

Recommendations of the Expert Panel on Shoreline ~~Management~~ ~~Erosion Control~~



to the
Urban Stormwater Workgroup
Annapolis, Maryland
April 15, 2014



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Outline



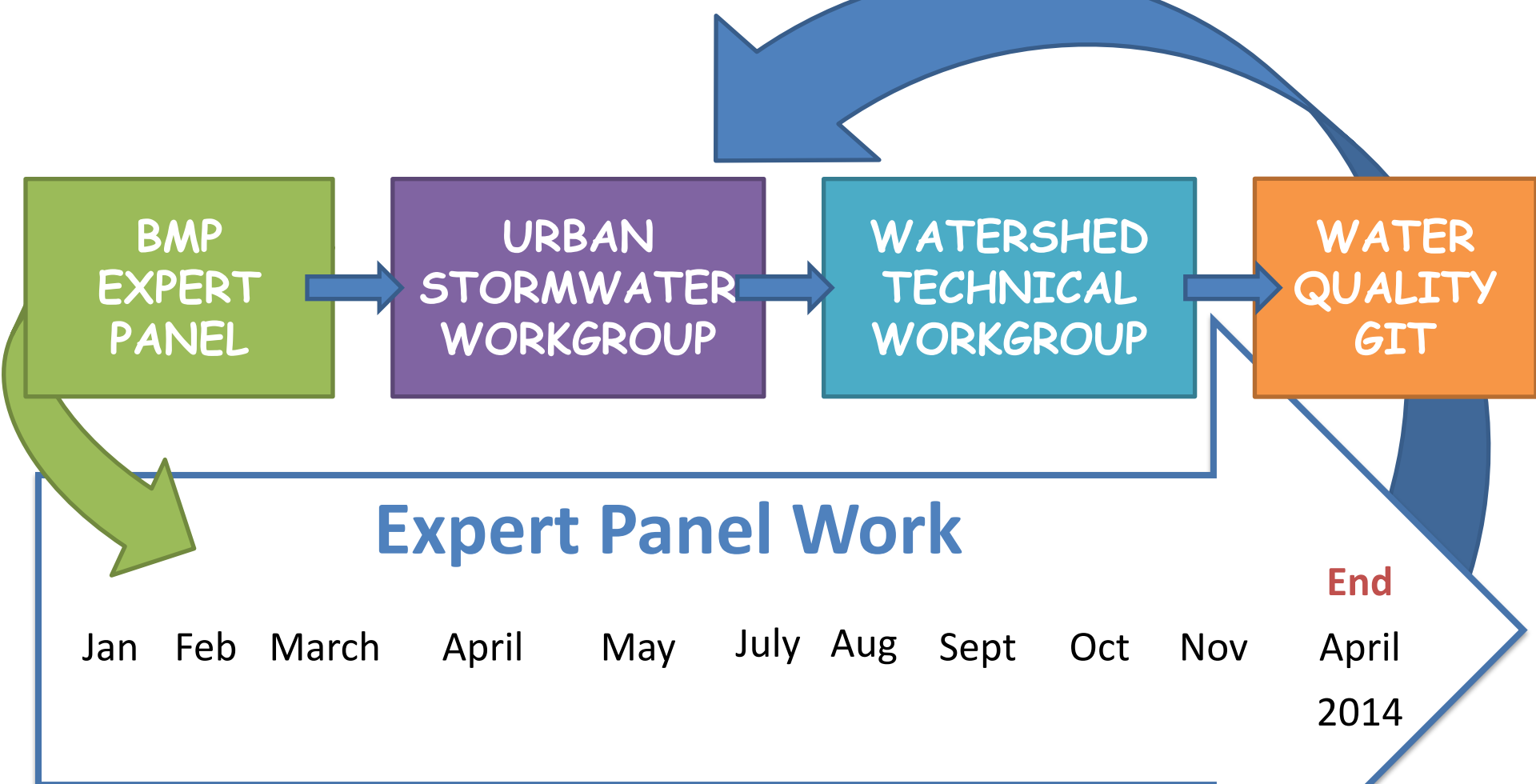
1. Charge and Membership of Expert Panel
2. Executive Summary
3. Definitions and Geographic Scope
4. Shore Erosion and Management in the Chesapeake Bay
 1. Q&A
5. Basic Qualifying Conditions
6. Rationale, Methods, and Examples for New Shoreline Management Protocols
7. Accountability and Unintended Consequences
8. Future Research and Management Needs
 1. Q&A
9. Dissenting View Document (Appendix L) – Jana Davis, Executive Director, Chesapeake Bay Trust

