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# Integrated Shoreline Management Decision Tree for Untreated Shorelines

Center for Coastal Resources Management, Virginia Institute of Marine Science



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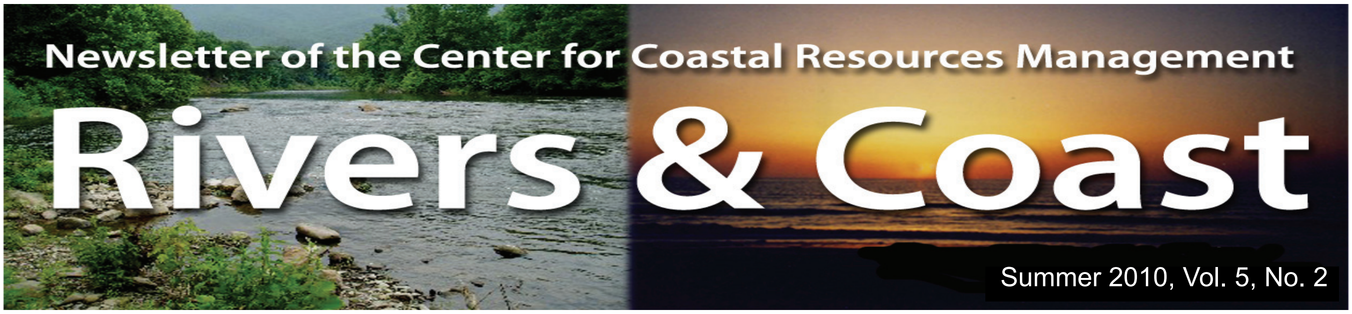


*In this issue. . .*

*We present a new decision making tool for local and state government staff and board members, property owners, contractors, and consultants.*

*The decision tree tool leads users to the environmentally preferable treatment for tidal shorelines based on shoreline characteristics.*

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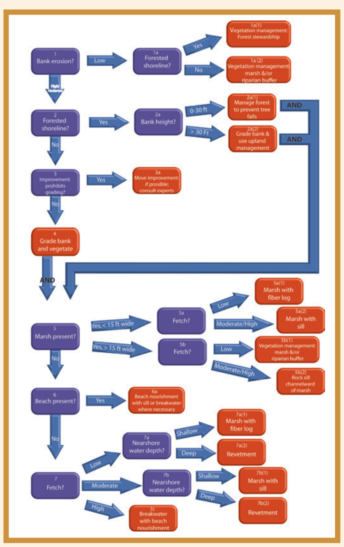

# Integrated Shoreline Management Decision Tree for Untreated Shorelines

In recent years, there have been many requests from property owners and localities for clear, easy to use guidance for tidal shoreline issues. In response, the Center for Coastal Resources Management at the Virginia Institute of Marine Science has begun to develop a series of decision trees that can be used on individual parcels of property. These decision trees are based on the concept of integrated shoreline management, which attempts to maximize ecological function on a shoreline while allowing for shoreline stabilization. An important component of the guidance behind these trees is the tradeoff between the protection of personal property and the impact to the aquatic community, a public resource.

A decision tree is a branching diagram of decisions, which identifies the relevant questions for a given situation and leads to a particular outcome. The benefits of a decision tree are they are simple and easy to use. All of the information used to reach a decision is explicitly laid out, allowing different users to have clear conversations about the factors involved in the recommendation. Decision trees help promote consistent decision making by ensuring that the relevant issues are considered for every situation.

The disadvantage of a decision tree is that it is restricted to questions whose answers fall into discrete categories. This means that there are times when a situation is too complicated to be adequately addressed by a decision tree. In addition, different people may have different perceptions of the answer to a particular question. This can lead to different people getting different recommendations for the same piece of property. However, we do not consider this to be a huge problem, because the decision tree will allow people to see exactly where their opinions differ and work to resolve just that particular issue. We have tried to define all elements of the decision tree as clearly as possible, so that our view on a particular shoreline is fairly transparent.

