accretion is more or less the opposite of erosion. It is the process of gaining sediment, sand, or more upland property by slow, day-to-day, natural deposition that results from natural causes.



• Losses or gains in upland property through the *natural* processes of erosion or accretion, respectively, change the location of an ambulatory boundary. Land *lost* through ***natural erosion*** becomes the property of the state, *shifting the property boundary landward*. Land *gained* through ***natural accretion*** becomes the property of the waterfront property owner, *shifting the property boundary waterward*.

Avulsion is a ***sudden or perceptible loss or gain of upland*** by the action of water. It differs from erosion or accretion because it happens rapidly, usually during a single tropical weather event. An avulsive event ***does not immediately change an ambulatory property boundary***.

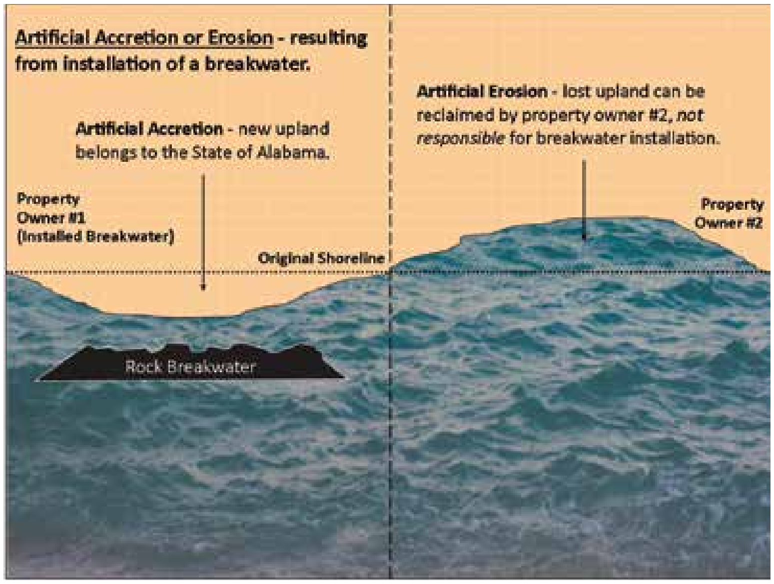
- **If waterfront property is *lost* because of avulsion,** the property owner bears the responsibility of demonstrating (usually through photographic evidence) that the property was lost due to one specific event (as opposed to natural erosion). He/she may then seek a permit from the Alabama Department of Conservation and Natural Resources (ADNCR) to fill and reclaim the lost land in a "timely manner."

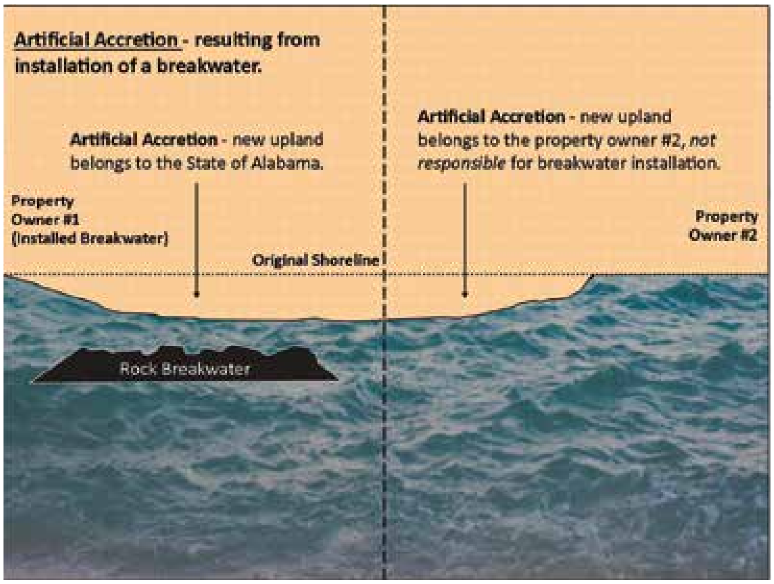


- **If waterfront property is *gained* because of avulsion**, the state retains ownership of the newly exposed land. The property owner retains all of the riparian rights over the new state upland area.

