Incorporating Oysters Into Living Shorelines

Photo Credit : CBF Staff

Living Shorelines are a creative and proven approach to protecting tidal shorelines from erosion. The technique consists of planting native wetland plants and grasses, shrubs, and trees at various points along the tidal water line. Plantings are often coordinated with carefully placed bioengineering materials, such as man-made coconut-fiber rolls or oyster reefs.

Oyster reefs can not only protect shorelines, but also improve the health of waterways and contribute to the economy. Oysters naturally filter the surrounding water, removing pollutants while creating reefs that serve as habitat for other key aquatic species. Native oyster restoration is an ongoing effort in the Bay's waterways, and providing additional habitat is critical to success.

This document goes into detail on the suitable conditions for installing oyster substrate, the various kinds of oyster substrate available, and information on each kind of substrate to help property owners decide which product is best for their project. **Please note that we strongly recommend you seek professional advice before purchasing or installing.**

Suitable Conditions:

Determining if your property is suitable for an oyster sill requires knowledge of the below site conditions. Keep in mind that many other site conditions need to be evaluated before moving forward with your living shoreline project. Use the list below for the preliminary evaluation and make the final decision after consulting with your contractor.

Salinity: *Are oysters already present along your shoreline?*

- **This question is the first step in determining if oysters are a viable option for your project.**
- If oysters are growing along your shoreline, then an oyster sill may be an effective stabilization method.
- If oysters are not present along your shoreline, then check to see if the salinity in your area is **above eight ppt.**

Bottom Type: *Are you able to walk along your shoreline without sinking in the mud?*

- Oysters cannot survive if submerged in the mud for too long. Also, natural recruitment will not occur on the substrates that subside into the sediment.
- This ideal bottom type for oyster substrate is sandy and firm.
- Muddy conditions are common in our waterways. If you do sink as you walk the shoreline, consider these questions:
  1. How much do you sink? Are you going to lose your shoe, or is it somewhat stable?
  2. If you stuck a pole into the sediment, do you feel sand underneath the mud?
  * Having answers to these questions and discussing them with your contractor will help determine a suitable substrate for your shoreline.
- See the section on **filter cloth** in *Design Considerations* for more information on a common material used to reduce sill structures from subsiding.

Erosion Source: *What are the main contributing factors eroding the shoreline?*

Four main energy sources that cause erosion along tidal shorelines:

Fetch:

- Fetch is the distance wind travels over an open body of water.
  - » Large Fetch = Large Waves
- The fetch needs to be **at or below one and a half miles** to qualify for a living shoreline group two permit.
  - » See the *Design Considerations* section to learn how to calculate fetch.
- The crest height of a wave will also determine the size of the oyster sill.
  - » See the*Design Considerations* section to learn how to calculate the average height of a wave.

Tidal Current:

- A fast-moving ebb and flood tide can play a significant role in the erosion of your shoreline.
- Water moves slower in shallow areas due to the increased friction with the seafloor. If your shoreline is experiencing a strong tidal current, the depth offshore may be too deep for an oyster sill.
  - » Verify this before moving forward with your project.

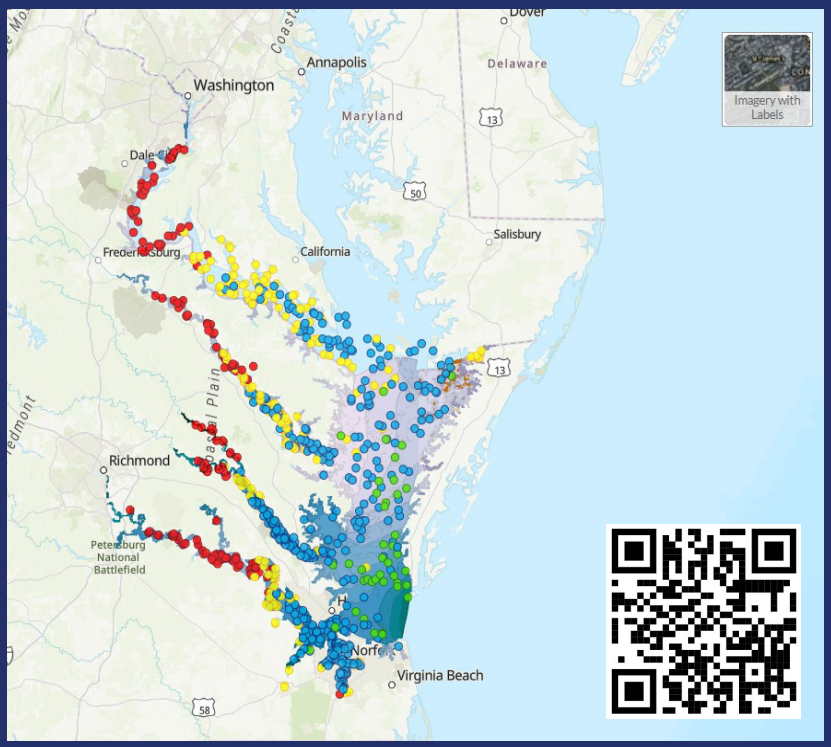
Tide Range:

- Oysters should be placed at or below mean low water (MLW). The best way to determine MLW is by visiting the proposed project site at low tide.
- The tide range will also factor in to the minimum crest height of the sill structure.
  - » See the *Design Considerations* section for more details.

Boat Wake:

- Sites that have little to no boat wake will result in a more successful living shoreline project.

Living Shoreline Oyster Reef Suitability Map for Virginia



This map provides further information on:

- Mean Tide Range
- Salinity
- Bottom Type

Use this (https://arcgis/1Gbfmr) tool to understand your site's conditions better.

This map is for educational purposes only, and if you choose to incorporate oysters into your living shoreline, we recommend speaking to a professional beforehand.


Photo Credit : CBF Staff

Design Considerations:

Now that you have determined oysters will grow along your shoreline, here are some design parameters to consider. Keep in mind that many other site conditions need evaluation before moving forward with your living shoreline project. Use the list below to help determine the best oyster substrate for your project but speak with a professional before purchasing.

Most of the information within the *Design Consideration* section is thanks to VIMS Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Full PDF can be found here: https://scholarworks.wm.edu/cgi/viewcontent.cgi?article=1833&context=reports

Determining the crest height of the oyster sill: The sill height plays a key role in the success of your living shoreline. Below are some factors to consider before choosing the oyster substrate for your project:

- Some oyster substrates have a height limit and are unable to be stacked. Pay close attention to this when determining the oyster substrate for your project.
- The sill height should be at least **one foot above mean low water** (MLW).
- The wave crest height also factors into the oyster sill height.
  - » This calculation may not be necessary if you are in a low fetch area with no boat wake.
  - » See the *How to calculate wave crest height?* within this section for an estimated average wave height.

How to calculate average fetch? Average Fetch is calculated by determining the distance to the far shore along five transects (a straight line that traverses across the open water to the opposite shoreline). Please note that this is just an estimated calculation. You should consult a professional before submitting the permit application.

Use the steps below to calculate average fetch. Keep in mind that if the fetch is over one and half miles, then it does not qualify for a living shoreline permit.

1. Open Google Earth Pro on your computer (If you have not downloaded this already, we highly recommend!)
2. Once the program is open, type in the address for your site in the search button located in the upper left-hand corner.
3. Once the zooms to the correct location, locate the measure tool. Once the ruler box appears, click line and change measurement to miles.
4. Click the middle of your shoreline and drag your mouse to draw a line that is perpendicular to the opposite shore.
5. Record the "Ground Length"
6. Make sure you click save to ensure the main transect line remains.
7. Repeat this for the 4 additional transects, 2 on either side of the main transect.
8. Note on the opposite shore, the line needs to be 22.5 degrees. See figure on the right for a visual. Once you have all the 5 measurements, plug them into this equation [(F1+F2+F3+F4+F5)/5]