The decision tree presented in this issue of Rivers and Coast is intended for undefended shorelines (i.e., no existing riprap, bulkheads, groins, etc. along the shoreline), and those with failed shoreline structures, where upland improvements are located in a reasonably low risk

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setting and there are no navigation issues or significant aquatic resources (e.g., submerged aquatic vegetation, oysters) that would limit the type of shoreline protection that can be installed. When upland improvements are in high risk settings (e.g., a house 20 feet from the top of a 30 foot bank), the engineering solution needed to make that setting safer is beyond a simple decision making process and requires the individual attention of a professional, preferably an engineer.

This shoreline decision tool is a tree-like graph of questions and answers about shoreline characteristics that leads the user to the environmentally preferable approach for management of that shoreline. The decision tree is described more fully in a manual that is available online on our website: *http://ccrm.vims.edu/education/workshops_events/april2010/index.html*. Comparable decision trees are in development for the full suite of activities/actions affecting tidal shorelines and tidal waters (see page 7).

## Integrated Shoreline Management

This decision tree is driven by the principle of "integrated shoreline management," based on the concept that all elements of the shoreline should be considered simultaneously when making a decision. This allows one to make decisions that optimize the natural functions of the shoreline, while still reducing risk to upland structures from intense or long term erosion.

Natural shorelines tend to be dynamic and interconnected with the surrounding landscape and plant and animal life. The intertidal, riparian and subaqueous areas of the shoreline system provide numerous water quality, habitat and erosion control benefits. Choices made about how land is used can affect the extent and health of tidal wetlands, beaches and riparian buffers and thereby the populations of important resources such as blue crabs and striped bass.

Any action taken on the shoreline has the potential to adversely affect ecosystem services onsite as well as on a larger scale. Shoreline management actions may increase risk on adjacent and downdrift shorelines; therefore, activities that impact subaqueous, intertidal and riparian zones should be avoided whenever possible. When erosion along a shoreline has the potential to result in significant loss of property and upland improvement, the consideration of shoreline erosion protection activities may be appropriate.

The best decisions regarding the management of coastal resources are made using integrated coastal zone management. Integrated management decisions specifically consider the impacts of activities in one part of the tidal shoreline system (i.e., upland, riparian buffer, intertidal wetlands, or littoral subaqueous lands) on the performance of the entire system. Integrated management adapts project design to local conditions in order to minimize cumulative adverse impacts to ecological services provided by the tidal shoreline system. In general, shoreline management decisions that maximize positive ecological elements and minimize negative elements are best for a shoreline. Preserving, creating or enhancing natural systems such as marshes, beaches and dunes is always the preferred approach to shoreline erosion protection. However, in areas with very high risk from erosion to permanent, upland structures, shoreline structures (such as breakwaters or revetments) may be appropriate.

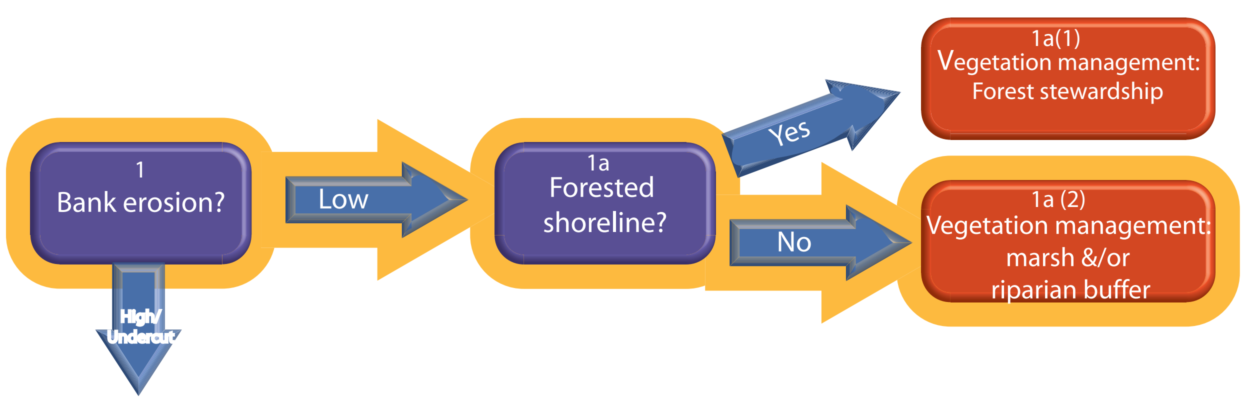
In general, impacts should be placed in the following order: in the upland, in the riparian zone, in the subaqueous zone and in the intertidal zone. The rational for this is the protection of the least abundant and most vulnerable resources over abundant or relatively easily replaced resources. However, when following this order of impacts would result in a much larger overall impact (e.g., a large sill structure and fill versus a small revetment), the order of preference may be modified.

