

Good Recipes for the Bay Pollution Diet

U-14 SHORELINE MANAGEMENT PRACTICES

PRACTICE AT A GLANCE

Shoreline management practices improve water quality and ecological conditions within the Bay and the surrounding tidal tributaries.

Shoreline management practices protect property, prevent erosion, improve nearshore aquatic habitat, and mitigate unintended consequences of storm events.

Shoreline management practices exist on a spectrum based on the amount of hardened armor used. They range from living shorelines to bulkheads, seawalls and revetments.

Nutrient and sediment reductions are calculated using four protocols. Specific qualifying criteria and verification standards must be satisfied to receive credits.

DESCRIPTION

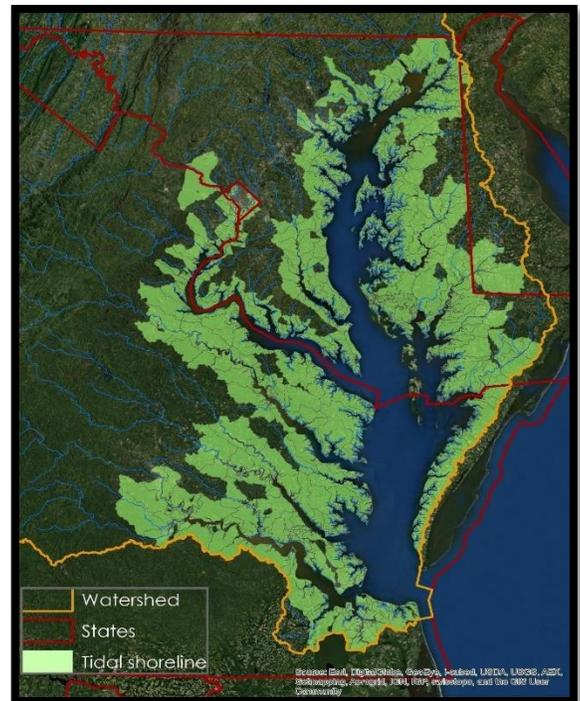
Shoreline management is any tidal shoreline practice that prevents and/or reduces delivery of tidal sediments to the Bay from both bank and nearshore erosion. There is no clear geographic boundary that defines where shoreline management can be implemented, though practices are typically placed in tidal areas where erosion is most prevalent. This fact sheet focuses on the shorelines of Maryland and Virginia, but the protocols can be applied to the District of Columbia and Delaware depending on the local regulatory conditions.

Shoreline management practices exist on a spectrum based on the amount of hardened armor used. The type of shoreline management practice selected will vary based on local policies, site characteristics, owner preference, available funding, and multiple other factors.

Living shorelines are erosion control measures that use natural materials to protect, restore or enhance natural shoreline habitat. They have few structural components and rely on elements like marsh vegetation, oyster reefs, coarse woody debris, and sand.

Hybrid living shorelines are projects that include natural habitat elements as well as some hard structures such as stone sills or breakwaters.

Structural shoreline practices include bulkheads, seawalls, revetments, breakwaters, groins, and jetties. These practices have no natural habitat components and should only be considered when living shorelines are not technically feasible. Qualifying criteria needed to receive nutrient and sediment reduction credit for each type of shoreline management practice is summarized in Table 1.



Shaded areas represent portions of the watershed adjacent to Chesapeake Bay tidal waters