Shoreline Management Expert Panel Charge

- Evaluate how shoreline practices are modeled, review literature, develop pollutant removal, and reporting units
- Provide a definition, geographic boundary, and qualifying conditions
- Recommend reporting, tracking, and verification procedures

Shoreline Management Panel Members

| Panelist | Affiliation |
|-----------------------------|---|
| Jana Davis, Ph.D. | CBT/HGIT |
| Kevin DuBois, PWS, PWD | City of Norfolk, VA |
| Jeff Halka | MD Geologic Survey, retired |
| Scott Hardaway, P.G. | VIMS Shoreline Studies Program |
| George Janek | USACE, Norfolk District |
| Lee Karrh | MD DNR |
| Eva Koch, Ph.D. | UMCES |
| Lewis Linker | CBPO |
| Pam Mason | VIMS Center for Coastal Resource Management |
| Ed Morgereth, MS ISS | Biohabitats |
| Daniel Proctor, P.E. | Stantec (formerly Williamsburg Environmental Group) |
| Kevin Smith | MD DNR |
| Bill Stack, P.E. | CWP, CBPO |
| Steve Stewart/Nathan Forand | Baltimore County Dept. of Environmental Protection and Sustainability |
| Bill Wolinski, P.E. | Talbot County Dept. of Public Works |



- Panel research, discussions, and make recommendations
- Present to EPA CBPO workgroups

Panel process information is online at:

- http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3
- [http://www.chesapeakebay.net/documents/Nutrient-Sediment Control Review Protocol 07162013.pdf](http://www.chesapeakebay.net/documents/Nutrient-Sediment%20Control%20Review%20Protocol%2007162013.pdf)

Table 1. Summary of shoreline management pollutant load reduction for individual projects.

| Prot ocol | Name | Units | Pollutants | Reduction Rate |
|--------------|----------------------|-----------------|--------------------|--|
| 1 | Prevented Sediment | Pounds per year | Sediment TN, TP | <ul style="list-style-type: none"> Measured TSS, TN and TP content in sediment prevented. Calculated based on shoreline erosion with reductions for sand content and bank instability |
| 2 | Denitrification | Pounds per year | TN | <ul style="list-style-type: none"> Measured TN removal for denitrification rate associated with vegetated area. 85 lbs TN/acre/yr |
| 3 | Sedimentation | Pounds per year | Sediment and TP | <ul style="list-style-type: none"> Measured TSS and TP removal rates associated with vegetated area. 6,959 lbs TSS/acre/yr 5.289 lbs TP/acre/yr |
| 4 | Marsh Redfield Ratio | Pounds | TN, TP | <ul style="list-style-type: none"> Measured TN and TP removal rates associated with vegetated area. Note that this is a one-time credit. 205 lbs TN/acre 9 lbs TP/acre |