Artificial Erosion or Accretion caused by the installation of living shoreline measures *does not (normally*) change an ambulatory property boundary.*

- **If waterfront property is *lost* by artificial erosion because a neighbor installed a living shoreline**, his/her rights are similar to someone whose land was lost due to avulsion. He/she may reclaim the lost land by first demonstrating that the living shoreline caused the erosion (rather than natural erosion or some other cause) and then seeking a permit from ADCNR to fill and reclaim the lost land in "a timely manner."





- **If waterfront property is *gained* by artificial accretion resulting from the property owner's installation of a living shoreline**, the owner cannot claim ownership of the newly exposed land. Similar to avulsion, the state retains ownership of the newly exposed land, but the property owner retains all of the riparian rights associated with it.

Property owners should be aware that if a project they construct has negative impacts on the riparian rights of adjacent properties, they may be required to address such impacts through adaptive management measures. This may include re-aligning or reconfiguring structures, adding, removing or bypassing sand fill and/or other similar measures.

****An important exception!!!* If waterfront property is gained by artificial accretion caused by a living shoreline installed along a neighboring property, *the newly accreted area may become the property of the owner who was not responsible for the installation of the living shoreline structure.***

4.0 Project Costs

Cost is a very important factor to property owners who want to protect their shorelines from erosion. Information on the costs of living shorelines components and estimates for bulkhead/seawall installation are provided below in a Cost Guide to Erosion Control Measures derived from Boyd (2014), in part to enable comparisons between living shorelines measures and bulkheads.

Cost Guide to Coastal Erosion Control Measures

Erosion Control Measure	Unit	Unit Cost Range	Comments
LIVING SHORELINE MEASURES			
Marsh and Dune Plants	Sq. Yard	$2.50 to $5.50/sq yard	Calculated at $.50 - $1 per plant at 18" centers (Delivery may cost $50 - $75
Clean Sand Fill	Cubic Yard	$15 to $20/cubic yard	Delivered - to coastal area
#3 Riprap	Ton	Less than $75/ton	Delivered. One cubic yard = 1.7 tons ≤ $127.50
Geofabric	Sq. Yard	Less than $12.40/sq yard	Determine needs and shop for better price.
Wooden Sills	Linear Foot	$65 to $100/linear foot	Installed
Oyster Shell	Bag	$2 to $5 per bag	Material cost only (not including labor)
Oyster Shell	Cubic Yard	$45 to $60/cubic yard	Material cost only (not including labor)
Concrete Reef Balls	Linear Foot	$100 to $200 per linear ft	Installed
ReefBLK™	Linear Foot	$175 to $250 per linear ft	Installed
Rock Breakwater	Linear Foot	$150 to $200 per linear ft	Installed
WADs®	Linear Foot	$350 to $450 per linear ft	Installed
BULKHEADS			
Vinyl Bulkhead	Linear Foot	$125 to $200 per linear ft	Based on four- to eight-foot height, including labor, materials, earthwork, and backfill. Toe protection is used to avoid scouring. Additional fill may be required over time.
Vinyl Bulkhead w/toe protection	Linear Foot	$225 to $300 per linear ft	
Wooden Bulkhead	Linear Foot	$115 to $180 per linear ft	
Wooden Bulkhead w/ toe protection	Linear Foot	$200 to $280 per linear ft	
Concrete Bulkhead	Linear Foot	$500 to $1,000 per linear ft	
Sheetpile Bulkhead	Linear Foot	$500 to $1,000 per linear ft	

5.0 Permitting Guidance

To construct a living shorelines project in Alabama, it is necessary to obtain permits from the U.S. Army Corps of Engineers (authorizing work in U.S. navigable waters) and the Alabama Department of Natural Resources, State Lands Division (to address riparian rights and impacts to State-owned Submerged Lands). The Corps of Engineers permit requires a water quality certification and an affirmative coastal consistency decision from the Alabama Department of Environmental Management before it can be issued. Inter-agency coordination begins when the applicant submits a completed Joint Application and Notification form. Normally, permits can be obtained from these agencies at no cost to the applicant within about four months.