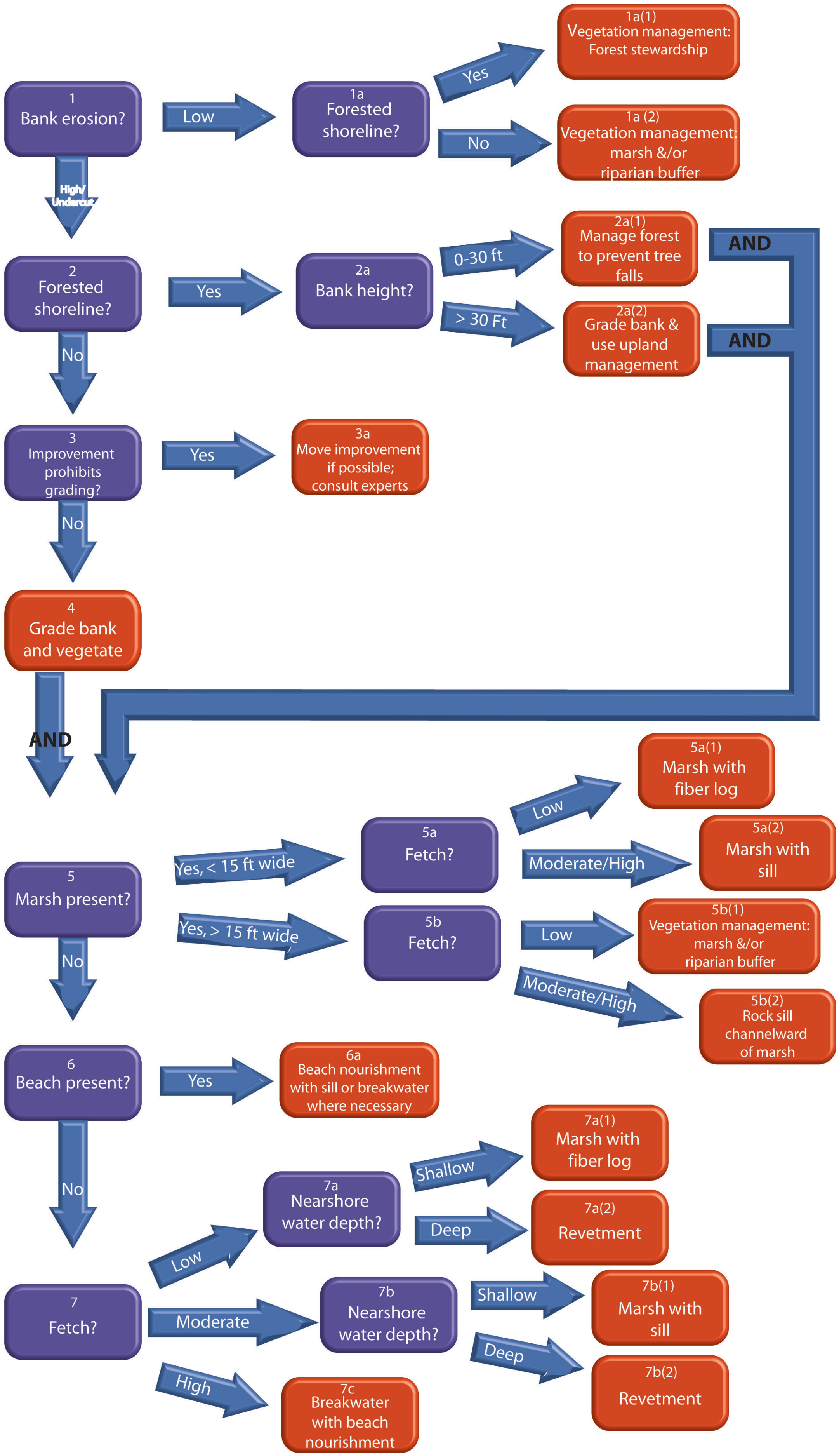
This decision tree has incorporated the principles mentioned above by: 1) Recommending that shorelines be left in their natural condition unless shoreline erosion has the potential to result in significant loss of property and upland improvement; 2) Preserving and enhancing natural shoreline elements where possible; and 3) Where impacts are unavoidable, locating erosion control treatments where they will have the least overall impact to ecosystem function.