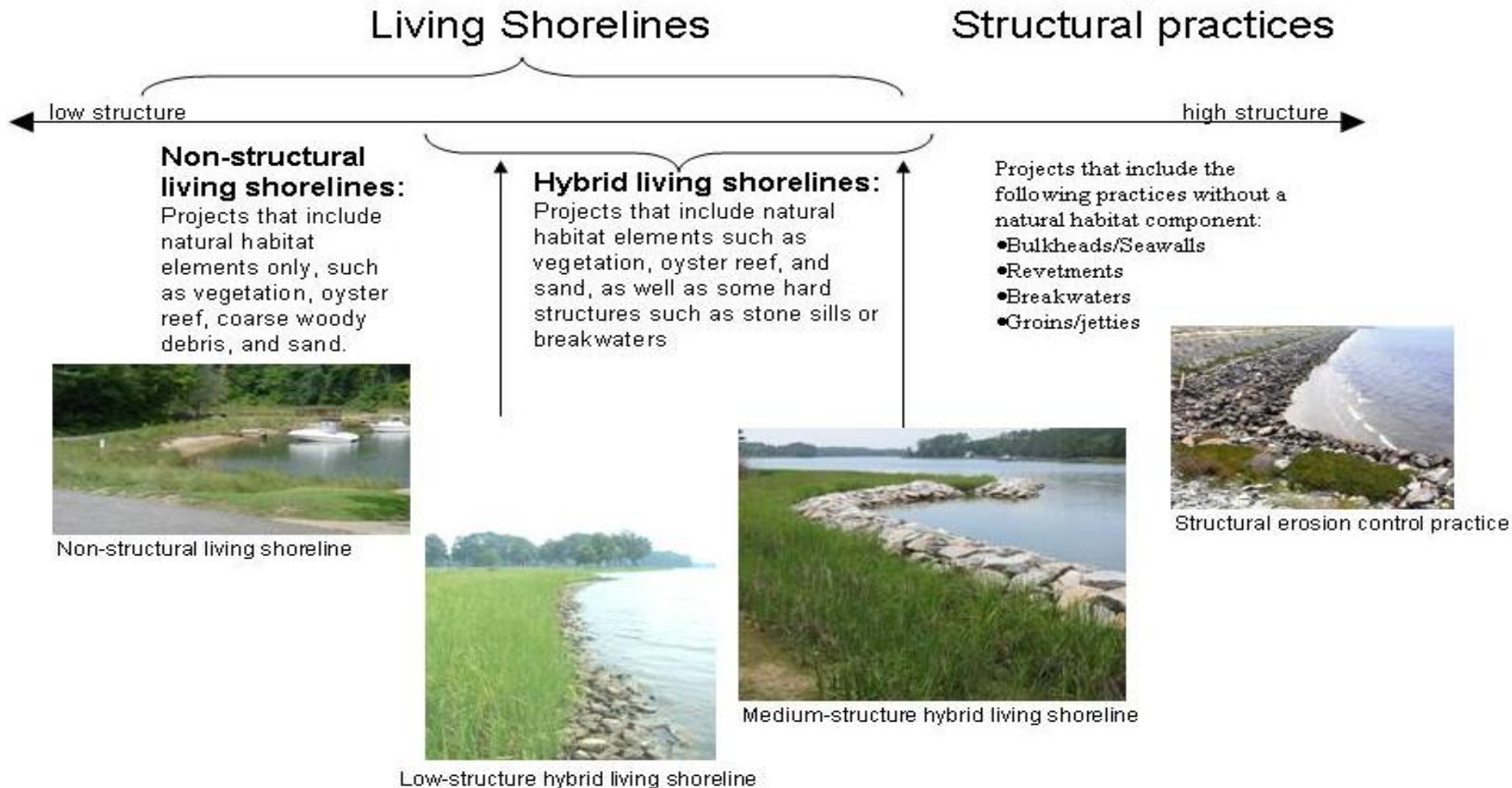
Definitions



- The Scenario Builder documentation (CBP, 2012) defines shoreline erosion control practices as “**protection of shoreline from excessive wave action by creating a marsh or an offshore structure such as a sill, breakwater, or sand containment structure.**”
- In Maryland and Virginia the following represent the shoreline erosion definitions:
 - “**Improvements to protect a person’s property against erosion shall consist of non-structural shoreline stabilization measures (i.e., living shorelines) that preserve the natural environment, such as marsh creation**” HB973 – Living Shoreline Protection Act of 2008 (MDE, 2008).
 - **Nonstructural Shoreline Stabilization Measures or “Living shoreline”** means a suite of stabilization and erosion control measures that preserve the natural shoreline and are designed to minimize shoreline erosion, maintain coastal processes, and provide aquatic habitat. Measures must include marsh plantings and may include the use of sills, sand containment structures, breakwaters, or other natural components (MDE, 2008).
 - In Virginia, as per Senate Bill 964, “**Living shoreline**” means a shoreline management practice that provides erosion control and water quality benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural and organic

Expert Panel Definition

“Shoreline management” is defined as any tidal shoreline practice that prevents and/or reduces tidal sediments to the Bay.