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Table 1. Qualifying criteria to receive credit for shoreline management practices	
Shoreline Management Practice	The Practice Must Meet these Criteria for TMDL Pollutant Load Reduction ¹
Living Shoreline – a) nonstructural; b) hybrid system including a sill; and c) hybrid system including a breakwater	<ol style="list-style-type: none"> 1. The site is currently experiencing shoreline erosion or is replacing existing armor. The site was graded, vegetated, and excess sediment was removed or used.² <p style="text-align: center;">AND</p> <ol style="list-style-type: none"> 2. When a marsh fringe habitat (a or b) or beach/dune habitat (c) is created, enhanced, or maintained.
Revetment AND/OR Breakwater system without a living shoreline	<ol style="list-style-type: none"> 1. The site is currently experiencing shoreline erosion, <p style="text-align: center;">AND</p> <ol style="list-style-type: none"> 2. A living shoreline is not technically feasible or practicable as determined by substrate, depth, or other site constraints. <p style="text-align: center;">AND</p> <ol style="list-style-type: none"> 3. When the breakwater footprint would not cover SAV, shellfish beds, and/or wetlands.
Bulkhead/Seawalls	<ol style="list-style-type: none"> 1. The site is currently experiencing shoreline erosion. <p style="text-align: center;">AND</p> <ol style="list-style-type: none"> 2. The site consists of port facilities, marine industrial facilities, or other marine commercial areas where immediate offshore depth (e.g., depths deeper than 10 feet 35 feet from shore) precludes living shoreline stabilization or the use of a breakwater or revetment.
<p>¹Projects that impact the Chesapeake Bay Preservation Act protected vegetation without mitigation receive no Chesapeake Bay TMDL pollutant load reduction. Further, WQGIT agreed to allow States to determine, on a case-by-case basis, when the unintended consequences of negative impacts to wetlands and SAVs caused by these shoreline management techniques, outweigh the benefits, in which case the practice will not be reported to the Bay Program for model credit.</p>	

OTHER BENEFITS OF SHORELINE MANAGEMENT PRACTICES

Sediment inputs have been a large factor in overall Bay health. While sediment and nutrient load reductions are a major benefit of shoreline management, there are many other benefits that these practices provide, including:

- **Increases in Submerged Aquatic Vegetation (SAV):** As fine grain sediment is reduced, more sunlight reaches SAV beds in the nearshore environment, producing larger, more resilient beds.
- **Improved nearshore habitat:** Healthier SAV beds, along with the natural elements of living shoreline projects, provide improved nearshore habitat to fish and marsh-dwelling species.
- **Flood resiliency:** Living shorelines and accompanying wetlands can help withstand storm surges and dampen wave energy while holding shoreline sediments in place.

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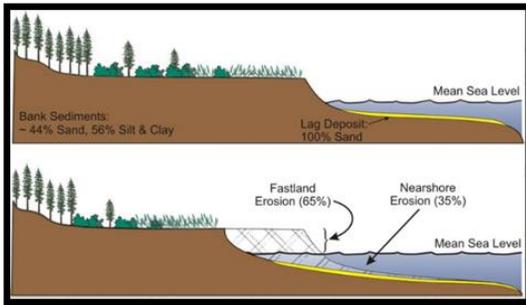
COMPUTING THE POLLUTANT REMOVAL CREDIT

There are four general protocols for defining pollutant load reductions associated with individual shoreline management projects plus a default rate for non-conforming projects:

Table 2. Summary of Nutrient and Sediment Reduction Protocols for Shoreline Management Practices

Protocol 1: Prevented Sediment

This protocol provides an annual mass sediment reduction credit for qualifying shoreline management practices that prevent tidal shoreline erosion that would otherwise be delivered to nearshore/downstream waters.



There is a 4-step process to calculate nutrient and sediment reductions:

Step 1: Determine if SAV is present and consult your local regulatory agency to determine if your project is eligible.

Step 2: Estimate shoreline erosion rates to determine annual loadings.

- MD estimates are available from the *Shoreline Rates of Change* layer of the MD DNR Coastal Atlas website
- VA estimates are available from the Virginia Institute of Marine Science (VIMS)
- Monitoring data can be used in the equation: $V=LEB$, where V=volume of sediment (cubic feet), L=length of shoreline (feet) project, E = Shoreline recession rate (feet/year) and B=bank height (feet)

Step 3: Estimate the reduction in annual load due to the restoration project.