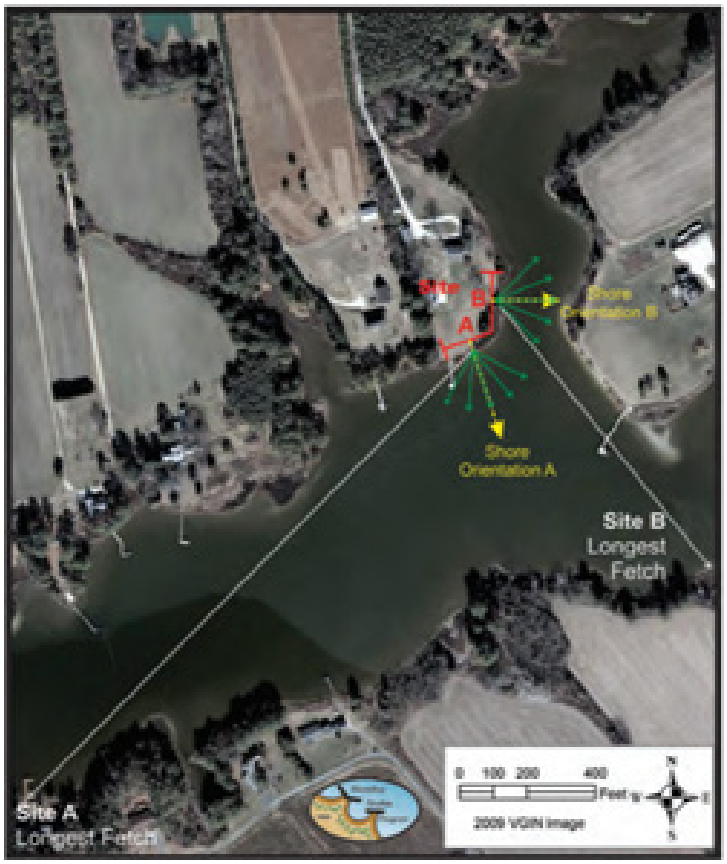


Photo Credit Virginia Institute of Marine Science
Photo depicting the longest fetch for two sections of a site. Section A's shore orientation (direction of face) is southeast while Section B's orientation is east. The green arrows show the vectors measured to determine average fetch while the white arrows show the vector of the longest fetch. Average fetches are measured from the shoreline to the opposite shoreline along the vector line.

How to calculate longest fetch? Longest Fetch is the distance from the site across open water to the farthest shore. This measurement can be important to determine possible conditions during storms when water levels and wave energy are high.

1. Using the same method of measuring as in average fetch, locate the farthest shoreline across open water.
2. Keep in mind, the line cannot intersect with any land.