Chesapeake Bay Watershed



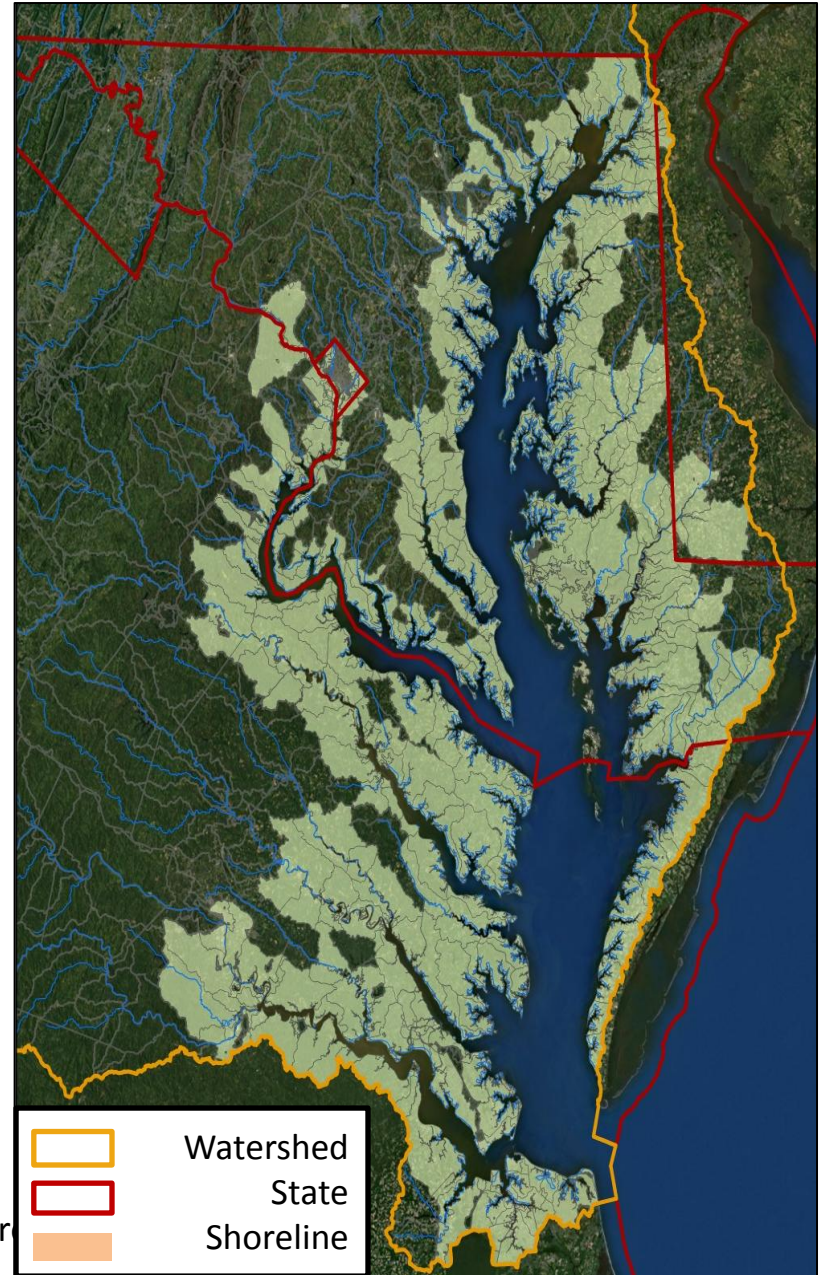
- Chesapeake Bay Watershed
- State Boundary
- Chesapeake Bay



Data Sources: Chesapeake Bay Program
 For more information, visit www.chesapeakebay.net
 Disclaimer: www.chesapeakebay.net/termsfuse.htm