5.1 Joint Application and Notification: U.S. Army Corps of Engineers, Mobile District and ADEM

The **Army Corps of Engineers, Mobile District** regulates installation of structures and activities via Individual Permits, Regional General Permits, or Nationwide Permits. Contact information for **the Corps** and **ADEM** is:

U.S. Army Corps of Engineers, Mobile District
Regulatory Division
109 Saint Joseph Street
Mobile, AL 36602
251-690-2658

ADEM, Coastal Section
3664 Dauphin St., Suite B
Mobile, AL 36608
251-304-1176
Fax 251-304-1189

To obtain a permit for Living Shorelines installation, applicants are required to provide a completed Joint Application and Notification to *both* the Corps and ADEM. The Corps recommends making an appointment with a Project Manager to obtain guidance through the process. The Joint Application form and information about Alabama permitting may be found at **http://www.sam.usace.army.mil/Portals/46/docs/regulatory/docs/alperm.pdf**. The application must include:

- A vicinity map;
- A complete description of the proposed activity that includes necessary drawings, sketches, or plans sufficient for project evaluation;
- The purpose and need for the proposed activity;
- Scheduling of the activity; and
- Names and addresses of adjoining property owners.

When this application is submitted, Corps personnel will acknowledge receipt, review the proposed project, and determine whether it is permissible under an Individual Permit, Nationwide Permit, or General Permit, each summarized below:

- An Individual Permit is required for large, more extensive projects, and requires a time period during which public comments are solicited.
- A Nationwide Permit is issued for small projects that restore, enhance, or reestablish wetlands and riparian areas.
- A General Permit for Living Shorelines (ALG10-2011), introduced by the Corps in 2011, encourages reef and/or breakwater construction in conjunction with living shorelines principles and provides a streamlined process towards project approval and completion.

Information about ALG10-2011 and other AL General Permits can be found on **http://www.sam.usace.army.mil/Missions/Regulatory/SourceBook/AlabamaGeneralPermits.aspx**.

5.2 State Permitting: Alabama Department of Conservation and Natural Resources, State Lands Division

ADCNR, SLD manages state-owned lands, including submerged lands, that are held in trust for the benefit of the public. Their contact information is:

ADCNR, State Lands Division
5 Rivers Delta Resource Center
31115 Five Rivers Boulevard
Spanish Fort, AL 36527
251-621-1238

Before issuing a permit for living shorelines installation, ADCNR requires submission of:

1) A copy of the Joint Application and Notification that was submitted to the Corps and ADEM,
2) Notice of Intent to Impact State-Owned Submerged Lands, and
3) Affidavit for Riparian Property Owners for Construction of Living Shorelines and Similar Bulkhead Alternatives.

Notice of Intent to Impact State-Owned Submerged Lands This is a one-page form that requires the name, contact information, and signature of the riparian owner; project location and tax parcel ID #; along with a project description and list of features. Attachments to it should show details of the project location, project description, and specifications for discharge of dredged or fill material.

Affidavit for Riparian Property Owners for Construction of Living Shorelines and Similar Bulkhead Alternatives This form provides the state confirmation that the property owner understands the conditions addressed in Alabama State Lands Division Regulation 220-4-.09 and the navigational concerns of the Alabama Marine Police.

5.3 Navigation Safety: Alabama Marine Police and the U. S. Coast Guard Eighth District Private Aids to Navigation Section

If installed structures might pose any threat to navigation, the **Alabama Marine Police** and the **Eighth Coast Guard District Private Aids to Navigation Section** in New Orleans must provide authorization. The Alabama Marine Police can advise, based on diagrams and descriptions, whether or not a living shorelines project potentially poses a threat. If it does, the Coast Guard requires submission of Private Aids to Navigation Application form CG-2554 (**http://www.uscg.mil/d11/dp/PATON/Blank_CG-2554.pdf**). The Coast Guard will require a copy of the Corps permit before they will review and approve any application. Their addresses are:

Alabama Marine Police Division
(Attn: Asst Admin Services Commander)
64 North Union Street
Montgomery, AL 36130-1451
334-353-3628