Photo Credit : CBF Staff

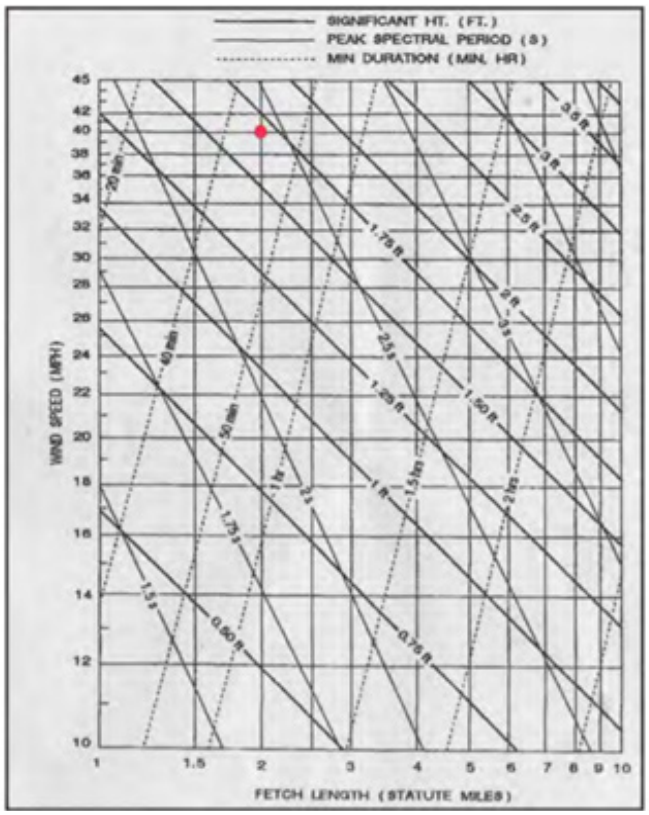


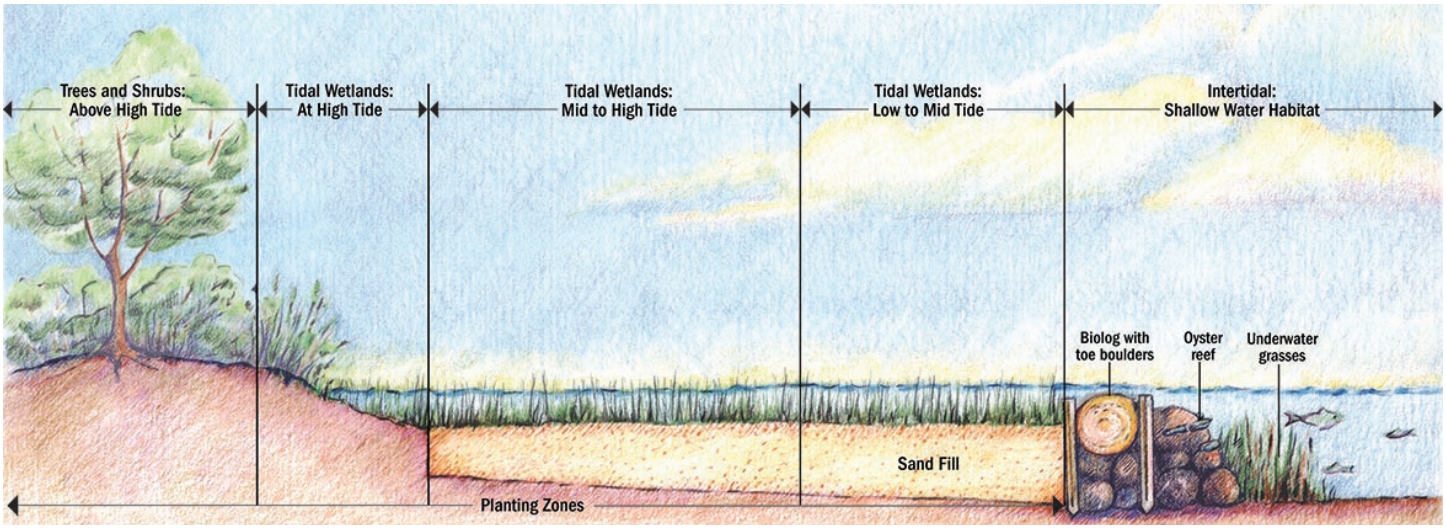
Photo Credit Virginia Insitute of Marine Science
Wave height and period estimation using wind speed, duration, and fetch. Appendix 13B-1 from VDOT (2017).

How to calculate wave crest height? The frequency and size of waves hitting the shoreline are the number one contributing factor for erosion. The below approach will provide a roughly estimated wave height and provide the necessary information for designing a small living shoreline system, such as oyster sills.

1. A wave height and period can be estimated based on wind speed, duration, and fetch length.
2. Once you have determined your average fetch, you will need to determine the average wind speed in your area.
   - This (https://weatherspark.com/y/22641/Average-Weather-in-Virginia-Beach-Virginia-United-States-Year-Round) website may be able to provide further information.
3. Once you have determined your average wind speed, use the table on the left to estimate the wave crest height.
   - For example, at a site with a 1.5-mile fetch with an average of 10 mph onshore wind, the design wave is roughly estimated at 0.5 ft, 1.5 seconds. Increasing the crest height of your sill structure may be necessary.

Fliter Cloth: Filter cloth is used in living shorelines to help prevent oyster substrates from subsiding. We recommend using this in oyster sill projects, even with a hard sandy bottom. Use some of the tricks below to make installation smooth:

1. Install at low tide.
2. To ensure you are installing the filer cloth straight, cut small pieces at a time. Weigh down the ends and as you place your oyster substrate, secure the side edges with your feet.



This illustration of an "ideal" living shoreline shows a succession of natural filters, from trees and shrubs above the tide line down to underwater grasses in shallow water, that normally would be found in undisturbed ecosystems. TERRY COKER PETERSON

Oyster Shell Spec Sheet

Loose recycled oyster shell.