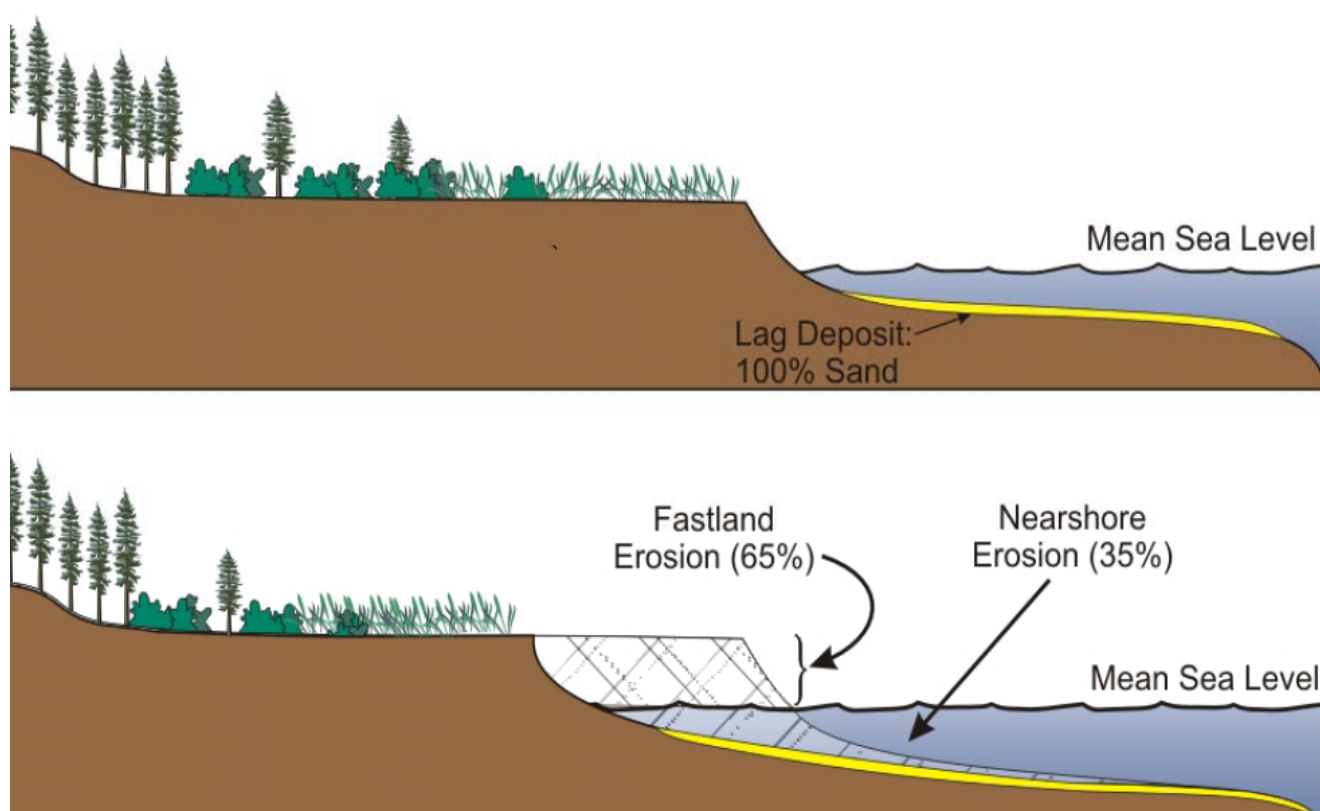
Created by EA, 1/24/08

UTM Zone 18N, NAD 83



Unprotected shore erosion is a major Chesapeake Bay sediment source

(Langland and Cronin, 2003)



Erosion of fastland from unprotected shorelines represents 65% of the total load; nearshore erosion represents 35%.

Need for Panel

- TN, TP, TSS removal rates approved by CBP in 2003

| Source | TN (lb per foot per year) | TP (lb per foot per year) | TSS (lb per foot per year) |
|-----------------|---------------------------------|---------------------------------|----------------------------------|
| CBP (2003) | 0.02 | 0.0025 | 2 |
| CBP (July 2013) | 0.20 | 0.068 | 54.25 |

- Need to update TN, TP, and TSS removal rates based on best available information
 - i.e., expert panel

Comparing the Numbers: Shoreline Erosion Loading Rates

| Source | TN (lb per foot per year) | TP (lb per foot per year) | TSS (lb per foot per year) |
|------------------------|--|--|---|
| Ibison, 1990 | 1.65 | 1.27 | 7,000 |
| Ibison, 1992 | 0.81 | 0.66 | 2,800 |
| Proctor, 2012 (WEG) | na | 0.38 or 0.29 | 1,300 |
| MDE, 2011* | 0.16 | 0.11 | 451 |
| BaCo (mean) | 0.36 | 0.23 | 974 |
| CBP (2003) | 0.02 | 0.0025 | 2 |
| CBP (July 2013) | 0.20 | 0.068 | 54.25 |

*MDE data based on Baltimore Co. DEPS analysis of 23 individual shoreline restoration projects completed by Baltimore Co. DEPS Capital Projects and Operations. Median values were used. (Nathan Forand presentation to the SEC panel on 2/25/13)