Eighth Coast Guard District
Private Aids to Navigation Section
500 Poydras Street, Suite 1230
New Orleans, LA 70130
504-671-2328

6.0 Native Planting Recommendations

6.1 Marsh Plants – These are among the most common coastal Alabama wetlands plants.

Common Name	Scientific Name	Comments
Black Needle Rush **Soft Rush**	*Juncus romerianus* *Juncus effusus*	Needle-shaped "leaves." Needle rush grows rapidly in fresh to almost full sea water and soft rush in fresh water only. Both can also grow on higher ground along marsh borders.
Smooth Cord Grass	*Spartina alterniflora*	A perennial deciduous grass that grows rapidly in brackish to almost full seawater. If planted adjacent to *Juncus*, it should be planted in deeper, more-offshore areas.
Bulrush	*Scirpus (or Schoenoplectus) robustus, californicus, etc.*	Sedges with triangular stems that grow rapidly in brackish to fresh water, but not seawater.

Salt marsh with smooth cord grass growing waterward of black needle rush.


Black Needle Rush


Bulrush


Cattails

Cattails	*Typha latifolia*	This ambitious freshwater species may find its way into your marsh even if you don't plant it.
Pickerelweed	*Pontederia cordata*	Freshwater aquatic plant with heart-shaped leaves and clusters of violet-blue flowers
Duck Potato **Arrowhead**	*Sagittaria latifolia* *Sagittaria lancifolia*	Freshwater aquatic plants with lance-shaped leaves and pink or white flowers.

6.2 Riparian Plants – These plants are found along coastal Alabama shorelines and dunes.

Common Name	Scientific Name	Comments
Salt Meadow Cord Grass	*Spartina patens*	Slender, wiry, hay-like grass found in upper areas bordering brackish marshes where it is only occasionally covered at high tide.


Pickerelweed


Duck Potato


Salt Meadow Cord Grass

Sea Oats

Seashore Saltgrass	*Distichlis spicata*	A hardy perennial grass with solid, stiff stems and grainy flowers that grows in upper areas bordering freshwater to salt marshes.
Sea Oats	*Uniola paniculata*	Particularly well-suited to saline environments, this iconic species dominates southeastern dune systems of the Atlantic and Gulf.
Morning Glories	*Ipomoea stolonifera*	Flowering vines suited to dunes and riparian areas. Most unravel into full, dramatic bloom in the early morning.
Bitter Panic Grass	*Panicum amarum*	Tall grass with thick rhizomes commonly used in dune stabilization projects.

Seashore Salt Grass

Morning Glory

Bitter Panic Grass


Live Oak

6.3 Upland Bank Plants – The following trees and bushes are found in maritime forests and are adapted to salt spray, wind, and the stresses of life along the shores of coastal Alabama.

Common Name	Scientific Name	Comments
Live Oak	*Quercus virginiana*	The most characteristic maritime forest canopy species is an iconic presence along our coast.
Loblolly Pine **Slash Pine**	*Pinus taeda* *Pinus elliottii*	Occur in lowland savannas along the coast. They grow rapidly and benefit from occasional burns
Bald Cypress	*Taxodium distichum*	Another iconic canopy species that tolerates occasional flooding. Intolerant of brackish or saline water.
Cabbage/Sabal Palm	*Sabal palmetto*	Common native understory palm


Loblolly Pines


Sabal Palms


Yaupon


Wax Myrtle


Groundsel

Yaupon	*Ilex vomitoria*	A thorny evergreen shrub in the holly family with small red berries eaten by birds and wildlife.
Wax Myrtle	*Myrica cerifera*	Evergreen, shrub with fire-resistant roots and fruit and seeds favored by birds.
Groundsel	*Baccharus halimifolia*	Fast-growing shrub tolerant of flooding, salt, and drought. Flowers attract butterflies and other insect pollenators.


Bald Cypress

7.0 Determining Living Shorelines Project Cost – "The Smith's Shoreline"

The following is an example case developed to demonstrate calculating material needs and project costs using several real living shorelines strategies that might be recommended in appropriate cases. The project described is not real, nor are "the Smiths" or their imaginary 100-foot shoreline. Each and every project requires site-specific designs to address the local coastal and ecological needs (as well as those of the client), but those used in this exercise were not designed by an engineer qualified to ensure project success on your shoreline!