To learn more about integrated shoreline management, please see the Winter 2007 Rivers and Coast, Volume 2, Number 1, available at: *http://ccrm.vims.edu/publications/pubs/rivers&coast/vol2_no1_int_guide.pdf*

## How to Use the Decision Tree

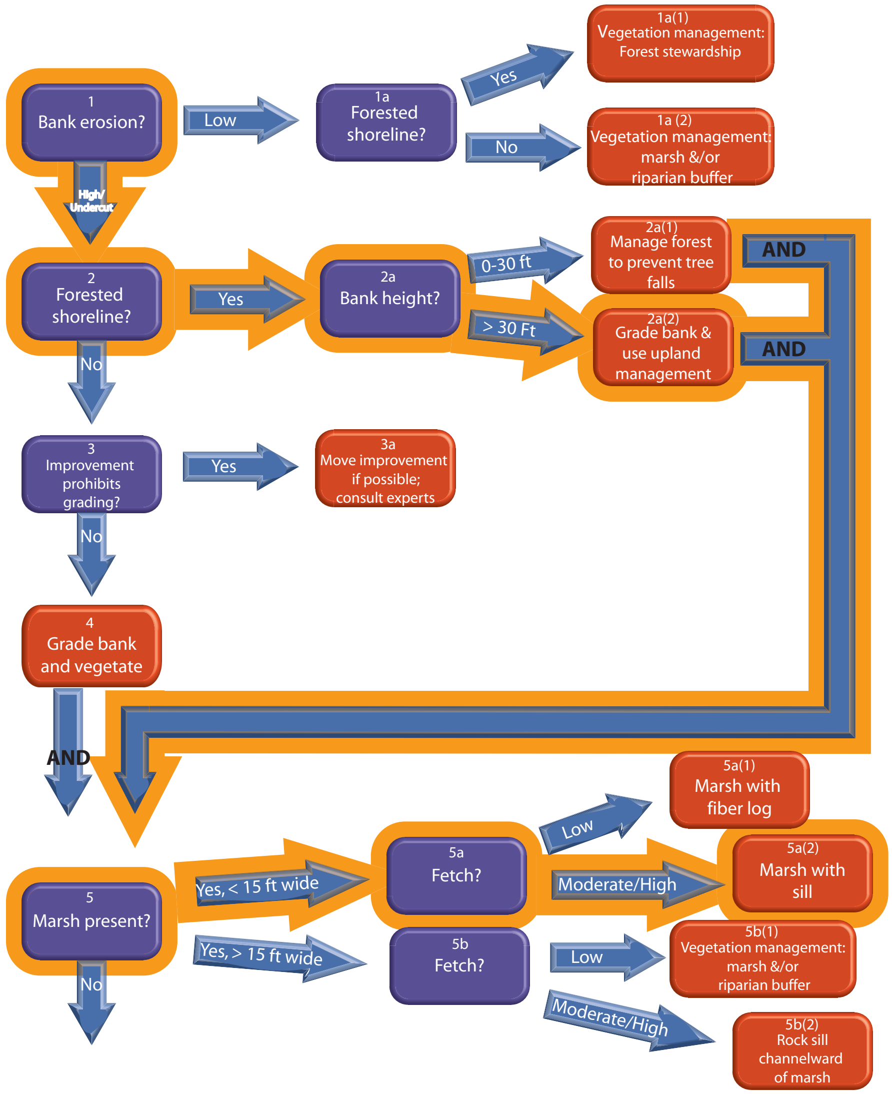
The decision tree is shown on page 4. To use the decision tree, begin at question 1, and evaluate the site in relation to this question. Follow the answer relevant to the site to the next appropriate number indicated by your response. You will not answer every question, because not every question is relevant to every situation. In the example below, following the orange highlighting, the answer to question 1 "What type of bank erosion is present?" is "Low erosion." This leads to question 1a, "Is the shoreline forested?", which is answered "No," and from there to the red recommendation box (1a(2)). For this case, no other questions must be answered, because they are only relevant in situations where there is high or undercut erosion.