3.3 Shoreline Management Habitat Impacts

- Tidal wetland losses
 - 18% of coastal wetlands lost are tidal salt marsh (Stedman and Dahl, 2008)
- Hard shore armor impacts
 - Past and future hard armor has negative impacts
 - Physical, chemical, ecological communities
- Not all sediment is “bad”
 - Ecological trade offs made
 - Large grained sediments (sand) provide geologic and ecologic functions, such as SAV



Photos Courtesy of Ed Morgereth

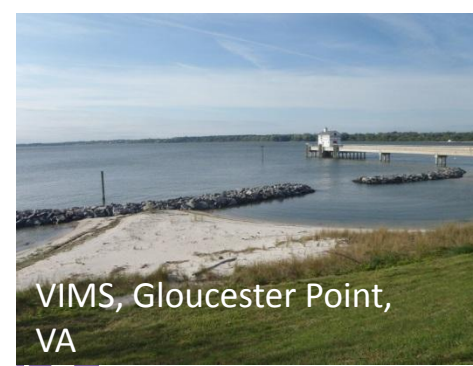
Q & A

Outline



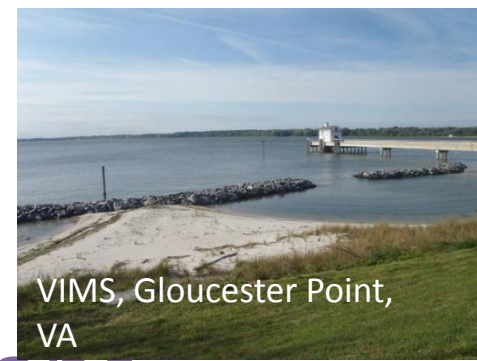
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Rationale for Basic Qualifying Conditions



- Use a watershed approach for preservation and restoration
- Shoreline management approach (Appendix D)
- Shoreline management should be implemented only in areas where needed and where appropriate
 - Common benchmarks(CBF, 2007; See also MDE, 2008 and Appendix G)
 - Urban considerations – available space for practice, legacy pollution at the site

Rationale for Basic Qualifying Conditions



- Sea Level Rise
 - Threat to coastal areas and need for better designs (Appendix F)
- SAV Habitat
 - Chesapeake Bay SAV goals and Chesapeake Bay TMDL intersect
 - Horizontal shoreline erosion of 2 ft/yr vetted with panel as a basic qualifying condition (Karrh et al., 2011); did not pass
 - Hard armor negatively impacts SAV

Table 7. Criteria for Chesapeake Bay TMDL pollutant load reduction for shoreline management practices. These are the basic qualifying conditions.

| 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 | <p>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> <p>AND</p> <p>When a marsh fringe habitat (a or b) or beach/dune habitat (c) is created, enhanced, or maintained.</p> |
| Revetment AND Breakwater system without a living shoreline | <p>The site is currently experiencing shoreline erosion. The site was graded, vegetated, and excess sediment was removed or used.²</p> <p>AND</p> <p>A living shoreline is not technically feasible or practicable as determined by substrate, depth, or other site constraints.</p> <p>AND</p> <p>When the breakwater footprint would not cover SAV, shellfish beds, and/or wetlands.</p> |
| Bulkhead/Seawalls | <p>The site is currently experiencing shoreline erosion.</p> <p>AND</p> <p>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> |

Rationale, Methods, and Examples for New Shoreline Management Protocols

- Literature review to support shoreline management protocols
 - Reviewed over 200 publications, group discussions, heard from experts, and used best professional judgment
- The science and past CBPO EPA panel precedent support the panel's recommendations for pollutant load reductions for shoreline management practices that:
 - prevent erosion and associated sediment and nutrients from entering the Bay ([Protocol 1: Prevented Sediment](#)); and
 - shoreline management practices that incorporate vegetation
 - promote denitrification and remove nitrogen ([Protocol 2: Denitrification](#));
 - promote accretion and sedimentation that remove sediment and phosphorus ([Protocol 3: Sedimentation](#)); and
 - promote vegetative uptake and associated nutrient removal ([Protocol 4: Marsh Redfield Ratio](#)).