"The Smiths" live on a 100-foot shoreline that has eroded almost to their retaining wall. Based upon recommendations from a qualified coastal engineer, they obtained a General Permit for Living Shorelines from the Corps of Engineers to construct two twenty-foot, rock, headland breakwaters at either end of their property, behind which they will place clean sand fill which they will plant with appropriate vegetation (see Smith's Living Shoreline Project on page 29). They have secured the services of a local contractor to place the rocks and sand (and the costs of material placement *are not included*). They want to determine the cost of materials for the project.

Note: *1 square yard = 9 square feet, and 1 cubic yard = 27 cubic feet. Since it's easier to measure feet, and materials are priced by cubic yard, these conversion factors are used frequently to determine costs.*

7.1 Cost of Breakwaters

The breakwaters, constructed with #3 riprap, will be placed with edges 10 feet from property lines with centers at the mean low tide (MLT) line, where the beach slope flattens. They will need to purchase enough geotextile/geogrid to underlie the breakwaters (Specifications are supplied in the Breakwater Schematic).

(20 ft)(15 ft) = 300 sq ft = 33.3 sq yds X 2 breakwaters = 66.6 sq yd

(67 sq yd)($9 per sq yd) = **$603 for geotextile/geogrid**

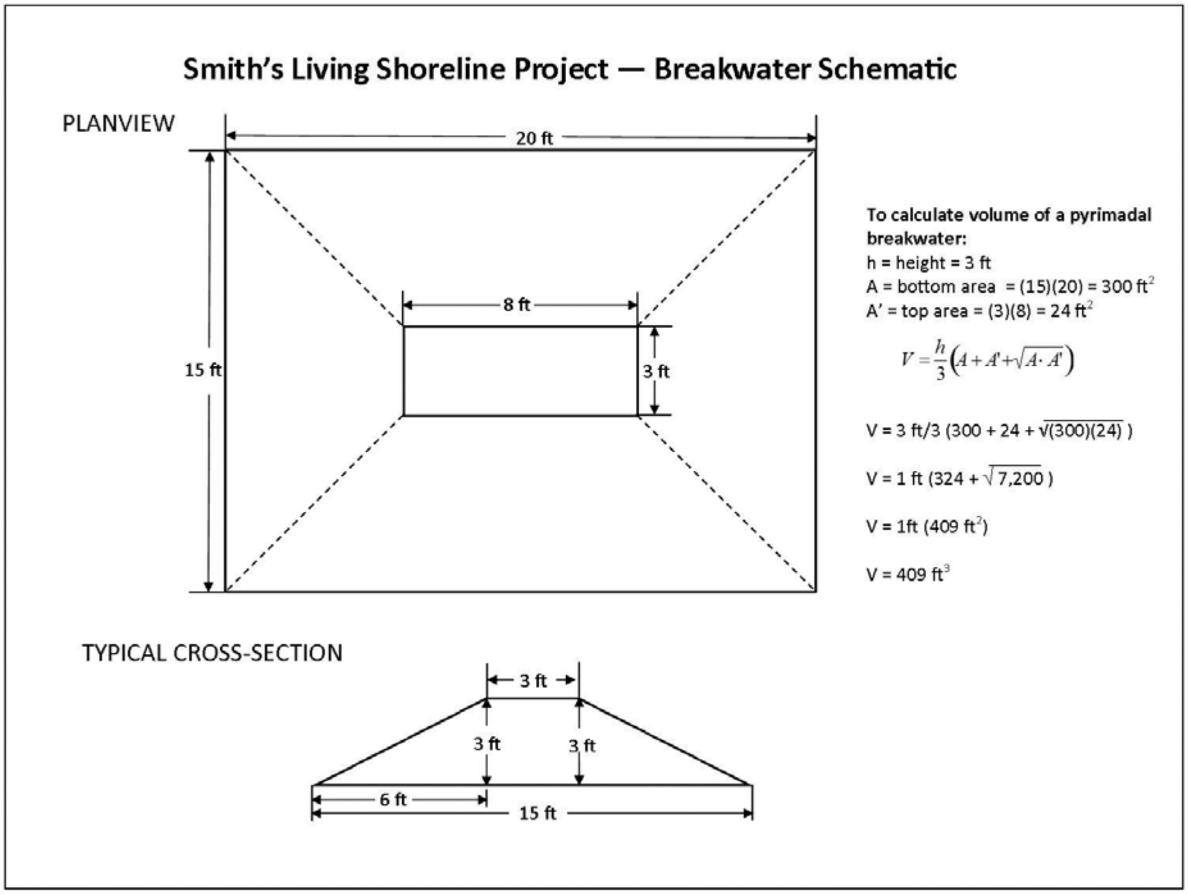
With a height and crest width of three feet, and 2:1 face slopes, the volume of the pyramidal breakwaters can be calculated using the equation provided in the Breakwater Schematic to determine that 818 cu ft is needed. But since about 30% of the actual volume of each breakwater represents voids or spaces and not rock, this is an overestimate of the amount of rock that we need. We can safely adjust by multiplying by 0.8 (0.7 might be cutting it too close).