1
Bank erosion?
Low
1a
Forested shoreline?
Yes
1a(1)
Vegetation management: Forest stewardship
No
1a (2)
Vegetation management: marsh &/or riparian buffer
High/ Undercut
2
Forested shoreline?
Yes
2a
Bank height?
0-30 ft
2a(1)
Manage forest to prevent tree falls
> 30 Ft
2a(2)
Grade bank & use upland management
AND
AND
No
3
Improvement prohibits grading?
Yes
3a
Move improvement if possible; consult experts
No
4
Grade bank and vegetate
AND
5
Marsh present?
Yes, < 15 ft wide
5a
Fetch?
Low
5a(1)
Marsh with fiber log
Moderate/High
5a(2)
Marsh with sill
Yes, > 15 ft wide
5b
Fetch?
Low
5b(1)
Vegetation management: marsh &/or riparian buffer
Moderate/High
5b(2)
Rock sill channelward of marsh
No
6
Beach present?
Yes
6a
Beach nourishment with sill or breakwater where necessary
No
7
Fetch?
Low
7a
Nearshore water depth?
Shallow
7a(1)
Marsh with fiber log
Deep
7a(2)
Revetment
Moderate
7b
Nearshore water depth?
Shallow
7b(1)
Marsh with sill
Deep
7b(2)
Revetment
High
7c
Breakwater with beach nourishment

Recommended actions are in the red boxes. In some cases, there will be more than one recommendation. In the example at right, bank erosion is high on a forested shoreline with a tall bluff, leading to the first recommendation (2a(2)). Continuing to follow the orange highlighting, there is a narrow fringe marsh present on the shoreline with moderate fetch, leading to the second recommendation (5a(2)). Use both recommendations on the shoreline for improved erosion protection.




## Shoreline Information Required for Using the Decision Tree

**Extent of bank erosion.** The extent of bank erosion determines whether any shoreline stabilization is necessary and what method of stabilization will work best. Shoreline stabilization should be limited to areas with shoreline erosion problems, and shoreline structures should not be used to establish lawn or improve a view.

**Whether the shoreline is forested.** A well-vegetated forested shoreline provides valuable benefits in terms of water quality improvement, habitat provision, and erosion control. The trees and associated vegetation slow overland flow, filter pollutants and take up nutrients in surface water and groundwater. Forested buffers provide habitat for upland and wetland animals. Trees are effective at stabilizing the soil in which they're rooted, providing resistance to erosion. However, a single tree or single row of trees often does not provide a high level of services, and is therefore not considered to be a forested shoreline.