Protocol 1. Prevented Sediment

- Shoreline erosion is a sediment source to the Bay
- Shoreline management practices prevent that sediment from entering the Bay and also protect coastal property
- *To reduce unintended consequences*, refinements were made to address the sand content of the prevented sediment, the bank instability, and a state basin cap
- Precedent for this protocol in the Urban Stream Restoration panel

Protocol 1. Prevented Sediment

- Step 1 – Estimate shoreline sediment erosion rate
- Step 2 – Convert shoreline erosion to nutrient loading rate
 - $V(\text{volume}) = L(\text{length}) E(\text{erosion rate}) B(\text{bank height})$
 - Default values:
 - Bulk density = 93.6 lb/ft³
 - 0.57 pounds TN/ton sediment
 - 0.41 pounds TP/ton sediment
- Step 3 – Estimate shoreline restoration efficiency
 - Used 100% effectiveness

Site specific sampling can be used

Sand and Bank Instability Reductions for Prevented Sediment

- Sand Reduction for Prevented Sediment

| State | Loading (kg/m/d) | | | Sand Reduction Factor |
|----------|------------------|-------|--------|-----------------------|
| | Total | Fines | Coarse | |
| Maryland | 2.43 | 1.34 | 1.02 | 0.551 |
| Virginia | 1.01 | 0.34 | 0.67 | 0.337 |

Source: Chesapeake Bay shoreline characteristics and shoreline erosion mass loading (averaged) (Cerco, 2010).

- Bank Instability for Prevented Sediment
 - Angle of repose and unconsolidated bank sediments (Clark et al. 2004)
 - Subtract 50% from prevented sediment

Pollutant Load Reduction Cap

- Reduce unintended consequences
- 1/3 of the state basin load may use shoreline management BMPs
- States can suballocate



Source: Tony Watkinson



VIMS, Gloucester Point, VA

Protocol 2. Denitrification

- Tidal marsh, especially fringe tidal marsh, are active denitrification removal areas (Greene, 2005; Merrill, 1999, Merrill and Cornwell, 2002, and others)
- Focus on fringe tidal marshes here and not larger wetland systems
- Literature review of 18 studies, summarized each study took the median denitrification rate, and converted to pounds TN/acre/yr
- This pollutant removal rate is based on the net vegetation area increase
- Result
 - 85.02 pounds TN/acre/yr
- See also Appendix H

Protocol 2. Denitrification

- **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).*



Protocol 3. Sedimentation

- Tidal marsh vegetation traps and accretes sediments
- Marsh edge is similar to living shoreline area and has high accretion
- Summarized studies in the Bay and other relevant areas that quantified sedimentation in the top 10 cm for sediment core, horizontal marker, and sediment flux studies
- Literature review of 22 studies, summarized each study took the median sedimentation rate and converted to pounds TSS/acre/yr and TP/acre/yr
 - Conservative bulk density used was 0.3895 g/cm^3 (Callaway et al. (2012))
- Result
 - 6,959 pounds TSS/acre/yr
 - 5.289 lbs TP/acre/yr
- See also Appendix I

Protocol 3. Sedimentation

- **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 sedimentation value (6,959 lbs total suspended solids/acre/yr).
- **Step 3.** For total phosphorus load removed multiply the acres of marsh planting by 5.289 lbs total phosphorus/acre/yr.



Source: VA DCR

Protocol 4. Marsh Redfield Ratio

- Tidal marsh vegetation ties up TN and TP that would otherwise enter the Bay
- Summarized studies in the Bay and other relevant areas that quantified marsh Redfield ratio and aboveground and belowground production
- Literature review over 50 studies, summarized each study took the mean aboveground and belowground biomass, and converted to pounds TN/acre/yr and TP/acre/yr
- This pollutant removal rate is based on the net vegetation area increase
- Result
 - A ONE TIME CREDIT REALIZED IN YEAR ONE ONLY
 - 205 pounds TN/acre/yr
 - 9 lbs TP/acre/yr
- See also Appendix J

Protocol 4. Marsh Redfield Ratio

- **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 tidal marsh planting by the unit marsh Redfield ratio value (205 pounds total nitrogen/acre and 9 pounds total phosphorus/acre).*



5.3 Examples

- Basic qualifying conditions examples in Table 12
- Maryland and two Virginia examples provided
 - See Appendix K Sediment Sampling Protocol





MD Example



| Pollutant | Protocol 1 Pollutant Load Reduction (lb/yr) | Protocol 2 Pollutant Load Reduction (lb/yr) | Protocol 3 Pollutant Load Reduction (lb/yr) | Protocol 4 Pollutant Load Reduction (lb) ¹ | Year 1 Total Pollutant Load Reduction (lb/yr) ^{2,3} |
|-----------|--|--|--|---|--|
| TN | 233 | 153 | NA | 369 | 755 |
| TP | 168 | NA | 9.520 | 16.2 | 193 |
| TSS | 450,070 | NA | 12,526 | NA | 462,596 |

¹Marsh Redfield Ratio pollutant load reduction if a one-time credit.