(0.8)(818 cu ft) = 654.4 cu ft = 24.2 cu yd

(25 cu yd)(1.7 tons per cu yd) = 42.5 tons

(42.5 tons)($75 per ton delivered) = **$3,187.50 for class #3 riprap delivered**

The total cost of materials for two breakwaters is $3790.50

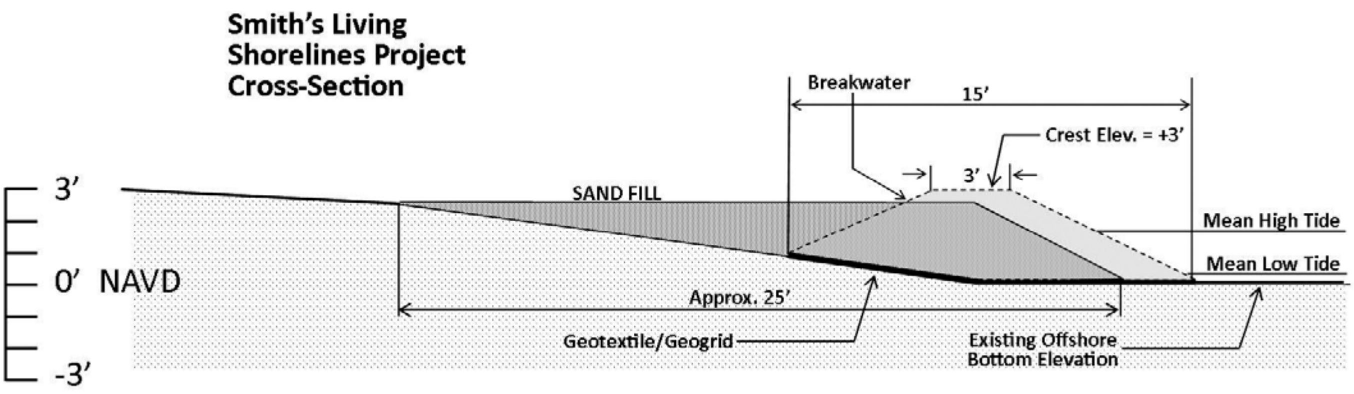


7.2 Cost of Clean Sand Fill

If you look at the Smith's Living Shoreline Cross Section, you will see that on this beach, the slope falls two and a half feet over a distance of 20 feet down to MLT where the pitch flattens. Sand will be placed from a depth of zero to 2.5 feet over the 20 feet to MLT, then tapering back down to zero depth five feet waterward of MLT along the whole 100-ft length of the property. To ensure no negative effects along neighboring properties, we were advised to ***double the amount of sand placed along the 10-foot sections between breakwaters and property boundaries.*** The total cross sectional area is 31.25 sq ft.