**Bank height -** the approximate vertical height of the upland bank. The ecological functions, as well as bank stability, of a forest bank are affected by the bank height. In general, trees contribute to the stability of a bank by anchoring the soil with their roots. However, tree falls can remove large amounts of soil and can destabilize that section of bank.


It is assumed that a forested bank >30 feet tall is not providing a significant water quality benefit because the groundwater comes out of the bank below the root zone, and surface water, even if slowed by the trees, will still induce erosion as it comes over the bank. Removing some of the forest by grading back in order to attain a sustainable stable slope may be the preferred action.

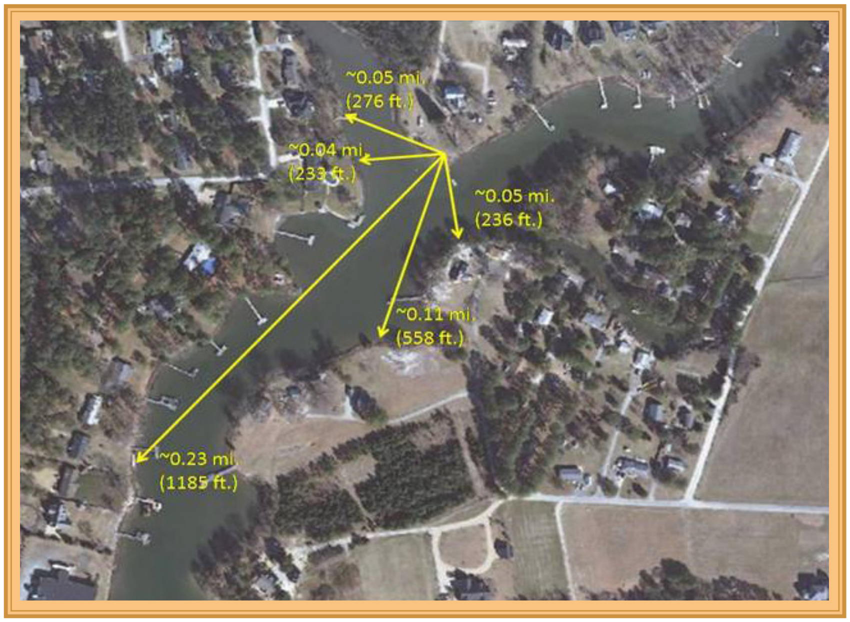
Very tall banks are difficult to stabilize because of their height and potential for catastrophic collapse. Extreme care should always be used when constructing houses at the top of a tall bank. Structures should be located as far back as the property will allow. Where structures already exist at the top of a tall bank, serious consideration should be given to moving the structure to a safer location on the property

**Location of upland improvements**. In a situation with high or undercut erosion of a non-forested shoreline, bank grading and vegetation planting is the preferred option. However, if upland improvements (e.g., house, well, septic system) would be in the grading zone, then moving the improvement, if possible, in order to allow for grading is recommended. In some cases, the improvement can be easily moved (e.g., a gazebo or small shed). In other cases, moving the improvement may be more difficult and require the services of experts. In some cases, moving the improvement may not be possible or feasible. In those cases, an alternative erosion protection approach may be necessary, also requiring the services of experts.