²The TN and TP totaled here are for the first year and include the one-time credit for the Marsh Redfield Ratio. In subsequent years there will be no TN or TP pollutant load reduction for this protocol.

³ This practice was 2,610 linear feet, had an erosion rate of 1 and 1.5 ft/yr, had a bank height of 4 and 7 feet, and had 1.8 acres of vegetation. See other site specifics in the project description.

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Accountability and Unintended Consequences

- Practices must be accounted for and verified to maintain the function and pollutant load reductions
- Reporting, tracking, and verification
 - Develop verification principles in the future
- Units for local government to re
- Expected values
 - See 5.3 Examples



Table 17. Units for local governments to report to state.

| Protocol | Parameters to Report | Notes |
|----------------------------------|--|--|
| All Protocols | <ul style="list-style-type: none"> Practice type Year installed Location coordinates 8 digit watershed where project is located and/or county Land use(s) If applicable, acres treated by practice | <ul style="list-style-type: none"> All reporting should be coordinated with the local and state permitting and reporting authority to ensure compliance General reporting requirements for all projects should be followed If values other than default values are used, these calculations should be reported to the reporting entities specification (e.g., TN, TP, and TSS for sites with site specific sampling data) Records should be kept and available for inspection to relay the data source, calculations made, and other data reported to the state |
| Protocol 1. Prevented Sediment | <ul style="list-style-type: none"> Length (ft) Height of project (ft) Erosion rate (ft/yr) | |
| Protocol 2. Denitrification | <ul style="list-style-type: none"> Protocol 1 parameters Vegetation surface area (acre) <ul style="list-style-type: none"> Net increase of vegetation | |
| Protocol 3. Sedimentation | <ul style="list-style-type: none"> Protocol 1 parameters Vegetation surface area (acre) <ul style="list-style-type: none"> Net increase of vegetation | |
| Protocol 4. Marsh Redfield Ratio | <ul style="list-style-type: none"> Protocol 1 parameters Vegetation surface area (acre) <ul style="list-style-type: none"> Net increase of vegetation | |

Accountability and Unintended Consequences

- Tracking
 - Name, location, permit number, county, location, practice type, and vegetation area
- Verification
 - Initial performance verification – responsible crediting party provide post construction documentation to the reporting agency
- Duration of shoreline management credit
 - 5 years

Accountability and Unintended Consequences

- Reporting to the state
 - Report to and coordinate with state agency
- Record keeping
- Future field verification to ensure project performance
 - Credit agency inspect every 5 yrs
- Previously installed and/or non-conforming projects
 - If installed in the last 5 yrs and conform to new standards, projects can receive these new credits
 - New protocols must be used if higher or lower than “old credit”
- Down-grading
 - Must bring project up to standards w/in one year of inspection/non compliance
 - Annual reporting for non MS4 communities

Accountability and Unintended Consequences

- Unintended consequences
 - Basic qualifying conditions
 - Sand reduction factor
 - Bank instability/angle of repose
 - State basin cap
 - Use state policy to ensure best practices are implemented in the watershed and on the shoreline
 - Protect habitat (e.g., SAV, fish, etc.)
 - Use a comprehensive shoreline management approach (Appendix D)



Future Research and Management Needs

(see Table 18)

- Panel's confidence in recommendations
 - Scientific gaps in shoreline management
 - Shoreline erosion rates
 - Shoreline management practice effectiveness
 - Habitat protection and restoration
 - Proposed timeframe for panel recommendations review and update
 - Every 2 years
 - Proposed refinements for CBWM or WQSTM next phase
 - Better simulation needed for land-river segments adjacent to tidal waters
 - See Appendix C Technical Requirements for Entering Practice into Scenario Builder

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Questions/Comments

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