- 100% reduction efficiency should be used since the practice prevents the fastland and nearshore erosion, while this protocol only accounts for the fastland sediment erosion.
- Monitoring data can be used if available.

Step 4: Adjust prevented sediment load to eliminate coarse grained sand.

- In MD: Multiply load reduction by 0.551
- In VA: Multiply load reduction by 0.337

Protocol 2: Tidal Marsh Denitrification

This protocol provides pollutant load reductions for shoreline management practices that incorporate vegetation and promote denitrification and remove nitrogen.

Step 1: Determine the total post construction area of the net increase in marsh plantings and convert to acres.

Step 2: Multiply the acres of marsh planting by the unit denitrification rate (85 pounds total nitrogen/acre/year).

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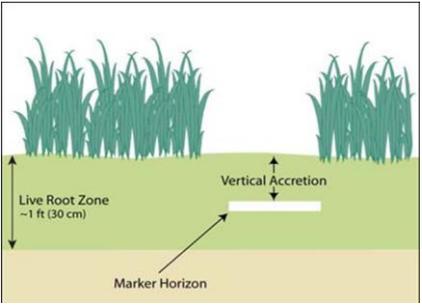
<p><u>Protocol 3: Sediment Trapping</u></p> <p>This credit is based on the sediment trapping capabilities of both vegetative planting and/or on sediment deposition behind shoreline management structures. The pollutant load reduction is based on the square footage of wetland planting in conjunction with a shoreline management project.</p> 	<p>Step 1. Determine the total post construction area of the net increase in marsh plantings and convert to acres.</p> <p>Step 2. Multiply the acres of marsh planting by the unit sedimentation value (6,959 lbs total suspended solids/acre/yr).</p> <p>Step 3. For total phosphorus load removed, multiply the acres of marsh planting by 0.76 mg/g (conversion = 0.00076) (5.289 lbs total phosphorus/acre/yr).</p>
<p><u>Protocol 4: Marsh Redfield Ratio</u></p> <p>This protocol is based on vegetative uptake of nutrients for vegetative growth in marshes. The pollutant load reduction is based on the square footage of wetland planting in conjunction with a shoreline management project.</p> 	<p>The marsh Redfield ratio represents the nitrogen and phosphorus that is biologically and chemically unavailable to nearshore waters and Chesapeake Bay due to vegetative processes.</p> <p>Step 1. Determine the total post construction area of the net increase in marsh plantings and convert to acres.</p> <p>Step 2. Multiply the acres of tidal marsh planting by the unit marsh Redfield ratio value (6.83 pounds total nitrogen/acre and 0.3 pounds total phosphorus/acre).</p> <ul style="list-style-type: none"> • In-lieu of the default pollutant load reduction, site determined values may be substituted, if based on scientifically defensible study design.

Table 3 summarizes the nutrient and sediment reductions that can be earned using each of the protocols. Reductions earned under each protocol can be additive. Default nutrient and sediment reduction rates are also provided, though it is recommended that they only be used in instances where the information required for reporting purposes is unavailable and to provide an estimate for planning.

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Table 3. Different protocols for defining pollutant load reductions for shoreline management projects				
Protocol	Submitted Unit	Total Nitrogen (lbs per unit)	Total Phosphorus (lbs per unit)	Total Suspended Sediment (lbs per unit)
Protocol 1 - Prevented Sediment	Linear Feet	Project-Specific*	Project-Specific*	Project-Specific
Protocol 2 – Denitrification	Acres of re-vegetation	85	NA	NA
Protocol 3 - Sedimentation	Acres of re-vegetation	NA	5.289	6,959
Protocol 4 – Marsh Redfield Ratio	Acres of re-vegetation	6.83	0.3	NA
Non- conforming/ Existing Practices *	Linear Feet	MD = 0.04756 VA = 0.01218	MD = 0.03362 VA = 0.00861	MD = 164 VA = 42