Specs: Two bushels of recycled oyster shell will be approximately 18" h x 2.5' w. Would not recommend going higher then two bushels.

Weight: One bushel of recycled oyster shell weighs approximately 40-45 lbs.

» If using volunteers to install, recommend two volunteers per bushel.

Suitable Energy: Very low energy sites.

Suitable for muddy conditions? Yes, but it may be necessary to install filter cloth underneath.

Permit Type: Group One Living Shoreline Permit

Install Period: April through October

Cost: Based off the available grants at the time.

Source: Depending on the available stock, the Chesapeake Bay Foundation may be able to provide shell bags.

» Please contact ***Kati Grigsby (kgrigsby@cbf.org)*** for more information.

Loose oyster shell is often used in addition to oyster substrates and core log designs. For example, if you are installing oyster castles, it may be helpful to place oyster shell in front of the structures to allow for a more gradual slope. This allows the sill structure to absorb the wave energy even further.

Oyster Shell Bag Spec Sheet

Recycled oyster shell within a plastic mesh bag.

Weight: 15 lbs. per bag

» A very easy product to install with volunteers.

Suitable Energy: Low energy sites.

Suitable for muddy conditions? Yes, but it may be necessary to install filter cloth underneath.

Permit Type: Group One Living Shoreline Permit

Install Period: April through October

Cost: Is based off the available grants at the time.

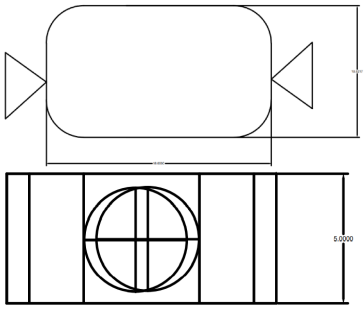
Source: Depending on the available stock, the Chesapeake Bay Foundation may be able to provide shell bags.

» Please contact ***Kati Grigsby (kgrigsby@cbf.org)*** for more information.

Tips:

- Switch between perpendicular to parallel each layer you go up.
- Would not recommend stacking more than three high.

**The most effective type of shell bag is made from plastic. Research is being conducted to find a biodegradable option. I would consult with the VMRC habitat manager to ensure they will approve the product before purchasing the material.*



Top View

Profile View


Photo Credit : Norman Colpitts

Oyster Castle Spec Sheet

Oyster Castles are interlocking concrete blocks.

Weight: 30 lbs. per block
- » A relatively easy product to install with volunteers.

Suitable Energy: Can withstand higher energy locations.

Suitable for muddy conditions? Yes, but installing filter cloth underneath is necessary.

Permit Type: Group Two Living Shoreline Permit

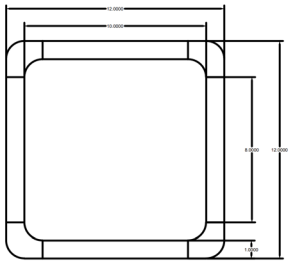
Install Period: April through October

Cost: $6.50/castle plus shipping.
- » One pallet holds 72 blocks.

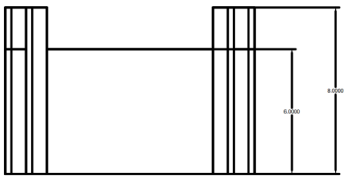
Source:
Allied Concrete Company
Richard Staton
434-989-0856
rstaton@alliedconcrete.com

Tips:
- The diagonal formation is the preferred layout.
- The taller the structure, the wider the base.
- Ensure the area that you are installing is as flat as possible.
- For the structures to interlock correctly, make sure the four corners align perfectly.
- Stack as you go along rather than placing a layer at a time.
- Use PVC or bamboo poles as a guide to stay on the correct path.
- Watch your fingers!