(31.25 sq ft)(100 ft + 20 ft) = 3,750 cu ft = 138.8 cu yd

(139 cu yd)($17.50 per cu yd delivered) = **$2,432.50 for clean sand fill delivered**

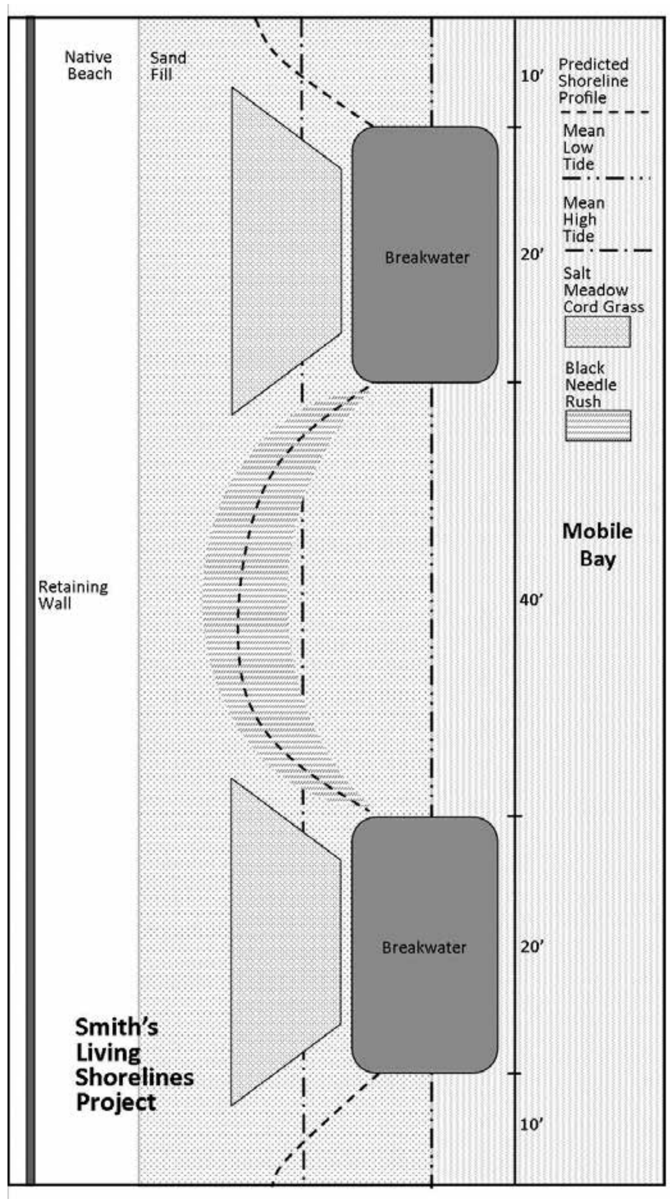


7.3 Cost of Plants

Both types of plant used in this project – black needle rush on the pocket beach and salt meadow cord grass on the headlands – are commercially available at a local supplier for $0.60 per two-inch plug. Since we will be planting about 25 sq yd at a cost of $5.50 per sq yd (delivered), **our plant cost will be $138 delivered**.

Total cost of materials for the Smith's living shorelines project is $6,361.

Depending upon installation costs, the cost of this living shorelines project will compare very favorably to most bulkheads while maintaining ecological benefits to fisheries, providing aesthetic enhancement to the property, and protecting the shoreline from day-to-day erosion.



8.0 References

Boyd, C. A. (2014) Cost Estimates for Shoreline Products in the Northern Gulf of Mexico. Are Living Shorelines the Cheapest Alternative? [PowerPoint presentation]. Retrieved from Mississippi State University website: **http://msucares.com/crec/envi/publications/cost_estimate_shoreline_products_2014.pdf**

One particularly good source of information is the Virginia Institute of Marine Science (VIMS) Center for Coastal Resources Management website: **http://ccrm.vims.edu/livingshorelines/.** While focusing on Chesapeake (and not Mobile) Bay, they offer comprehensive treatment and training modules.

Another good source of information, again with a Chesapeake Bay focus, is the Maryland Department of Natural Resources website: **http://dnr.maryland.gov/ccs/livingshorelines.asp.** Links to Frequently Asked Questions and Financial and Technical Resources are particularly valuable.