**The WTWG initially recommended reductions for TN and TP be made only after the Modeling Workgroup had an opportunity to evaluate the availability of TN and TP in shoreline sediments in 2017. The WTWG approved the reductions in 2017 following the Modeling Workgroup analysis which estimated an average of 0.00029 lbs TN/lb of TSS and 0.000205 lbs TP/lb of TSS in eroded tidal shoreline sediment. These values can be used directly by jurisdictions for their calculations in Protocol 1, and were adapted for non-conforming/exiting practices by multiplying the default TSS reduction for non-conforming projects by the average nutrient concentrations in sediment. Note: the MD numbers also apply to DE and DC. The default rate for sediment is based on fine sediment erosion estimates from Table 3 with a 50% reduction factor applied. The first number applies to MD, DE, and DC and the second number applies to VA.*

HOW TO REPORT THE PRACTICE TO THE STATE

Pollutant load reductions are available for five years and renewable upon field verification to ensure they are still working as designed. It is recommended that the following project information be collected and reported in order to earn full credit for your project:

- Practice type
- Year installed
- Project Location (lat/long, or USGS hydrologic unit code (HUC))
- Load reductions earned (lbs of TN, TP, TSS)

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In addition, it's recommended that records be kept on data sources and calculations used to determine the reductions. Depending on the protocol used, the following parameters may be needed:

- Length of project reach (ft)
- Height of project (ft)
- Erosion rate (ft/year)
- Vegetation surface area

In cases where shoreline management practice parameters are unavailable (i.e. planning efforts, historic projects, nonconforming projects) default reduction values can be used as seen above in Table 3. States may track shoreline management projects using their own databases. Please check with your state regulatory agency for any additional tracking and reporting requirements.

WHAT IS REQUIRED TO VERIFY THE PRACTICE OVER TIME

Shoreline management practices, like all Chesapeake Bay BMPs, must be inspected and verified to ensure their continued function. Shoreline management pollutant load reduction credits last for 5 years and can be renewed using local inspection, verification, and reporting protocols.

An initial performance verification provided by the designer, local inspector, or state permit authority is recommended to certify that the project was installed properly and meets or exceeds the restoration objectives. The initial verification should demonstrate that vegetation present in the area is stable and has acceptable coverage.

Future verification inspections should be conducted once every five years to ensure that individual projects are still capable of removing nutrients and sediments. The panel recommends that states develop performance standards to aid in performance assessments. These standards may include plant coverage thresholds, evaluation of structure-induced toe scour, or change in wetland acreage.

If a field inspection indicates that a project is not performing to its original specifications, the locality has up to one year to take corrective maintenance or rehabilitation actions to bring it back into compliance. If the facility is not fixed after one year, the pollutant reduction for the project would be eliminated, and the locality would report this to the state in its annual MS4 report, WIP progress updates or other relevant annual progress report. Finally, the load reduction can be renewed if evidence is provided that corrective actions were performed that restored the practice performance.



USGS Researcher at the Patuxent Wildlife Refuge

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RESOURCES

Type of Resource	Title of Resource	Web link
Expert Panel Report	Recommendations of the Expert Panel to Define Nutrient and Sediment Removal Rates from Shoreline Management Projects (2018)	https://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2018/05/Revised_SHORT-SHORELINE-MGMT-EPR-05152018.pdf
Archived Webcast	Shoreline Erosion Management 101 to Support Chesapeake Bay Health (2015)	https://chesapeakestormwater.net/events/webcast-tidal-shoreline-management/
Archived Webcast	Shoreline Management Insights (2018)	https://chesapeakestormwater.net/events/webcast-shoreline-management-insights/
More Tools & Resources	A Summary of Sediment Processes In Chesapeake Bay Watershed (2003)	https://chesapeakestormwater.net/download/5910/
	Tidal Shoreline Management Suggested Reading (2015)	http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2015/06/Tidal-Shoreline-Webcast-Suggested-Reading.pdf
	MD DNR Coastal Atlas	http://dnr.maryland.gov/ccs/coastalatlus/Pages/default.aspx