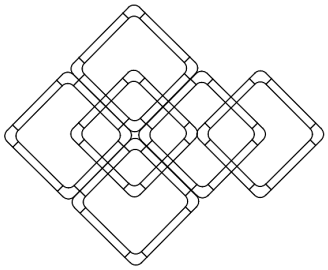
Top View



Profile View



Diagonal



Straight

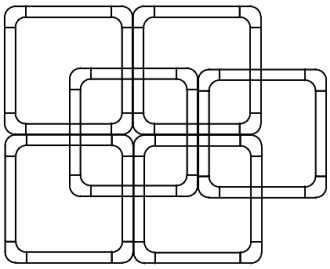


Photo Credit : CBF Staff

Reef Ball Spec Sheet

Reef balls are hollow, concrete structures made from an equal part mixture of sand, concrete and pea gravel. They are three dimensional and can be used as a perimeter to oyster reefs or along shorelines. Reef balls can be set with oyster larvae prior to placement to kick start the local oyster population for the project.

Suitable Energy: Can withstand higher energy locations.

Suitable for muddy conditions? Not suitable for muddy conditions.

Permit Type: Group Two Living Shoreline Permit

Install Period: April through October

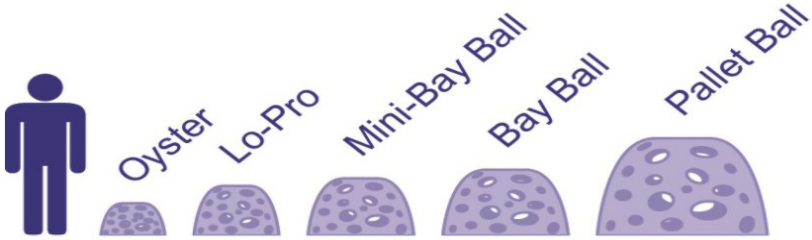


Photo Credit : Reef Ball Foundation

Cost: As shown below, there are many size options available. For cost and any additional information needed, conact the Reef Ball Foundation.

Source:
Reef Ball Foundation
http://www.reefball.org/brochure.htm

Style	Width (ft.)	Height (ft.)	Weight (lbs.)
Oyster	≈ 1.5	≈ 1.5	30-45
Lo-Pro	≈ 2	≈ 1.5	80-130
Mini-Bay Ball	≈ 2.5	≈ 1.75	150-200
Bay Ball	≈ 3	≈ 2	375-750
Pallet Ball	≈ 4	≈ 2.9	1500-2200


Photo Credit: Ready Reef Inc.

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Ready Reef Spec Sheet

Ready Reef structures are shaped to break wave energy, recruit wild oysters, and protect living shorelines marsh grasses.

Specs: Please visit Ready Reef's site for detailed information on size and weight of each structure.

Suitable Energy: Can withstand higher energy locations.

Suitable for muddy conditions? Not suitable for muddy conditions.

Permit Type: Living Shoreline Group Two Permit

Install Period: April through October

Cost: $15-$250 per structure, depending on reef size and configuration.

Source:
Ready Reef Inc.
(804) 338-3103

http://www.readyreef.com/
www.facebook.com/readyreef
They can provide product, transportation and installation services. They do provide materials for homeowners to install themselves but recommend having them come and install or hiring a marine contractor.


Photo Credit : Ready Reef Inc.

Sandbar Oyster Catcher™ Table & Pillow Spec Sheet

Sandbar Oyster Catcher™ Table & Pillow substrates are created using plant fiber cloth that is coated with a mineral-based hardening agent and then wet-formed.

Weight: 30 lbs. per structure
- » Volunteers are able to carry but recommend wearing long sleeves.
- » Pillows should be carried by two people.

Suitable Energy: Can withstand higher energy locations.

Suitable for muddy conditions? Is suitable for muddy locaitons.
- » Filer cloth will need to be installed under the pillows.

Permit Type: Living Shoreline Group Two Permit

Install Period: April through October

Cost: Please contact Sandbar Oyster Company for further information on pricing and lead time.
- » http://www.sandbaroystercompany.com/

Tips:
- If working in hard bottom conditions, have a tool available to open a hole and/or break up any shell layered within the sediment.
- The material does not have a long shelf life outside of the water.
- Be careful during transport - legs can be fragile.
- The tables should be pushed down to the height of the pillows.
  - » Pillows can be stacked.
- Maneuver the structure so the table chanel ward is at an angle.
  - » Can bend the table legs to achieve the angle.