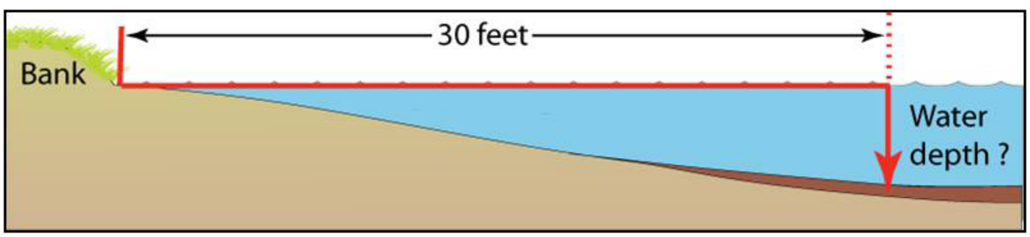
**Presence of marsh.** Marshes provide erosion protection through their extensive root systems, which help hold the sediment in place, and the grass stems, which help reduce wave energy. The wider the marsh is, the more the waves will be reduced, and the more effectively the marsh will protect the adjacent upland. Marshes also improve water quality and provide habitat for a variety of animals, including birds, reptiles, small mammals, invertebrates and fish. The existence of a marsh on a shoreline indicates that the conditions (such as light and wave energy) are appropriate for marsh growth. Shoreline treatment may target increasing the width of the marsh in either a channelward or landward direction to enhance its capabilities to provide shoreline erosion control, or protection of existing wide marsh features. Absence of a marsh does not mean that marsh creation will not be successful, but modifications to light regime, depth, and/or wave energy may be necessary for success.

**Presence of beach.** Beaches are sandy shorelines, frequently found in high energy areas. They protect the shoreline by reducing wave energy and reducing the potential for storm damage. Beaches may be quite wide or very narrow. The common characteristic is the presence of sand. The wider the beach is, the more potential for the reduction of wave energy, reducing the potential for storm damage to the upland. Where beaches exist, protection and enhancement through beach nourishment and breakwater construction may be recommended.

**Fetch.** Fetch is the horizontal distance across open water over which wind blows and waves are generated. This distance is measured at all angles from the shoreline. In this decision tree, fetch is used to represent potential wave energy impinging on the shoreline. Some shoreline treatments require a relatively low energy environment, while others are appropriate for higher energy situations.




**Nearshore water depth -** the vertical distance between the water surface and the submerged bottom, measured at 30 feet channelward from mean low water, usually referenced in feet below the mean low water elevation (e.g., - 2 ft. MLW). Shallow water depths allow the conversion of subtidal waters to intertidal area with a minimum amount of fill, and the marsh or beach created is more likely to persist than it would in a deep water situation. Marsh creation will increase the intertidal width, and vegetation will help reduce wave energy. Placing fiberlogs or a sill at the channelward edge of the newly created marsh or beach may be required to provide long-term protection.




Additional decision trees are in development for the full suite of activities/actions affecting tidal shorelines and tidal waters:

| Future decision tree | Target completion date |
| --- | --- |
| Currently defended shorelines | Summer 2010 |
| Dredging | Fall 2010 |
| Marinas/Risk assessment | Winter 2011 |
| Mitigation/Compensation/Restoration | Spring 2011 |
| Boat ramps/Community piers/Aquaculture | Summer 2011 |
| General fill/Wetlands fill | Fall 2011 |
| Utility/Transportation crossings | Winter 2012 |


## Shoreline Decision-Making: Integrated is better

Each year in Virginia, hundreds of applications are submitted for shoreline projects that fill and impact tidal wetlands, riparian buffers and subaqueous lands. Decisions regarding the differing shoreline resources are made by different authorities and on separate timelines. This can lead to decisions where impacts to any given resource may be avoided by "pushing" the action onto the adjacent resource. In the end, the adverse effects are not truly avoided and may even be greater than necessary to meet the desired goal. The effects of thousands of projects and the loss of native landscapes have been linked to degraded water quality and reductions in fish and crab populations.

**Ways to stem the loss of natural shoreline resources:**

- Promote the use of natural landscapes for erosion control. Commonly known as "living shorelines," shoreline treatments that use vegetated wetlands, riparian buffer vegetation and even sandy beaches can address many situations. One way to promote living shorelines would be to create a process to expedite permits for those projects.
- Enable consideration of projects from a larger perspective including actions proposed outside of, but potentially affecting, the jurisdiction of the decision-makers.
- Develop concise guidance reflective of all relevant management programs aimed toward long-term ecosystem health.